

**DAVIDSON WATER, INC.
WELCOME, NORTH CAROLINA**

**CONTRACT DOCUMENTS
FOR
HYATTOWN PUMPING STATION**

H&S PROJECT NO. 30961-010

**SINGLE PRIME CONTRACT
DAVIDSON
WATER, INC.**



ISSUED FOR CONSTRUCTION

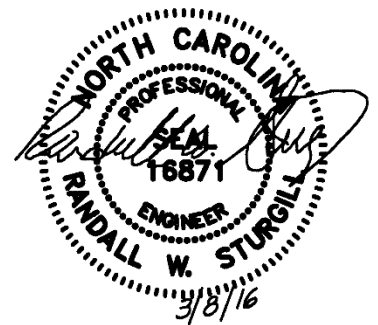
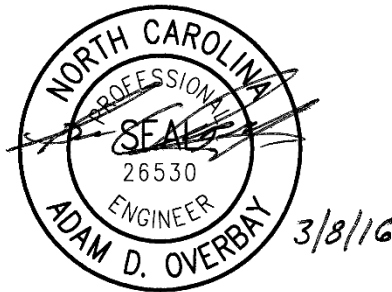
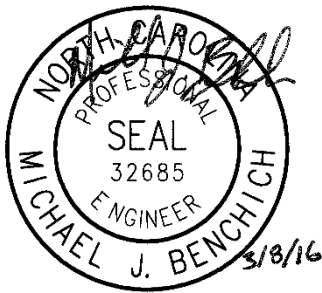
March 2016
Hazen

**DAVIDSON WATER, INC.
WELCOME, NORTH CAROLINA**



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FOR
HYATTOWN PUMPING STATION**

**H&S PROJECT NO. 30961-010
SINGLE PRIME CONTRACT**



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**DAVIDSON WATER, INC.
DAVIDSON COUNTY, NORTH CAROLINA**

HYATTOWN PUMPING STATION

SECTION 00003

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- END OF SECTION -

SECTION 00010

NOTICE TO BIDDERS

**DAVIDSON WATER, INC.
WELCOME, NORTH CAROLINA**

HYATTOWN PUMPING STATION

SINGLE PRIME CONTRACT

Sealed Bids for the construction of the Hyattown Pumping Station will be received by Davidson Water, Inc., hereinafter called the Owner, in their main office at 7040 Old U.S. 52, Lexington, NC 27295 until 3:00 p.m., local prevailing time on April 8, 2016.

The Work to be performed under this Contract and in accordance with the Drawings and Specifications consists of the construction of a new 19.1-mgd pumping station at the existing Hyattown Storage Tank site to house 10 pumps that will serve the Glen Anna and Welcome pressure zones. The new pumping station will replace the existing pumping station at the same site. The new pumping station will include installing eight (8) Owner-furnished vertical can pumps, one (1) Owner-furnished generator set, two (2) surge tanks, two (2) flow meters vaults, piping, and electrical equipment as shown on the Drawings. The new pump building will be a one-story, block edifice with hollow core roof. Construction will require the installation of a new tank outlet in the slab of the existing Hyattown Storage Tank. Operations at the existing pumping station shall be continuous during construction except as specified elsewhere, and shall be shut down permanently only after successful startup of the new pumping station. Services of the Contractor are to include, but may not be limited to, surveying, geotechnical, test pitting, utilities location and relocation, securing, permitting, construction, commissioning, and training. The site location is 1276 Leonard Road, Lexington, NC 27295.

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

A pre-bid conference will be held for this project on March 29, 2016, at the Owner's offices, 7040 Old U.S. 52, Lexington, NC, 27295 at 1:30 p.m. local time. A tour of the project site shall follow an initial project presentation at the Owner's offices. All Bidders are required to attend the pre-bid conference, including the site tour.

Each Bid must be made on the blank forms provided in the bound copies of the Contract Documents and must be enclosed in an opaque, sealed envelope and addressed to Davidson Water, Inc., Attn: Mr. Robert Walters, Vice President. The name, address, and NC Contractor's License Number of the Bidder must be plainly written on the outside of the envelope, and the envelope marked "Sealed Bid for the Hyattown Pumping Station Contract". No Bid shall be considered or accepted by the Owner unless, at the time of its filing, the same shall be accompanied by a cashier's check 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 payment to the Owner 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 Owner, 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 the State of 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 and to Award the Contract to the Bidder who, in the Owner's judgment, is in the best interest of the Project.

Digital copies of the Contract Documents, in PDF format, are available free of charge. Bidders may also purchase printed copies of the Contract Documents from Hazen and Sawyer for a fee of \$150 per set of documents. Each request for printed copies must be accompanied by a check made payable to Hazen and Sawyer in the amount required for the requested number of copies. No partial sets will be printed.

For further information on this project, please call, e-mail, or fax:

OWNER

Mr. Robert Walters
Vice President
Davidson Water, Inc.
7040 Old US Hwy 52
Lexington, NC 27295
Tel. (336) 731 – 5526

ENGINEER

Mr. Michael Benchich
Associate
Hazen and Sawyer
4944 Parkway Plaza Blvd, Suite 375
Charlotte, NC 28217
Tel. (704) 941 - 6058

- END OF SECTION -

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 EJCDC Document C-700 (2007 edition) located in Section 00700, 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

2.1 Bidders shall submit qualifications as specified in the Bid Proposal. 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.

2.2 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.

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 promptly notify Engineer in writing of all conflicts, errors, or discrepancies in the Contract Documents.

3.1.6 inspect the site only in the company of an authorized representative of the Owner with appointments made through Mr. Robert Walters.

3.2 Reference is made to Section 01010 - Summary Of Work of the Specifications for the identification of those surveys and investigation reports of subsurface or latent physical conditions at the site or otherwise affecting performance of the work

which have been relied upon by Engineer in preparing the Drawings and Specifications. Subsurface data are offered in good faith solely for the purpose of placing the Bidder in receipt of all information available to Owner and Engineer and in no event is to be considered part of the Contract Documents. 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 investigation must advise the Owner for coordination of access.

Prior to the Contractor doing any additional subsurface investigations, he must obtain a permit as required from Davidson County and an additional Encroachment Agreement from the N.C. Department of Transportation and shall furnish evidence of such Documents to the Engineer prior to any activity in the street right-of-way. The Contractor shall be responsible for any damage (including damage to any underground utility) as a result of additional subsurface investigations.

- 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.

4. INTERPRETATION

- 4.1 All questions about the meaning or intent of the Contract Documents shall be submitted in writing to Hazen and Sawyer at 4944 Parkway Plaza Boulevard, Suite 375, Charlotte, NC 28217, Attn: Mr. Michael Benchich (Tel. 704.941.6058; Email: mbenchich@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 three (3) 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 North Carolina. 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 Each Bid must be accompanied by a list of all subcontractors, equipment manufacturers, and suppliers the Bidder proposes to use to execute the Work. For each listed subcontractor, equipment manufacturer, and supplier the Bidder shall provide an experience statement with pertinent information as to similar projects and other evidence of qualifications. If Owner or Engineer after due investigation has reasonable objection to any proposed subcontractor, equipment manufacturer, or supplier, he may before giving the Notice of Award request the Bidder submit an acceptable substitute without an increase in his Bid Price. Any subcontractor, equipment manufacturer, or supplier 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. Once the Notice of Award is given, the Contractor shall not be permitted to substitute non-listed subcontractors, equipment manufacturers, or suppliers for listed entities without the Owner's written approval. In all cases, all subcontractors, equipment manufacturers, and suppliers which ultimately perform Work under this Contract shall be responsible for complying with the Contract Specifications.

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 in the manner, time, and place indicated in the Notice to Bidders and accompanied by the Bid security and other required documents. No Proposal will be considered unless filed on or before the date and 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:

Davidson Water, Inc.
7040 Old U.S. 52
Lexington, NC 27295
Attn: Mr. Robert Walters

Mark envelope clearly with the Project title (Hyattown Pumping Station) and Bidder's name. 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) Affidavit of Organization and Authority and Sworn Statement
- 3) Statement of Experience of Bidder
- 4) Enter Contractor's License Number where called for in Proposal and on the outside of the sealed envelope containing the Proposal.
- 5) Photocopy of Contractor's License
- 6) Non-Collusive Affidavit
- 7) Certified list of subcontractors, equipment manufacturers, and suppliers

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

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.

11. OPENING AND REVIEW OF BIDS

The Owner will open, review and disseminate to all Bidders the Bid results by April 12, 2016 at 3:00 p.m. local time.

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, equipment manufacturers, and suppliers 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, equipment manufacturers, and suppliers 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 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 Conference

A mandatory pre-bid conference will be held on March 29, 2016 at 1:30 p.m. at the Owner's offices (7040 U.S. 52, Lexington, NC 27295) to discuss the Project and answer prospective Bidder's pertinent questions. A tour of the Project Site shall follow the initial project presentation at the Owner's offices.

Representatives of the Owner and Engineer will be available to answer questions.

- END OF SECTION -

SECTION 00300

PROPOSAL

TO: DAVIDSON WATER, INC.
 ATTN: ROBERT WALTERS, VICE PRESIDENT

FROM: BIDDER _____

 ADDRESS _____

 DATE OF BID _____, 2016

The undersigned hereby signifies that it is _____ (his/her/their) intention and purposes to enter into a formal Contract with Davidson Water, Inc., 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

HYATTOWN PUMPING STATION

for the construction of the Hyattown Pumping Station, in accordance with the Contract Documents, including Addenda Nos. * _____. There is deposited, herewith, a certified check or cashier's 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 Addenda 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 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, cashier's check, 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, cashier's check, 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 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.

THAT: The Contractor agrees to comply with all requirements included in the Encroachment Agreement between the Owner and the North Carolina Department of Transportation.

PROPOSAL

(BID FORM)

SINGLE PRIME CONTRACT
FOR
HYATTOWN PUMPING STATION

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

_____ Dollars and

_____ Cents (\$ _____).

CONTRACTOR _____
(Print)

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 00300-8)

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 _____, 2016.

The name of the PRINCIPAL is _____ (1)

_____ (2)

The name of the SURETY is _____

Davidson Water, Inc. 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:

HYATTOWN PUMPING STATION

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.

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 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. Name of Project Manager and Field Supervisor who will be assigned to the work and a list of projects of similar character and value, with references, on which the indicated persons have held those positions.

6. 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 5 with his Bid package and at the discretion of the Bidder the information required under Item 6 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 _____) ss.

_____ 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
Charlotte, 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

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, which will be the Owner.
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 00500-13: 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 2016, by and between Davidson Water, Inc, party of the first part, hereinafter called the Owner, and

_____ of _____, party of the second part, hereinafter call the Contractor.

WITNESSETH

THAT, WHEREAS, a Contract for:

HYATTOWN PUMPING STATION

as prepared by Hazen and Sawyer, 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 455 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, as liquidated damages and not as a penalty, \$1,000 per day for each and every calendar day the work remains incomplete beyond the Contract Time.

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 corporate name by its _____, attested by its secretary and its Official Corporate Seal to be affixed all by order of its board of directors as of the day and year first above written.

(SEAL)

(SEAL)

ATTEST

(SEAL)

Secretary
(SEAL)

By: _____

Title: _____

ATTEST:

Davidson Water, Inc.

(TITLE)
(SEAL)

BY: _____, Secretary

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 North Carolina

COUNTY OF Davidson

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: _____

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 _____

Davidson Water, Inc. 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 _____, 2016 for work described by Plans and Specifications prepared by Hazen and Sawyer of Charlotte, North Carolina, herein called and referred to as the Engineer, a copy of said Contract is hereto attached and made a part hereof for the construction of:

HYATTOWN PUMPING STATION

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 _____

Davidson Water, Inc. 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 Charlotte, 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:

HYATTOWN PUMPING STATION

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 North Carolina)
) SS
COUNTY OF Davidson)

_____ 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
Charlotte, North Carolina

OWNER: Davidson Water, Inc.

PROJECT: Hyattown Pumping Station

Contract No. _____ Contract Amount \$ _____

You are hereby notified to commence work on the referenced project on or before
_____ and are to fully complete the work within 455 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



AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASSOCIATED GENERAL CONTRACTORS OF AMERICA

AMERICAN SOCIETY OF CIVIL ENGINEERS

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
A Practice Division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

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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".

1.01.A.44 Add the following after the last sentence:

“Successful completion of any and all field testing shall be requisite for Substantial Completion.”

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, 2007 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 "Davidson Water, Inc. 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 |
| | | \$ 2,000,000 | aggregate |
| 2. Contract No. | , Electrical Construction - | \$ 1,000,000 | per occurrence |
| | | \$ 2,000,000 | aggregate |
| 3. Contract No. | , HVAC Construction - | \$ 1,000,000 | per occurrence |
| | | \$ 2,000,000 | aggregate |
| 4. Contract No. | , Plumbing Construction - | \$ 1,000,000 | per occurrence |
| | | \$ 2,000,000 | aggregate |

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

- | | | | |
|-----------------|--------------------------|--------------|----------------|
| 1. Contract No. | , General Construction - | \$ 1,000,000 | per occurrence |
| | | \$ 2,000,000 | aggregate |

2. Contract No. , Electrical Construction - \$ 1,000,000 per occurrence
\$ 2,000,000 aggregate
3. Contract No. , HVAC Construction - \$ 1,000,000 per occurrence
\$ 2,000,000 aggregate
4. Contract No. , Plumbing Construction - \$ 1,000,000 per occurrence
\$ 2,000,000 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 \$6,000,000

- 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 \$2,000,000 per occurrence and \$2,000,000 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 \$2,000,000 per occurrence and \$2,000,000 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.

- 6.13 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

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: Davidson Water, Inc.

ADDRESS: 7040 Old U.S. 52
Lexington, NC 27295

RE: Hyattown Pumping Station

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 Hyattown Pumping Station. The project involves the construction of a masonry block water booster pumping station; the installation of (8) Owner-furnished 200 HP vertical turbine can pumps; 2 bladder-type surge tanks; and associated process valves and piping, electrical, HVC, and instrumentation. The proposed facilities will replace the existing pumping facilities on the same site.
- B. 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.
- 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 performed is indicated in the set of Drawings entitled Hyattown Pumping Station, dated March 2016, and the Project Manual entitled Hyattown Pumping Station, dated March 2016. The numbers and titles of all Drawings appear Index of Drawings presented on Drawing G1 of the Drawings. 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 02604, 13207, 15290, 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 16492.
- 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 has obtained the following permits, attached to the end of the specification for reference.
 - 1. NCDEQ Public Water System Authorization to Construct – Serial No. 16-00080
 - 2. NCDOT Driveway Access Permit No. _____
 - 3. Davidson County Buidling Permit No. _____
- 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.
- D. The Contractor shall provide any required Performance and Indemnity Bond(s) and any additional specific insurance coverage required of the Owner by the Encroachment Agreement(s) in accordance with the Encroachment Agreement(s) between the Owner and the North Carolina Department of Transportation - Division of Highways. The Contractor shall fully comply with all of the requirements of the Owner included in the Encroachment Agreement(s). Encroachment Agreements are included herein and are found at the end of this Section.

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. Charges assessed against the Contract shall be deducted from the monies due to the Contractor.
- B. Work beyond normal working 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 outside of normal working hours and days shall be borne by the Contractor unless the Owner specifically and explicitly in writing waives their right to collect such expenses and/or damages. The Owner, at his sole discretion, shall define and limit over what time period any waiver is in force.
- 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. Hourly rates will depend on the number and classifications of employees involved, but in no case shall such charges exceed \$100 per hour for field personnel and \$150 per hour for engineering personnel.
- 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 SUBSURFACE DATA

- A. Subsurface data contained in Appendix E are offered in good faith solely for placing the Bidder in receipt of all information available to the Owner and Engineer and in no event is to be considered as part of the Contract Documents.
- B. The Contractor must interpret such subsurface data according to his own judgment and acknowledge that he is not relying upon the same as accurately describing the subsurface conditions, which may be found to exist.
 - 1. The test boring logs present factual information of the subsurface conditions at the specific test boring location only. The Bidder should not consider, or conclude, that the subsurface conditions will be consistent between test boring locations.
- C. The Contractor further acknowledges that he assumes all risks contingent upon the nature of the sub-surface conditions to be actually encountered by him in performing the work covered by the Contract, even though such actual conditions may result in the Bidder performing more or less work than he originally anticipated.
- D. The Contractor is further advised that the Owner has made sub-surface investigations and a report has been prepared, in connection with this project for the Engineer, a copy of which is appended to the rear of these specifications.
- E. In making this data available, the Owner makes no guarantee, either expressed or implied, as to their accuracy or to the accuracy of any interpretation thereof.

1.09 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.

1.10 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.

1.11 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.

1.12 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.

1.13 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.

1.14 BLASTING AND EXPLOSIVES

- A. The use of blasting or explosives shall not be allowed.

1.15 LIMITS OF WORK AREA

- A. The Contractor shall confine his construction operations within the Owner's property lines and in compliance with the Contract limits shown or described on the Drawings. 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.

1.16 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.

1.17 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. Unightly 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.

1.18 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.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -



PAT MCCRORY

Governor

DONALD R. VAN DER VAART

Secretary

S. JAY ZIMMERMAN

Director

February 17, 2016

ROBERT WALTERS, VICE PRESIDENT CONST & ENGINEERING
DAVIDSON WATER, INC
7040 OLD US HWY 52
LEXINGTON, NC 27295

Re: **Authorization to Construct**
HYATTOWN PUMPING STATION
DAVIDSON WATER INC
DAVIDSONCOUNTY, NC0229025

Authorization to Construct (This is not a Final Approval)

Dear Applicant;

This letter is to confirm that a complete Engineer's Report and a Water System Management Plan have been received, and that engineering plans and specifications have been approved by the Department for **HYATTOWN PUMPING STATION, Serial No. 16-00080.**

The Authorization to Construct is valid for 24 months from the **Issue Date** (refer to next page). Authorization to Construct may be extended if the Rules Governing Public Water Supplies and site conditions have not changed (see Rule .0305). The Authorization to Construct and the engineering plans and specifications approval letter shall be posted at the primary entrance of the job site before and during construction.

Upon completion of the construction or modification, and prior to **placing the new construction or modification into service**, the applicant must submit an Engineer's Certification and Applicant Certification directly to CHRISTYN FERTENBAUGH, P.E. of this office.

- **Engineer Certification:** in accordance with Rule .0303 (a), the applicant shall submit a certification statement signed and sealed by a registered professional engineer stating that construction was completed in accordance with approved engineering plans and specifications, including any provisions stipulated in the Department's engineering plan and specification approval letter.
- **Applicant Certification:** in accordance with Rule .0303 (c), the applicant shall submit a signed certification statement indicating that the requirements for an Operation and Maintenance Plan and Emergency Management Plan have been satisfied in accordance with Rule .0307 (d) and (e) and that the system has a certified operator in accordance with Rule .1300. The "Applicant Certification" form is available at <http://www.deh.enr.state.nc.us/pws/> (click on Plan Review Forms, under Plan Review heading).

If this Authorization to Construct is for a new public water system, the owner must submit a completed **application for an Operating Permit** and the appropriate fee. For a copy of the application for an Operating Permit please call (919) 707-9085.

Once the certifications and permit application and fee, (if applicable), are received and determined adequate, the Department will issue a Final Approval letter to the applicant. In accordance with Rule .0309 (a), **no portion of this project shall be placed into service until the Department has issued Final Approval.**

Sincerely,

Robert W. Midgette, J.E., Operations Branch Head
Public Water Supply Section
Division of Water Resources

cc: ERIC HUDSON, P.E., Winston-Salem Regional Office
Hazen And Sawyer, Pc - Charlotte

North Carolina Department of Environmental Quality
Division of Water Resources

Public Water System Authorization to Construct

Public Water System Name and Water System No.:	DAVIDSON WATER INC NC0229025
Project Name:	HYATTOWN PUMPING STATION
Serial No.:	16-00080
Issue Date:	02/17/2016
Expiration Date:	24 Months after Issue Date

In accordance with NCAC 18C .0305, this Authorization to Construct must be posted
at the primary entrance to the job site during construction.

ATTACH ENCROACHMENT
AGREEMENT(S) HERE
IF APPLICABLE

SECTION 01015

CONTRACTOR COORDINATION OF OWNER-FURNISHED EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide all labor, materials and equipment necessary to unload, store on site, install, adjust, start-up, test, and place into satisfactory operation the Owner-furnished equipment as specified herein. The equipment shall be installed at the locations indicated on the Drawings. For equipment not being installed and field tested by the equipment supplier, Contractor shall install and field test in strict accordance with the equipment manufacturer's installation drawings, instructions, and recommendations.
- B. Equipment furnished by Owner includes:
1. Eight (8) vertical can pumps including cans, sixteen (16) air relief/vacuum valves, sixteen (16) pressure gauges.
 2. Two (2) pump cans for future pumps.
 3. Motor control centers MCC-1 and MCC-2.
 4. One (1) main switchgear assembly.
 5. Twelve (12) 24" butterfly valves and six (6) 36" butterfly valves, including valve boxes, operating nuts, and extension stems for buried service.

Each assembly includes the following Owner-furnished items, as detailed in the appendices:

- Spare parts;
 - Field service for inspection/certification of installation, initial start-up, operator training, and performance testing and optimization;
 - Submittals and O&M manuals;
 - Freight to the job site.
- C. See Appendices A, B, C, and D for Owner-furnished equipment suppliers' scope of supply and services, including those required during construction.
- ##### 1.02 SCHEDULE, DELIVERY, HANDLING, AND INSTALLATION OF THE EQUIPMENT
- A. Contractor's responsibility for the Owner-furnished equipment shall begin upon receipt and acceptance by the Contractor. Contractor shall carefully examine all equipment prior to acceptance and shall advise Owner of any defective items. Owner may accept rejected items and authorize their installation.
- B. Contractor shall secure, protect, bond, and insure all Owner-furnished equipment upon receipt and acceptance.

- C. Anticipated delivery date for Owner-furnished pump cans is May 20, 2016. Earliest delivery date for remaining Owner-furnished equipment is August 1, 2016. Contractor shall include in monthly schedule updates the required delivery dates for all Owner-furnished equipment. Contractor shall confirm firm date to Owner no later than 30 days prior to date of delivery.
- D. At the time of delivery of equipment to be installed in the building, the building shall be complete to the extent that the equipment may be set in their designated locations in the building with roof and walls completed and heating/cooling systems operational.
- E. The Contractor shall unload all Owner-furnished equipment from a truck within 6 hours from the time the truck arrives at the site. The Contractor shall be responsible for paying any additional costs incurred by the Owner due to failure to unload trucks within 6 hours of arrival.
- F. The Contractor shall immediately move and lift equipment that has been unloaded from the truck to the building. The Contractor shall have the equipment pad, conduit, etc. prepared such that the equipment is installed in their designated locations within 12 hours after arrival at the site.
- G. For equipment to be installed by Owner's equipment supplier, the Contractor shall prepare the site so that Installer's vehicles, personnel, tools, and materials have space and access for immediate equipment installation upon arrival.

PART 2 -- EQUIPMENT

2.01 GENERAL

- A. The Contractor shall furnish and install all equipment and materials required for the interface with the Owner-furnished equipment including piping, fittings, conduit, wire, etc.
- B. Contractor is responsible for furnishing and installing all pipe supports, brackets, anchorages, flange bolts, nuts, gaskets, washer, and fasteners required for installation of Owner-furnished equipment unless specifically provided for by Owner's equipment suppliers.

PART 3 -- EXECUTION

3.01 GENERAL

- A. The Contractor shall unload, move, lift, assemble and install all Owner-furnished equipment in strict accordance with recommendations of the equipment manufacturers.
- B. Installation shall be performed in the presence of qualified, technical representatives of the manufacturers who, upon completion of installation, shall certify to the Owner that all equipment has been installed in accordance with the manufacturer's recommendations.
- C. Coordinate delivery, installation, and testing schedules with Owner and Owner's equipment suppliers for field services to be provided during and after equipment installation. Contractor shall provide and pay for manufacturer's field services beyond that explicitly to be provided under Owner-furnished equipment suppliers' scope of supply and services, to provide a complete and operating installation.

- 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
HI	-	Hydraulic Institute
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
Hydraulic Institute Standards (HI)
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. Refer to Section 01210.

1.03 PROGRESS MEETING

- A. Progress meetings will be held monthly at the Contractor's Field Office or offices 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 01210

PRECONSTRUCTION PLANNING AND SCHEDULING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. This section specifies the Preconstruction Planning and Scheduling work that shall take place after the Notice to Proceed and prior to the start of Demolition and Construction Work. The preconstruction planning and scheduling effort shall include identification and organization of Contractor's work team; planning of the construction activities with Owner and Engineer; planning and coordinating with existing activities of the pumping station; site security; on-site surveys and verification of existing conditions and equipment; providing verification of purchase and acceptance by vendors of terms and conditions of major mechanical, electrical, control and instrumentation equipment; preparation and delivery of priority submittals; development and approval of a cost and resource loaded PCM progress schedule; and other activities relate to planning and scheduling as may be deemed necessary.
- B. To accomplish the Planning and Scheduling work, the Contractor will be required to provide staff, including proficient scheduling staff, and key subcontractor/supervisors as necessary to meet at the project site or other designated area as needed to participate in Preconstruction Workshops to accomplish the preconstruction work. The Planning and Scheduling work shall be completed no later than 60 calendar days after issuance of Notice to Proceed. Satisfactory completion of the Planning and Scheduling work, as determine by the Owner and engineer, will be a prerequisite to the issuance of the notice to proceed for demolition and construction activities. Upon completion of the Planning and Scheduling and coincident with the issuance of the notice to proceed for demolition and construction the Owner will pay Contractor a sum equal to 2% of the Contract price less retainage as Payment for Preconstruction Planning and Schedule Phase.
- C. The Preconstruction Conference will be held after execution of the Contract, but before any Work is started at the Site. Engineer will fix the date, time and location of the conference. In addition to the Preconstruction Conference, planning workshops will be held. The first planning workshop will be scheduled at the Preconstruction Conference.
- D. Engineer will prepare agenda, preside at conference/workshops, record minutes to include significant proceedings and decisions, and distribute the minutes to all parties in attendance.
- E. Contractor shall bring to the Preconstruction Conference a preliminary schedule of each of the following:
 - 1. Progress
 - 2. Shop Drawings
 - 3. Values

1.02 PRECONSTRUCTION CONFERECE

A. The purpose of the Preconstruction Conference is to designate responsible personnel and discuss status of contractual documentation. Preliminary schedules shall be delivered. A complete agenda will be furnished to Contractor prior to the conference date. However, Contractor should be prepared to discuss all of the following:

1. Status of Contractor's insurance.
2. Designation of responsible personnel.
3. Subcontractors.
4. Coordination with Owner and park activities.
5. Contractor's preliminary schedules.
6. Transmittal, review, and distribution of Contractor's submittals.
7. Processing of request for clarifications, Field Orders, Change Orders, and Applications for Payment.
8. Requirements for copies of Contract Documents.
9. Use of Site, office and storage areas, security, housekeeping and Owner's needs.
10. Contractor(s) responsibilities for safety and first aid.
11. Major equipment deliveries and priorities.
12. Critical work sequencing.
13. Scheduling of planning workshops.
14. Maintaining record documents.

1.03 REQUIRED ATTENDANCE AT CONFERENCE AND WORKSHOPS

- A. Contractor's project manager, Project Engineer, Field Superintendent or General Foreman, Scheduling Consultant and General Foreman, and major Subcontractors and Suppliers.
- B. Representatives of Owner and Engineer will also be attendees.

1.04 PRECONSTRUCTION SUBMITTALS

- A. The following is a list of submittals/information required from Contractor to complete the Planning and Scheduling Phase. Other submittals and/or information identified during the workshops may be required.
 1. Sequence of Construction for all events that require coordination with Owner, construction within streets and roads, and Duke Energy.

2. Schedule of Values
3. Progress Schedule
4. Submittal Schedule
5. Proof of Purchase with acknowledgement of acceptance by vendor or subcontract containing time commitments for shop drawing submittals and fabrication/delivery of equipment/materials for the major process, control, and instrumentation and operation equipment required for the Work.
6. Shop drawing submittals/sample for concrete, reinforcing steel, underground piping, etc. for which the Contractor wants approval to be able to start construction immediately after receipt of Notice to Proceed for Construction.

1.05 ON-SITE INVESTIGATIONS

- A. The Contractor shall perform on-site investigations in support of technical submittal preparation during the Preconstruction Planning and Scheduling Phase. Activities include, but may not be limited to the following:
1. Establishment of horizontal and vertical survey control to identify locations and features identified during eth on-site investigations.
 2. Exploratory excavation and test pits to locate buried utilities, structures, piping, and electrical lines (Contractor, Engineer, and Owner shall jointly identify locations for test excavations). Contractor shall furnish proper equipment, labor, trench support methods, backfill, and pavement patching materials to support the operations. The Contractor shall be prepared to repair and damage caused during exploratory activities. The Contractor shall be prepared to perform investigations during non-consecutive work periods. Prior to investigations, provide Engineer advance notice of two working days.
 3. Inspect and identify existing equipment and electrical circuits that are to be relocated, demolished, or interface with the Work.
 4. Asbestos inspection and written report.

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. The approved progress schedule is required during the Preconstruction Planning and Scheduling Phase and prior to allowing demolition and construction activities on site.
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. Progress Schedule shall be prepared as specified in Section 01310.

B. Shop Drawing Schedule

1. Contractor shall prepare and submit five (5) copies of his schedule of principal items or 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 schedule delivery.
- h. Date on which delivery is actually made.

C. Shop Drawings

- 1. 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.
- 2. 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.
- 3. 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.
- 4. 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.

5. 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 five (5) 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:

"Furnish as Submitted" (FAS) - no exceptions are taken

"Furnish as Corrected" (FAC) - minor corrections are noted and shall be made.

"Furnish as Corrected – Confirm" (FACC) - some corrections are noted and a partial resubmittal or additional information are required as specifically requested.

"Revise and Resubmit" (R&R) - major corrections are noted and a full resubmittal is required.

"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. Photographs shall be taken using a digital camera with a minimum 14 MegaPixel rating.
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. Each month, provide all photographs to Engineer electronically in a "JPEG" format.

4. At completion of the work, all electronic files shall be turned over to the Owner.

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 01470

WATERTIGHTNESS TESTING OF CONCRETE STRUCTURES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. It is the intent of these Specifications that all concrete work and sealing work around built-in items and penetrations be performed as required to insure that groundwater, surface water, and water or liquids in tanks, channels and containers will not intrude into any equipment rooms, pipe galleries, habitable areas or other generally dry areas.
- B. The required watertightness shall be achieved by quality concrete construction and proper sealing of all joints and penetrations.
- C. Each unit shall be tested separately and the leakage tests shall be made prior to backfilling and before equipment is installed. Testing water shall be from any potable, non-potable, or natural moving source such as a river or stream, but not from any still water source such as a lake or pond, and not from any wastewater source.
- D. All water holding structures shall be tested for leakage by the Contractor. The Contractor shall provide at his own expense all labor, material, temporary bulkheads, pumps, water measuring devices, etc., necessary to perform the required tests.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01400 – Quality Control
- B. Section 03300 – Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ACI 350.1-10 - Specification for Tightness Testing of Environmental Engineering Concrete Structures

1.04 SUBMITTALS

- A. Testing procedures shall be submitted for approval prior to the test.
- B. Testing Report: Prior to placing the structure in service, submit for review and approval a detailed bound report summarizing the watertightness test data, describing the testing procedure and showing the calculations on which the test data is based.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 TEST PREPARATION

- A. The design capability of the structure to withstand testing shall be verified for the pressures to be applied. Another type of test shall not be substituted for hydrostatic tightness testing without approval of the Engineer.
- B. The structure shall not be tested before all elements of the structure which resist any portion of the retained liquid pressure are in place and the concrete has attained its specified compressive strength.
- C. Unless otherwise specified, coatings shall not be applied until after the hydrostatic tightness testing is complete. Liners that are mechanically locked to the surface during the placement of the concrete shall be installed before the hydrostatic tightness testing. Interior liners shall be visually examined for deficiencies (pinholes, tears and partially fused splices) and must pass integrity testing. Deficiencies shall be prepared.
- D. Clean the exposed concrete surfaces of the structure, including the floor, of all foreign material and debris. Prior to testing, standing water in or outside of the structure that would interfere with the inspection of the exposed concrete surfaces of the structure shall be removed.
- E. The concrete surfaces and concrete joints shall be thoroughly inspected for potential leakage points. Areas of potential leakage shall be repaired before filling the containment structure with water.
- F. All openings, fittings, and pipe penetrations in the structure shell shall be inspected at both faces of the concrete, if practical. Defective or cracked concrete shall be repaired prior to testing. All structural penetrations and inlet/outlets shall be securely sealed to prevent the loss of water from the structure during the test. All structural penetrations shall be monitored before and during the test to determine the watertightness of these appurtenances. If the structure is to be filled using the inlet/outlet pipe, positive means shall be provided to check that water is not entering or leaving through this pipe once the structure is filled to the test level. Leakage at these inlet/outlets shall be repaired prior to testing. No allowance shall be made in test measurements for uncorrected known points of leakage
- G. The flow from any underdrain system, if a system is provided, shall be monitored during this same period, and any increase in flow shall be recorded and considered for information as a part of the hydrostatic tightness testing.
- H. The ground water level shall be brought to a level below the top of the base slab and kept at that elevation or at a lower elevation during the test.
- I. No backfill shall be placed against the walls or on the wall footings of the structure to be tested unless otherwise specified.

3.02 PROCEDURE

- A. The initial filling of a new structure should not exceed a rate of 4 ft/h. Filling shall be continued until the water surface is at the design maximum liquid level, or either 1 in. below any fixed overflow level in covered containment structure or 4 in. in open structure, whichever is lower.
- B. The exterior surfaces of the structure shall be inspected during the period of filling the structure. If any flow of water is observed from the structure exterior surfaces, including joints or cracks, the defect causing the leakage shall be repaired prior to testing.
- C. Watertightness Test - Part 1: Qualitative Criteria
 - 1. The water shall be kept at the test level for at least 3 days prior to Part 2 of the testing.
 - 2. The exterior surfaces of the structure shall be observed in both the early mornings and later afternoons during the 3-day period before Part 2 of the test. If any water is observed on the structure exterior surfaces, including joints, repaired honeycombed areas and cracks, where moisture can be picked up on a dry hand, the containment structure shall be considered to have failed Part 1 of the test.
 - 3. Wet areas on top of wall footing shall not be cause to fail Part 1 of the test unless the water can be observed to be flowing.
 - 4. Part 2 of the test may begin prior to completion of repairs for Part 1. However, all defects causing the failure of Part 1 shall be repaired before the structure is accepted.
- D. Watertightness Test - Part 2: Quantitative Criteria
 - 1. The test measurements shall not be scheduled for a period when the forecast is for a difference of more than 35°F between the ambient temperature readings at the times of the initial and final level measurements of the water surface. The test shall also not be scheduled when the weather forecast indicates the water surface would be frozen before the test is completed.
 - 2. The vertical distance to the water surface shall be measured to within 1/16 in. from a fixed point on the structure above the water surface. Measurements shall be recorded at 24-hour intervals. Measurements taken at the same time of day will reduce the probability of temperature difference.
 - 3. Measurements shall be taken at two locations, 180° apart, which will minimize the effect of differential settlement. Measurements shall be taken at the same locations to reduce the probability of measurement differences.
 - 4. The test period shall be at least the theoretical time required to lower the water surface 3/8 in. assuming a loss of water at 0.050% of the water volume per 24-hour period. The test period shall not be longer than five days.
 - 5. The water temperature shall be recorded at a depth of 18 in. below the water surface at the start and end of the test.

6. A floating, restrained, partially filled, calibrated, open container for evaporation and precipitation measurement should be positioned in open structures and the water level in the container recorded at 24-hour intervals. Determination of evaporation by a shallow pan-type measuring device is not acceptable due to possible heating of the bottom of the shallow pan resulting in accelerated evaporation.

3.03 EVALUATION

- A. The containment structure shall continue to be observed in both the early mornings and late afternoons to verify compliance with Part 1 of the test during Part 2.
- B. At the end of the test period, the water surface shall be recorded to within 1/16-in at the location of original measurements. The water temperature and the evaporation and precipitation measurements shall be recorded.
- C. The allowable loss of water for tightness tests shall not exceed 0.050% of the test water volume in 24 hours.
- D. The change in water volume in the structure shall be calculated and corrected, if necessary, for evaporation, precipitation, and temperature based on the change recorded in the water level from the open container. If the loss exceeds the allowable loss, the structure shall be considered to have failed the test.
- E. During Part 2 of the test, observed flow or seepage of water from the exterior surface, including that from cracks and joints, should be considered as a failed test. The structure shall also be considered to have failed the test if moisture can be transferred from the exterior surface to a dry hand. Dampness or wetness on top of a footing shall not be considered as a failure test.

3.04 RETESTING

- A. A restart of the test shall be required when test measurements become unreliable due to unusual precipitation or other external factors.
- B. The Contractor shall be permitted to immediately retest when no visible leakage is exhibited. If the structure fails the second test or if the Contractor does not exercise the option of immediately retesting after the first test failure, the interior of the structure shall be inspected by a diver or by other means to determine probable areas of leakage. The structure shall only be retested after the most probable areas of leakage are repaired.
- C. If the leakage exceeds the allowable limit, the work shall be corrected by methods approved by the Engineer.
- D. Upon completion of the necessary remedial work, the leakage test shall be repeated until it is successfully passed.

3.05 NOTIFICATION BY ENGINEER

- A. If any leaks, in excess of the specified amount, are not remedied by the Contractor within four (4) weeks of notification by the Engineer, regardless of whether the cause of these leaks is or is not determined, the Engineer shall have the authority to have these leaks repaired by others. The cost of repairs, by others, shall be deducted from monies due or to become due to the General Contractor.

- END OF SECTION -

SECTION 01510

TEMPORARY UTILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. 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.
- B. 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.
- C. At the completion of the work, or when the temporary services are no longer required, the facilities shall be restored to their original conditions.
- D. 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.
- E. 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.
- F. 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.

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.

3. 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.
4. 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.

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.

5. 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.

6. 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.
7. 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.
8. 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.

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.

9. 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.

G. 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.

H. 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.

I. Temporary Water

1. The Owner shall install a temporary water service connection for construction purposes, sanitary facilities, fire protection, field offices and for cleaning. The Contractor shall pay the \$50.00 membership fee 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 PUMPING 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 existing pumping station in order to avoid service disruption to customers.
- B. 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.
- C. 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 Engineer 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 existing pump station is maintained in continuous operation. All short-term or partial systems shutdowns shall not be performed without the approval of the Engineer. Long-term shutdowns 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 operations are restored. If the Contractor completes all required Work before the specified shutdown period has ended, the Owner may immediately resume normal operations.
- 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 72 hours before the scheduled shutdown. Owner personnel shall operate Owner's facilities involved in the short-term and long-term shutdowns.

- C. Short term shutdowns will be allowed for tie-ins to existing facilities. All such shutdowns shall be scheduled for low-demand periods, which may be on weekend days, and shall be limited to less than two (2) hours. Any shutdown longer than two (2) hours in duration shall be defined as a long-term shutdown. The Contractor shall provide appropriate temporary facilities, to be approved by the Owner, and at no additional cost to the Owner, when the existing pump station cannot be shut down for a sufficiently 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 service to customers will not be disrupted during the requested shutdown period. 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 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 pump station as a result of not complying with specified provisions for maintaining plant operations, then the Contractor shall immediately make all repairs or replacements and do all work necessary to restore the plant 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 effect 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 Plant Site, Roadways, and Parking Areas
 - 1. An unobstructed traffic route to the work site shall be maintained at all times for the Owner's operations personnel and maintenance equipment. Parking for personal vehicles of construction personnel shall not be allowed within the fence of the pump station. Construction personnel may park on Owner property outside the pump station fence in areas approved by the Engineer. The 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.
 - 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 plant 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 Owner personnel must be maintained throughout construction.

C. Plumbing Facilities

1. All existing building plumbing systems such as roof and floor drains, pumping, etc., shall be maintained for all structures.

D. Building Heating and Ventilating

1. Building heating and ventilating for the existing buildings shall be in service for the entire construction period. Additional temporary heating and ventilation shall be provided as required to maintain facilities under construction adequately heated and vented. The temperatures to be maintained in all interior spaces, whether new, existing or temporary, shall be maintained at a minimum of 55°F during construction.

E. 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. 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. 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. Owner's phone service to the plant shall be maintained in continuous operation during construction.

F. 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.

I. Sump Pumps and Sumps

1. All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.

J. Seal Water and Service Water Piping

1. A supply of service and seal water and the necessary connections to existing equipment shall be maintained during construction. Interim piping shall be provided as required.

1.04 SHUTDOWN SCHEDULE

- A. The shutdowns describe work which requires bypasses, shutdowns and coordination of existing operating facilities. The list does not purport to include all Work necessary and it may be modified to suit existing conditions which are encountered. It shall be used as a guide to prepare the construction schedule and the shutdown schedule. Shutdowns are not necessarily listed in the order they must be performed. Contractor is solely responsible for scheduling the shutdowns in conjunction with the anticipated construction sequence.

B. General requirements which apply to all shutdowns:

1. Shutdown periods are indicated in 24-hour calendar days, or number of hours.
2. Simultaneous shutdowns of more than one facility, except as specifically indicated or allowed by the Owner, will not be permitted.
3. The Contractor shall submit a plan consisting of a construction sequence, time schedule, details of labor, equipment and material available for work to be performed during each shutdown to the Engineer. The plan shall demonstrate the Contractor's ability to meet the time limitations.
4. Insofar as possible, all equipment to be incorporated into existing facilities, shall be ready for installation before the existing facilities are shutdown, including the performing necessary modifications to PLC's, and identification of wiring required to transfer power, monitoring and control of existing and new equipment. Contractor shall identify these requirements to ensure the new work for each shutdown will be complete within the specified period and that the re-start of existing equipment will not be delayed. This may require Contractor to identify and coordinate with the Owner additional shutdowns that are specifically listed herein to complete the work.
5. For all shutdowns, prior work that shall be completed by the Contractor includes:
 - a. Confirm all field measurement for installation clearances.
 - b. Identify any other relocations that may be required. Confirm all access points for removals and installations.
 - c. Have pipe assemblies pre-assembled to the greatest extent practical, and have all piping ,fittings, couplings, valves, and blind flanges, etc., located immediately adjacent to the work area.

- d. Have on-hand temporary dewatering equipment and a method to dispose of the water away from the work area.
 - e. Prior to placing facilities into service, submit and obtain approval of Operations and Maintenance Manuals from the Owner. Complete Manufacturer's Field Services, including training of Owner's personnel.
6. If the Work, during shutdown periods, is not done satisfactorily, or as planned, or within the time required or approved, the Engineer may order the Contractor to work a 24-hour work schedule with a full crew, or he may order the Contractor to place the facility back in service and reschedule the shutdown or, he may order the Work required to place the facility back in service done with other forces. If the work is done by other forces, the Owner's costs will be deducted from the amounts due to the Contractor. In no case shall the Owner be required to make additional payment for overtime work or redoing the work caused by the Contractor's failure to complete the work in the allotted time.
7. Upon completion of a minimum of seven (7) days consecutive and continuous days of operation of the new pumping station, the Owner will assume operation and operating cost of the equipment, provided that a Certificate of Substantial Completion for equipment has been issued by Engineer.

C. Shutdown No. 1 – 48" Pipe Outlet Installation in Hyattown Storage Tank Floor

- 1. General Description: Shutdown and isolation of the Hyattown Storage Tank to install the new 48" pipe outlet under the tank floor.
- 2. Shutdown Period: 10 calendar days. Work shall be scheduled between November 1 and February 28 of the following year.
- 3. Prior Work:
 - a. Install, disinfect, and pressure test new 48" and 36" water lines from the tank to the nearest 36" butterfly valves.
 - b. Owner will operate the necessary valves to isolate and drain the storage tank. Contractor shall coordinate the Work with Owner's valve operation schedule.
- 4. Work to be Completed During Shutdown:
 - a. Coordinate with Owner to operate existing valves and pump station to isolate Contractor's work area as much as possible.
 - b. Excavation and trench shoring if necessary under the tank floor and outside the tank.
 - c. Chip out tank floor for new outlet pipe.
 - d. Install new outlet pipe to installed 48" water line.

- e. Install necessary steel reinforcement in the concrete pipe floor cap.
 - f. Form and pour concrete pipe encasement and the concrete pipe cap on the tank floor.
 - g. Clean and disinfect new valve and piping as well as tank area exposed to foreign materials during shutdown activities.
 - h. Pressure test new pipe and valves.
5. At completion of the shutdown, the new tank connection shall be fully functional.
- D. Shutdown No. 2 – Connection of new pumping station Welcome discharge line to existing Welcome transmission main.
- 1. General Description: Shutdown of the Welcome transmission main and Welcome side of the existing pump building to transfer Welcome service to new pump building.
 - 2. This shutdown and associated work shall comply with the requirements set forth in Section 01530.
 - 3. This shutdown shall not take place until the new Welcome pumping system, including pumps, piping, valving, instrumentation, surge tank, flow meter and vault, and all associated appurtenances are installed, tested, disinfected, and ready for operation.
- E. Shutdown No. 3 – Connection of new pumping station Glen Anna discharge line to existing Glen Anna transmission main.
- 1. General Description: Shutdown of the Glen Anna transmission main and Glen Anna side of the existing pump building to transfer Welcome service to new pump building.
 - 2. This shutdown and associated work shall comply with the requirements set forth in Section 01530.
 - 3. This shutdown shall not take place until the new Glen Anna pumping system, including pumps, piping, valving, instrumentation, surge tank, flow meter and vault, and all associated appurtenances are installed, tested, disinfected, and ready for operation.
- F. Shutdown No. 4 – Connection of existing 24" bypass suction line to new suction piping.
- 1. General Description: Shutdown of 24" bypass suction line to connect it to the new suction piping.
 - 2. This shutdown and associated work shall comply with the requirements set forth in Section 01530.
 - 3. This shutdown shall not take place until Shutdown Nos. 1, 2, and 3 have been completed.

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 identified, or unsafe practices on the part of his employees. At minimum, the Contractor shall comply with all OSHA safety regulations. In the event of the Contractor's failure to comply, the Owner may take the necessary measures to correct the conditions or practices identified, 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.
- 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. Identify all conflicts prior to ordering materials of any kind so that corrections can be made to the shop drawings prior to the order.
- D. The work shall be carried out in a manner to prevent disruption of existing services (except as described in Section 01520) and to avoid damage to the existing utilities. 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.

1.05 CONNECTIONS TO EXISTING WATER TRANSMISSION MAINS

- A. Contractor shall coordinate schedule for shutdown of existing pipelines with Owner. Connections to existing water transmission mains shall be done outside normal time of work, between the hours of 9:00 PM and 5:00 AM.
- B. Time limit of shutdown of existing water transmission mains shall be 5 hours per connection.
- C. 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 operation is restored.
- D. The Contractor shall schedule shutdowns in advance and shall present all desired shutdowns in the 30 day look-ahead schedules at the progress meetings. Shutdowns shall be fully coordinated with the Owner at least 72 hours before the scheduled shutdown. Owner will advise Contractor of the number and location of affected customers for each water transmission main shutdown connection. Owner will provide notification door-hanger to Contractor. Contractor shall post door-hangers to the affected customers. Owner personnel will operate Owner's facilities and valves involved in the shutdowns. Owner does not guarantee that valves are or will be leak-proof, water, or gas tight. Contractor shall provide, at no additional cost to the Owner, all temporary caps, plugs, dewatering, pumping and other measures required to perform the Work.
- E. Any temporary work, facilities, roads, walks, protection of existing structures, piping, bulkheads, plugs, blind flanges, valves, equipment, bypass pumping, etc. that may be required shall be furnished by the Contractor at no extra cost to the Owner. Temporary facilities, including but not limited to pumps, pipes, valves, bulkheads, blind flanges, plugs, etc., shall be thoroughly cleaned and disinfected with chlorine solution prior to use. Temporary facilities shall be suitable for use in potable water applications, and shall have no prior use in non-sanitary applications. When installing plugs and/or performing work, disinfect all materials, equipment, and wet suits with chlorine in accordance with Owner's standards and requirements.
- F. 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 system operations. The Owner reserves the right to cancel scheduled shutdowns if conditions warrant.
- G. The Contractor shall provide the services of emergency repair crews on call 24-hours per day, and shall have emergency repair items such as repair clamps, bulkheads, etc., on hand prior to commencing with a shutdown.
- H. Contractor shall provide all temporary lighting as required.
- I. At least 48-hours prior to performing exploratory excavation work, Contractor shall submit to Owner a pre-excavation schedule request. After written authorization from Owner, Contractor may perform exploratory excavation. After completion of all exploratory excavations, Contractor shall provide minimum 72 hours written notice prior to performing construction excavation.
- J. The Contractor shall repair any damage to existing paved surfaces, curb and gutter, etc. that occurs. Any areas disturbed along the shoulders of roads shall be repaired, graded, seeded, etc. as necessary to match pre-existing conditions.

K. Draining Pipes and Conduits

1. The contents of pipes 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.

L. Prior Work: Contractor shall have completed the following work prior to commencing with the shutdowns necessary for pipe tie-ins.

1. Confirm locations, depths, pipe material and dimensions of existing pipelines at tie-in points. Identify any other relocations that may be required. Install excavation support systems and dewatering measures.
2. Have pipe assemblies pre-assembled to the greatest extent practical, and have all piping, fittings, couplings, valves, etc. located immediately adjacent to the work area.
3. Provide bulkheads, plugs, blind flanges, restrained couplings, etc. and have temporary dewatering equipment operational and method to dispose of the water away from the work area.
4. If Contractor elects to use tapping sleeve and valve for the connection in Clifton Road, Contractor shall confirm existing pipe material, diameter, and furnish materials that are rated for the specified test pressure. No reduction in nominal tap pipe diameter will be permitted. Contractor shall furnish all temporary and permanent blocking. Permanent blocking and restraint design details shall be sealed by a North Carolina professional engineer and submitted to Engineer in advance of performing the Work. Contractor shall secure all easements for blocking if placed outside the limits of work.

M. Disruptions, shutdowns, demolition, or abandonment of any pipeline that results in permanent disruption (partial or whole) to existing pumping station service shall not be performed until the new pumping station is in operation, except as otherwise indicated in Section 01520.

N. The Contractor shall submit a plan consisting of a construction sequence, time schedule, and details of labor, equipment and material used for the work to be performed during the connections to existing watermains to the Owner and Engineer.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01540

DEMOLITION AND REMOVAL OF EXISTING STRUCTURES AND EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. This Section covers the demolition, removal, and disposal of existing buildings, structures, pavement, curbs, and sidewalk, removal and disposal of asbestos materials, and any existing equipment including electrical, plumbing, heating and ventilating equipment and piping not required for the operation of the rehabilitated plant as indicated on the Drawings and as specified hereinafter. The Contractor shall furnish all labor, materials and equipment to demolish buildings and structures and to remove fixtures, anchors, supports, piping and accessories designated to be removed on the Drawings.

1.02 TITLE TO EQUIPMENT AND MATERIALS

- A. Contractor shall have no right or title to any of the equipment, materials or other items to be removed from the existing buildings or structures unless and until said equipment, materials and other items have been removed from the premises. The Contractor shall not sell or assign, or attempt to sell or assign any interest in the said equipment, materials or other items until the said equipment, materials or other items have been removed.
- B. Contractor shall have no claim against the Owner because of the absence of such fixtures and materials.

1.03 CONDITION OF STRUCTURES AND EQUIPMENT

- A. The Owner does not assume responsibility for the actual condition of structures and equipment to be demolished and removed.
- B. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner so far as practicable.
- C. The information regarding the existing structures and equipment shown on the Drawings is based on visual inspection and a walk-through survey only. Neither the Engineer nor the Owner will be responsible for interpretations or conclusions drawn therefrom by the Contractor.
- D. Prior to the execution of the work, the Contractor, Owner, and Engineer shall jointly survey the condition of the adjoining and/or nearby 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.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

3.01 DEMOLITION AND REMOVALS

- A. The removal of all equipment and piping, and all materials from the demolition of buildings and structure shall, when released by the Owner and Engineer, shall be done by the Contractor and shall become the Contractor's property, unless otherwise noted, for disposition in any manner not contrary to the Contract requirements and shall be removed from the site to the Contractor's own place of disposal.
- B. The Electrical Contractor (Subcontractor) specifically, shall de-energize all panelboards, lighting fixtures, switches, circuit breakers, electrical conduits, motors, limit switches, pressure switches, instrumentation such as flow, level and/or other meters, wiring, and similar power equipments prior to removal. Any electric panels or equipment which are to be retained shall be relocated or isolated by the Electrical Contractor (Subcontractor) specifically, prior to the removal of the equipment specified herein.
- C. The Contractor shall proceed with the removal of the equipment, piping and appurtenances in a sequence designed to maintain the plant in continuous operation as described in Section 01520, Maintenance of Utility Operations During Construction, and shall proceed only after approval of the Engineer.
- D. Any equipment piping and appurtenances removed without proper authorization, which are necessary for the operation of the existing facilities shall be replaced to the satisfaction of the Engineer at no cost to the Owner.
- E. Excavation caused by demolitions shall be backfilled with fill free from rubbish and debris.
- F. Burning of any debris resulting from the demolition will not be permitted at the site.

3.02 PROTECTION

- A. Demolition and removal work shall be performed by competent experienced workmen for the various type of demolition and removal work and shall be carried out through to completion with due regard to the safety of Owner employees, workmen on-site and the public. The work shall be performed with as little nuisance as possible.
- B. The work shall comply with the applicable provisions and recommendation of ANSI A10.2, Safety Code for Building Construction, all governing codes, and as hereinafter specified.
- C. The Contractor shall make such investigations, explorations and probes as are necessary to ascertain any required protective measures before proceeding with demolition and removal. The Contractor shall give particular attention to shoring and bracing requirements so as to prevent any damage to new or existing construction.
- D. The Contractor shall provide, erect, and maintain catch platforms, lights, barriers, weather protection, warning signs and other items as required for proper protection of the public, occupants of the building, workmen engaged in demolition operations, and adjacent construction.

- E. The Contractor shall provide and maintain weather protection at exterior openings so as to fully protect the interior premises against damage from the elements until such openings are closed by new construction.
- F. The Contractor shall provide and maintain temporary protection of the existing structure designated to remain where demolition, removal and new work is being done, connections made, materials handled or equipment moved.
- G. The Contractor shall take necessary precautions to prevent dust from rising by wetting demolished masonry, concrete, plaster and similar debris. Unaltered portions of the existing buildings affected by the operations under this Section shall be protected by dust-proof partitions and other adequate means.
- H. The Contractor shall provide adequate fire protection in accordance with local Fire Department requirements.
- I. The Contractor shall not close or obstruct walkways, passageways, or stairways and shall not store or place materials in passageways, stairs or other means of egress. The Contractor shall conduct operations with minimum traffic interference.
- J. The Contractor shall be responsible for any damage to the existing structure or contents by reason of the insufficiency of protection provided.
- K. Where parts of existing structures are to remain in service, demolish the portions to be removed, repair damage, and leave the structure in proper condition for the intended use.

3.03 WORKMANSHIP

- A. The demolition and removal work shall be performed as described in the Contract Documents. The work required shall be done with care, and shall include all required shoring, bracing, etc. The Contractor shall be responsible for any damage which may be caused by demolition and removal work to any part or parts of existing structures or items designated for reuse or to remain. The Contractor shall perform patching, restoration and new work in accordance with applicable Technical Sections of the Specifications and in accordance with the details shown on the Drawings. Prior to starting of work, the Contractor shall provide a detailed description of methods and equipment to be used for each operation and the sequence thereof for review by the Engineer.
- B. All supports, pedestals and anchors shall be removed with the equipment and piping unless otherwise specified or required. Concrete bases, anchor bolts and other supports shall be removed to approximately 1-inch below the surrounding finished area and the recesses shall be patched to match the adjacent areas. Superstructure wall and roof openings shall be closed, and damaged surfaces shall be patched to match the adjacent areas, as specified under applicable Sections of these Specifications, as shown on the Drawings, or as directed by the Engineer. Wall sleeves and castings shall be plugged or blanked off, all openings in concrete shall be closed in a manner meeting the requirements of the appropriate Sections of these Specifications, as shown on the Drawings, and as directed and approved by the Engineer.
- C. Materials or items designated to remain the property of the Owner shall be as hereinafter tabulated. Such items shall be removed with care and stored at a location at the site to be designated by the Owner.

- D. Where equipment is shown or specified to be removed and relocated, the Contractor shall not proceed with removal of this equipment without specific prior approval of the Engineer. Upon approval, and prior to commencing removal operations, the equipment shall be operated in the presence of representatives of the Contractor, Owner and Engineer. Such items shall be removed with care, under the supervision of the trade responsible for reinstallation and protected and stored until required. Material or items damaged during removal shall be replaced with similar new material or item. Any equipment that is removed without proper authorization and is required for plant operation shall be replaced at no cost to the Owner.
- E. Wherever piping is to be removed for disposition, the piping shall be drained by the Contractor and adjacent pipe and headers that are to remain in service shall be blanked off or plugged and then anchored in an approved manner.
- F. Materials or items demolished and not designated to become the property of the Owner or to be reinstalled shall become the property of the Contractor and shall be removed from the property and legally disposed of.
- G. The Contractor shall execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the building.
- H. In general, masonry shall be demolished in small sections, and where necessary to prevent collapse of any construction, the Contractor shall install temporary shores, struts, and bracing.
- I. Where alterations occur, or new and old work join, the Contractor shall cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, so as to leave the altered work in as good a condition as existed prior to the start of the work. The materials and workmanship employed in the alterations, unless otherwise shown on the Drawing or specified, shall comply with that of the various respective trades which normally perform the particular items or work.
- J. The Contractor shall finish adjacent existing surfaces to new work to match the specified finish for new work. The Contractor shall clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.
- K. The Contractor shall cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.
- L. The Contractor shall confine cutting of existing roof areas designated to remain to the limits required for the proper installation of the new work. The Contractor shall cut and remove insulation, etc., and provide temporary weather tight protection as required until new roofing and flashings are installed.
- M. The Contractor shall remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the work.

3.04 MAINTENANCE

- A. The Contractor shall maintain the buildings, structures and public properties free from accumulations of waste, debris and rubbish, caused by the demolition and removal operations.
- B. The Contractor shall provide on-site dump containers for collection of waste materials, debris and rubbish, and he shall wet down dry materials to lay down and prevent blowing dust.
- C. At reasonable intervals during the progress of the demolition and removal work or as directed by the Engineer, the Contractor shall clean the site and properties, and dispose of waste materials, debris and rubbish.

- 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.

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 NCDOT 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 01590

FIELD OFFICE, EQUIPMENT AND SERVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Contractor's Field Office

1. Each Contractor shall furnish, equip and maintain a field office at the site of a size required for his operations. Each Contractor shall provide his own telephone service and shall have readily accessible at the field office, copies of the Contract Documents, latest approved Shop Drawings and all field Project related correspondence, Change Order, etc.
2. The office shall be erected on a location approved by the Owner.
3. All doors and windows shall be equipped with locking devices to prevent unauthorized entry. The office shall contain adequate heating, air conditions, and ventilating facilities. All costs in relation to the work including all heat, light, water, and sanitary facilities shall be furnished and paid for by the Contractor.
4. The following furniture shall be furnished at a minimum:
 - i. Metal office folding tables and chairs of sufficient quantity to conduct progress meetings.
 - ii. Legal size steel filing cabinets.
 - iii. Rack from which to hang drawings.
 - iv. Fire extinguishers
 - v. First aid cabinet
5. On completion of the project, the field office shall be removed from the site.

B. First Aid Cabinet shall conform to the OSHA requirements for an office of up to 15 persons or a construction site of up to 5 persons.

C. Project Sign and Sign Panel

1. The General Contractor shall erect a sign at the Project site identifying the Project. **The sign shall be erected within twenty-one (21) days after the Notice to Proceed**, and shall be in accordance with the Specifications and details included in this Section. The project sign and sign panel shall be furnished, erected, and maintained by the Contractor at the location designated by the Engineer. Wording and colors shall be as shown on the detail after the end of this Section.
2. The project sign shall be fabricated, erected and maintained by the Contractor in accordance with the following specifications:

0121148BR

- a) Sign Panel: The sign panel shall be constructed of 3/4 inch minimum thickness marine plywood rabbeted into a 2 inch x 4 inch wood frame. All fasteners used in the construction of the sign shall be of a rustproof nature.
- b) Painting: All supports, trim and back of the sign panel shall be painted with at least two (2) coats of the same paint used for the sign face. All paint used shall be exterior grade paint, suitable for use on wood signs.
- c) Sign Supports: The supports for the project sign shall be at least two 4" by 4" treated wood posts. The sign panel shall be securely fastened to the sign supports with at least six (6) 3/8 ϕ galvanized bolts, nuts and washers. The positioning and alignment of the sign shall be as determined by the Engineer.
- d) Maintenance: The project sign shall be maintained by the Contractor, in good condition, at all times, for the duration of construction.
- e) Removal of Sign from Project Site: The removal of the project sign from the construction site by the Contractor shall be at the completion of construction, when ordered by the Engineer.
- f) Payment: The cost of the fabrication, erection, maintenance, and removal of the project sign, including all labor and materials, shall be included in the General Contractor's Lump Sum Bid. No extra payment will be made for obliterating certain names and offices and replacement thereof of others because of administrative changes during the course of this Contract.

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. 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. Five (5) 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 start-up 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 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 start-up period so as to cause minimum disruption to the pumping station 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 start-up 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).
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 3 -- EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 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.

3.05 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. The use of explosives shall not be permitted.

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.

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. Excavation by blasting shall not be permitted.
- 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

	Density % Std. Proctor (D698)	Density % Mod. Proctor (D1557)	Max. Lift Thickness as Compacted Inches
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 Subsection 2.01 in this Section

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 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
 - 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.
- 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, the location and nature of the erosion and sediment control devices may require adjustment 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 require prior acceptance from 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 02200 – Earthwork
- D. 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 Transportation Standard Specifications for Roads and Structures, latest edition
 - 4. 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 construction, the Contractor shall discharge stormwater associated with construction activity including clearing, grading and excavation activities resulting in the disturbance of land and related support activities with controls, limitations, and monitoring as specified below.
1. The Contractor shall submit an erosion 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:
 - i. No paint or liquid wastes in streams or storm drains.
 - ii. 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.
 - iii. Earthen-material stockpiles must be located a minimum of 50' from storm drains and streams unless no reasonable alternatives are available.
 - iv. 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).
- d. 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 $\frac{1}{4}$ 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:

Temporary Silt Fence Material Property Requirements					
	Test Material	Units	Supported¹ Silt Fence	Un-Supported¹ Silt Fence	Type of Value
Grab Strength	ASTM D 4632	N (lbs)			
Machine Direction			400	550	MARV
			(90)	(90)	
x-Machine Direction			400	450	MARV
			(90)	(90)	
Permittivity ²	ASTM D 4491	sec-1	0.05	0.05	MARV
Apparent Opening Size ²	ASTM D 4751	mm	0.60	0.60	Max. ARV ³
		(US Sieve #)	(30)	(30)	
Ultraviolet Stability	ASTM D 4355	% Retained Strength	70% after 500 hours exposure	70% after 500 hours exposure	Typical
¹ 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. ² 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. ³ 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 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.

2.05 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.

2.06 FIBER FILTRATION TUBES (FFT_s) 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.

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 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.

- A. 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.
- B. 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.

3.05 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.

3.06 FIBER FILTRATION TUBES (FFT)s 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.

3.07 ADDITIONAL REQUIREMENTS

- A. All streets around the construction area shall be scraped as necessary to prevent accumulation of dirt and debris.
- B. 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.

3.08 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.
 - 1. 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.

3.09 MONITORING AND REPORTING

- A. Monitoring: The Contractor shall monitor the installed sediment and erosion control devices in compliance with the following:
 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. 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.

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.

3.10 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 upgrade 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 --

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 02510

PAVING AND SURFACING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, equipment and materials and perform all operations in connection with the construction of asphalt concrete pavement, asphalt concrete overlay, reinforced concrete pavement, gravel roads, concrete curb and gutter, repair and reconstruction of existing asphalt concrete pavement, repair of existing gravel roads, and pavement markings complete as specified herein and as detailed on the Drawings.
- B. All new roads including the replacement of portions of the existing roads shall be to the limits, grades, thicknesses and types as shown on the Drawings. Patches for pipe crossings and areas damaged during the construction work shall be asphalt and/or gravel, depending upon the material encountered, unless otherwise indicated.

1.02 RELATED SECTIONS

- A. Section 02200 - Earthwork
- B. Section 03300 - Cast-In-Place Concrete

1.03 STANDARD SPECIFICATIONS

- A. Except as otherwise provided in the Specifications or on the plans, all work shall be in accordance with the North Carolina Department of Transportation Standard Specifications for Roads and Structures, 2002 except that any reference to "NCDOT", "Department" or "Unit" shall mean the "Owner". When reference to these Specifications is intended, the description will be NCDOT Specifications.
- B. Except with the approval of the Engineer, the placing of concrete or asphalt concrete surface paving shall be subject to the Seasonal and Weather Restrictions set forth in NCDOT Specifications.

PART 2 -- MATERIALS

2.01 SELECT FILL

- A. The Contractor shall place select fill as necessary to complete the embankments, shoulders, subgrade foundation and replacement for removed unsuitable material in accordance with NCDOT Section 235, and Section 02200, Earthwork.

2.02 GRAVEL

- A. All work, including materials, associated with gravel shall be in accordance with NCDOT Section 545, Incidental Stone Base, except that Articles 545-6 and 545-7, shall be deleted.

2.03 AGGREGATE STABILIZATION

- A. All work, including materials, associated with Aggregate Stabilization shall be in accordance with NCDOT Section 510, Aggregate Stabilization, except that Articles 510-6 and 510-7, shall be deleted.

2.04 AGGREGATE BASE COURSE (ABC)

- A. All work, including materials, associated with Aggregate Base Course shall be in accordance with NCDOT Section 520, Aggregate Base Course, except that Articles 520-11 and 520-12 shall be deleted. Type "A" or "B" aggregate will be acceptable for this project.

2.05 ASPHALT BINDER FOR PLANT MIX

- A. All work, including materials, associated with asphalt binder shall be in accordance with Section 620, Asphalt Binder for Plant Mix, Grade PG 64-22, of the NCDOT Standard Specifications for Roads and Structures, except Articles 620-4 and 620-5 shall be deleted.

2.06 ASPHALT PAVEMENTS

- A. All work, including materials, associated with asphalt pavement shall be in accordance with Section 610, Asphalt Concrete Plant Mix Pavements, of the NCDOT Standard Specifications for Roads and Structures, except Articles 610-15 and 610-16 shall be deleted. Surface Course shall be Superpave S-9.5B, Intermediate Course shall be Superpave I-19.0B, and Base Course shall be Superpave B-25.0C. Asphalt pavement mix designs shall be in accordance with TABLE 610-2 of the NCDOT.
- B. The job mix formulas shall be delivered to the Engineer at least two (2) weeks prior to beginning paving operations.

2.07 RIGID PORTLAND CEMENT CONCRETE PAVEMENT

- A. All work, including materials associated with rigid concrete pavement shall be in accordance with Section 03300, Cast-In-Place Concrete. Class A concrete shall be used. Placement shall be in accordance with Section 03300 and NCDOT Section 700, General Requirements for Portland Cement Concrete Pavement and Section 710, Concrete Pavement, except that Articles 700-2, 700-15, 710-3, 710-4, 710-8, 710-9, 710-10, and 710-11 shall be deleted.

2.08 RIGID CONCRETE PAVEMENT REINFORCING

- A. Reinforcing, if specified, shall be as shown on the Structural Drawings and as specified under Section 03200, Reinforcing Steel.

2.09 ASPHALT TACK COAT

- A. All work, including materials, associated with asphalt tack coat shall be in accordance with Section 605, Asphalt Tack Coat, of the NCDOT Standard Specifications for Roads and Structures, except that Article 605-10 shall be deleted.

PART 3 -- EXECUTION

3.01 EMBANKMENT

- A. The embankment shall be constructed in accordance with Section 02200, Earthwork.

3.02 SUBGRADE

- A. The subgrade, where shown on the Drawings, shall be aggregate stabilized by the addition and mixing of coarse aggregate with the top 3-inches of subgrade in accordance with NCDOT Section 510-4. Aggregate stabilization shall be applied to the subgrade at a rate of 300-pounds per square yard. Following the application of stabilizer aggregate, the subgrade shall be formed true to crown and grade, and shall be compacted with a minimum of four (4) passes of a 15-ton vibratory roller to conform to the maximum densities determined by AASHTO T99 Standard Specifications.

3.03 BASE COURSE

- A. The finished base course of all paving shall be ABC and shall be of the thickness shown on the Drawings, formed true to crown and grade. Gravel roads, including repair to existing gravel roads shall be ABC and shall be of the thicknesses shown on the Drawings, formed true to crown and grade. No fill material except new ABC shall be placed on top of existing gravel.

3.04 ASPHALT BASE COURSE (OR INTERMEDIATE COURSE)

- A. Asphalt Concrete Base (or Intermediate) Course shall be placed in accordance with NCDOT Standard Specifications for Roads and Structures 610-8, Spreading and Finishing. Asphalt Concrete Base (or Intermediate) Course shall be compacted in accordance with NCDOT Standard Specifications for Roads and Structures 610-9, Compaction. Thicknesses shall be as shown on the Drawings.

3.05 ASPHALT CONCRETE SURFACE COURSE

- A. Prior to placement of the asphalt concrete surface course, the base/intermediate course shall be inspected for damage or defects and repaired to the satisfaction of the Engineer. The surface of the base/intermediate course shall be approved by the Engineer.
- B. The asphalt tack coat shall be applied to the surface of the approved base/binder course as described in NCDOT Section 605. Equipment for applying the tack coat shall be power-oriented pressure spraying or distributing equipment suitable for the materials to be applied and approved by the Engineer.
- C. The Asphalt Concrete Surface Course shall be placed and compacted on the base/intermediate course in layers not to exceed 2-inches and at the rate of 110-pounds per square yard per inch. Surface Course shall be compacted in accordance with NCDOT Standard Specification for Roads and Structures, Article 610-9. Thicknesses shall be as shown on the Drawings.

3.06 RIGID PORTLAND CEMENT CONCRETE

- A. The subgrade and base course beneath portland cement concrete pavement shall be prepared in accordance with the applicable Sections of these Specifications and referenced Standard Specifications, except that the Contractor shall use an approved automatically controlled fine grading machine to produce final subgrade and base surfaces meeting the lines, grades, and cross sections (thicknesses) shown on the Drawings or established by the Engineer.
- B. The surface of the base shall be damp at the time the concrete is placed. The Contractor shall sprinkle the base when necessary to provide a damp surface. The Contractor shall satisfactorily correct all soft areas in the subgrade or base prior to placing concrete.
- C. Hauling over the base course shall not be allowed except where specifically permitted by and in writing by the Engineer. The Engineer may allow equipment dumping concrete to operate on the base to the extent and under the conditions the Engineer deems necessary to facilitate placing and spreading the concrete.
- D. Installation of the rigid concrete pavement shall be in accordance with the details shown on the Drawings and Division 3 - Concrete. The rigid concrete pavement shall cure a minimum of ten (10) calendar days and until the concrete has attained a minimum flexural strength of 550 psi as indicated by flexural strength testing. The Contractor shall coordinate and pay for all flexural strength testing with a minimum of four (4) 6-inch by 6-inch by 20-inch beams for every fifty (50) cubic yards of pavement concrete installed.
- E. Contraction joints shall be spaced at intervals as shown on the Drawings. Transverse contraction joints shall be formed by an approved joint insert. Expansion joints shall be placed when the pavement abuts a structure using 1-inch expansion joint material (filler) and sealant as specified herein.

3.07 UNDERGROUND UTILITY LINES

- A. Where an underground utility line is beneath the new roadway, the backfilling shall be carried out with special care, and the final consolidation shall be accomplished by a vibratory roller. Construction of the roadway over the trench shall be deferred as long as practicable.

3.08 JUNCTION WITH OTHER PAVING

- A. Where new asphalt concrete pavement abuts existing asphalt concrete pavement, the existing pavement shall be cut back to insure obtaining the specified compaction of the new pavement courses and interlocking adjoining courses. Existing subbase courses shall be cut back from the subgrade level of the new pavement on a one-on-one slope into the existing pavement, and the asphalt courses of the existing pavement shall be removed for an additional 6-inches back from the slope. The edge of the existing asphalt courses shall be saw cut straight and true. The faces between new and existing asphalt courses shall receive an application of tack coat.
- B. Where new rigid concrete pavement abuts existing rigid concrete or asphalt concrete paving, the existing paving shall be saw cut straight and true. An expansion joint of a 1/2-inch minimum thickness with filler material and sealant shall be placed between the new concrete pavement and the existing rigid concrete or asphalt concrete paving.

3.09 ASPHALT CONCRETE OVERLAY

- A. Where asphalt concrete is proposed to be placed over an existing asphalt or rigid concrete surface, the surfaces shall be thoroughly cleaned by power brooming and a tack coat shall be applied in accordance with NCDOT Section 605, Asphalt Tack Coat, of the NCDOT Standard Specifications for Roads and Structures, prior to installing the overlay. The overlay shall be applied in accordance with Subsections 2.06 and 3.05 and Standard Details shown on the Drawings.

-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 VAULTS

- 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 thereto:
 1. Materials shall conform to Section 03400, Precast Concrete.
 2. The date and name of manufacturer shall be marked inside each precast section.
 3. No more than two lift holes may be cast or drilled in each section.
 4. Dimensions shall be as shown on the Drawings.
 5. Covers and frames shall be as specified in Section 2.13.
 6. 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 BRICK

- A. Brick shall be sound, hard-burned common brick conforming to ASTM C32, Grade MS.

2.03 MORTAR

- A. Mortar shall conform to Section 04100 Mortar and Masonry Grout.

2.04 CONCRETE

- A. Concrete shall conform to Section 03300, Cast-in-Place Concrete.

2.05 REINFORCING

- A. Reinforcing shall conform to Section 03200, Reinforcing Steel.

2.06 PRECAST CONCRETE

- A. Precast concrete shall conform to Section 03400, Precast Concrete.

2.07 CONCRETE BLOCK

- A. Concrete block shall be solid, rectangular concrete masonry units conforming to ASTM C139.

2.08 CASTINGS

- A. Castings shall conform to Section 05540, Castings. Casting shall be of the type and size indicated on the Drawings.

2.09 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.

2.10 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.

2.11 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 ensure pre-cast structure resists flotation when empty and subjected to full height groundwater conditions.

2.16 FLEXIBLE JOINT SEALER

- A. Flexible joint sealer shall be a rubber ring waterstop as manufactured by Fernco Joint Sealer Co., or equal.

2.17 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 units shall be installed plumb and level.
- E. All lift holes and joints shall be filled with non-shrink grout conforming to Section 03600, grout inside and out.
- F. 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.
- G. Backfill structures in accordance with Section 02200, Earthwork.

- H. Clean all structures of any accumulation of silt, debris, or foreign matter and keep clean until final acceptance of the work.
- I. Excavation shall conform to Section 02200, Earthwork.
- J. Structure bases shall bear on a minimum of 8 inches of compacted stone unless otherwise indicated on the Drawings.

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.

- 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 angled outward. 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.
- B. Shop Drawings shall include a site plan that shows the locations of all proposed posts.

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 1 inch 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.

2.09 SLIDING GATES

- A. Sliding gate shall be a manually operated double slide cantilever type of the same height as adjacent fence. Gate shall be constructed of 2-1/2-inch O.D. Schedule 40 pipe with 2-inch O.D. braces. Unit shall be similar in construction to swing gates.
- B. The slide gate shall be entirely supported from fence posts.

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 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 Section 02200 – Earthwork.

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 by the Contractor at his own expense.
- 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 ripped 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 reseedings 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 ^a	Seed	Fertilizer	Straw ^b Mulch	Topdressing ^a	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:

- a. Application rates and/or chemical analysis shall be confirmed or established by soil test.
- b. 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.
- c. Apply asphalt at rate of 0.10 gallon per square yard (10 gal/1000 ft²) to tack straw mulch.

- END OF SECTION -

SECTION 03100

CONCRETE FORMWORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Provide materials, labor, and equipment required for the design and construction of all concrete formwork, bracing, shoring and supports in accordance with the provisions of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 - Reinforcing Steel
- B. Section 03250 - Concrete Accessories
- C. Section 03290 - Joints in Concrete
- D. 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. North Carolina Building Code
 - 2. ACI 318 - Building Code Requirements for Structural Concrete
 - 3. ACI 301 - Specifications for Structural Concrete for Buildings
 - 4. ACI 347 - Recommended Practice for Concrete Formwork
 - 5. U.S. Product Standard for Concrete Forms, Class I, PS 1
 - 6. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Manufacturer's data on proposed form release agent
 - 2. Manufacturer's data on proposed formwork system including form ties

1.05 QUALITY ASSURANCE

- A. Concrete formwork shall be in accordance with ACI 301, ACI 318, and ACI 347.

PART 2 -- PRODUCTS

2.01 FORMS AND FALSEWORK

- A. All forms shall be smooth surface forms unless otherwise specified.
- B. Wood materials for concrete forms and falsework shall conform to the following requirements:
 - 1. Lumber for bracing, shoring, or supporting forms shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20. All lumber used for forms, shoring or bracing shall be new material.
 - 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine high density overlaid (HDO) plywood manufactured especially for concrete formwork and shall conform to the requirements of PS1 for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.
- C. Other form materials such as metal, fiberglass, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade indicated may be submitted to the Engineer for approval, but only materials that will produce a smooth form finish equal or better than the wood materials specified will be considered.

2.02 FORMWORK ACCESSORIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 7/8-inch, and all such fasteners shall be such as to leave holes of regular shape for reaming.
- B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. A preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.
- C. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "bug holes" in cast-in-place concrete.

PART 3 -- EXECUTION

3.01 FORM DESIGN

- A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.
- B. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.
- C. All forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

3.02 CONSTRUCTION

- A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.
- B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.
- C. Forms shall be true to line and grade, and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.
- D. Forms shall be mortar tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form.
- E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

- F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.
- G. Adequate clean-out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean-outs shall be as acceptable to the Engineer.
- H. Construction joints shall not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. For flush surfaces at construction joints exposed to view, the contact surface of the form sheathing over the hardened concrete in the previous placement shall be lapped by not more than 1 inch. Forms shall be held against hardened concrete to prevent offset or loss of mortar at construction joints and to maintain a true surface.
- I. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. Set forms and intermediate screed strips for slabs accurately to produce the designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. When formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.
- J. Positive means of adjustment (wedges or jacks) for shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Shores and struts shall be securely braced against lateral deflections. Wedges shall be fastened firmly in place after final adjustment of forms prior to concrete placement. Formwork shall be anchored to shores or other supporting surfaces or members to prevent upward or lateral movement of any part of the formwork system during concrete placement. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- K. Runways shall be provided for moving equipment with struts or legs. Runways shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

3.03 TOLERANCES

- A. Unless otherwise indicated in the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in ACI 117.
- B. Structural framing of reinforced concrete around elevators and stairways shall be accurately plumbed and located within 1/4 in. tolerance from established dimensions.

- C. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used for reference purposes to check tolerances. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- D. Regardless of the tolerances specified, no portion of the building shall extend beyond the legal boundary of the building.

3.04 FORM ACCESSORIES

- A. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.
- B. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to wastewater or enclosed surfaces above the wastewater, and not less than 1 inch from the formed face of all other concrete. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified in Section 03350 - Concrete Finishing. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. No snap ties shall be broken off until the concrete is at least three days old. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

3.05 APPLICATION - FORM RELEASE AGENT

- A. Forms for concrete surfaces that will not be subsequently waterproofed shall be coated with a form release agent. Form release agent shall be applied on formwork in accordance with manufacturer's recommendations.

3.06 INSERTS AND EMBEDDED ITEMS

- A. Sleeves, pipe stubs, inserts, anchors, expansion joint material, waterstops, and other embedded items shall be positioned accurately and supported against displacement prior to concreting. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

3.07 FORM CLEANING AND REUSE

- A. The inner faces of all forms shall be thoroughly cleaned prior to concreting. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.08 FORM REMOVAL AND SHORING

- A. Forms shall not be disturbed until the concrete has attained sufficient strength. Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to sustain all resulting stresses. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.
- B. Provided the strength requirements specified above have been met and subject to the Engineer's approval, forms may be removed at the following minimum times. The Contractor shall assume full responsibility for the strength of all such components from which forms are removed prior to the concrete attaining its full design compressive strength. Shoring may be required at the option of the Engineer beyond these periods.

Ambient Temperature (°F.) During Concrete Placement

	<u>Over 95°</u>	<u>70°-95°</u>	<u>60°-70°</u>	<u>50°-60°</u>	<u>Below 50°</u>
Walls	5 days	2 days	2 days	3 days	Do not remove until directed by
Columns	7 days	2 days	3 days	4 days	Engineer (7 days minimum)

- C. When, in the opinion of the Engineer, conditions of the work or weather justify, forms may be required to remain in place for longer periods of time.
- D. An accurate record shall be maintained by the Contractor of the dates of concrete placings and the exact location thereof and the dates of removal of forms. These records shall be available for inspection at all times at the site, and two copies shall be furnished the Engineer upon completion of the concrete work.

- 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 03100 - Concrete Formwork
- B. Section 03230 - Stressing Tendons
- C. Section 03250 - Concrete Accessories
- D. Section 03300 - Cast-in-Place Concrete
- E. 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. Mill test certificates - 3 copies of each.
3. Description of the reinforcing steel manufacturer's marking pattern.
4. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.
5. Proposed supports for each type of reinforcing.
6. Request to use splices not shown on the Drawings.
7. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' capacity.
8. Request and procedure to field bend or straighten partially embedded reinforcing.
9. International Code Council–Evaluation Services Evaluation Services Report (ICC-ES ESR) for dowel adhesives.
10. Certification that all installers of dowel adhesive are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.
11. Adhesive dowel testing plan.

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.
- B. Installer Qualifications for Drilled-In Rebar: Drilled-in rebar shall be installed by an Installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

- C. Installer Training: 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 for drilled-in anchors, 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. Rebar doweling preparation and installation.
 - 5. Proof loading/torquing.
- D. Special inspections for adhesive dowels shall be conducted in accordance with the manufacturer's instructions. Downward installations require periodic inspection and horizontal and overhead installations require continuous inspection.

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. 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.
- C. Field welding of reinforcing steel will not be allowed.
- D. 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.

2.03 MECHANICAL COUPLERS

- A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being

spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.
- C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.
- D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

- A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.
- B. All holes shall be drilled in accordance with the manufacturer's instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer's requirements.
- C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer's instructions with compressed air and a wire brush prior to installation of adhesive and reinforcing bar.
- D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.
- E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer's instructions.
- F. Embedment Depth:
 - 1. The embedment depth of the bar shall be as shown on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on "PE 1000+" by Powers Fasteners. If the Contractor submits one of the other named dowel adhesives from the list below, 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.
 - 2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.
 - 3. 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, embedment depths stated in the manufacturer's ICC-ES ESR.

- G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.
- H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "Epcon C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, "HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. "SET-XP Epoxy Adhesive Anchors" as manufactured by Simpson Strong-Tie Co. or "PE-1000+ Epoxy Adhesive Anchor System" by Powers Fasteners. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.
- I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

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.

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. 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.
- H. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.

I. Adhesive Dowel Testing

1. At all locations where adhesive dowels are shown on the Drawings, at least 25 percent of all adhesive dowels installed shall be tested to the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.
2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.
3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State of North Carolina. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.
4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.
5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

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. Mechanical splices shall be used only where shown on the drawings or when approved by the Engineer.
- D. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

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 03230

STRESSING TENDONS

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. The Contractor shall furnish and place all stressing tendons for pretensioned and post-tensioned prestressed concrete, including all burning, measuring, draping, preventing bond, jacking and any special work necessary to hold the tendons in place and protect them from injury and corrosion in accordance with the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 - Reinforcing Steel

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the 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 time of Bid.

- | | | |
|----|-------------|--|
| 1. | ASTM A416 | Uncoated 7-Wire Stress-Relieved Strand for Prestressed Concrete |
| 2. | ASTM A421 | Uncoated Stress-Relieved Wire for Prestressed Concrete |
| 3. | ASTM A910 | Uncoated, Weldless, 2 and 3 Wire Steel Strand for Prestressed Concrete |
| 4. | AASHTO M203 | American Association of State Highway and Transportation Officials |
| 5. | ACI 222R | Protection of Metals in Concrete Against Corrosion |
| 6. | ACI 222.2R | Report on Corrosion of Prestressing Steels |
| 7. | ACI 318 | Building Code Requirements for Structural Concrete |
| 8. | ACI 350 | Code Requirements for Environmental Engineering Concrete Structures |

1.04 SUBMITTALS

- A. The Contractor shall submit the following in accordance with the requirements of Section 01300, "Submittals".
 - 1. Records of standard, certified mill tests run by the tendon manufacturer shall be kept on file, and current copies shall be submitted to the Engineer.

2. The manufacturer's certification and load-elongation curve, in accordance with the prestressed concrete fabricator for each lot of tendon. The Contractor shall obtain and submit the data to the Engineer for approval, in permanent record form.
3. Tubular conduit for preventing bond, when breaking bond at specific locations as required by the design.
4. Bed layout showing method of draping and tensioning, including calculations.
5. Records of initial jacking load, final jacking load and respective elongation.

PART 2 -- PRODUCTS

2.01 PRESTRESSING TENDONS

- A. Prestressing tendons for use in pretensioned and post-tensioned, prestressed concrete shall consist of multi-wire (2, 3 or 7) stress-relieved strands, stress-relieved single wire, or low-relaxation strands conforming to the requirements of ASTM A910, ASTM A416, and ASTM A421, respectively.
- B. Wires shall be uncoated and shall be of a size and of a stress relieved or low relaxation type such as to insure sufficient prestress transfer bond. Only cold-drawn wire shall be utilized, no quenched and tempered steel shall be allowed.
- C. Oil tempered wires shall not be used.
- D. The tendons shall be clean and free of excessive rust, scale and pitting.
- E. Strands or wires used in units of any one bed layout shall be manufactured by the same plant.

PART 3 -- EXECUTION

3.01 TENSIONING DEVICES

- A. Devices for tensioning shall be adequate to produce and maintain the required tension in all tendons until the concrete has reached the required transfer strength. All jacks shall be equipped with accurate and calibrated gages for registering jacking loads. Gages shall be calibrated for the jacks with which they are used. All jacks and gages shall be calibrated by an approved testing company at no cost to the Owner at intervals not to exceed 12 months. During progress of the work, if gage readings and elongations indicate materially differing loads, recalibration may be required. Gages shall have a full load capacity of 1-1/2 to 2 times their normal working load. The loads to be gaged shall be not less than one-fourth or more than three-fourths of the total graduated capacity unless calibration data clearly establishes consistent accuracy over a wider range. Gages shall have indicating dials at least 6 inches in diameter and the gage pointers shall not fluctuate, preventing an accurate reading, but shall remain steady until the jacking load is released. All gages shall have an accuracy of reading within 2 percent. Means shall be provided for measuring the elongation of tendons within 1/4-inch.

3.02 PLACING STRANDS

- A. Tendons shall be positioned in accordance with the detailed dimensions shown on the Drawings or as detailed by the supplier and effectively secured against displacement from their correct positions. The steel reinforcing shall be placed in final position after tensioning of the tendons. All tie wires shall be bent to the inside of the member so that the ends are farther from the edge than the material being tied. Bottom tendons shall be supported at spacings not to exceed 20 feet by supports meeting the requirements of Section 03200 or by other means approved by the Engineer.
- B. Tendons with kinks, bends, nicks, scale, excessive rust or other defects will not be permitted. No more than one broken wire per casting bed will be permitted. Slight rusting will not be cause for rejection, provided it is not sufficient to cause visible pits. Precautions shall be taken to prevent contamination of tendons and reinforcing steel. The tendons and reinforcing steel shall be cleaned to an acceptable condition before concrete is poured. Concrete shall not be placed in the forms until the tendon and reinforcement condition and arrangement have been inspected by the plant inspector.
- C. Tendon splices will only be permitted at the end of a reel and when using a single strand jack. The tendon lengths to be spliced together shall have the same lay of wire to avoid unraveling and the splice shall be positioned so that it does not fall within a member. The ends of the tendon lengths to be spliced shall not be torch cut. They shall be cut by shears, abrasive grinders, or other means approved by the Engineer. No more than one strand splice will be permitted on an individual strand and the reuse of strands will not be permitted.
- D. Where bonding of tendons is to be prevented, it shall be accomplished by encasing the tendons in a tubular conduit capable of resisting the pressure exerted by the concrete. Slit conduit shall not be used. The conduit used shall be of high density polyethylene or polypropylene with a minimum wall thickness of 0.025 inch. The inside diameter of the conduit shall be of sufficient size to allow free movement of the encased tendon but it shall not be greater than the diameter of the tendon plus 1/8-inch. The conduit shall be secured so that longitudinal movement along the tendon will be prevented, and bonding of the tendon will be prevented at the location shown on the Drawings plus or minus 1 inch. Concrete shall be prevented from entering the conduit by taping. The tape shall be manufactured from a non-corrosive material compatible with the concrete, conduit, and steel.

3.03 CORROSION PROTECTION

- A. All tendons, including all trimmed strand ends, shall be protected by multi-level corrosion protection appropriate for an aggressive environment. Examples of multi-level protection include adequate concrete or grout cover, use of low permeability concrete and grout, use of corrosion inhibiting admixtures, water resistant grease, sheathing, encapsulated strands, etc.
- B. Time between tendon stressing and grouting shall be not exceed 7 days to limit corrosion risk of unprotected tendons. Temporary corrosion protection is required when time between tendon stressing and grouting will exceed 7 days.

3.04 TENSIONING PROCEDURE

- A. Each tendon shall be tensioned to the required load prior to placing the concrete.

- B. The load induced in the tendon shall be measured both by jacking gages and strand elongations on at least the first 5 tendons and every third tendon thereafter on each pour. Loads on all other tendons shall be measured by either jacking gages or tendon elongations. When both methods of measurement are used, if a discrepancy between gage and elongation of more than 5 percent is apparent, the entire operation shall be carefully checked and the source of error determined before proceeding further. The computed elongation and jacking loads shall make appropriate allowances for load losses due to friction and all possible slippage or relaxation of the anchorage. References shall be established periodically at each tendon anchorage to indicate any yielding or slippage that may occur between the time of initial tensioning and final release of the tendons.
- C. In determining the applied load by measuring the elongation of the tendon, a modulus of elasticity taken from the typical stress-strain curve for the brand, size, and type of tendon being tensioned shall be used. The Contractor shall submit stress-strain curve data for the actual heats of material used in the tendons to the plant inspector before the tendons are used. Each reel or tendon shall be identified by tagging in accordance with AASHTO M203. A standard color marking every 100 ft. on the tendons will be required. The standard color markings shall be white for stress relieved tendons, green for low relaxation tendons and a double marking of green and red for special low relaxation tendons.
- D. Tendons may be tensioned in a group or individually. Prior to being given its full tensioning, each tendon shall be brought to an initial tension of 2,000 lbs, for all beds under 150 ft in length, 3,000 lbs, for all beds 150 to 300 ft in length, and 4,000 lbs for all beds longer than 300 ft. in length. This initial tension shall be measured by a calibrated gauge or other approved means, and the elongation due to initial tensioning shall then be computed. The difference between the required final tension and the initial tension shall be used to compute the expected additional elongation.
- E. After initial tensioning, the tendons shall be tensioned until the required elongation and jacking load are attained and reconciled with the limits specified above. A permanent record shall be kept of the initial jacking load, the final jacking load and the elongation produced thereby. In single tendon tensioning, rotation of the jacking ram will not be allowed.
- F. When draped tendons are to be used, the Contractor shall submit to the Engineer for his approval a bed layout showing the method of draping and tensioning the draped tendons and also calculations determining the loads required for tensioning the draped tendons. The tendons for all members to be cast in any one tensioning operation shall be draped before any beam is cast. End templates or bulkheads at ends of beams shall remain vertical or as otherwise shown on the Drawings. Unless otherwise approved by the Engineer, draping for all members shall be done either simultaneously or in increments not to exceed one-fourth of the total draping.
- G. The device used for deflecting the draped tendons shall be of a type and dimensions approved by the Engineer. The part in contact with the tendon shall be rounded to a diameter of not less than 3/4-inch. Support and hold-down devices shall be of sufficient rigidity and have adequate support so that the final position of the tendons will be as shown on the Drawings.
- H. With tendons tensioned in accordance with the above requirements and with other reinforcement in place, the concrete members shall be cast so as to achieve the required lengths. Tendon load shall be maintained between anchorages until the concrete has reached the required compressive strength for transfer of load from the anchorages to the members.

3.05 TRANSFER OF LOAD

- A. Transfer of load procedures shall be such as to not cause cracks in members. Transfer of load shall be by gradual release of the tendons as a group, by gradual release of part of the group, or by burning of the fully tensioning tendons at the ends of the members. If tendons are to be released by a method other than gradual release of the entire group, the proposed method and pattern of release, if not so shown on the Drawings, shall be submitted by the Contractor to the Engineer for his approval. The approved method and pattern of release shall be rigidly followed. When the fully tensioned tendons are being burned each tendon or group of tendons shall be burned simultaneously at each end of the bed in its indicated order in the pattern and at each end of each member before proceeding to the tendons in the next group in the pattern at any point.
- B. When detensioning all beams, girders, cored slabs, and piles, tendons shall not be burned quickly but shall be heated with a low oxygen flame played along the tendon for a minimum of 5 inches until the metal gradually loses its strength. Heat shall be applied at such a rate that failure of the first wire in each tendon shall not occur until at least 5 seconds after heat is first applied. When detensioning other members, the above procedure shall be followed unless an alternate procedure has been approved by the Engineer. Detensioning by arc welder will not be allowed.
- C. All tendon releases shall be in a manner as to cause a minimum shock and lateral eccentricity of loading and shall meet the Engineer's approval. Failure to follow the above procedures for transfer of load will be grounds for rejection of the members involved.

- 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, contraction joint inserts, and epoxy bonding agent.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03290 - Joints in Concrete
- C. Section 03300 - Cast-in-Place Concrete
- D. Section 07900 - Joint Fillers, Sealants, and Caulking

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 |
| 2. | ASTM D412 | Standard Tests for Rubber Properties in Tension |
| 3. | ASTM D 624 | Standard Test method for Rubber Property - Tear Resistance |
| 4. | ASTM D 638 | Standard Test Method for Tensile Properties of Plastics |
| 5. | ASTM D1751 | Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (nonextruding and resilient bituminous types) |
| 6. | ASTM D 1752 | Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction |
| 7. | ASTM D 1171 | Standard Test Method for Ozone Resistance at 500 pphm |
| 8. | ASTM D 471 | Standard Test Method for Rubber Properties |

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. Proposed system for supporting PVC waterstops in position during concrete placement
 - 3. Samples of products if requested by the Engineer.

PART 2 -- PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) WATERSTOPS

- A. PVC waterstops for construction joints shall be flat ribbed type, 6 inches wide with a minimum thickness at any point of 3/8 inches.
- B. Waterstops for expansion joints shall be ribbed with a center bulb. They shall be 9 inches wide with a minimum thickness at any point of 3/8 inch unless shown or specified otherwise. The center bulb shall have a minimum outside diameter of 1 inch and a minimum inside diameter of 1/2 inch.
- C. The waterstops shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment whatsoever. The properties of the polyvinyl chloride compound used, as well as the physical properties of the waterstops, shall exceed the requirements of the U.S. Army Corps. of Engineers' Specification CRD-C572. The waterstop material shall have an off-white, milky color.
- D. The required minimum physical characteristics for this material are:
 - 1. Tensile strength - 1,750 psi (ASTM D-638).
 - 2. Ultimate elongation - not less than 280% (ASTM D-638).
- E. No reclaimed PVC shall be used for the manufacturing of the waterstops. The Contractor shall furnish certification that the proposed waterstops meet the above requirements.
- F. PVC waterstops shall be as manufactured by BoMetals, Inc., DuraJoint Concrete Accessories, or Sika Greenstreak.
- G. All waterstop intersections, both vertical and horizontal, shall be made from factory fabricated corners and transitions. Only straight butt joint splices shall be made in field.

2.02 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.

2.03 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.

2.04 JOINT SEALANTS

- A. Joint sealants shall comply with Section 07900, Joint Fillers, Sealants, and Caulking.

2.05 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.

2.06 CONTRACTION JOINT INSERTS

- A. Contraction joint inserts shall be ZipCap Control Joint former by Greenstreak Plastic Products.

2.07 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).

2.08 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 PVC WATERSTOPS

- A. PVC waterstops shall be provided in all construction and expansion joints in water bearing structures and at other such locations as required by the Drawings.
- B. Waterstops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all waterstops shall be secured in correct position at 12" on center along the length of the waterstop on each side, prior to placing concrete. Such method of support shall be submitted to the Engineer for review and approval. Grommets or small pre-punched holes as close to the edges as possible will be acceptable for securing waterstops.
- C. Splices in PVC waterstops shall be made with a thermostatically controlled heating element. Only straight butt joint splices will be allowed in the field. Factory fabricated corners and transitions shall be used at all intersections. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80 percent of the strength of the unspliced material.
- D. All splices in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, discoloration, charring, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review and all faulty material shall be removed from the site and disposed of by the Contractor at no additional cost to the Owner.
- E. Waterstop installation and splicing defects which are unacceptable include, but are not limited to the following:
 - 1. Tensile strength not less than 80 percent of parent material.
 - 2. Overlapped (not spliced) Waterstop.
 - 3. Misalignment of Waterstop geometry at any point greater than 1/16 inch.
 - 4. Visible porosity or charred or burnt material in weld area.
 - 5. Visible signs of splice separation when splice (24 hours or greater) is bent by hand at sharp angle.

3.02 EXPANDING RUBBER WATERSTOPS

- A. Waterstops shall be installed only where shown on the Drawings.
- B. Waterstops shall be installed in strict accordance with manufacturer's recommendations.

3.03 WATERSTOP ADHESIVE

- A. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.

- B. Adhesive shall be used where waterstops are attached to existing concrete surfaces.

3.04 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.

3.05 CONTRACTION JOINT INSERTS

- A. For contraction joints in slabs, inserts shall be floated in fresh concrete during finishing.
- B. For contraction joints in walls, inserts shall be secured in place prior to casting wall.
- C. Inserts shall be installed true to line at the locations of all contraction joints as shown on the Drawings.
- D. Inserts shall extend into concrete sufficient depth as indicated on the Drawings or specified in Section 03290, Joints in Concrete.
- E. Inserts shall not be removed from concrete until concrete has cured sufficiently to prevent chipping or spalling of joint edges due to inadequate concrete strength.

3.06 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.

3.07 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 03290

JOINTS IN CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. Provide all materials, labor and equipment required for the construction of all joints in concrete specified herein and shown on the Drawings.
- B. Types of joints in concrete shall be as follows:
 - 1. Construction Joints - Joints between adjacent concrete placements continuously connected with reinforcement.
 - 2. Expansion Joints - Joints in concrete which allow thermal expansion and contraction of concrete. Reinforcement terminates within concrete on each side of joint.
 - 3. Contraction Joints - Joints formed in concrete to provide a weakened plane in concrete section to control formation of shrinkage cracks.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03250 - Concrete Accessories
- C. Section 03300 - Cast-in-Place Concrete
- D. Section 07900 - Joint Fillers, Sealants and Caulking

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
 - 3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.

1. Layout drawings showing location and type of all joints to be placed in each structure.
2. Details of proposed joints in each structure.

PART 2 -- MATERIALS

2.01 MATERIALS

- A. All materials required for joint construction shall comply with Section 03250 - Concrete Accessories, and Section 07900 - Joint Fillers, Sealants and Caulking.

PART 3 -- EXECUTION

3.01 CONSTRUCTION JOINTS

- A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and its location to Engineer for approval.
- B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.
- C. Maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45'-0". For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25'-0".
- D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.
- E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.
- F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.02 EXPANSION JOINTS

- A. Size and location of expansion joints shall be as shown on the Drawings.

- B. All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall have a center-bulb type waterstop. Waterstop shall be as shown on Drawings and specified in Section 03250, Concrete Accessories.

3.03 CONTRACTION JOINTS

- A. Location of contraction joints shall be as shown on the Drawings.
- B. Contraction joints shall be formed with contraction joint inserts as specified in Section 03250, Concrete Accessories.
- C. Sawcutting of contraction joints in lieu of forming will not be allowed unless otherwise noted on the Drawings. Where sawcutting is allowed, joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.
- D. Unless noted otherwise on Drawings, depth of contraction joints shall be 1-1/2 inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

3.04 JOINT PREPARATION

- A. No concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.
- B. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.
- C. 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 surface shall present a clean and even appearance.
- D. All joints shall be sealed as shown on the Drawings and specified in Section 03250, Concrete Accessories.

- 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, sidewalks and pavements, except where noted otherwise in the Contract Documents. All concrete shall be Class A1 concrete unless another class is specifically called for on Contract Documents or specified herein.
 - 2. Class A2 Concrete: Normal weight structural concrete to be used for interior slabs where a Type "D" Steel Troweled Finish or Type "G" Hardened Finish is required.
 - 3. Class A3 Concrete: Normal weight structural concrete to be used where specifically called for on Contract Drawings or where specifically requested by Contractor and approved by Engineer. Class A3 concrete shall be similar to Class A1 except Class A3 concrete shall contain a mandatory addition of high range water reducer to aid in placement of concrete.
 - 4. Class A4 Concrete: Normal weight structural concrete to be used where specifically called for on Contract Drawings or areas where specifically requested by Contractor and approved by Engineer. Class A4 concrete is identical to Class A1 concrete except that coarse aggregate specified in Article 2.05 below shall be Size #8 in accordance with ASTM C33. Class A4 concrete may also require a mandatory addition of high range water reducer to aid in placement of concrete.
 - 5. Class A6 Concrete: Normal weight structural concrete used where concrete is placed under pressure (pumped). Class A6 concrete shall be used only where specifically approved by Engineer.
 - 6. 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 03100 - Concrete Formwork
- B. Section 03200 - Reinforcing Steel
- C. Section 03250 - Concrete Accessories

- D. Section 03290 - Joints in Concrete
- E. Section 03350 - Concrete Finishes
- F. Section 03370 - Concrete Curing
- G. 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. North Carolina 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 C42 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 and proposed for use on the job.
7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein and proposed for use on the job.

1.05 QUALITY ASSURANCE

- A. Tests on materials used in the production of concrete shall be required as specified in PART 2 -- 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 alkalis 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 alkalis 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 alkalis 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_2O plus 0.658 times the percentage of K_2O) 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 concrete to be used 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 concrete to be used 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 #8M 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 magnesium 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, 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.
- 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 Pozzoloth 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, A2, A3, A4, A6	4,500 psi (minimum) 7,500 psi (maximum)
b.	Class B	3,000 psi (minimum)
2.	Maximum water/cementitious materials ratio, by weight	
a.	Concrete Class A1, A2, A3, A4, A6	0.42
b.	Class B	0.50
3.	Slump range	4" nominal unless high range water reducing admixture is used. 3" max. before addition of high range water reducing admixture.
4.	Air Content	
a.	Class A1, A3, A4, A6	6% ±1.5%
b.	Class A2, B	3% Max

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 PART 2 -- 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/cement 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 ± 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 ± 1 percent
 - b. Water ± 1 percent
 - c. Aggregates ± 2 percent
 - d. Admixtures ± 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-cement 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.

3.05 Not used

3.06 PLACING CONCRETE UNDER PRESSURE (CLASS A6 CONCRETE)

- 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 by the Engineer.
- 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. Extensive repair or replacement will be considered for concrete placed having compressive strengths greater than maximum strength specified. 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 03100 – Concrete Formwork
- B. Section 03300 – Cast-in-Place Concrete
- C. 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

2.01 CONCRETE FLOOR SEALER

- A. Floor sealer shall be Diamond Clear VOX or Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions.

2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

- A. Concrete liquid densifier and sealant shall be a high performance, deeply penetrating concrete densifier and sealant. Product shall be odorless, colorless, VOC-compliant, non-yellowing silicate based solution designed to harden, dustproof and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The product must contain a minimum solids content of 20% of which 50% is silicate. Acceptable products are Diamond Hard by the Euclid Chemical Company, Seal Hard by L&M Construction Chemicals and MasterKure HD 210 WB by BASF Master Builder Solutions.

2.03 NON-METALLIC FLOOR HARDENER

- A. The specified non-metallic mineral aggregate hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specifically processed graded mineral aggregate, selected Portland cement, and necessary plasticizing agents. Acceptable products shall be "Surflex" by the Euclid Chemical Company, "Harcot" by Sonneborn, "Maximent" by BASF, and "Mastercon" by BASF.

2.04 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

- A. Non-oxidizing heavy duty metallic floor hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specifically processed non-rusting aggregate, selected Portland cement, and necessary plasticizing agents. Product shall be "Diamond-Plate" by the Euclid Chemical Company, or Masterplate by BASF Construction Chemicals.

2.05 NON-SLIP FLOORING ADDITIVE

- A. Non-slip flooring additives for slip resistant floors shall be non-metallic. Non-slip flooring additives shall be Frictex NS by BASF Construction Chemicals, A-H Alox by Anti-Hydro, or Euco Grip by the Euclid Chemical Company.

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 "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.
7. 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.
8. 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 CONCRETE SEALERS

- A. Concrete sealers shall be applied where specifically required on the Contract Drawings or specified herein.
- B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer's requirements.
- C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.

- D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.
- E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 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.

3.05 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures:	
From 1 feet below water surface to bottom of wall	II
From top of wall to 1 feet below water surface	II
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
All interior exposed concrete walls and vertical surfaces	III
All interior finish floors of buildings and structures and walking surfaces which will be continuously or intermittently wet	D
All interior finish floors of buildings and structures which are not continuously or intermittently wet	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Garage, storage area floors, and loading docks	G
Precast concrete hollow core planks	J

- 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 03100 – Concrete Formwork
- B. Section 03300 – Cast-In-Place Concrete
- C. 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 procedures for protection of concrete under wet weather placement conditions.
2. Proposed normal procedures for protection and curing of concrete.
3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
4. Proposed method of measuring concrete surface temperature changes.
5. Manufacturer's literature and material certification for proposed curing compounds.

PART 2 -- PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

- A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m² when applied at 300 sq.ft./gal. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company, and Cure & Seal 30 Plus by Symons Corporation.
- B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are "Kurez DR VOX" or "Kurez W VOX" by the Euclid Chemical Company. Install in strict accordance with manufacturer's requirements.

2.02 EVAPORATION REDUCER

- A. Evaporation reducer shall be BASF, or Euclid Chemical "Euco-Bar".

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. Use of a curing compound will not be acceptable for applications of this type.
- 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.
 5. If approved by the Engineer, application of a curing compound in accordance with Article 3.04.
- 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.

3.04 USE OF CURING COMPOUND

- A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of five days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.
- B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.
- C. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. Maximum coverage for the curing and sealing compound shall be 300 square feet per gallon for trowel finishes and 200 square feet per gallon for floated or broom surfaces. Maximum coverage for compounds placed where subsequent finishes will be applied shall be 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05 EARLY TERMINATION OF CURING

- A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:
 - 1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.
 - 2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

- 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 03230 - Stressing Tendons
- D. Section 03300 - Cast-in-Place Concrete
- E. Section 03350 - Concrete Finishes
- F. Section 03370 - Concrete Curing
- G. Section 03600 - Grout
- H. Section 05010 - Metal Materials
- I. Section 05035 - Galvanizing
- J. Section 05050 - Metal Fastening
- K. Section 05830 - Bearing Devices

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.
- 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 in accordance with Section 05035, Galvanizing.

2.06 WELDING

- A. Welding shall conform to Section 05050, Metal Fastening.

2.07 BEARING PADS

- A. Neoprene bearing pads shall conform to Section 05830, Bearing Devices and Anchors.
- B. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

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 03415

PRECAST PRESTRESSED CONCRETE
HOLLOW CORE PLANKS

PART 1 -- GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall furnish all materials, labor, equipment, tools, etc., required for the design, fabrication, delivery and erection of precast, prestressed concrete hollow core planks in accordance with the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03400 – Precast Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these 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 423 - Recommendations for Concrete Members Prestressed with Unbonded Tendons
 - 2. PCI Design Handbook

1.04 SUBMITTALS

- A. Submittals shall comply with Section 03400, Precast Concrete.

1.05 QUALITY ASSURANCE

- A. Quality assurance shall comply with Section 03400, Precast Concrete.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Materials shall comply with Section 03400, Precast Concrete, except as stated below.
- B. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi.

PART 3 -- EXECUTION

3.01 DESIGN CRITERIA

- A. All units shall be designed in accordance with the applicable provisions of ACI 318 and PCI Design Handbook, prestressed to sustain the superimposed dead and live loads indicated herein and on the Drawings. Design and subsequent fabrication shall provide for a camber in each unit to eliminate total dead load deflection.
- B. Superimposed Roof Loads
 - 1. Dead Loads - Uniform load shall be that resulting from weight of member and weights of insulation material, built-up roofing, ballast, and lightweight concrete, as shown on the Drawings.
 - 2. Live Loads - Uniform live load shall be 30 psf unless noted otherwise on the Drawings.
 - 3. Other applicable loads per the North Carolina Building Code as indicated on the Drawings.

3.02 FABRICATION AND CASTING

- A. All hollow core planks shall comply with Section 03400, Precast Concrete.
- B. Hollow core plank dimensions shall comply with PCI Design Handbook and as indicated on the Drawings.
- C. Curing of hollow core planks shall be equivalent to three days moist curing at 70°F.
- D. Unless otherwise noted on the Drawings, permitted dimensional tolerances are as follows:
 - 1. Length $\pm 1/2"$
 - 2. Width $\pm 1/4"$ Max.
 - 3. Depth $\pm 1/4"$ Max.
 - 4. Differential Camber
Between Adjacent Units $1/4"$ Max.
 - 5. Horizontal Alignment $\pm 1/8"$ per 10' $\pm 1/2"$ Max.
 - 6. Location of openings,
blockouts, anchors,
plates and inserts $\pm 1/2"$ Max.
 - 7. Square Ends $\pm 1/8"$ per 12" of Height

3.03 HANDLING, TRANSPORTING, AND STORING

- A. Handling, transporting, and storing shall comply with Section 03400, Precast Concrete.

3.04 ERECTION

- A. Erection shall comply with Section 03400, Precast Concrete.
- B. All hollow core planks shall bear on bearing pads at each end.

1. All hollow core planks shall bear on plastic or neoprene bearing pads at each end in accordance with Section 03400, Precast Concrete. Pads shall be the size shown on the Contract Drawings.
 2. Where neoprene pads are shown on the Drawings, hollow core planks shall bear on elastomeric bearing pads at each end in accordance with Section 05830, Bearing Devices. Pads shall be the size shown on the Contract Drawings and shall be adhered to the supporting concrete surface below with an approved adhesive.
- C. The top of all hollow core planks which receive concrete topping shall be cleaned of all contaminants and thoroughly wetted just prior to placing the topping.

- 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.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical.
2. Epoxy grout shall be modified as required for each particular application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be Sikadur 42, or Grout-Pak by Sika Corporation.

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.
 3. Epoxy grout shall be used for bonding new concrete to hardened concrete.

4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.
- 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 04100

MORTAR AND MASONRY GROUT

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. Principal items of work include:
 - 1. Mortar for unit masonry work.
 - 2. Grout for grouting masonry.
 - 3. Mortar for pointing and touchup.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 04150 - Masonry Accessories
- B. Section 04200 - Unit Masonry

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the Specifications, the Work shall conform to the applicable requirements of the following documents:
 - 1. ASTM C91 Standard Specification for Masonry Cement
 - 2. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
 - 3. ASTM C150 Standard Specification for Portland Cement
 - 4. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes
 - 5. ASTM C270 Standard Specification for Mortar for Unit Masonry
 - 6. ASTM C476 Standard Specification for Grout for Masonry
 - 7. ASTM C979 Pigments for Integrally Colored Concrete
 - 8. ASTM C1019 Standard Methods of Sampling and Testing Grout
 - 9. ACI 530.1/ASCE 6 Specification for Masonry Structures

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Manufacturer's data and mixing instructions for each product.
 - 2. Certificate of compliance with these specifications for each material specified below.
 - 3. Test reports.
 - 4. Samples of colored masonry mortar.

1.05 DELIVERY AND STORAGE

- A. Deliver materials in manufacturer's original containers, bearing labels indicating product and manufacturer's name.
- B. Store cementitious materials in waterproof locations to prevent damage by elements. Reject containers showing evidence of damage.
- C. Store aggregates in separate bins to prevent intrusion of foreign particles. Do not use bottom 6 inches of sand or other aggregate stored in contact with the ground.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications provide products manufactured by one of the following:
 - 1. LaFarge, Reston, VA
 - 2. Lehigh Cement Company, Allentown, PA
 - 3. Holcim, Inc., Dundee, MI

2.02 MATERIALS

- A. Mortar and Grout Materials
 - 1. Portland Cement: ASTM C-150, Type I above grade and Type II below grade.
 - 2. Hydrated lime: ASTM C-207, Type "S".
 - 3. Sand: Clean, coarse, free of loam, salt, organic and foreign matter and conforming to ASTM C-144.
 - 4. Coarse and fine aggregates for grout: ASTM C-404.

5. Masonry Cement: ASTM C 91, Type S and meet the following criteria:
 - a. Prepackaged masonry cement shall contain Portland Cement, hydrated lime and plasticizing admixtures or hydraulic hydrated lime. Masonry cements which contain other materials, including ground limestone, ground slag, or other cementitious and non-cementitious materials, are not acceptable.
6. Water - clean, fresh, potable and free from injurious amounts of oil, acids, alkalis, salts, organic matter or other deleterious substances.

B. Admixtures

1. Do not use calcium chloride.
2. Provide water repellent admixture in mortar used for architectural concrete masonry units. Admixture shall be compatible with ACMU water repellent admixture.
3. Do not use admixtures, without written approval of Engineer.

C. Mortar pigment

1. Natural or synthetic iron oxide and chromium oxides meeting the requirements of ASTM C979.
2. Pigment shall not exceed 10% of the weight of Portland cement. Carbon black shall not exceed 2% of Portland cement.
3. Color shall be selected by the Owner from the manufacturer's full range of colors and closely match the architectural concrete masonry units.

2.03 GROUT AND MORTAR MIXES

A. Masonry mortar shall be Type "S" according to ASTM C-270. Proportions for masonry mortar shall be one of the following:

1. Proportions by volume: 1 part Portland cement to 1/4 - 1/2 parts hydrated lime, and aggregate volume of not less than 2-1/4 or more than 3 times the sum of the volumes of cement and lime.
2. Proportions by volume: 1/2 part Portland cement to 1 part masonry cement, and aggregate volume of not less than 1-1/4 or more than 3 times the sum of the volumes of cement and lime.

B. Proportions for pointing mortar.

1. Proportions by volume: 1 part Portland cement to 1/4 part hydrated lime and 2 parts extra fine sand.

C. Masonry Grout shall conform to the requirements of ASTM C 476 and ACI 530.1/ASCE 6, strength of grout, tested in accordance with ASTM C 1019 shall be equal to f'_m as specified in Section 04200, but not less than 2,000 psi.

1. Test grout for every 5,000 square feet of masonry, with a minimum of one test per structure.

PART 3 -- EXECUTION

3.01 FIELD MORTAR MIXING

- A. Mixing shall be by mechanically operated batch mixer. Entirely discharge before recharging. Mix sand, lime, cement and admixtures dry for two (2) minutes minimum, add water and mix for three (3) minutes minimum. Control batching procedures by measuring materials by volume. Measurement by shovel count shall not be permitted. Mix mortar with less water than the maximum amount, consistent with workability, to provide near maximum tensile bond strength. Mix only quantity that can be used before initial set, or within the first one-half hour.
- B. Mixers, wheel barrows, mortar boards, etc., shall be kept clean.
- C. Retempering of mortar will not be permitted and mortar allowed to stand more than one (1) hour shall not be used.

3.02 INSTALLATION

- A. Install mortar and grout in accordance with ACI 530.1/ASCE 6.

3.03 REPOINTING MORTAR

- A. Prehydrate the mortar by mixing ingredients together dry, and then add only enough water to make a damp, stiff mix that will retain its form when pressed into a ball. After one to two hours, add water to bring it to the proper consistency.

- END OF SECTION -

SECTION 04150

MASONRY ACCESSORIES

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. Principal items of work include:
 - 1. Metal joint reinforcement for masonry.
 - 2. Accessories for masonry construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 04100 - Mortar and Masonry Grout
- B. Section 04200 - Unit Masonry

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications, Work shall conform to the applicable requirements of the following documents:
 - 1. ASTM A82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - 2. ASTM A153 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
 - 3. ASTM A 951 Standard Specification for Steel Wire Masonry Joint Reinforcement
 - 4. ASTM D1056 Standard Specification for Flexible Cellular Materials - Sponge or Extruded Rubber
 - 5. ACI 530.1/ASCE 6 Specifications for Masonry Structures

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300, Submittals, submit the following:
 - 1. Provide manufacturer's complete product data.

2. Provide manufacturer's certification attesting compliance of material and source of each material specified below.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS FOR MASONRY REINFORCEMENT

- A. Subject to compliance with the Specifications, provide products manufactured by the following:
 1. AA Wire Products, Company, Chicago, IL
 2. Dur-O-Wal, Inc., Arlington Heights, IL
 3. Heckmann Building Products, Inc., Chicago, IL.
 4. Holman and Barnard, Inc., Hauppauge, NY.

2.02 MATERIALS

- A. Single Wythe Joint Reinforcement

Steel ladder type reinforcement conforming to ASTM A 951 with 3/16 inch side rods and 9 gauge continuous cross rods; manufactured with wire conforming to ASTM A 82, with widths 2-inches less than nominal wall thickness.

- C. Anchors: Cast into concrete or weld to steel.

1. Dovetail Slot shall be 1 inch back by 1 inch deep by 5/8 inch throat, 22 gauge, foam filled.
2. Dovetail Anchor - accessory for anchoring triangular flexible tie to dovetail slot, shall be 12 gage by 1 inch wide 1/2 inch long dovetail section.
3. Wire/Strap Anchor - 1/4 inch wire or 12 gauge x 3/4 inch x length required, welded or mechanically attached to back up structure.

- D. Ties

1. Triangular Flexible Tie: 3/16 inch wire, sized to suit application.
2. Adjustable Tie: Pintel and eye full tie; properly sized for application, 3/16 inch cold drawn steel.

- G. Finish

1. Reinforcements, anchorages and ties shall be hot dipped galvanized, Class B-2, after fabrication in accordance with ASTM A153.

2.03 ACCESSORIES

A. Expansion and Joint Filler Material

1. Closed cell neoprene material conforming to ASTM D 1056, with a minimum compressibility of 50%. Horizontal joint filler shall be 1/4 inch thick. Expansion joints shall be a minimum 3/8" thick.

B. Control Joint

1. Wide flange rapid preformed neoprene or PVC gasket.

C. Hardware Cloth

1. Waterproof paper backed with 1/2 inch hardware cloth.

PART 3 -- EXECUTION

3.01 REINFORCEMENT AND ANCHORAGE

- A. In masonry wall panels, place horizontal joint reinforcement at a vertical spacing of 16 inches on center, unless otherwise noted.
- B. Lap side rods at each end joint a minimum of 6 inches.
- C. Install prefabricated corner and tee assemblies at each wall corner and intersection.
- D. Mitre and butt end joints are prohibited.
- E. Place horizontal joint reinforcement in approximate center of out-to-out wall assembly and assuring a 5/8 inch, minimum, mortar coverage on exterior face and 1/2 inch on interior face.
- F. Adjustable anchor assemblies may be offset no more than that which is stated in manufacturer's published instructions. Pintles may be installed either up or down.
- G. Install horizontal joint reinforcement continuous, terminating only at vertical control joints.
- H. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend 24 inches minimum each side of opening.
- I. Place joint reinforcement continuous and at 8 inches on center vertically above roof.
- J. Place reinforcing bars supported and secured against displacement. Maintain position with 1/2 inch to true dimension.
- K. Coordinate and verify that dowels and anchorages embedded in concrete and attached to structural steel members are properly placed.
- L. Place at maximum 8 inches on center each way around perimeter of openings, within 12 inches of openings.

- M. Masonry adjacent to steel and concrete columns to be attached to the column with masonry anchors at 16 inches on center. Anchors to be attached to each face of the column which is adjacent to a masonry wall, unless otherwise noted.

3.02 DOVETAIL SLOTS AND ANCHORS

- A. Provide dovetail slots to concrete contractor for placement into the concrete construction. Dovetail slots shall be placed vertically and spaced 16 inches on center horizontally.
- B. Remove slot filler after forms are removed.
- C. Hook dovetail anchor into slots and set in masonry joints at 16 inches on center.

3.03 BENDING, CUTTING AND SPLICING REINFORCEMENT

- A. Make bends and splices in reinforcement only where indicated, or prior-approval by Engineer. Bend reinforcement only when cold, and prior to any placement in construction, forming around a steel pin of diameter at least 6 times the reinforcement size. Cut bars only by approved sawing, shearing or welding methods. Make ends of reinforcement straight, square, clean and free of defects before splicing. Do not heat or weld bends and splices at points of maximum stress. Clip and bend any tie wires as required to direct the ends away from external surfaces of masonry walls.
- B. Where welding is necessary, provide materials and perform welding in accordance with AWS requirements.
- C. All lap splices to be 48 bar diameters, unless otherwise noted.

- END OF SECTION -

SECTION 04200

UNIT MASONRY

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 work.
 - 1. Principal items of work include:
 - a. Exterior masonry wall construction.
 - b. Installation of masonry reinforcement and accessories.
 - c. Masonry unit lintels.
 - d. Building into masonry work all anchors, inserts, hangers and the like provided under other Sections.
 - e. Pointing and cleaning of exposed masonry surfaces.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 04100 – Mortar and Masonry Grout
- B. Section 04150 – Masonry Accessories
- C. Section 07210 – Building Insulation

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications the Work shall conform to the applicable requirements of the following documents:
 - 1. TMS 402/ACI 530/ASCE 5 Building Code Requirements for Masonry Structures
 - 2. ACI 530.1/ASCE 6 Specifications for Masonry Structures
 - a) ACI 530.1/ASCE 6, jointly published by the American Concrete Institute and the American Society of Civil Engineers, hereafter referred to as ACI 530.1 shall be considered minimum specifications for all materials, workmanship, methods and techniques for all masonry work.
 - b) Obtain a copy of the above Specifications prior to beginning any work in this Section.

- | | | |
|----|----------------|---|
| 3. | ASTM C90 | Standard Specification for Load-Bearing Concrete Masonry Units |
| 4. | ASTM C140 | Standard Methods for Sampling and Testing Concrete Masonry Units |
| 5. | ASTM C744 | Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units |
| 6. | ANSI A41.1 R70 | Code Requirements for Masonry |

1.04 TESTING

A. Tests

The Owner reserves the right to test materials for compliance with these specifications. Sampling and testing will be done in accordance with the ASTM standard, by an independent testing agency employed by the Owner. Materials that fail to meet requirements are considered defective. Subsequent tests to establish compliance (of the same or new materials) shall be paid for by the Contractor.

1.05 SUBMITTALS

A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:

1. Samples of each material to be used showing full range of colors.
2. Manufacturer's specifications and certifications of compliance to the Specifications, including results of tests on masonry units showing such compliance, for each type of masonry. Provide handling, storage, and installation instructions along with protection instructions. Indicate by transmittal that installer has received copies of each instruction.
3. Cold and/or hot weather construction procedures in accordance with ACI 530.1/ASCE 6 sections 2.3.2.2. and 2.3.2.3.
4. Cleaning procedures and cleaner for each masonry type.

1.06 MOCK-UPS

- A. Build mock-ups at the site, where directed, full thickness and approximately 4 feet x 6 feet, indicating the proposed color range, texture and workmanship for each type of masonry. Obtain Engineer's acceptance of visual qualities of the mock-up before start of masonry work. Do not alter, move or destroy mock-ups until Work is completed and removal is directed by the Engineer.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in the manufacturer's original unbroken, undamaged and unopened packaging with labels bearing the name of the manufacturer and the product. Masonry units and brick shall be factory packaged and strapped, delivered to the site and stored on skids.
- B. Store and handle materials to prevent inclusion of water or foreign matter and to prevent damage of any nature.
- C. Distribute materials on floor slabs to prevent overloading. Designated live loads shown for floor shall not be exceeded.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Provide special shape, type or size indicated or for application requiring a form, size or finish which cannot be produced from standard masonry units by sawing. Provide solid units where masonry unit is exposed.
- B. Masonry units for fire-rated walls shall comply with Underwriter's Laboratory requirements for fire rating shown on the Drawings.

2.02 MATERIALS

A. Mortar

- 1. In accordance with Section 04100 - Mortar and Masonry Grout

- 4. Net area compressive strength of concrete masonry units shall be a minimum of 1,900 psi when tested in accordance with ASTM C140. Compressive strength of masonry (f'm) shall be a minimum of 1,500 psi in accordance with ACI 530.1 when these units are used with the mortar specified in Section 04100.

D. Concrete Masonry Lintels

Specially formed units with reinforcing bars and mortar fill provided where shown and wherever openings in masonry are indicated without structural steel or other supporting lintels.

E. Architectural Concrete Masonry Units

1. Ground faced smooth and split-face CMU shall be manufactured by firm producing architectural concrete masonry units for a minimum of five years.
2. Units shall conform to ASTM C-90, Type I, normal weight.
3. Provide units with integral water repellant admixture. Absorption shall not exceed 10 lbs per cubic foot.
4. Net area compressive strength of concrete masonry units shall be a minimum of 3,000 psi when tested in accordance with ASTM C140. Compressive strength of masonry (f'm) shall be a minimum of 1,900 psi in accordance with ACI 530.1 when these units are used with the mortar specified in Section 04100.
5. Color shall be selected from manufacturer full line of colors. Up to three colors shall be selected.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Examine areas and conditions under which masonry is to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.
- B. Do not wet concrete masonry units.
- C. Clean reinforcing, removing loose rust, ice or other coatings from bars, before placement.
- E. Thickness of cavity and composite walls, and other masonry construction shall be the full thickness shown. Build single wythe walls to the actual size of masonry units.
- D. Build chases and recesses as shown and as required for the work of other trades.
- E. Build other work into masonry work as shown, fitting masonry units around other work and grouting to assure anchorage.
- F. Cut masonry units with motor driven saw designed to cut masonry with clean, sharp, unchipped edges. Cut units as required to provide pattern shown or specified, and to fit adjoining work neatly.

H. Cold and hot weather construction.

1. No masonry shall be erected when ambient temperature has dropped below 45°F unless it is rising and at no time when it has dropped below 40°F. Provisions shall be made for heating and drying of materials, and the complete work shall be protected in accordance with the ACI 530.1/ASCE 6 Section 2.3.2.2. Masonry shall not be laid with ice or frost on its surfaces, and no masonry shall be laid on frozen work. Any work which freezes before the mortar has set shall be removed and replaced at the Contractor's own expense. Do not use any admixtures or antifreeze in the mortar.
2. When the temperature is above 100°F or 90°F with a wind velocity greater than 8 mph, mortar beds shall be spread no more than 4 feet ahead of masonry and masonry units shall be set within one minute of spreading mortar.

3.02 CONSTRUCTION TOLERANCES

- A. Variation from plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.
- B. Variation from level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.
- C. Variation of Linear Building Line: For position shown on plan and related portion of columns, walls, and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
- D. Variation in Cross Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".
- E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.03 LAYING MASONRY WALLS

- A. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half size units at corners, jambs, and wherever possible at other locations.
- B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.
- C. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below.

- D. Stopping and Resuming Work: Rack back 1/2 unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly, and remove loose masonry units and mortar prior to laying fresh mortar.
- E. Cover top of walls at the end of each day. Protect wall from water infiltration from the top until wall is capped.
- F. Built-In Work: As work progresses, build-in items specified under this and other sections of these Specifications. Fill in solidly with masonry around built-in items.
 - 1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 - 2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of hardware cloth in the joint below and rod grout into core.
 - 3. Fill cores in hollow masonry units with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar items, unless otherwise noted.
 - 4. Seal masonry tight around wall penetrations such as beams, joists, pipes, ducts, and conduit by cutting masonry units to fit as tightly as possible, then closing final gap all around with mortar, or joint filler and caulking as necessary.

3.04 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
- B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells; also bed webs with mortar in starting courses on footing or floors, and where adjacent cells are to be reinforced or filled with grout. For starting courses where cells are not grouted, spread full mortar bed including areas under cells.
- C. Maintain joint widths of 3/8", except for minor variations required to maintain bond alignment.
- D. Tooling: Joints shall be tooled to a uniform concave joint. Head joints first and then the bed joints.
- E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners and jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean and reset in fresh mortar.

3.05 JOINT REINFORCING

- A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints not more than 16" o.c. vertically.
- B. Parapets: Use continuous horizontal joint reinforcement installed in horizontal joints at 8" o.c. vertically.

- C. Reinforced masonry openings greater than 12" wide, with horizontal joint reinforcing placed in 2 horizontal joints immediately above the lintel and immediately below the sill. Extend reinforcements 2'-0" beyond jambs of the opening except at control joints.
- D. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- E. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, pipe enclosures and other special conditions.
- F. Intersecting Load-bearing Walls: Provide rigid steel anchors at not more than 2'-0" o.c vertically. Embed ends in mortar-filled cores.
- G. Non-loadbearing Interior Partitions: Build full height of story to underside of solid floor or structure above, unless shown otherwise. Fill joint with mortar after dead load deflection of structure above approaches final position.

3.05 CONTROL AND EXPANSION JOINTS

- A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Where not shown provide vertical control joints in concrete masonry units at 40 feet on center maximum or as recommended by the masonry unit manufacturer. Build-in related items as the masonry work progresses.

3.06 LINTELS

- A. Install galvanized steel lintels where indicated.
- B. Provide masonry lintels where shown and wherever openings of more than 8" for brick size units and 1'-4" for block size units are shown without structural steel or other supporting lintels. Provide precast or poured-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.
- C. For hollow concrete masonry unit walls, use specially formed "U"-shaped lintel units with reinforcement bars placed as shown and filled with grout.
- D. Provide minimum bearing of 8" at each jamb.

3.07 REINFORCED UNIT MASONRY

- A. Vertical reinforcement shall be held in place by means of frames or other suitable means. Place horizontal joint reinforcement as masonry work progresses. Provide minimum clear distance between longitudinal bars equal to nominal diameter of bar. Minimum thickness of mortar or grout between masonry and reinforcement shall be 1/4", except 6 gage or smaller wires may be laid in 3/8" mortar joints. Collar joints which contain both horizontal and vertical reinforcement shall have a minimum width of 1/2" larger than the diameter of the horizontal and vertical reinforcement.
- B. Bar splices shall be contact lap splices. Length of splice shall be a minimum of 24" for #4 bars and 30" for #5 bars.

- C. Low lift grouting shall be used when grout space is less than 2" in width. Place grout at maximum intervals of 24" in lifts of 6 to 8 inches as the work progresses. Cores to be grouted shall be clean of mortar, mortar dropping and debris. Agitate grout to assure complete filling and coverage of reinforcement. Hold grout 1-1/2 inches below top of masonry if work is discontinued for more than an hour.
- D. High lift grouting may be used when the grout space is greater than 2". Grout shall not be placed in lifts greater than 4 feet. Grout core shall be kept clean of mortar, mortar dripping and debris. Provide cleanout holes as required for inspection and cleaning. Replace cleanout plugs after inspection and acceptance. Do not place grout until entire wall has been in place a minimum of 3 days. Hold grout 1-1/2 inches below top of masonry if work is discontinued for more than an hour.
- E. Forms and shoring shall be substantial and tight to prevent leakage of mortar or grout. Brace and shore forms to maintain position and shape. Do not remove forms or shoring until masonry gains enough strength to sufficiently carry its own weight and any other loads, temporary or permanent, placed on it during construction.

3.08 PROTECTION OF WORK

- A. Exposed masonry surfaces shall be protected from staining. Tops of wall shall be covered with nonstaining waterproof coverings when work is not in progress. Installed material shall be secure in high winds.
- B. Protection shall be provided for all openings in the walls to prevent damage to sills, jambs, etc., from all causes. Aluminum or steel frames and other finish materials shall be protected from damage during masonry work.

3.09 REPAIR, POINTING AND CLEANING

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing of Masonry: At the completion of the masonry work, all holes in exposed masonry shall be pointed. Defective joints shall be cut out and tuckpointed solidly with mortar. Pointing and tuckpointing shall be done with a pre-hydrated mortar. The mortar cement shall be controlled so that, after curing of the mortar, no difference in texture or color exists with that of adjacent masonry.
- C. Masonry Cleaning: While laying masonry units, good workmanship and job housekeeping practices shall be used so as to minimize the need for cleaning the masonry work. Protect the base of the wall from mud splashes and mortar droppings. The technique for laying masonry shall be such that mortar does not run down the face of the wall or smear onto the face.
 - 1. After the joints are tooled, cut off mortar failings with the trowel and brush excess mortar burrs and dust from the face of the masonry, use a bricklayer's brush made with medium soft hair.
 - 2. Remove all large mortar particles with a hardwood scraper.
 - 3. If, after using the above outlined techniques, additional cleaning of the walls is found necessary, allow the walls to cure one month prior to initiating further cleaning processes.
- D. Clean masonry to comply with the masonry manufacturer's directions and applicable NCMA "Tek" bulletins or BIA technical notes and the following requirements.
 - 1. Saturate the wall with clean water. The wall shall be thoroughly saturated prior to and at the time the cleaning solution is applied.
 - 2. Clean masonry with an approved cleaning solution for each type of masonry applied with a brush, starting at the top of the wall. Approved cleaners shall be composed primarily of detergents, wetting agents, buffering agents, and a maximum of 10% muriatic acid. Do not use acids on masonry surfaces that will be damaged by use of an acid cleaner. The use of any of the above cleaning agents shall first be approved in writing by the manufacturer of the masonry being cleaned and the Engineer. The concentration, method of application of the cleaning solution, and method of scraping shall be as outlined on the container by the manufacturer.
 - 3. High pressure water and sandblasting shall not be used for cleaning except with the recommendation of the masonry manufacturer and the written approval of the Engineer.
 - 4. Immediately after cleaning a small area, the wall shall be rinsed thoroughly with quantities of water.

5. Protect adjacent surfaces and materials during masonry cleaning operations.
6. After the walls are cleaned, take the necessary precautions to ensure that other contractors and subcontractors do not damage or soil the walls. Mud protection around the base of walls shall be left in place until the grading work is done.

- 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 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed below:

- | | | |
|----|---|-----------------------|
| 1. | Steel W Shapes | A992 |
| 2. | Steel M, S, C, and MC shapes and Angles, Bars, and Plates | A36 |
| 3. | Rods | F 1554 Grade 36 |
| 4. | Pipe - Structural Use | A53 Grade B |
| 5. | Hollow Structural Sections | A500 Grade C or A1085 |

2.02 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 |

2.03 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.

2.04 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 |

2.05 BRONZE

- A. Material types and ASTM designations are listed below:

- | | | |
|----|-----------------------|--------------------------|
| 1. | Rods, Bars and Sheets | ASTM B138 - Alloy B Soft |
|----|-----------------------|--------------------------|

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 05035

GALVANIZING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Where galvanizing is called for in the Contract Documents, the galvanizing shall be performed in accordance with the provisions of this Section unless otherwise noted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Further requirements for galvanizing specific items may be included in other Sections of the Specifications. See section for the specific item in question.

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. ASTM A123 - Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
5. ASTM A780 - Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings
6. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 1. Certification that the item(s) are galvanized in accordance with the applicable ASTM standards specified herein. This certification may be included as part of any material certification that may be required by other Sections of the Specifications.

PART 2 -- PRODUCTS

2.01 GALVANIC COATING

- A. Material composition of the galvanic coating shall be in accordance with the applicable ASTM standards specified herein.

PART 3 -- EXECUTION

3.01 FABRICATED PRODUCTS

- A. Products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips, 1/8 inch thick and heavier which are to be galvanized shall be galvanized in accordance with ASTM A123. Products shall be fabricated into the largest unit which is practicable to galvanize before the galvanizing is done. Fabrication shall include all operations necessary to complete the unit such as shearing, cutting, punching, forming, drilling, milling, bending, and welding. Components of bolted or riveted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating. The galvanizer shall be a member of American Galvanizers Association.
- B. Components with partial surface finishes shall be commercial blast cleaned prior to pickling.
- C. Sampling and testing of each lot shall be performed prior to shipment from the galvanizer's facility per ASTM A123.

3.02 HARDWARE

- A. Iron and steel hardware which is to be galvanized shall be galvanized in accordance with ASTM A153 and ASTM F2329.

3.03 ASSEMBLED PRODUCTS

- A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.

3.04 SHEETS

- A. Iron or steel sheets which are to be galvanized shall be galvanized in accordance with ASTM A924.

3.05 REPAIR OF GALVANIZING

- A. Galvanized surfaces that are abraded or damaged at any time after the application of zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 coats of zinc rich paint meeting the requirements of Federal Specification DOD-P-21035A and shall be thoroughly mixed prior to application. Zinc rich paint shall not be tinted. The total thickness of the 2 coats shall not be less than 6 mils. In lieu of repairing by painting with zinc rich paint, other methods of repairing galvanized surfaces in accordance with ASTM A780 may be used provided the proposed method is acceptable to the Engineer.

- 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
- B. Section 05035 - Galvanizing
- C. Section 05120 - Structural Steel

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. Manufacturer's installation instructions.

3. Copy of valid certification for each person who is to perform field welding.
4. Certified weld inspection reports, when required.
5. Welding procedures.
6. Installer qualifications.
7. Certification of Installer Training.
8. Inspection Reports.
9. 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.
- H. Special inspections for concrete adhesive anchors shall be conducted in accordance with the manufacturer's instructions and Specifications Section 01450. Downward installations require periodic inspection and horizontal and overhead installations require continuous inspection.

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 HIGH STRENGTH BOLTS

- A. High strength bolts and associated nuts and washers shall be in accordance with ASTM A325 or ASTM A490. Bolts, nuts and washers shall meet the requirements of AISC 348 "The 2009 RCSC Specification for Structural Joints".
- B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

2.03 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.

2.04 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. Anchors in Seismic Design Categories C through F shall conform to the North Carolina Building Code and ACI 318 Appendix D requirements as applicable, including seismic test requirements.
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 (f_y) less than 58 ksi nor an ultimate strength (f_u) 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.

2.05 MASONRY ANCHORS

- A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.

- B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust with nylon (not wire) brush prior to installation of adhesive and anchor. Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "HIT HY-70 System" as manufactured by Hilti, Inc., or "SET-XP Epoxy-Tie or "AT-XP Acrylic-Tie" as manufactured by Simpson Strong-Tie Co.
- C. Masonry anchors used to anchor 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, masonry anchors shall also be galvanized.
- D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

2.06 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.

2.07 WELDED STUD CONNECTORS

- A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.08 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. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.
2. Concrete anchors designed by the Contractor shall be classified as structural or non-structural based on the requirements indicated above.
3. Concrete Anchor Testing:
 - a. At all locations where concrete anchors meet the requirements for structural anchors at least 25 percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one tested anchor per anchor group. If no test value is indicated on the Drawings but the installed anchor meets the requirements for structural anchors, the Contractor shall notify the Engineer to allow verification of whether anchor load proof testing is required.
 - b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.

- c. Where Contract Documents indicate anchorage design to be the Contractor's responsibility and the anchors are considered structural per the above criteria, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State of North Carolina. The Contractor's Engineer shall also submit documentation indicating the Contractor's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E488.
 - d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.
 - e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.
- 4. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.
 - 5. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

D. 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. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required.
- B. 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.
- C. 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 05120
STRUCTURAL STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and services required to provide all structural steel work in accordance with the Contract Documents. The term "structural steel" shall include items as defined in the AISC "Code of Standard Practice".

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05035 - Galvanizing
- C. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.
 - 1. North Carolina Building Code
 - 2. AISC - "Code of Standard Practice."
 - 3. AISC - "Specification for Structural Steel Buildings".
 - 4. AISC 348 - "The 2009 RCSC Specification for Structural Joints".
 - 5. AWS - "Structural Welding Code".

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Certified Mill Test Reports
 - 2. Affidavit of Compliance with grade specified
 - 3. Shop Drawings which include the following:
 - a. Layout drawings indicating all structural shapes, sizes, and dimensions.
 - b. Beam and column schedules.
 - c. Detailed drawings indicating jointing, anchoring and connection details.

1.05 QUALITY ASSURANCE

- A. Shop inspection may be required by the Owner at his own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.
- B. The erector shall be a qualified installer who participates in the AISC Certification program and is designated an AISC Certified Erector, Category ACSE.
- C. The fabricator shall be a qualified fabricator who participates in the AISC Certification program and is designated an AISC Certified Plant, Category STD.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Structural Steel
 - 1. Structural steel for W shapes shall conform to ASTM A992 unless otherwise indicated.
 - 2. Structural steel for S, M, C, and MC shapes and angles and plates shall conform to ASTM A36 unless otherwise indicated.
 - 3. Steel pipe shall be ASTM A53, Grade B.
 - 4. HSS shall be ASTM A500, Grade C or ASTM A1085. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.
 - 5. All unidentified steel will be rejected and shall be removed from the site and replaced by the Contractor, all at the expense of the Contractor.
 - 6. Fasteners for structural steel shall be in accordance with Section 05050, Metal Fastening.
- B. Welds
 - 1. Electrodes for welding shall be in accordance with Section 05050, Metal Fastening.

PART 3 -- EXECUTION

3.01 MEASUREMENT

- A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

- A. Fabrication shall be in accordance with the AISC "Specification for Structural Steel Buildings and AISC "Code of Standard Practice". Fabrication shall begin only after Shop Drawing approval.
- B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.
- C. All holes in structural steel members required for anchors, anchor rods, bolts, sag rods or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.
- D. All materials shall be properly worked and match-marked for field assembly.
- E. Where galvanizing of structural steel is required, it shall be done in accordance with Section 05035, Galvanizing.

3.03 DELIVERY, STORAGE AND HANDLING

- A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.
- B. Structural steel members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

- A. The erection of all structural steel shall conform to the applicable requirements of the AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice". All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.
- B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened.
- C. No cutting of structural steel members in the field will be allowed except by the written approval of the Engineer.

- D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.
- E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05050, Metal Fastening.
- F. All bolted connections shall use high strength bolts in accordance with Section 05050, Metal Fastening. High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Bolts specified or noted on the Drawings to be a tension or slip critical "SC" type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.
- G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.
- H. Misfits at Bolted Connections
 - 1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.
 - 2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.
 - 3. Where misalignment between anchor rods and rod holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.
- I. Grouting of Base Plates and Bearing Plates
 - 1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.
 - 2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.
 - 3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03600, Grout.
 - 4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.
- J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

- A. Painting shall be performed according to Section 09900, Painting and the following additional requirements.
1. Concrete Encased Steel: Steel members which will be encased in concrete shall be cleaned but not painted prior to encasement.
 2. Contact Surfaces: Contact surfaces such as at field connections, shall be cleaned and primed but not painted.
 3. Finished Surfaces: Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating which is easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.
 4. Surfaces Adjacent to Field Welds: Surfaces within 2 inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

- END OF SECTION -

SECTION 05500

METAL FABRICATIONS

PART 1 -- GENERAL

1.01 REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.
- B. Work shall include but may not be limited to lintels and guard posts.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05050 - Metal Fastening
- C. Section 05035 - Galvanizing
- D. Certain specific items 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. Without limiting the generality of other requirements of the 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 time of Bid.
 - 1. North Carolina Building Code
 - 2. AISC - Specification for Structural Steel Buildings
 - 3. AISI - Specifications for the Design of Cold-Formed Steel Structural Members
 - 4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Complete fabrication and erection drawings of all metalwork 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 in metal fabrications shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used in metal fabrication shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 LINTELS

- A. Provide lintels as shown on the Drawings and specified herein with 8 inches minimum bearing each side unless noted otherwise.
- B. All lintels shall be steel in accordance with Section 05120, Structural Steel, and shall be galvanized in accordance with Section 05035, Galvanizing, unless noted otherwise.

2.04 GUARD POSTS (BOLLARDS)

- A. Guard posts shall be 6-inch diameter Schedule 40 galvanized steel pipe in accordance with ASTM A53.
- B. Guard posts shall be concrete filled and crowned, as detailed in 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. 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.
- G. Fabricated items shall be shop painted when specified in Section 09900, Painting.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions
- C. Metal work shall be field painted when as specified in accordance with Section 09900, Painting.

- END OF SECTION -

SECTION 05515

LADDERS

PART 1 -- GENERAL

1.01 REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all ladders in accordance with the requirements of 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 Specifications, all work specified herein shall conform to the applicable requirements of the following documents.
 - 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 metalwork 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 ladders shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used for ladders shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 LADDERS

- A. Ladders shall be furnished with all mounting brackets, baseplates, fasteners, and necessary appurtenances for a complete and rigid installation.
- B. All ladders shall be aluminum alloy 6061-T6 or 6063-T5, with a clear, anodized finish, Aluminum Association M12C22A41.
- C. All ladders shall conform to dimensions indicated on the Drawings and shall comply with OSHA requirements.
- D. Side rails shall be 1-1/2 inch diameter Schedule 80 pipe, minimum.
- E. Rungs shall be serrated 3/4 inch diameter, minimum.
- F. All exposed connections shall be welded and ground smooth.
- G. Ladders shall be as manufactured by Thompson Fabricating Company, or equal.

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.
- 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.
- G. Fabricated items shall be shop painted when specified in accordance with Section 09900, Painting.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.

- B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.
- C. Metalwork shall be field painted when specified in accordance with Section 09900, Painting.

- END OF SECTION -

SECTION 05531

GRATINGS, ACCESS HATCHES, AND 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 05035 - Galvanizing
- C. 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 GRATING

- A. General - Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation, shall be furnished as indicated on the Drawings.

1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and material as the main bars, including ends at all cutouts.
2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No fasteners shall be permitted to project above the walking surface.
3. Grating shall be designed for a loading of 150 psf unless otherwise required by the Drawings. Grating deflection shall not exceed 1/4 inch under a uniform load of 100 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.
4. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall include anchor straps or headed studs at a maximum of 18" on-center, a minimum of two each side. Support frames shall be fabricated from the same material as the grating.

B. Aluminum Grating

1. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.
2. Grating shall be "19-SI-4 I-Bar Swage Locked" by Alabama Metal Industries Corporation (AMICO), "IB" by Harsco Industrial IKG, "I-Bar 19SGI4", by Ohio Grating Inc., or "I-Bar" by Thompson Fabricating LLC.

2.04 ACCESS HATCHES

- A. Access hatches shall be aluminum unless noted otherwise.
- B. All access hatches shall be checker plate with an approved raised pattern, non-skid surface.
- C. Access hatches shall be designed to carry a minimum live load of 150 psf, or a concentrated load of 300 pounds at the center, whichever produces the greatest stress.
- D. Access hatches shall not exceed an allowable fiber stress of 16,000 psi. Live load deflection shall be limited to L/240 of the span, but not more than 1/4-inch.

- E. All access hatches shall be fabricated from 1/4" plate, minimum and shall be stiffened as required to maintain allowable stress and deflection requirements specified herein. Stiffeners shall consist of angles or bars welded to the bottom of the plate.
- F. Hinges, where indicated on the Drawings, shall be insulated, heavy-duty, cadmium plated bronze with stainless steel pins and fasteners.
- G. All access hatches as indicated on the Drawings shall be provided with recessed handles. Handle material shall be as shown on the Contract Drawings.
- H. Air-tight and water-tight access hatches shall be provided with a 1/8 inch thick neoprene gasket between the checkered plate and the support frame. Gasket material shall be bonded to the support frame and access hatches shall be bolted to the structural support frame with countersunk stainless steel flathead screws.

2.05 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 be routed as indicated on the Drawings.

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.

C. Roof Access Doors

1. Doors shall be designed for 50 psf live load unless noted otherwise.
2. Doors for service stairs shall be Bilco Type L roof Scuttles.
3. Doors for ladder access shall be Bilco Type S or SS Roof Scuttles.

D. Fixed Ladders

1. Where the Contract Documents indicate fixed ladders or manhole steps are required under access doors, they shall be provided with "LadderUp, Model LU-4" by Bilco Company, "L1E Ladder Extension" by Halliday Products Inc., or "Ladder Climb-out Device" by Thompson Fabricating.
2. The safety posts shall be manufactured of the same material as the access door with telescoping tubular sections that lock automatically when fully extended.
3. Upward and downward movement shall be controlled by a stainless steel balancing mechanism.
4. Safety posts shall be assembled in strict accordance with manufacturer's recommendations.

2.06 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. All gratings, access hatches, and 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.
- C. Grating shall not be field cut or modified unless approved by Engineer.
- D. Grating shall not be used for equipment support or anchorage.

- 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

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 HL93 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 05830

BEARING DEVICES AND ANCHORING

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. The Contractor shall furnish and install bearing plates, pads, expansion devices, anchor rods and bolts and/or other devices used in conjunction with bearings and anchoring of bearing devices and assemblies at supports in accordance with this item and in conformity with the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05035 - Galvanizing
- C. Section 05050 - Metal Fastening
- D. Section 05120 - Structural Steel
- E. Section 09900 - Painting

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified hereunder shall conform to the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

1.	RMA Rubber Handbook	A4-F3-T.063-B2, Grade 2, Method B
2.	ASTM A240,	Standard Specification for Heat Resisting Chromium and Chromium - Nickel Stainless Steel Plate and Sheet
3.	ASTM A480	Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip
4.	ASTM D395, Method B	Standard Test for Rubber Property – Compression Set
5.	ASTM D412	Standard Test for Rubber Properties In Tension
6.	ASTM D471	Standard Test for Rubber Property - Effect of Liquids
7.	ASTM D573	Standard Test for Rubber-Deterioration In Air Oven

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| 8. | ASTM D575,
Method A | Standard Test for Rubber Properties In Compression |
| 9. | ASTM D624, Die C | Standard Test for Rubber Property - Tear Resistance |
| 10. | ASTM D746 | Standard Test for Brittleness Temperature of Plastics and Elastomers by Impact |
| 11. | ASTM D792 | Standard Test for Specific Gravity and Density of Plastics by Displacement |
| 12. | ASTM D1149 | Standard Test for Rubber Deterioration - Surface Ozone Cracking In a Chamber (Flat Specimens) |
| 13. | ASTM D1785 | Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40 |
| 14. | ASTM D2240 | Standard Test for Rubber Property - Durometer Hardness |
| 15. | ASTM D2256 | Standard Test for Breaking Load (Strength) and Elongation of Yarn by the Single-Strand Method |
| 16. | ASTM D4894 | Standard Specification for PTFE Granular Molding and RPM Extension Materials |
| 17. | ASTM D4895 | Standard Specification for PTFE Resin Produced From Dispersion |

1.04 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01300, Submittals:

1. Certification of compliance that the materials furnished under this section meet and conform to the property and physical requirements, including all testing, as stated herein and as referenced. Specifically, the certification shall state compliance with the applicable standards (ASTM, ANSI, etc.) for fabrication and testing.
2. Shop Drawings for all materials, including installation and adjustment instructions. Included with the Shop Drawings shall be all material certifications, mill test results, working drawings, etc., which are required by this and other applicable sections of the Specifications.

PART 2 -- PRODUCTS

2.01 ELASTOMERIC BEARING PADS

- A. The elastomer portion of pads shall be new neoprene compound. Pads shall be cast under heat and pressure and may be individually molded or cut from pressure-cast stock. Variations from the dimensions shown on the Drawings shall not be more than the following: thickness, $\pm 1/16$ inch; width, $-1/8$ to $+1/4$ inch; length, $-1/8$ to $+1/4$ inch. Tolerances, dimensions, finish and appearance, flash, and rubber-to-metal bonding shall conform to the requirements of A 4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be furnished in one piece and shall not be laminated unless otherwise specified. Pads shall be furnished in identifiable packages.
- B. Adhesive for use with elastomer pads shall be an epoxy-resin compound compatible with the elastomer having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20°F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikodur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.
- C. Laminated pads shall consist of alternate laminations of elastomer and hot-rolled steel sheets molded together as a unit. Outer metal laminations shall be $3/16$ inch, and inner laminations shall be 14 gage. Outer laminations of elastomer shall be $1/4$ inch, and inner laminations shall be of equal thickness (at least $3/8$ but not more than $1/2$ inch), depending on the number of laminations and thickness of the pad. Edges of metal laminations shall have a cover of approximately $1/8$ inch of elastomer. The top and bottom bearing surfaces shall each have an integral sealing rib approximately $1/8$ inch in depth, in addition to the specified total thickness, and $3/16$ inch in width around their peripheries. The bond between the elastomer and metal shall be such that failure shall occur in the elastomer and not between the elastomer and steel when tested for separation. Variations from specified dimensions for individual laminations shall not be more than those specified herein. The total thickness of the complete pad shall not vary more than $\pm 1/8$ inch.
- D. Material having a nominal durometer hardness of 70 and 50 shall be used for nonlaminated pads and laminated pads, respectively. Test samples will be prepared from finished pads. Samples of each thickness will be taken from 2 full-size pads from each shipment of 300 pads or less, with 1 additional pad for each additional increment of 300 pads or fraction thereof. When tested using the ASTM methods designated, samples shall comply with the following physical requirements.
 - 1. **Original Physical Properties:** Test results for tear resistance, tensile strength, and ultimate elongation shall not be more than 10 percent below the following specified value:

	Nominal	Hardness
	50	70
Min. tear resistance, ASTM D624, Die C (lb/in of thickness)	180	200
Hardness, ASTM D2240 (points)	50 \pm 5	70 \pm 5
Min. tensile strength, ASTM D412 (average psi of longitudinal and transverse)	2,500	2,500
Min. ultimate elongation (%)	400	300

The compressive deflection tested in accordance with ASTM D575, Method A, shall be as follows:

- a. **Laminated Pads:** The maximum compression deflection shall be 5 and 7 percent of the total rubber thickness at loads of 500 and 800 pounds per square inch, respectively. The maximum shear resistance shall be 50 pounds per square inch of the plan area at 25 percent shear deformation at –20°F. Test pads shall be subjected to a compressive load of 1.5 times the maximum design load without visible damage to the bearing.
 - b. **Nonlaminated Pads:** When loaded within 300 to 800 pounds per square inch, material shall show a compressive deflection within 20 percent of that given in the charts of Method A, interpolating for actual measured hardness.
2. **Changes in Original Physical Properties:** When pads are oven aged 70 hours at 212°F in accordance with ASTM D573, changes shall not be more than the following:

Property	Value
Hardness (points change)	0 to +15
Tensile strength (% change)	±15
Ultimate elongation (% change)	-40

- 3. **Extreme Temperature Characteristics:** Compression set under constant deflection, ASTM D395, Method B, 22 hours at 212°F, shall not be more than 35 percent. With the low-temperature brittleness test, ASTM D746, breaks shall not occur above –20°F.
- 4. **Ozone Cracking Resistance:** Upon exposure to 100 parts per million of ozone in air by volume at a strain of 20 percent and a temperature of 100±2°F in a test otherwise in accordance with ASTM D1149, cracks shall not develop within 100 hours. Samples shall be wiped with solvent before the test to remove traces of surface impurities.
- 5. **Oil Swell:** The volume change shall not be more than +120 percent when tested in accordance with ASTM D471 with ASTM Oil No. 3, 70 hours at 212°F.

2.02 TFE BEARING SURFACES

- A. TFE resin shall be virgin material conforming to the requirements of ASTM D4894 or D4895. The specific gravity shall be 2.13 to 2.19. The melting point shall be 623±2°F.
- B. Filler material shall be milled glass fibers, carbon, or other approved inert filler materials.
- C. Adhesive material shall be an epoxy resin conforming to FS MMM-A-134, FEB film or equal, as approved by the Engineer.
- D. When tested in accordance with ASTM D4894 or D4895, finished unfilled TFE sheets shall have a tensile strength of at least 2,800 pounds per square inch and an elongation of at least 200 percent.

- E. Filled TFE sheets shall contain inert filler material uniformly blended with TFE resin. Finished filled TFE sheets containing glass fiber or carbon shall conform to the following:

	ASTM Method	15% Glass Fibers	25% Carbon
Min. tensile strength	D4894/D4895	2,000 psi	1,300 psi
Min. elongation	D4894/D4895	150%	75%
Min. specific gravity	D792	2.20	2.10
Melting point	D4894/D4895	327±10°C	317 ±10°C

- F. Fabric containing TFE fibers shall be manufactured from oriented multifilament TFE fluorocarbon fibers and other fibers as required by specific designs. When tested in accordance with ASTM D2256, the tensile strength of TFE fibers shall be at least 24,000 pounds per square inch and the elongation shall be at least 75 percent.
- G. Where TFE sheets are to be epoxy bonded, one surface of the sheet shall be factory treated by an approved manufacturer using the sodium naphthalene or sodium ammonia process.
- H. Stainless steel mating surfaces shall be at least 16 gage in thickness and shall conform to the requirements of ASTM A240, Type 304. The mating surface shall be a true plane surface with a Brinnell hardness of at least 125 and a surface finish of an at least No. 8 mirror finish in accordance with ASTM A480. Stainless steel mating surfaces shall be polished or rolled as necessary to conform to the friction requirements specified herein. The stainless steel shall be attached to the sole plate by means of a seal weld around the entire perimeter of the facing material.
- I. The coefficient of friction for the completed bearing assembly shall not be more than the following:

Material	Bearing Pressure		
	500 psi (3.447 MPa)	2,000 psi (13.790 Mpa)	3,500 psi (24.132 MPa)
Unfilled TFE, fabric Containing TFE fibers, TFE perforated metal composite	.08	.06	.04
Filled TFE	.12	.10	.08
Interlocked bronze and filled TFE structures	.10	.07	.05

2.03 PREFORMED FABRIC BEDDING MATERIAL

- A. Material shall be composed of multiple layers of 8-ounce cotton duck impregnated and bound with high-quality natural rubber or its equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness after compression and vulcanizing. Finished pads shall withstand compression loads perpendicular to the plane of the laminations of at least 10,000 pounds per square inch without a detrimental reduction in thickness or extrusion.

2.04 ANCHOR RODS

- A. Anchor bolts shall be as specified in Section 05050, Metal Fastening.

2.05 PIPE SLEEVES AND COLLARS

- A. Pipe sleeves and collars shall be cut from schedule 40 PVC plastic pipe meeting the requirements of ASTM D1785 unless otherwise noted on the Drawings.

PART 3 -- EXECUTION

3.01 STEEL PLATES, SHAPES, AND BARS

- A. Unless galvanizing is indicated on the Drawings, items shall be painted in accordance with the Drawings and Section 09900, Painting.
- B. If galvanizing is indicated on the Drawings, steel bearing assemblies for both structural steel beams and girders and prestressed concrete members shall be galvanized as specified in Section 05035, Galvanizing. Except for attachments of bearing plates to beams, all fabrication and welding of bearing plate assemblies shall be performed before the steel is galvanized. All joints of welded parts shall be sealed with weld material. Welds made for attaching bearing plates to beams or girders shall be cleaned and given 2 coats of zinc rich paint having a minimum total coating thickness of 3 mils.

3.02 BRONZE PLATES

- A. Sliding surfaces of bronze plates shall be polished.

3.03 COPPER-ALLOY PLATES

- A. Finishing of rolled copper-alloy plates will not be required provided their surfaces are plane, true, and smooth.

3.04 SELF-LUBRICATING PLATES

- A. Plates shall be fabricated from cast bronze or rolled copper alloy.
- B. Sliding surfaces of plates shall be provided with annular grooves or cylindrical recesses or a combination thereof, which shall be filled with a lubricating compound. The lubricating compound shall be compressed into recesses under sufficient pressure to form a nonplastic lubricating inset. The inset shall comprise at least 25 percent of the total area of the plate. The frictional coefficient shall not be more than 0.10. The compound shall be free from material that will cause abrasive or corrosive action on metal surfaces and able to withstand extremely high pressures and atmospheric elements over long periods of time.
- C. Items shall be the standard products of the manufacturer of such materials for the application.

- D. Prior to assembly, the steel surface that will bear on the self-lubricating bearing plate shall be thoroughly lubricated with additional antioxidant lubricant furnished by the manufacturer. Coatings shall be removed before application of antioxidant lubricant.

3.05 ELASTOMERIC PADS

- A. Care shall be taken in fabricating pads and related metal parts so that effects detrimental to their proper performance, such as uneven bearing and excessive bulging, will not occur.

3.06 PLACEMENT OF BEARING PLATES AND PADS

- A. Bearing areas shall be finished to a true level plane which shall not vary perceptibly from a straightedge placed in any direction across the area.
- B. Bearing plates or pads shall be set level in exact position and shall have a uniform bearing over the entire area. Provision shall be made to keep plates or pads in the correct position during erection of beams or placement of concrete.
- C. Elastomeric pads and other flexible bearing materials shall be placed directly on masonry surfaces finished to a roughness equivalent to that of a No. 36 to No. 46 grit. Pads, bearing areas, or bridge seats and metal bearing plates shall be thoroughly cleaned and free from oil, grease, and other foreign materials. Metal bearing plates or bottoms of prefabricated beams that are to bear on elastomeric pads shall be coated with epoxy and then surfaced with a No. 36 to No. 46 silicon carbide or aluminum oxide grit. Bearing areas shall be finished to equivalent roughness.
- D. Metal bearing plates shall be bedded on seats as follows:
 - 1. The seat bearing areas shall be thoroughly swabbed with approved paint, and three layers of duck, 12 to 15 ounce per square yard, shall be placed on it, each layer being thoroughly swabbed with paint on its top surface.
 - 2. Superstructure shoes or pedestals shall be placed in position while paint is plastic. As an alternate to duct and paint, preformed fabric bedding material at least 1/8 inch in thickness may be used when called for on the Drawings or approved in writing by the Engineer.

3.07 PLACEMENT OF ANCHOR RODS

- A. All necessary anchor rods and bolts (anchors) shall be accurately set either in the concrete as they are being placed, in formed holes, or in holes cored after the concrete has set. If set in the concrete, the rods and bolts shall be accurately positioned by means of templates and rigidly held in position while the concrete is being placed. Holes may be formed by inserting or casting in the fresh concrete oiled wooden plugs, metal pipe or plastic sleeves, or other approved devices, and withdrawing them after the concrete has partially set or left in place as indicated on the Drawing's or approved by the Engineer. Holes so formed shall be at least 3 inches in diameter or at least 2.5 times the diameter of the rod or bolt. If cored, holes shall be at least 2.5 times the diameter of the anchor used or as indicated on the Drawings. Equipment used for coring concrete shall have been approved by the Engineer. Impact tools will not be permitted. Reinforcing steel shall be placed to provide adequate space to core rod/bolt holes without cutting the reinforcing steel. For cored holes, anchor rods and bolts shall be adequately held in place at the centroid of the hole or as specified on the Drawings by using approved pre-fabricated equalizers designed to allow grout to penetrate and fill the hole completely and spaced as approved by the Engineer.

- B. During freezing conditions, anchor holes shall be protected from water accumulations at all times.
- C. Anchors which are to be placed in holes of sufficient and specified diameter after the concrete has set shall be bonded to the concrete with a non-shrink high-strength Portland cement grout in accordance with Section 03600 – Grout or shall be adhesive anchors in accordance with Section 05050 - Metal Fastening. The type anchoring system and grout shall be as indicated on the Drawings. The grout or adhesive shall completely fill the holes. Anchors shall be tested for sufficient pull-out capacity as indicated in applicable sections of the Specifications or as indicated on the Drawings.
- D. Anchors that are not designed to project through bearing plates shall be checked for proper projection above the masonry bearing area immediately prior to placement of bearing plates and beams. Nuts on anchor rods at expansion ends shall be adjusted to permit free movement of the span.
- E. Angles for anchor assemblies to be attached to sides of concrete beams shall not be installed until beams have received their full dead load and supporting falsework has been removed.

- END OF SECTION -

SECTION 07180

LIQUID APPLIED WATER REPELLANTS

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work as shown on the Drawings and specified herein.
- B. Principal items of work
 - 1. Seal all masonry exposed to exterior weather conditions.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Manufacturer's product data.
 - 2. Test reports confirming compliance with specifications.

1.03 SHIPPING, HANDLING AND STORAGE

- A. Deliver material in manufacturer's original sealed containers.
- B. Store materials in such a way as to prevent any damage to container or product and protect from freezing temperatures.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. L&M Construction Chemicals
- B. BASF Master Builder Solutions
- C. Tex-Cote
- D. Tnemec
- E. Prosoco

2.02 ACCEPTABLE MATERIALS

- A. Liquid applied water repellent shall be a clear penetrating, water based silane and/or Siloxane product.

2.03 PERFORMANCE CRITERIA

- | | | |
|--|------------|----------------------|
| A. Water Permeance | ASTM E514 | 99% Improvement |
| B. Moisture Vapor
Transmission Rate | ASTM D1653 | 24.4 gm/sq ft/24 hrs |
| C. Freeze Thaw Resistance | ASTM C672 | No Scaling |
| D. Resistance to chloride | Excellent | |

PART 3 -- EXECUTION

3.01 INSPECTION

- A. Verify that masonry surfaces are ready to receive water repellent. Report any unacceptable conditions to the Engineer and do not begin application until unacceptable conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Alkali or efflorescence shall be removed or neutralized prior to application. Neutralizing shall be in accordance with manufacturer's recommendations.
- B. Caulking, glazing, painting and other materials shall be protected from damage prior to application.

3.03 APPLICATION

- A. Flood surface with water repellent as recommended by manufacturer. Apply material to assure that water repellent has soaked into surface and penetrated, hairline cracks and similar opening. Apply product at a minimum rate of 100 square feet per gallon.

3.04 CLEANING

- A. Clean windows, metals, caulking, and other materials not required to be coated, which get coated, immediately in manner approved by manufacturer of item coated.

- END OF SECTION -

SECTION 07190

VAPOR BARRIER

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, material, equipment and appliances required for complete execution of Work shown on Drawings and specified herein.
- B. Principal items of work include:
 - 1. Vapor barrier below structural slabs on grade.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 - Cast-in-Place Concrete

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Manufacturer's data and installation instructions.

PART 2 -- PRODUCTS

2.01 VAPOR BARRIER

- A. Vapor Barrier: A reinforced laminate membrane with a minimum tensile strength of 75 lbs/in. in accordance with ASTM D-882, vapor transmission rating of 0.02 perms in accordance with E-96, and a puncture resistance of 25 lbs in accordance with ASTM D-4833.
- B. Adhesive/Tape: Type approved by the Manufacturer of the vapor material.
- C. Penetration sealing: Provide manufacturer's recommended penetration seals at all pipe, conduit, and similar penetrations.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Viper Vapercheck 10 by Insulation Solutions, Inc.
 - 2. Griffolyn Type-85, by Reef Industries, Inc.
 - 3. Or Equal

PART 3 -- EXECUTION

3.01 VAPOR BARRIER

- A. Vapor barrier shall be placed on top of compacted structural fill stone, free of debris and protrusions, as shown on the Drawings for structural slabs.
- B. Lap edges 12 inches and seal with adhesive tape. Lay with seams perpendicular to and lapped in the direction of placement. Do not penetrate vapor barrier.
- C. Protect from damage until concrete is placed. Punctures and tears in vapor barrier shall be repaired using patches of the material which overlaps puncture or tear a minimum of 12 inches; seal with tape or adhesive.
- D. Penetrations through vapor barrier, such as pipe, drains, conduits and similar penetrations, shall be sealed in strict accordance with manufacturer's recommended instructions.

- END OF SECTION -

SECTION 07210

BUILDING INSULATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work as shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 - Cast-in-Place Concrete
- B. Section 04200 - Unit Masonry

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications Work shall conform to applicable requirements of the following documents:

- 1. HH-I-526C Insulation Board, Thermal (Mineral Fiber).
- 2. HH-I-1972/1 Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil On one side.
- 3. TT-S-001657 Sealing Compound Single Component, Butyl Rubber Based, Solvent Release Type (For Buildings and other Types of Construction).
- 4. ASTM C 578 Specification for Preformed, Block Type Cellular Polystyrene Thermal Insulation

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:

- 1. Manufacturer's literature, specifications, installation instructions, technical data, and general recommendations.
- 2. Samples of each type of insulation specified.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened, undamaged original packaging with bearing the manufacturer's name.
- B. Store materials in clean, dry, protected areas. Do not leave materials exposed to the weather or sunlight, except to the extent necessary to perform the work.
- C. Protect against ignition.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the requirements, provide products as manufactured by the following:
 - 1. Manufacturers of Polyisocyanurate Foam Insulation
 - a. Apache Products Company.
 - b. Atlas Energy Products.
 - c. The Celotex Corporation.

2.02 MATERIALS

- A. Unit Masonry Insulation: Fill ungrouted cells of masonry with foamed in place two component thermal insulation. Insulation shall be a Class A material with an R value of 4.9 per inch. Provide masonry insulation as manufactured by CORE-FILL 500 as manufactured by Tailored Chemical Products, Hickory, NC, or acceptable equal.
- B. Roof Insulation: Provide a minimum of 2" polyisocyanurate insulation. Provide a minimum of two staggered layers, unless otherwise indicated. Provide tapered insulation where roof structure does not slope. Roof insulation shall be approved by roofing manufacturer in accordance with the requirements of the roofing warranty. Roof insulation shall meet the requirements of a UL Class A and FM Class 1 roof. Insulation shall have an aged R-value of 5 per inch. Secure insulation as required by the roofing manufacturer to achieve an FM 90 installation. Install ½" glass faced gypsum board where insulation is installed over metal deck.
- C. Adhesive and Fasteners: Type compatible with insulation, masonry, concrete, or other substrate and as recommended or produced by the insulation manufacturer.
- D. Sealer and Tape: Type recommended by insulation manufacturer and having perm rating and fire resistance characteristics similar to that of the insulation.

PART 3 -- EXECUTION

3.01 GENERAL

- A. Insulation shall be provided in walls, slabs and ceilings and where shown on Drawings.

3.02 INSTALLATION OF INSULATION

- A. Install in accordance with the manufacturer's printed installation instructions to provide maximum sound and thermal benefits for material specified. Install to fill or cover voids. Cut neatly to snugly fit angles, corners and irregular areas and carefully wrapped around pipes, conduits, outlets, switches, beams, etc., to maintain continuity of insulation. Avoid gaps or bridges.
- B. Block Insulation: Install foamed in place two component thermal insulation in all ungrouted cells of masonry in exterior walls.
- C. Roofing Insulation: Install roofing insulation in accordance with insulation and roofing manufacturer printed instructions and recommendations.

3.03 ADJUSTMENT AND CLEANING

- A. Adequately protect Work from damage resulting from subsequent construction operations. Replace damaged or soiled Work.

- END OF SECTION -

SECTION 07530

SINGLE PLY MEMBRANE ROOFING (EPDM)

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. Principal items of work include:
 - 1. Preparation of roof deck to receive new roofing materials.
 - 2. Application of insulation, and accessories.
 - 3. Installation of fully adhered roofing system.
 - 4. Twenty year "Total Roofing System Warranty".
 - 5. Removal and cleanup of excess materials and debris.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 06100 - Rough Carpentry
- C. Section 07210 - Building Insulation
- D. Section 07600 - Flashing and Sheet Metal
- E. Section 07700 - Roof Specialties and Accessories

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM Designations; Stipulated under PART 2 - PRODUCTS.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300, submit the following:
 - 1. Manufacturer's Data.
 - 2. Manufacturer's Installation Instructions including fastening requirements of insulation and roof recovery board.

3. Sample of Total System Warranty.

1.05 QUALITY ASSURANCE

- A. The installer must be skilled and experienced and approved by roofing membrane manufacturer for type of roofing and associated work required, and equipped to perform workmanship in accordance with recognized standards.
- B. Provide periodic inspections by an official manufacturer's technical representative on all roofing and flashing. Inspections to be made at the beginning of the job and a minimum of one more while the roofing and/or flashing work is in progress to insure workmanship is in accordance with the manufacturer's specifications.
- C. Roof shall be designed to resist wind loads as required by the State Building Code.

1.06 GUARANTEE

- A. Furnish to the Owner a twenty (20) year written and signed Manufacturer's Watertightness Warranty covering materials and workmanship for the entire "Roofing System", including repair and replacement of roofing components which are deemed faulty or in disrepair during the guarantee period. Such items in disrepair shall be repaired at no cost to the Owner. Cover both labor and materials necessary to effect watertightness, including that required to repair roof leaks caused by standing water, defective material or workmanship, without limit as to amount required to effect watertightness.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's unopened containers identified with name, type, grade, class and all other qualifying information, including UL and other specified insurance agency's labels.
- B. Store materials in a dry location, in such manner as to prevent damage or intrusion of foreign matter. Conspicuously mark "Rejected" on materials which have once been wet or damaged and remove from the job site.

1.08 PRE-ROOFING CONFERENCE

- A. Contractor shall have a pre-reroofing conference to include manufacturer's technical representative, Engineer, Owner, roofing subcontractor, roofing foreman, and other trades whose piping, conduits, fans, lightning protection, etc. will be affecting the roofing system. Conference shall be held after roof substrate is installed. Inspection of the roof substrate shall be a part of the conference.
- B. Conference shall include inspection of the substrate. Overview of the shop drawings and a detailed discussion of the installation methods and procedures to be utilized by the roofing subcontractor. Objections to substrate conditions or roofing installation and protection shall be remedied during the conference. Work can begin only after all objections are incorporated into the work.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS, OR EQUAL

- A. Carlisle Syn Technical Systems Corporation or equal.
- B. Firestone Building Products Company.

2.02 MATERIALS

- A. Membrane shall be 0.060-inch thick EPDM (white on black). The membrane conforms to the minimum physical properties which meet ASTM D4637. Provide largest sheets possible to minimize seams.

EPDM MEMBRANE

<u>PROPERTY</u>	<u>TEST METHOD</u>	<u>SPECIFICATION</u>
Color		White
Tolerance on Nominal Thickness percent	ASTM D412	±10
Elongation, Ultimate Min., percent	ASTM D412	300% Min.
Tear resistance, lbf/in	ASTM D624	175 Min.
Brittleness point, max., degrees Fahrenheit (degrees F)	ASTM D746	-49°F
Resistance to heat aging Properties after 1 week at 240 degrees F	ASTM D573	
• Breaking Strength Min., lbF (N)		1,500 psi
• Elongation, Ultimate Min., percent		250
• Linear Dimensional Change Max., percent		±1
Ozone Resistance* Condition after exposure to 100 phm	ASTM D1149	No cracks
Resistance to Outdoor Weathering	ASTM G155	No cracks or crazing

B. Fasteners:

1. General:

- a. The pullout values listed below are considered minimum and have been established to reflect the structural soundness of the deck to provide proper membrane and/or insulation attachment. They are not intended to address additional design loads for the roofing system.
- b. Fasteners shall be properly coated to resist corrosion and deterioration from the effect of the item being fastened, the substrate or adjacent materials including but not limited to moisture and treatment products.

- c. Manufacturers Factory Mutual approved concrete fasteners shall be used. Fasteners shall penetrate the deck a minimum of 2 inches to a maximum of 2 1/2 inches. A pilot hole shall be predrilled to a sufficient depth to prevent contact between the fastener point and any accumulated dust in the predrilled hole.
 - d. A minimum pullout value of 800 pounds must be provided.
- C. Flashing: EPDM (white) flashing, furnished by the membrane manufacturer for this system.
 - D. Bonding Adhesive: Bonding adhesive, furnished by the membrane manufacturer for this system.
 - E. Splicing Cement: Splicing cement, furnished by the membrane manufacturer for this system.
 - F. Splice Cleaner and Splice Wipes: Furnished by the membrane manufacturer for this system.
 - G. Lap Sealant: Shall be trowel or gun consistency. Furnished by the membrane manufacturer for this system.
 - H. In Seam Sealant: Special sealant applied in the splice. Furnished by the membrane manufacturer for this system.
 - I. Water Cut-Off Mastic: Furnished by the membrane manufacturer for this system.
 - J. Molded pipe Flashing: Furnished by the membrane manufacturer for this system.
 - K. Nite Seal and Lay Flat Tubing: Furnished by the membrane manufacturer for this system.
 - L. Pourable Sealer: Furnished by the membrane manufacturer for this system.
 - M. Rubber Fastening Strip: Furnished by the membrane manufacturer for this system.
 - N. Seam Fastening Plates: Two inch diameter metal fastening plates, furnished by the membrane manufacturer for this system.
 - O. Edging: Metal or hard rubber material, furnished by the membrane manufacturer for this system.
 - P. Walkway system shall be compressed rubber walkways. Install walkways around all roof mounted equipment.
 - Q. Recovery Board: ½-in minimum thickness, high density wood fiber with asphalt coated facer. Minimum compressive strength of 30 psi and a minimum density of 15 psf.

PART 3 -- EXECUTION

3.01 SURFACE PREPARATION

- A. Contractor shall be responsible for providing proper substrate to receive the roofing system. Installer shall notify Contractor, in writing, of defects in the substrate, and work shall not proceed until defects have been corrected. The starting of work implies the acceptance of such surfaces.
- B. Construction work on the roof shall be complete before the roofing operations commence. The roof surfaces shall be clean, smooth, dry, and free from loose and foreign materials, dirt, oil, grease, and holes.
- C. Surface joints (including walls and substrate) shall be 1/4-inch or less in width. Repair all joints wider than 1/4-inch with approved joint filler before proceeding with installation.
- D. Vents and all other projections through the roof shall be secured in position before roofing is commenced.

3.02 INSTALLATION

- A. Roofing shall be furnished and installed in compliance with U.L. Class "A" requirements. Manufacturer's instructions for the installation of such roofing system shall be strictly adhered to. All accessories necessary to complete the installation shall be provided.
- B. The roofing shall be applied and finished in one area in a continuous operation. Care shall be taken to insure that water does not flow beneath any completed sections of roof. Loose edges of membrane shall be temporarily sealed with an approved night seal when the weather is threatening. When work is resumed, the sheet shall be pulled free before continuing installation.
- C. Insulation and roof recovery board shall be installed as required by roofing manufacturer to ensure proper attachment to meet wind load as required by the State Building Code. Recovery board shall be installed above the roof insulation.
- D. Roofing and flashing installation at the junction of all parapet walls, curbs, and other roof openings shall be in accordance with the roof membrane manufacturer's standard details unless shown otherwise on the Drawings. Typical details of all actual roof conditions shall be submitted for approval prior to membrane installation.
- E. Where required by the Drawings or approved Drawings, wooden nailers shall be installed at the perimeter of the roof and around all vents, skylights, hatches and similar penetrations.
- F. The EPDM roofing membrane shall be placed over the approved substrate without stretching. The membrane shall be allowed to relax approximately one half hour prior to splicing and flashing. The roofing membrane shall be fully adhered to the membrane. Adjoining sheets shall be positioned in the same manner, lapping edges a minimum of 3-inches.

- G. Splices shall be made with a minimum lap of 3-inches, using splicing cement, and lap sealant as directed by the manufacturer. When set, clean edge, apply lap sealant and feather to completely cover splice edge.
- H. The roofing membrane shall be mechanically fastened at the roof perimeter and around the penetrations according to the manufacturer's directions.
- I. Perimeter flashing and flashing around vents, skylights, etc., shall be done with manufacturer's standard flashing using the longest pieces practicable. The splice between the flashing and the main roof sheet should be completed before bonding the flashing to the vertical surface. This splice must be sealed at least 3-inches beyond the fasteners which attach the horizontal membrane to the nailer.
- J. Flash all projections (pipes, conduits, etc.) passing through the membrane. Prefabricated pipe seals shall be used to flash all pipes. All flashings and terminations shall be done in accordance with the manufacturer's approved details.

3.03 QUALITY CONTROL

- A. At completion of roofing installation an inspection shall be made by a representative of the manufacturer in order to ascertain that the roofing system has been installed properly.

- END OF SECTION -

SECTION 07700

ROOF SPECIALTIES AND ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 06100 – Rough Carpentry
- B. Section 07510 – Built-up Bituminous Roofing

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:

- 1. TT-P-641 (1) Primer Coating, Zinc Dust - Zinc Oxide (for galvanized surfaces)
- 2. ASTM A 525 Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process.
- 3. ASTM A 526 Specification for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Commercial Quality.
- 4. ASTM B 209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- 5. Sheet Metal and Air Conditioning Contractors National Association "Architectural Sheet Metal Manual" (ASMM).
- 6. The Aluminum Association "Specification for Aluminum Sheet Metal Work in Building Construction."
- 7. American Welding Society (AWS).

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300, Submittals, submit the following:
 - 1. Manufacturers literature and installation instructions.
 - 2. Samples, of each material listed.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in factory packed unopened cartons and crating bearing the manufacturer's labels.
- B. Store materials in clean, dry protected area in such manner to preclude damage of any nature.
- C. Handle all materials with proper care to avoid denting, marring, warping or other distortions during delivery, storage and handling.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. General: Provide roof specialties and accessories of design and construction compatible and approved for use with roofing manufacturer.
- B. Fasteners: Provide all fasteners and attachments required to secure item to substrate and support loads required by applicable Building Code. Use only non-corrosive fasteners which are compatible with materials being joined.
- C. Colors: Colors shall be selected by Owner.

2.02 SCUPPERS AND DOWNSPOUTS

- A. Material: 0.040 inch aluminum unless otherwise noted.
- B. Design: Manufacture gutters tapered and notched to provide telescoping joint. Design gutters and downspouts to accommodate expected thermal movement.
- C. Supports and Fasteners: Provide manufacturers' standard straps, brackets and fasteners. Place supports and fasteners at 36 inches on center or as recommended by the manufacturer. Finish of supports, brackets and fasteners shall match gutter and downspout.
- D. Accessories: Provide end caps, flashing, trim, and other items required for a complete installation.
- E. Finish: Baked on Kynar, with 20 year warranty.

2.03 ROOF CURBS

- A. Material: 18 gauge, G-90 galvanized steel, 12 inches high with mitered and continuous welded corners and seams, factory installed pressure treated wood nailers, and rigid fiberglass insulation.

- B. Design: Provide roof curb units manufactured to fit manufactured roof panels. Provide integral water diverter. Design roof curb to support weight of equipment. Coordinate roof curb unit with roof panel manufacturer to ensure proper fit. Roof curb shall be approved for use by manufacturer.
- C. Accessories: Provide interior liner, flashing, trim and other items required for a complete installation.

2.05 COPINGS

- A. Material: 0.040 inches aluminum with smooth surfaces.
- B. Splice Plate: Aluminum and finished to match coping. Provide six inch wide units at twelve foot centers with extruded butyl seal strips.
- C. Anchor Plate: Galvanized steel. Anchor to substrate with anchors as recommended by manufacturer.
- D. Manufactured: Product shall be manufactured and tested product and approved by the roofing manufacturer. Product shall be designed to resist wind loads stipulated by the North Carolina Building Code.
- D. Finish: "Baked" on Kynar, with 20 year warranty.
- E. Guarantees: Twenty year performance guarantees relative to blow-off, leaktightness and finish.

PART 3 -- EXECUTION

3.01 INSTALLATION - GENERAL

- A. Install roof accessories and specialties in accordance with the manufacturer's instructions. Provide a complete watertight and weatherproof installation. Install with provision for expansion and contraction.

3.02 DAMAGED MATERIAL

- A. Repair or replace materials damaged during installation.

3.03 ADJUSTING AND CLEANING

- A. Check levels and adjust as necessary after roofing and flashing is complete.
- B. Protect materials from damage by other trades. Remove protective coatings at completion of project.

- END OF SECTION -

SECTION 07820

METAL FRAMED SKYLIGHTS

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.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 07900 - Joint Fillers, Sealants, and Caulking

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Manufacturer's product literature including glazing instructions.
 - 2. Samples shall include:
 - a. Finish and color samples for all items.
 - b. Samples of extrusions.
 - c. Samples of rough hardware.
 - 3. Shop Drawings shall include, but not be limited to:
 - a. Complete assembly, layout and installation drawings and schedules with clearly marked dimensions. Drawings shall indicate gages, sizes, shapes of members, methods of shop joinery, field assembly and connections to abutting construction.
 - b. Detail drawings indicating all aluminum and/or steel reinforcement and stiffening members required.
 - c. Detail drawings of all required anchoring and fastening devices.

1.04 QUALITY ASSURANCE

- A. All skylight components will be inspected prior to installation. All components which are abraded, dented, bent, bowed or show structural damage or distortion, will be marked and removed from the site.

1.05 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be boxed and/or crated and suitably protected prior to shipment from the factory.
- B. Protect products against damage during delivery, storage and handling. If site storage is necessary, stack materials on blocking clear of ground, tilted to permit water drainage and cover with tarpaulins or heavy gage polyethylene film.

PART 2 -- PRODUCTS

2.01 UNIT SKYLIGHTS

- A. Unit skylights shall be thermally broken curb mounted units with polycarbonate glazing material. Curb shall be 12" high minimum. Polycarbonate glazing shall be designed to provide fall protection in accordance with OSHA or a fall protection screen shall be provided. Frame shall be 6063-T5 extruded aluminum. Factory assembly units. Provide units with integral gutter, gaskets, and retaining frame. Provide both inner and outer aluminum liners. Unit skylights shall be manufactured by WASCO Products, Inc., Hillsdale Industries, Inc., Naturalite/EPI, Inc.

PART 3 -- EXECUTION

3.01 ERECTION

- A. Installer must examine conditions, the surrounding areas where the skylights and associated items are to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with Work until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Comply with manufacturer's shop drawings, specifications and recommendations for installation.
- C. Set plumb, level and true to line, without warp or rack of frames or panels and anchor securely in place in accordance with approved shop drawings.

3.02 ADJUST AND CLEAN

- A. Clean aluminum and glass surfaces during installation of components. Remove excess sealant compounds, dirt and other substances.

3.03 GUARANTEE

- A. Upon completion, submit two copies of written guarantee signed by the Contractor agreeing to replace aluminum skylight units which fail in materials or workmanship within 10 years of the date of acceptance. Failure of materials or workmanship shall include (but not be limited to) excessive leakage or air infiltration finish deterioration in excess of normal weathering to the extent covered by the Finish Warranty and defects in accessories, weatherstripping and other components of the work.
- B. The Contractor shall further agree to replace insulating glass units which fail to maintain hermetic seal of the air space, but not including that due to glass breakage after acceptance of units, or which show deterioration of color, or which lose heat-exclusion ratings, or deterioration in any other manner due to failure of materials or workmanship.
- C. Provide Owner with glass manufacturer's warranty.

- END OF SECTION -

SECTION 07900

JOINT FILLERS, SEALANTS AND CAULKING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03250 - Concrete Accessories
- B. Section 03290 - Joints in 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 C-920 Elastomeric Joint Sealants
- 2. ASTM D-1056 Flexible Cellular Materials - Sponge or Expanded Rubber
- 3. SWRI Sealant and Caulking Guide Specification

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:
 - 1. Manufacturers literature and installation instructions.
 - 2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

- A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened labeled packages.
- B. Store materials in location protected from freezing or damages.
- C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Sealants

- 1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.
 - 2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by BASF Construction Chemicals.
 - 3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by BASF Construction Chemicals.
 - 4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, Sonolastic Omni Plus by BASF Construction Chemicals.
 - 5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, Sonneborn Sonolac by BASF Construction Chemicals.
 - 6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.
 - 7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.
 - 8. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type 19, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, Sonolastic Ultra by BASF Construction Chemicals.
- B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.

- C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.
- D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.
- E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.
- F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 -- EXECUTION

3.01 QUALITY CONTROL

- A. Coordinate work with details shown on approved shop drawings prepared by other trades.
- B. Verify conditions in the field.
- C. Schedule work to follow closely the installation of other trades.
- D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.
- E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

- A. Protect finished surfaces adjoining by using masking tape or other suitable materials.
- B. Clean and prime joints before starting any caulking or sealing work.
- C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.
- D. Joint Requirements
 1. All joints and spaces to be sealed in exterior work shall be less than 1/2 inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.
 2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than 1/4 inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the 1/4 inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

Joint Width	Sealant Depth	
	Minimum	Maximum
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inch	1/2 inch	1/2 of width

3.03 APPLICATION

- A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.
- B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.
- C. All joints shall be waterproof and weathertight.
- D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.
- E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.
- F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

- A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.
- B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless noted otherwise herein or on Drawings.	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.

Application	Sealant	Color
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints less than 1¼" wide.	Type 2	To closely match adjacent surfaces and as selected by the Owner.
Masonry expansion and control joints equal or greater than 1¼ inches wide and not to exceed 2".	Type 1	To closely match adjacent surfaces and as selected by the Owner.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit.	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the Owner.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids. See Note 1.	Type 1	Manufacturer's standard
Submerged in liquids with high concentration of chlorine (> 2 ppm).	Type 7	Manufacturer's standard
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

Note 1. Sealants which will come in contact with potable water shall meet the requirements of NSF 61.

- END OF SECTION -

SECTION 08225

FIBERGLASS DOORS AND FRAMES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor, materials, equipment and appliances required for the complete execution of the Work as shown on Drawings and specified herein.
- B. Principal Items of work include:
 - 1. Fiberglass frames and doors.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 04200 - Unit Masonry
- B. Section 08710 - Finish Hardware

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Samples shall include:
 - a. Corner sections of frames and trim.
 - b. Corner sections of doors.
 - c. Finish and color charts.
 - d. Warranty
 - 2. Shop Drawings shall include, but not be limited to:
 - a. Complete layout and installation drawings and schedules with clearly marked dimensions. Indicate details of construction, profiles, gauges, reinforcing and location of all doors and frames.
 - 3. Manufacturer's literature.

1.04 WARRANTY

- A. The Manufacturer shall unconditionally guarantee the fiberglass reinforced-plastic doors and frames for five (5) years against failure due to corrosion by environmental conditions. Under

this guarantee a new door will be offered replacement or the original factory price will be refunded at the discretion of the manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be boxed or crated and suitably protected prior to shipment from the factory. Protect all hardware which may be attached.
- B. Protect products against damage during delivery, storage, and handling. Stack materials on blocking clear of ground, tilted to permit water drainage and protected from corrosion and construction abuse.
- C. Frames and doors, after being set shall be protected with heavy Kraft paper or other approved means in such manner to prevent damage. Protection shall be maintained until such time as directed by the Engineer.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, provide products from one of the following manufacturers:
 - 1. Tiger Doors by Overly
 - 2. FIB-R-Door Systems
 - 3. Chem Pruf Door Company

2.02 MATERIALS

- A. Provide doors and frames from the same manufacturer.
- B. Fiberglass reinforced plastic doors and frames shall be manufactured to create a seamless fiberglass door with a UV – resistant gel-coat, fiberglass stile and rail reinforcement, resin and core material molded together. Do not adhesive bond perimeter. Provide core and reinforcements required to provide strength and rigidity to door. Window openings, door hardware preparation and other reinforcements shall be molded into the door at the factory. Secondary cutting and coating will not be allowed. Doors shall be flat and warp-free. Where doors are required to be fire rated include fire-resistant core and materials to meet NFPA 80. Color shall be integral and be selected from manufacturer's full range of colors.
- C. The fiberglass laminate shall have the following minimum physical properties using the applicable ASTM Standards.

Tensile strength	10,000 psi	ASTM D638
Flexural strength	20,000 psi	ASTM D790
Flexural modulus	1.0x10 ⁶	ASTM D790

Impact, Notched Izod foot pound per inch	20.0	ASTM D256
Barcol hardness	40 min. average	ASTM D2583
Water Absorption, degrees 24 hours	0.1 percent	ASTM D570
Average coefficient of thermal expansion inch per inch per degree fahrenheit	10.5x10 ⁶	ASTM D696
Flame Spread	25 or less	ASTM E84

2.03 FIBERGLASS REINFORCED PLASTIC FRAMES

- A. FRP frames shall be fiberglass. The stop and frame will be molded in one piece. The frame shall be integrally gel-coated to the Owner's color to match door. Jambs and headers to utilize miter corner connections chemically welded with FRP materials and ground smooth for a visibly smooth face.
- B. Hardware Preparations/Internal Reinforcement: Doors and frames shall be reinforced and mortised for hardware with a minimum of 1-1/2 inches x 1-1/2 inches of solid fiberglass to allow application of hinges and locks, in accordance with the hardware schedule, hardware manufacturer's instructions and templates. Reinforcement Blocking: Non-swelling polymer or firestop blocking will be used for all lockset, surface mounted hardware and thru-bolted hardware blocking. A minimum pull out value of 900 pounds per screw shall be provided at hinges.
- C. Frame shall meet the industry accepted design details of a standard frame profile which is minimum 5-3/4 inches overall jamb depth with a two inch face, 5/8 inch stop and 5/8 inch return for both wrap around or butt mounting.
- E. The gel-coat shall be of .025 thick resin rich surface of an isolphthalic or chemical-resistant polyester resin which is resistant to moisture, ultra violet sunlight and many industrial acids, alkalies and solvents and protects the glass reinforcements from degradation.

2.04 DOORS

- A. Fiberglass doors shall be flush type of 1-3/4 inch thickness. Doors shall be constructed with a gel-coat surface of 0.25 resin rich surface of an isophthalic or chemical resistant to moisture, ultra violet sunlight and many industrial acids, alkalies and solvents and protects the glass reinforcement from degradation. The Fiberglass laminate of 1/8 inch thickness shall be the primary structural component of the door. Color shall be selected from manufacturer's full range of colors.
- B. The core shall be continuously bonded to the laminate for structural support and rigidity. To enhance this bond, the core shall be perforated so that resin posts are formed during the molding process which additionally ties the outer laminates together.
- C. The fiberglass door shall be formed to size to produce a totally seamless door.
- D. The fiberglass door shall have continuous FRP or stainless steel reinforcement for hinge mounting. The lock edge of the door shall be the same steel reinforcement, except it will be interrupted at the lock location for lock installation. The manufacturer shall provide a 1/8 inch thick, 5-inch high x 18 inch long steel reinforcement for closer mounting. Totally encapsulated reinforcements in fiberglass.
 - 1. The door shall be prepared for hardware specified in Section 08710 - Finish Hardware.

2.05 FIRE RETARDANT

- A. The doors and frame shall be "Fire Resistant" and will not support combustion.

2.06 ANCHORS

- A. Jamb anchors shall be manufacturer's recommended non-corrosive anchors to suit frame. Set anchors 24" on center maximum with a minimum of three per jamb.
- B. For cast-in-place concrete, anchor frame jambs with 3/8 inches minimum counter-sunk stainless steel bolts into expansion shield or inserts, with crush-proof sleeves. Set anchors 24" on center maximum with a minimum of three per jamb.
- C. Provide floor anchors at door frames as recommended by manufacturer.

PART 3 -- EXECUTION

3.01 FRAME INSTALLATION

- A. Install plumb, level and true to line, rigidly secured in openings. Set frames in masonry walls prior to beginning masonry work.

3.02 DOOR INSTALLATION

- A. Install plumb, level and true to line. Apply and adjust hardware to achieve quiet and smooth operation.
- B. Doors shall fit snugly and close without forcing or binding. Door clearances shall not exceed 1/8 inch at jambs and heads and meeting stiles at pairs of doors. Clearance between bottom of door and finished floor material or threshold shall not exceed 1/4 inch. Frames shall be manufactured and machined to within 1/32 inch for all dimensions.

3.03 PROTECTION

- A. Protect installation from damage and touch up scratched areas with same paint used for shop coats. Damaged work shall be repaired or replaced.

- END OF SECTION -

SECTION 08330

ROLL-UP DOORS

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.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 08710 – Finish Hardware
- B. Section 09900 – Painting
- C. Electrical connections for motors, and accessories are specified in Division 16.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Manufacturer's literature and installation instructions.
 - 2. Drawings showing details of the products, connections to adjoining materials, and schedules showing sizes and types.
 - 3. Finish and color samples.
 - 4. UL certification for fire-rated doors and frames, including oversized doors.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver products in original and unbroken packages, containers, or bundles bearing the name of the manufacturer.
- B. Store materials carefully in an area that is protected from the elements, and in a manner that will prevent damage or marring of the door.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with these specifications provide products from one of the following manufacturer:
 - 1. Cornell Iron Works, Inc.

2. Atlas Roll-lite Door Corporation.
3. The Cookson Company.
4. Overhead Door Corporation.

2.02 MATERIALS

A. Door Curtains

Provide insulated aluminum curtain slats with interlocking sections designed to meet 20 psf minimum windload. Provide high strength endlocks on alternating slats and windlocks as required to meet design windload. Bottom bar as recommended by manufacturer for type of curtain specified with combination weatherstrip and reversing edge for motor operated doors.

B. Guides

Form from galvanized structural steel angles with a minimum 3/16 inch thickness. Provide windlock bars as required to meet design windload. Attach guides to jamb with not less than 3/8 inch steel bolts anchored not more than 30 inches on center.

C. Counterbalance Assembly

Counterbalance by means of adjustable steel helical torsion springs, mounted around a steel shaft and mounted in a spring barrel and connected to the door curtain with the required barrel rings. Use grease -sealed ball bearings or self-lubricating graphite bearings for all rotating members.

1. Fabricate spring barrel of hot-formed, structural-quality carbon steel, galvanized welded or seamless pipe, of sufficient diameter and wall thickness to support the roll-up of curtain without distortion of slats and limit barrel deflection to not more than .03 inches per foot of span under full load.
2. Fabricate spring balance of one or more oil-tempered, heat-treated steel helical torsion springs.
3. Fabricate torsion rod for counterbalance shaft of case-hardened steel, of required size to hold the fixed spring ends and carry the torsional load.
4. Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate with bellmouth guide groove for curtain.

D. Door Hoods

Formed of 24 gauge G90 galvanized steel with baked on polyester primer. Form to enclose coiled curtain at opening head. Reinforce top and bottom edges. Provide closed ends for surface mounted units. Provide intermediate supports as required to prevent excessive sag.

- E. Operation: Provide motor operator with auxiliary hand chain.
 - 1. Endless hot-dip galvanized hand chain of length so bottom of chain is four feet above finished floor. Provide sprockets and reduction gears for ease of operation and a maximum pull of 35 pounds.
 - 2. Provide heavy duty motor operator with open drip-proof motor, removable without affecting auxiliary hand chain or setting of limit switches. Furnish motor complete with controller, over-current protection and push-button station marked "Open-Close-Stop". 480V, 3 phase, 60 Hz.

F. Weatherstripping

Equip bottom bar with vinyl weatherstrip. Provide motor operated doors with vinyl sensing/weather edge. Equip end guides with weatherstripping to seal both faces of door curtain. Equip hood with neoprene air baffle to close top of hood with curtain and brush weatherseal at door head.

H. Finish

Aluminum shall be powder coated. Galvanized steel to be chemically cleaned and powder coated. Parts inaccessible after installation shall be given an additional coat in the shop. Color shall be selected by Owner from full range of colors.

PART 3 -- EXECUTION

3.01 INSPECTION

- A. Examine substrates and adjoining conditions, where roll-up door is to be installed. Correct unsatisfactory conditions prior to proceeding with the work.

3.02 INSTALLATION

- A. Install units and operating equipment complete with necessary hardware, jamb, and head moldings, anchors, inserts, hangers and equipment supports in accordance with final approved shop drawings, manufacturer's printed instructions and as specified herein.
- B. Field touch-up shop applied finishes of surfaces scratched or abraded during installation.
- C. Do all cutting, drilling, fitting and other work of similar character required for fitting and setting units in connection with this work and adjoining work of other trades.

3.03 PROTECTION, CLEANING AND ADJUSTMENT

- A. Protect units prior, during and after installation.
- B. After installation, lubricate, test and adjust to operate easily and freely from warps, twists or distortion and weathertight fit.

- END OF SECTION -

SECTION 08710
FINISH HARDWARE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor, materials, equipment and appliances required for the complete execution of Work as shown on Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 08110 – Steel Doors and Frames

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. ANSI/BHMA 156

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Manufacturers data for each item of hardware. Include installation and maintenance instructions.
 - 2. Furnish templates to fabricators of other work which is to receive hardware.
 - 3. Hardware schedule organized into "hardware sets," indicating complete designation of every item required for each door or opening. Furnish initial draft of schedule at the earliest possible date, in order to facilitate the fabrication of other work (such as hollow metal frames) which may be critical in the project construction schedule. Furnish final draft of schedule after samples, manufacturer's data sheets, coordination with shop drawings for other work, delivery schedules and similar information has been completed and accepted.
 - 4. Prepare a keying schedule in consultation with the Owner.

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1.05 QUALITY ASSURANCE

- A. Provide materials, assemblies, equipment and services from a single source for each category except that locksets, latchsets and cylinders must originate from the same manufacturer.
- B. Replace any item of finish hardware which cannot be installed or will not function properly.
- C. Provide hardware complying with NFPA 80 and UL labeled for fire rated openings.
- D. Furnish templates or information to door and frame manufacturer. Coordinate between the manufacturers where two or more articles of hardware are to be mounted on the same door. Verify all dimensions, new and existing.
- E. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Handle, store, distribute, protect and install hardware in accordance with manufacturer's instructions or recommendations. Deliver packaged materials in original containers with seals unbroken and labels intact.
- B. Properly mark or label, so each piece of hardware is readily identifiable with the approved hardware schedule. Tag each change key or otherwise identifying the door of which its cylinder is intended. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and hardware schedule.
- C. Provide secure storage area for hardware.

PART 2 -- PRODUCTS

2.01 MATERIALS AND FABRICATION

- A. Hand of Door
 - 1. Drawings show swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish hardware for proper installation and operation of door.
- B. Manufacturer's Name Plate
 - 1. Do not use manufacturer's products which have name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels.
- C. Base Metals
 - 1. Produce hardware units of the basic metal and forming method indicated, using manufacturer's non-corrosive metal alloy, composition, temper and hardness but in no case of lesser quality material than specified.

D. Fasteners

1. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self tapping sheet metal screws, except as specifically indicated.
2. Furnish stainless steel fasteners for installation with each hardware item. Exposed finish (under any condition) to match hardware finish or surfaces of adjacent work. Match the finish of adjacent work as closely as possible, including surfaces to receive painted finish.
3. Provide fasteners which are compatible with unit fastened and the substrate, and which will not cause corrosion or deterioration of finish hardware, base material or fastener.

E. Tools for Maintenance

1. Furnish a complete set of specialized tools as needed for Owner's continued adjustment, maintenance, removal and replacement of builder's hardware.

F. Hardware Finishes

1. Stainless steel, US32D unless otherwise noted.
2. Closers shall have a USP finish unless otherwise noted.

G. Field Checks

1. Make periodic checks during installation of finish hardware to ascertain the correctness of the installation. After completion of the work, certify in writing, that all items of finish hardware have been installed, adjusted and are functioning in accordance with Specification requirements.

2.02 DESCRIPTION OF PRODUCTS

A. Hinges

1. Stainless steel full mortise concealed oil impregnated ball bearing type, five knuckle with non-rising pins for interior doors, and non-removable and non-rising pins for exterior doors. Tips shall be flat.
2. Sizes and weights of hinges:
 - a. Doors up to 36 inches – 4-1/2 inches regular weight.
 - b. Doors 36 inches to 40 inches – 5 inches regular weight.
 - c. Doors 40 inches to 48 inches – 5 inches heavy weight.
 - d. Fire Rated Doors up to 36 inches – 5 inches regular weight.

3. Provide three hinges per door leaf up to and including 90 inches and one additional hinge for each 30 inches of additional height.
4. Acceptable Manufacturers: Stanley Hardware, Hager Hardware

B. Locksets and Latchsets

1. Stainless steel, heavy-duty mortise type conforming to ANSI A156.13 Series 1000, Grade 1.
2. Wrought steel box strikes.
3. Stainless steel deadbolt with 1" throw approval.
4. 2 3/4 inch back set, 3/4 inch throw, two-piece anti-friction latchbolt.
5. Non-ferrous critical internal parts.
6. Cylinders shall be manufactured to conform to Owner's key program. Coordinate with Owner.
7. Trim Design: LWM with wrought escutcheon by Corbin\Ruswin or equal lever with return. Provide knurling on all levers leading into hazardous rooms and electrical rooms.
8. Acceptable Manufacturers: Yale, Corbin\Ruswin, Schlage

C. Keys and Keying

1. Provide construction keyed, removable core master key system as directed by the Owner.
2. Furnish ten core removal keys and 10 master keys. Furnish a minimum of 15 change keys per cylinder.
3. Furnish cylinders with cores compatible with Owner's key system.
4. Coordinate with Owner's key system.
5. Acceptable Manufacturers: Yale, Corbin\Ruswin, Schlage

D. Panic Hardware

1. Heavy duty push bar exit device, U.L. labeled, with corrosive resistant construction.
2. ANSI A156.3, Grade 1.
3. Exterior trim to closely match locksets.
4. Single doors: mortise type.
5. ANSI Function 08.
6. Acceptable manufacturer's: Von-Duprin, Adams Rite Manufacturing Company, Corbin/Ruswin

E. Closers

1. Cast iron case with seamless one-piece forged steel spring tub.
2. Heavy duty forged steel arm.
3. Non-sized fully adjustable from size 1-6.
4. Backcheck intensity and location valves.
5. Delayed action closing.
6. Full metal cover.
7. Mechanical hold open device, except at fire rated doors.
8. ANSI 156.4, Grade 1.
9. Conforms to ADA 5 lbf. maximum door opening force requirement for non-fire rated interior doors.
10. Provide mounting brackets, and fasteners required for proper attachment.
11. Provide closers at fire rated doors.
12. Acceptable manufacturers: Corbin/Ruswin, LCN, Norton

F. Automatic Flush Bolts

1. U.L. listed.
2. Forged brass or stainless steel construction, 1/2" diameter flattened bolt tip, 12" long rod.
3. Fully automatic.
4. Operation shall incorporate an override function.
5. Tested for a minimum of 100,000 cycles.
6. Provide dust proof strikes.
7. Acceptable manufacturers: Glynn-Johnson, Hager Hardware, and H.B. Ives.

G. Kickplates

1. Stainless steel, 0.050" thick, beveled 3 sides, 8" high, width 2 inches less than door width.
2. Acceptable manufacturers: H.B. Ives, Hager Hardware, and Builders Brass Works.

H. Thresholds

1. Extruded aluminum saddle type and fiberglass for opening with fiberglass door and frames. Provide with stainless steel fasteners. Six inches wide or as shown on drawings.
2. Acceptable manufacturers: Pemko, National Guard Products, Incorporated, and Zero International. Fiberglass threshold by fiberglass door and frame manufacturer.

I. Door Bottom Seal

1. Extruded aluminum with neoprene seal.
2. Acceptable manufacturers and products: Pemko Model 57, Zero International Model 328 and National Guard Products, Inc. Model 96.

J. Weatherstripping

1. Extruded aluminum with neoprene seal.
2. U.L. Labeled.
3. Acceptable manufacturers and products: Pemko Model 294, National Guard Products, Inc. Model 190, and Zero International Model 328.

PART 3 -- EXECUTION

3.01 GENERAL

A. Templates

1. After the hardware schedule is approved furnish to the various manufacturers, required blueprint templates for fabrication purposes. Templates shall be made available not more than ten (10) days after receipt of the approved hardware schedule.

B. Packaging and Marking

1. Ship hardware with proper non-corrosive fastenings for secure application. Each package of hardware shall be legibly marked indicating the part of the work for which it is intended. Markings shall correspond with the item numbers shown on the approved hardware schedule. Keys shall be tagged within each package set and plainly marked on the face of the envelope with the key control number, door designation and all identification as necessary.

3.02 INSTALLATION

- A. Install hardware in a manner which will eliminate cracks on surfaces.
- B. Mount hardware units at heights recommended in "Recommended Locations for Builders Hardware" by BHMA, except as otherwise indicated or required to comply with governing regulations.
- C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on the substrate.
- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as is necessary for proper installation and operation.
- E. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with factory standards.
- F. Cut and fit thresholds and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.
- G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel which will not corrode in contact with the threshold metal.
- H. Set thresholds in a bed of either butyl rubber sealant or polyisobutylene mastic sealant to completely fill concealed voids and exclude moisture. Do not plug drainage holes or block weeps. Remove excess sealant.

3.03 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function. Lubricate moving parts as recommended by manufacturer. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application.
- B. Final Adjustment
 - 1. One week prior to acceptance or occupancy make a final check and adjustment of all hardware items. Clean and relubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices and compensate for final operation of heating and ventilating equipment.
- C. Instruct Owner personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

3.04 HARDWARE SETS

- A. The door hardware sets on the Drawings indicates functional and general requirements. Items shall be quality and finish as specified. Hardware set identification refers to set numbers indicated on the Drawings. Provide hardware required to meet Code requirements. Consult Drawings for set number required.
- B. Hardware shall be as follows:

Hardware Sets

- 1. Hinges
Panic Hardware
Overhead Door Closer and Holder
Kickplate
Threshold
Door Bottom Seal
Weatherstripping
- 2. Hinges
Entrance Lock Set
Door Closer and Holder each Leaf
Automatic Flush Bolts
Coordinator
Kickplate
Threshold
Door Bottom Seal
Weatherstripping
Astragal with Weatherstripping

- 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-SP10 Near-White Metal Blast
- g. SSPC-SP13/NACE6 Surface 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. 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 & Razor 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 & Razor 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 SCHEDULE OF COLORS

- A. Match colors indicated on the Drawings. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Owner. No variation shall be made in colors without the Owner'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.

3.07 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.

3.08 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
PAINING 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
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	
<u>Metals</u>				
Interior and exterior nonsubmerged (gloss)	All new pumps, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer	104	4-6
		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	4-6 3-5
Steel door frames, structural steel, misc. metals (steel)		1 coat epoxy polyamide	102	5-8
		1 coat aliphatic polyurethane	115	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 10400
IDENTIFYING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all labor, materials, equipment and appliances required for the complete execution of the Work as shown on the Drawings and specified herein.
- B. Principal items of work include:
 - 1. Plastic engraved door and informational signs as indicated on the Drawings.
 - 2. Safety signs

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Color and finish samples for all nameplates, signs and building name letters.
 - 2. Shop Drawings shall include, but not be limited to:
 - a. Complete details for all signs and building name letters giving sizes and styles of lettering and colors.
 - b. Complete schedules for all nameplates, signs, and building name letters giving location, message, letter, size, color, and method of attachment.
 - c. Details of fabrication and attachment of all items.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in unopened, unbroken and undamaged original packaging bearing the manufacturer's label and identification for installation.
- B. Handle all materials with care to prevent defacement of any nature.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Andco Industries Corporation

2. Innerface Architectural Signage Incorporated
3. Environmental Sign Systems

2.02 MATERIALS

A. Signs

1. Interior signs shall be self extinguishing plastic with raised letters meeting the requirements of the American with Disabilities Act of 1990; total thickness minimum of 0.125 inch; rounded corners.
 2. Exterior signs shall be aluminum with vinyl lettering and numbering.
- B. Character size and style shall be 3/4 inch high minimum upper case Helvetica. Spacing and proportions of letters shall be in strict accordance with the Americans with Disabilities Act of 1990.
- C. Colors shall be as selected by the Owner from the manufacturer standard colors.
- D. Materials shall be suitable for exterior or interior exposure as applicable.

2.03 ACCESSORIES

- A. Mounting Hardware: Stainless steel screws.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

2.04 FABRICATION

- A. All items specified herein to be factory fabricated to the extent practicable.
- B. Provide all attachments and anchors necessary for concealed installments for door numbers, room name plates, and bulletin boards.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All materials specified herein shall be installed in compliance with the approved manufacturer's printed specifications. Mounting devices, bolts, screws, nuts and the like shall be of high strength aluminum or stainless steel. The final location of each sign shall be as determined by the Engineer.
- B. Plastic door numbers and room name plates shall be attached stainless steel oval Phillips head screw at each corner.
1. Submit a schedule of door numbers and name plates to the Engineer for approval.

2. Install door and name plates after final field finish has been applied and thoroughly dried.

3.02 ADJUSTMENT AND CLEANING

- A. After completion of project, remove all protective devices, touch up as necessary and clean all exposed surfaces with a mild solution of detergent and warm water. Leave all surfaces in a neat and clean condition.

3.03 SCHEDULES

- A. FIRE RELATED SIGNS provide each sign with wording and pictogram. Signs shall have red background and white letters and pictogram.

Wording	Size	Quantity
FIRE EXTINGUISHER	7x7	2

- B. CAUTION SIGNS shall have a yellow background with the word CAUTION 2 inches high with white letters and black background centered above wording below in black letters. Each sign shall be provided with pictogram showing figure in compliance with sign (i.e. a figure wearing glasses)

Wording	Size	Quantity
EAR PROTECTION MUST BE WORN IN THIS AREA	7x17	3

- D. SAFETY SIGNS. Signs shall comply with ANSI Z S35 requirements.

Wording	Size	Quantity
NO ENTRY AUTHORIZED PERSONNEL ONLY (with pictogram)	6x3	3

Note 1: Sign shall be 2½ inches high x length required. Sign shall be centered.

- END OF SECTION -

SECTION 10522

FIRE EXTINGUISHERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish and install fire extinguishers as shown on the Drawings and specified herein.

1.02 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. NFPA 10 - Portable Fire Extinguishers

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300, Submittals, submit the following:

- 1. Manufacturer's data sheets and verification of U.L. ratings.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications provide products from one of the following manufacturers:

- 1. Kidde Fire Extinguisher Company
- 2. Ansul Fire Protection
- 3. Potter - Roemer
- 4. J. L. Industries

2.02 MATERIALS

- A. Dry Chemical (DC) Fire Extinguishers

- 1. Provide where indicated on the Drawings, 10 lb. capacity, hand portable, with heavy duty steel wall mount, tri-class dry chemical type, with Underwriters' Laboratories rating of 4-A: 60 BC.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Fire extinguishers shall be installed where directed by the Engineer.
- B. Wall mounts for extinguishers shall be securely mounted to masonry with lag bolts and shields.
- C. Fire extinguishers shall be installed so that the top of the fire extinguisher is not more than 5 feet above the floor.

- 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.
- F. The installation, testing, and placing into acceptable operation of Owner-furnished pumping equipment shall be performed in accordance with this section.

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 PERFORMANCE AFFIDAVITS

- A. When required in the individual equipment Specifications, the Contractor shall submit manufacturer's Performance Affidavits for equipment to be furnished.
- B. By these affidavits, each manufacturer must certify to the Contractor and the Owner, jointly, that he has examined the Contract Documents and that the equipment, apparatus, or process he offers to furnish will meet in every way the performance requirements set forth or implied in the Contract Documents.
- C. The Contractor must transmit to the Engineer three (3) original copies of the affidavit given him by the manufacturer or supplier along with the initial Shop Drawing submittals.

- D. The Performance Affidavit must be signed by an officer of the basic corporation, partnership, or company manufacturing the equipment and witnessed by a notary public.
- E. The Performance Affidavit shall have the following format:

Addressed to: Davidson Water, Incorporated

Reference: Hyattown Pumping Station

Text: (Manufacturer's Name) has examined the Contract Documents and hereby states that the (Product) meets in every way the performance requirements set forth or implied in Section _____ of the Contract Documents.

Signature: Corporate Officers shall be Vice President or higher, unless statement authorizing signature is attached.

1.04 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.
17. Paint and coatings details. Provide ANSI/NSF61 certifications for each coating applied to an equipment part in contact with potable water.

B. SHOP DRAWINGS ON ITEMS REQUIRING PERFORMANCE AFFIDAVITS WILL NOT BE REVIEWED UNTIL ACCEPTABLE PERFORMANCE AFFIDAVITS ARE RECEIVED.

1.05 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.

1.06 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.

1.07 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 Section 05120, Structural Steel.
- 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 Section 05035, Galvanizing.

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. 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.

- C. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.08 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.

2.10 ANSI/NSF 61 CERTIFICATION

- A. All equipment components and coatings which are in contact with potable water, shall be ANSI/NSF61 approved.

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 Contractor.

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 +/- 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 +/- 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

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, perform any other tests specifically required by the individual equipment Specifications or by the manufacturer.
- 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.

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.
- E. 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.
- F. 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.
- G. 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.
- H. 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 INSTALLATION, TESTING, AND COMMISSIONING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall install, test, and make fully operational all Owner-furnished pumping equipment, complete with all necessary accessories, in compliance with the Contract Documents.
- B. Refer to Appendix A for detailed information for the Owner-furnished pumping equipment. The Contractor is responsible for providing any and all materials, equipment, and components not provided by the pumping equipment manufacturer but required for a complete installation.

PART 2 -- PRODUCTS

2.01 OWNER FURNISHED EQUIPMENT

- A. Owner will furnish to the Contractor:
 - 1. Vertical pumps
 - 2. Pump cans
 - 3. Pressure gauges for vertical pumps
 - 4. Air relief/vacuum (AR/V) valves on pump cans and pump discharge piping
- B. Pump Manufacturer will install vertical pumps, pressure gauges, AR/V valves, and will assist in can installation as described in Appendix A.
- C. Contractor is responsible for coordinating the installation, testing, and commissioning of the pumps and associated appurtenances, and to provide all labor, equipment, materials, and tools required to comply with the specifications herein if not so provided in the Pump Manufacturer's scope of services.

PART 3 -- EXECUTION

3.01 PUMP MANUFACTURER SERVICES

- A. The Pump Manufacturer is Charles R. Underwood Pumps, of 2000 Boone Trail Road, Sanford, NC 27330.
- B. At the Owner's cost, the Pump Manufacturer will provide the following services during construction:
 - 1. Install pumps and motors, including pump delivery and off-loading. They will provide a crane and operator for pump installation.
 - 2. Inspect and assist pump can placement and alignment prior to concrete pour.

3. Provide and install plywood covers for the cans to protect the inside prior to pump installation.
 4. Furnish air release/vacuum valves for Contractor to install.
 5. Provide start-up and Owner training services.
 6. Conduct pump field testing.
 7. Conduct pump vibration testing.
 8. Furnish pump and motor O&M manuals.
 9. Other miscellaneous services as stipulated in Appendix A-.
- C. Contractor shall bear the costs of all other work not listed above but required to install, test, and commission the pumps in accordance with these specifications.
- D. Contractor's costs to coordinate with the Pump Manufacturer shall be borne completely by the Contractor.

3.02 INSTALLATION

- A. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain, properly supported with brackets.
- B. Concrete shall not be poured around the pump cans until the Pump Manufacturer has inspected and approved the pump can placement and alignment.

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 Appendix A.
- 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.

- END OF SECTION -

SECTION 13120

DISINFECTION OF WATER SUPPLY SYSTEM

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall disinfect the existing storage tank, surge tanks, pump cans, pipe, and other appurtenances that contains/conveys potable water. All such items that are impacted by construction activities shall be disinfected prior to placing or returning that component to service in accordance with the North Carolina Department of Environmental and Natural Resources Public Water Supply (NCDENR PWS) Regulations and as specified herein.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all work hereunder shall conform to the applicable requirements of the following documents to the extent that the requirements therein are not in conflict with the provisions of this Section.
 - 1. The latest revision of AWWA C652 – Disinfection of Water Storage Facilities
 - 2. The latest revision of AWWA B300 – Hypochlorites
 - 3. NCDENR PWS Rules Governing Public Water Systems Section .1000 – Disinfection of Water Supply Systems (North Carolina Administrative Code, Title 15A, Subchapter 18C).

PART 2 -- PRODUCTS

2.01 CHEMICALS AND FEED EQUIPMENT

- A. Chlorine for disinfection shall be in the form of sodium hypochlorite solution or calcium hypochlorite granules or tablets.
- B. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of AWWA B300 and C653.
- C. All chemicals used for disinfection and dechlorination shall be NSF approved for use in potable water.
- D. Any equipment used either for disinfection or dechlorination shall be either new or previously used only for disinfection or dechlorination.

PART 3 -- EXECUTION

3.01 SCHEDULING AND INSTALLATION

- A. The Contractor shall submit to the Owner a detailed plan for disinfection, bacteriological sampling and testing, and treatment and/or disposal of superchlorinated water for approval.

The Owner reserves the right to adjust, modify, and/or alter the proposed plan to serve the best interests of the Owner at no additional cost to the Owner.

- B. The Contractor shall coordinate all work with the Owner at a time mutually agreeable to the Owner, and shall give the Owner and Engineer at least 48 hours advance notice of his intent to begin disinfecting any portion of the water supply system.
- C. All disinfection, bacteriological testing, and treatment and/or disposal of superchlorinated water shall be witnessed by the Engineer and a representative of the Owner.
- D. The Owner will provide reasonable quantities of potable water necessary for disinfection, and testing of facilities associated with this Project. The Owner reserves the right to limit the volume of water used per day and the times of the day when the Contractor is permitted to use water for the project.
- E. Contractor shall provide means to convey water to the locations as necessary, install sample taps if required, and shall dechlorinate and dispose of water in accordance with all federal, state and local requirements in such a manner as to cause no adverse environmental effects such as fish kills or erosion.
- F. The Contractor shall have no claim for monetary compensation from the Owner for the inability of the Owner to provide adequate water at the proposed time of disinfection. Compensation to the Contractor is limited to an extension of time to the Contract only.
- G. All tanks, pipes and appurtenances shall be filled slowly either through an existing valves or through taps. The Contractor shall coordinate with the Owner the operation of all existing valves. All valve operations shall be done by the Owner's personnel only.

3.02 BACTERIOLOGICAL TESTING

- A. The Owner will perform bacteriological testing for verification of disinfection procedures.

3.03 DISINFECTION

- A. Perform in accordance with the procedures described in the references given in Part 1.02.
- B. Disinfection shall be accomplished after the particular water supply system component has been thoroughly cleaned in accordance with the applicable reference. The water supply system component shall be disinfected by the methods of chlorination identified in AWWA C562 and as approved by NCDENR PWS. The Contractor shall submit the proposed method to the Engineer prior to performing the work. Disinfection shall be repeated as often as necessary, and as directed by the Engineer and/or the Owner until the minimum residual chlorine content has been reached.
- C. Appropriate personal protective equipment and proper safety procedures shall be used when handling chemicals.
- D. After the chlorination procedure is completed, Contractor shall dispose of the water shall be in conformance with AWWA and in compliance with all Federal, state, and local regulations for disposal of highly chlorinated water. The spent chlorine solution must be disposed of in such a way as not to be detrimental to animal, plant or fish life. The Contractor shall pay all civil penalties, fines, costs, assessments, etc., associated with any discharge of spent chlorine solution associated with the Contractor's work. Contractor may add an NSF 61

approved reducing agent to the highly chlorinated water to reduce the chlorine residual to 0 mg/L.

- E. After the chlorination procedure is completed and before the water supply system component is drained, flushed, and placed in service, bacteriological sampling and testing must be successfully completed.
 - 1. Bacteriological testing will be performed by the Owner at Owner's Laboratory.
 - 2. If contamination is indicated, then the disinfection procedure shall be repeated by Contractor. Contractor shall drain and dechlorinate that volume of water, refill the component to be disinfected, chlorinate the component, and retest for bacteriological contamination.
 - 3. Owner will notify the NCDENR PWS of the sample results as required.
 - 4. When bacteriological testing confirms no contamination, the Contractor shall flush the water supply system component until chlorine residual tests conducted by the Owner demonstrate that chlorine residual is not in excess of 1 ppm.
- F. Contractor shall disinfect piping in accordance with Section 15000 – Basic Mechanical Requirements. Where it is otherwise impractical to use this procedure, Contractor may disinfect short segments of water supply system piping as described below.
 - 1. Piping and valves shall have applied a chlorine solution of 200 mg/L of free available chlorine. The chlorine solution shall be thoroughly applied with spray equipment or brushed at all surfaces to be treated, including inlet and outlet piping such that it will have available chlorine of not less than 10 mg/L. The disinfected surfaces shall remain in contact with strong chlorine solution for a minimum of 30 minutes.
 - 2. The chlorine disinfection solution shall be thoroughly flushed out with potable water prior to placing the piping in service. The Contractor is cautioned that the spent chlorine solution must be disposed of in such a way as not to be detrimental. An NSF approved reducing agent may be added to the highly chlorinated water to reduce the chlorine residual to an acceptable level. A water disposal plan shall be submitted to the Owner prior to cleaning, filling, or disinfection.
- G. The Contractor shall pay all civil penalties, fines, costs, assessments, etc. associated with any discharge of spent chlorine solution due to the Contractor's work.

- END OF SECTION -

SECTION 13207

BLADDER-TYPE SURGE TANK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, deliver, install, test and place in satisfactory operation a bladder-type pressure tank for potable water system surge control at the location shown on the Drawings and as specified herein.
- B. Equipment shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions.

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
 - 2. Tank Manufacturer's surge hydraulic analysis report confirming the suitability of the tank capacities and specifications contained herein.
 - 3. Detailed, scaled drawings of all equipment, accessories, supports, connections, outlets and all related piping.
 - 4. Specifications for system components, accessories and protective coating.
 - 5. Equipment weights.
 - 6. Tank support and anchorage design calculations sealed by a professional engineer licensed in the state of North Carolina.
 - 7. A list of ten (10) U.S. installations of a bladder-type surge tank of size and design conditions similar to the proposed equipment and in successful operation for at least five (5) years. The list shall include owner contact names, phone numbers, length of service, and design criteria.
 - 8. Manufacturer shall provide in-house x-rays of welds, hydrostatic test, and ASME inspection. The Engineer reserves the right to inspect the vessel manufacturing facility to confirm requirement above.
 - 9. ANSI/NSF 61 certification(s) for all wetted components and coatings.

1.04 AFFIDAVIT

- A. Provide a performance affidavit for each tank furnished as described in Section 11000 –

Equipment General Provisions.

1.05 WARRANTY

- A. Warranty and guarantee shall be as specified in Section 11000, with the exception that the warranty period shall be for two (2) years.
- B. Manufacturer shall guarantee that the bladder-type surge tank shall perform as specified and shall warrant the system, complete, to be free from defects in materials and workmanship for a period of two (2) years from the date of Substantial Completion. The bladder-type surge tank manufacturer shall repair or provide replacement for any defective components at no cost to the Owner under this warranty.

1.05 PERFORMANCE GUARANTEE

- A. In the event that the test results or surge analysis fail to establish the capability of the equipment to meet the performance conditions specified herein, the manufacturer shall upgrade the surge control equipment and systems as necessary and verify their capability to meet the specification requirements at no additional expense to the Owner.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The manufacturer of the bladder-type surge tank shall be one recognized and established in the design, production, assembly, field service, and operation of bladder-type storage tanks for potable water surge control with a minimum of ten (10) years of experience and ten (10) bladder-type surge tanks in operation in the U.S. similar in size and design conditions to the proposed equipment and in successful operation for at least five (5) years.
- B. The manufacturer shall be ISO-9001 certified which includes engineering, design, manufacturing and testing complete components. Vessel manufacturer shall manufacture their own vessels and within the same plant as per quality control through ISO.
- C. The bladder-type surge tank shall be as manufactured by Charlotte of America or approved equal.

2.02 GENERAL

- A. The surge tank shall be a horizontal, bladder-type vessel suitable for use with potable water.
- B. The surge tank shall not require the permanent installation of, or connection to, an air compressor to properly maintain air pressure between the tank shell and bladder. The surge tank shall be delivered pre-charged with air and require only periodic inspection of air pressure and re-charging.
- C. The size of the surge tanks specified herein shall be confirmed by the bladder-type surge tank manufacturer using a hydraulic analysis.

- D. The surge tank model name, steel, coatings, bladder and manufacturing facility shall be ANSI/NSF-61 listed and approved.

2.03 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. The hydraulic performance conditions and design data for the surge tank are shown in the table below. Specified pressure (and tank level) limits are for conditions based on operating four pumps at full speed. In the event that the manufacturer's verification of the transient analysis of the system yields varying design requirements, the manufacturer shall promptly inform the Engineer in writing prior to fabrication of the surge tank.

Parameter	Value	
	GAST-1	WST-1
Tag No.		
Tank Configuration	Horizontal	Horizontal
Minimum Capacity	18,500 gallons	9,300 gallons
Maximum Tank Outside Diameter	120"	120"
Maximum Tank Length	36 ft	20 ft
Maximum design pressure	250 psi	250 psi
Precharge pressure setting	Per Manufacturer Recommendation	Per Manufacturer Recommendation
Minimum operating volume ¹	20% of total tank volume	20% of total tank volume
Outlet Flange Diameter	24"	24"
Outlet Flange Pressure Rating	Class 150 per ANSI B16.5	Class 150 per ANSI B16.5
Minimum Access Manhole Diameter	24"	24"
Minimum Transient Pressure ²	40 psi	40 psi

¹ Minimum liquid level applies under any operating or surge condition.

² Values apply under surge conditions in the discharge headers at the pumping station.

- B. The Contractor and surge tank manufacturer shall guarantee satisfactory performance of the surge tank without unacceptable valve slam or pressure spikes in excess of the pressure ratings of the affected piping and appurtenances and without compromising the surge tank design safety factors.

2.04 COMPONENTS

A. Tank Vessel

- The tank materials and the design, shop fabrication, and shop inspection of the tank shall comply with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code with only the plate steels in Table UCS-23 being used. Surge tank shall be provided with an ASME code stamp, pressure vessel National Board of Boiler & Pressure Vessel Inspectors Registration Number, and a nameplate indicating the pressure rating.
- Surge tank shell shall be constructed of deep drawn carbon steel SA516 Gr 60. Domes shall be double sub-arc welded, and side shells shall have double-welded seams.

B. Bladder

1. Tank shall be equipped with a food grade, heavy duty butyl rubber bladder suitable for potable water service. The calculated pre-charge pressure will be located between the shell of the tank and the bladder. The bladder shall be sized to conform to the inner shape and dimensions of the vessel when inflated without stretching.
2. Bladders and replacement bladders shall be manufactured in the tank manufacturer's plant. Surge tanks shall be fabricated by the tank manufacturer, not by an outside supplier.

C. Tank Outlet

1. The tank shall connect to system piping via a flanged bottom outlet.
2. The outlet shall include one (1) 1" NPT threaded port, one (1) ½" NPT threaded port, and two (2) 2" flange side connections.

D. Gas-Side Manifold and Connections

1. Provide gas-side manifold which includes connections for an air fill nozzle, pressure gauge, pressure relief valve, and level monitoring tubing.
2. The manifold shall connect to the tank through a minimum 1" NPT threaded port. A 1" ball valve shall be provided to isolate the manifold from the tank.
3. The tank manufacturer shall provide the gas fill nozzle, pressure gauge, and pressure relief valve as described below and each shall be installed so as to be accessed and observed from ground level.
 - a. Gas Fill Nozzle: A stainless steel SA-240 nozzle shall be provided as a part of the pressure vessel for the gas pre-charge connection. Nozzle shall be connected to a ½" isolation ball valve.
 - b. Pressure Relief Valve: Install on the gas pre-charge connection to limit the fill pressure to the pressure recommended by the tank manufacturer. The pressure setting shall be field adjustable. Valve shall be of stainless steel construction.
 - c. Pressure Gauges shall be furnished by the tank manufacturer and shall conform to the pressure gauge specifications listed in Section 15400.
 - 1) Pressure gauge shall be connected to a ½" isolation ball valve.
4. All ball valves shall be furnished by the tank manufacturer and shall conform to the ball valve specifications listed in Section 15114.

C. Access Manhole

1. Surge tank shall be provided with an access manhole to allow inspection and maintenance of the rubber bladder. Provide permanently installed davit to remove access cover.

D. Safety Relief Valve

1. In accordance with ASME Section VIII, Division 1, provide safety relief valve approved by The National Board of Boiler and Pressure Vessel Inspectors. Safety relief valve shall be set at 10% above the maximum design pressure.
2. Safety relief valve shall be installed on the tank outlet connection. There shall be no other valve between the surge tank and safety relief valve.
3. Outlet of safety relief valve shall have 1" NPT female connection and shall be piped to drain approximately 2" above concrete slab.

E. Tank Supports and Anchorage

1. The tank manufacturer shall design the surge tank, supports, and anchor bolt sizing/layout to conform to all applicable local building codes in addition to the following criteria. Calculations must be performed by a registered professional engineer in the state of North Carolina.
2. Seismic design parameters shall conform to the most recent edition of the International Building Code.
3. Wind design parameters shall conform to the most recent edition of the International Building Code.
4. Surge tank shall have a minimum hydrostatic test pressure of 1.5 times the design pressure with no reactive load permitted through the inlet/outlet piping.
5. Surge tank shall be supported by a minimum of four (4) support legs attached to a concrete pad as shown on the Drawings. The support legs shall incorporate extensions as required to accommodate connected piping underneath the tank as shown on the Drawings. Materials of construction of support legs shall comply with ASTM A36 or ASTM A285, Grade C. Support legs shall be welded to the underside of the surge tank at the place of manufacture prior to painting and coating of the tank. Legs welded to the side of the tank that extend beyond the footprint of the tank shall not be permitted. Cradles, webbing or other ancillary components shall be provided with the legs as necessary to adequately support the tank.

F. Lifting Attachments

1. To permit lifting of the tank with a single crane or hoist, permanent lifting attachments shall be welded to the surge tank at the place of manufacture prior to painting and coating of the tank.

2.05 HEAT TRACING AND INSULATION

- A. Heat trace and insulate the surge tank and exposed piping. Refer to Section 15290 and Section 15391 for requirements.
- B. Insulation rings shall be provided and attached to the exterior of the tank by the manufacturer to support heat tracing and insulation.

2.06 PAINTING AND COATING

- A. All surface preparation, painting and coating shall comply with the requirements of Section 09900 – Painting. All surface preparation, painting, and coating on the interior of the tank shall be completed at the manufacturer's factory. Field painting and coating shall not be acceptable for interior surfaces. Coatings on wetted components shall be ANSI/NSF 61 approved for use in potable water systems.

2.07 LEVEL MONITOR ASSEMBLY

- A. Each surge tank shall be provided with a level monitor assembly which uses differential pressure between the water inside the tank bladder and the gas outside the tank bladder. Installation shall include the sensors, stainless steel isolation ball valves, and reinforced stainless steel sheathed capillary tubing as required for a complete, functioning system as shown on the Drawings.
- B. Pressure sensor shall be Rosemount Model 3051.
- C. The instrument shall include an LCD display parameterized as a percentage of total volume. Display shall be readable from ground level.

2.08 SPECIAL TOOLS AND SPARE PARTS

- A. The manufacturer shall furnish one (1) spare manway gasket and one (1) set of all special tools required to disassemble, service, repair, and adjust the equipment and appurtenances.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The Contractor shall furnish and install the bladder-type surge tank in accordance with the manufacturers' recommendations and in accordance with Section 11000 – Equipment General Provisions.
- B. The Contractor shall provide and install all supports, piping, valves, and related appurtenances required for a complete and operable system.

3.02 MANUFACTURER'S FIELD SERVICES

- A. The Tank Manufacturer shall provide a qualified technical representative provided in accordance with Section 11000.
 - 1. At least one (1) trip of one (1) day to supervise and inspect the installation and testing of the furnished equipment.

2. At least one (1) trip of two (2) days to perform startup assistance and to instruct the Owner's personnel in the proper operation of the equipment.
 3. At least one (1) trip of one (1) day to perform a warranty inspection near the end of the specified warranty period.
 4. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.
- B. The times specified exclude 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.

3.03 TESTING

- A. Following equipment startup, Contractor shall provide onsite field testing and monitoring of the completed installation to verify performance complies with the requirements indicated herein. Testing shall be functional tests of simulated power failure with one, two, three, and four pumps running at full speed. Testing shall be performed in order of increasing number of pumps operating. Successive tests shall be conducted only when satisfactory results are achieved for the immediately prior test. Owner, at his sole discretion, reserves the right to waive tests involving 3 and/or 4 operating pumps. Contractor shall prepare and submit a detailed commissioning and testing procedure for Engineer's review and approval.
- B. Contractor shall provide, calibrate, install, program and maintain all test equipment and devices required to perform the specified testing and performance monitoring. Contractor shall be responsible for providing all taps, valves, electrical power, and/or other components necessary to conduct the testing and monitoring as required. Contractor and/or surge tank manufacturer shall collect and analyze all data and shall provide detailed report(s) as necessary to thoroughly document the system's performance and to identify and resolve any and all discrepancies. Contractor shall provide a final written report of the testing and performance monitoring, which shall be approved by the Engineer before Substantial Completion will be granted. Upon request of the Owner or Engineer, all raw data collected throughout the monitoring period shall be provided in original digital format.
- C. Performance monitoring shall be conducted commencing at startup of the surge tank and continuing until all required field testing has been completed and the Contractor has successfully demonstrated acceptable performance of the surge tanks and associated components, to the satisfaction of the Engineer.
- D. Throughout the testing and performance monitoring, transient pressures shall be monitored both inside the pump station below the 36" 90 degree bend on the discharge header and at one Owner-specified location in the distribution system. The connection methods shall be as directed by the Owner.
- E. Transient pressure monitoring devices shall be capable of continuous, unattended monitoring and uninterrupted data collection for a period of at least 7 days with a hard drive capable of recording at intervals of 0.010 second (i.e. recording rate of 100 Hz).

Recorded data shall allow segmentation according to time period or event to manage file size. The recorder background pressure reading interval (sample rate) shall be user adjustable from 1 reading per second (1 Hz.) to 1 reading per day. A change in pressure that exceeds a user-adjustable threshold shall trigger the recorder to sample at a transient pressure reading interval (sample rate) that is user adjustable from 100 readings per second (100 Hz.) to 1 reading per second (1 Hz.). A return to background sample rate shall occur when the change in pressure readings falls below a user-adjustable threshold. The transient pressure monitors shall use high-speed analog pressure transducers that are digitally sampled at 1 kHz. The transducer output shall be 1 to 5 Volts where 1 Volt = 0 psi (absolute) and 5 Volts = no more than 500 psi. The transducer shall have a true operating range of -14.7 psi (gauge) to 500 psi and shall be accurate to within 0.25% full-scale with an unexpired calibration certification. Transient pressure monitors shall be provided with GPS antennas and shall automatically synchronize their internal clocks to a common GPS time clock at least every hour. Accurate GPS coordinates shall also be recorded by the device and recorded along with the pressure data. Transient pressure monitors shall be TP-1 by Pipetech International or equivalent. Contractor shall set and adjust the various user-adjustable parameters in consultation with the Engineer, and Contractor shall ensure that all parameters allow for collection of adequate and appropriate data to perform the required performance evaluation.

- F. Flow rate, system pressure, and surge tanks water level data shall be sampled and recorded by the electronic chart recorder at sufficient rate to accommodate the required performance evaluations. Contractor shall provide all instrumentation and data loggers required to collect the data.

- 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.
- G. Wedge restraints or similar restrained couplings may be used in instances where necessary to connect to existing piping or where require for connection of valves hydrants to buried restrained joint piping systems. Restrained couplings shall be specifically selected for the pipeline material and meet the specified test and restraint design pressures.

1.02 MATERIAL CERTIFICATION AND SHOP DRAWINGS

- A. The Contractor shall furnish to 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. 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.
- 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. Restrain solid sleeve couplings with MegaLug Series 1100 by EBAA Iron or equal product from Sigma Corporation or Star Pipe Products.

2.05 METAL EXPANSION JOINTS

- A. Metal expansion joints shall be Unaflex Style 44 SHP. Bellows shall be of stainless steel construction. End connections shall be fixed ANSI 150 pound flanges. Overall lay length when installed shall not exceed 9 inches. Minimum pressure rating of coupling shall be 250 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. Pressure and service shall be the same as connected piping.
- C. Materials shall be cast iron for pipes up to 12 inch diameter and high strength steel.
- D. 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.
- E. Bolts and nuts shall be alloy steel, corrosion-resistant and prime coated.
- F. Flanged adapters shall be EBAA Iron Megaflange ® Series 2100.

2.08 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 PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

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 manufacturer's 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.
- 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.
- 3.04 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 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. 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. 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.

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. 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. 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.
- K. After flushing, all 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.

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 PVC pipe and stainless steel pipe.

- 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 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, pressure 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 pressure class 250 pipe shall be used for flanged spools.
- D. Reference Section 15000, Basic Mechanical Requirements and Section 15390, Schedules.
- E. Submit affidavit of Compliance with AWWA and NSF 61 Standards for the pipe lining and seal coat specified herein.

PART 2 -- PRODUCT

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. All pipe and fittings 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. The lining and seal coat shall comply with ANSI/NSF 61 for potable drinking water systems. 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. 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.
- C. Flanged joints and fittings shall have a minimum pressure rating of 250 psi with 150 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 on the Drawings.

- D. Gaskets shall be the "Ring Gasket" type, 1/8-inch minimum thickness, cloth inserted rubber, red rubber or neoprene and shall be suitable for potable water containing chlorine dioxide, free-chlorine, and/or combined chlorine (chloramines) residual for disinfection. 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.
- E. 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.
- F. 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. Unless otherwise noted on the Drawings, restraint of mechanical joint fittings shall be accomplished using EBAA Series 1100 Megalug® or equal product from Sigma Corporation or Star Pipe Products.
- G. Bolts for mechanical joints shall be high strength corrosion resistant low-alloy steel tee-head bolts with hexagonal nuts.
- H. 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.
- I. 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.
- J. Thrust restraint and harnessing systems such as thrust blocks, threaded-rods, friction clamps, retainer glands, and other proprietary systems shall be used only where specifically specified herein, indicated on the drawings, or allowed by the Engineer in isolated applications where conditions warrant and necessitate their use. 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

(2) heavy coats or coal tar epoxy after installation.

- K. 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 PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements and Section 15390, Schedules.
- B. Submit Affidavit of Compliance with NSF standards for PVC pipe furnished for drinking water and potable water applications.

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 80.
- B. PVC pipe shall be Type 1 Grade 1 conforming to ASTM D 1784 and D 1785. Fittings shall be either socket type flange as indicated on the Drawings or in Section 15390.
- C. Flanged fittings shall be of the same material as the specified pipe and conform 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. Socket type joints shall conform to ASTM D 2467. Solvent cement for socket type joints shall conform to ASTM D 2564 for PVC pipe and fittings.
- F. Perforated and closed drainage pipe and fittings shall be rigid PVC pipe, Schedule 40 unless otherwise shown or specified with solvent welded type joints, or approved equal. Pipe shall be slotted or have two rows of 1/4-inch diameter holes spaced 4-inches apart along the circumference of the pipe. Longitudinal spacing of holes shall be 5-inches maximum.

PART 3 -- EXECUTION

2.01 INSTALLATION

- A. 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.

- END OF SECTION -

SECTION 15010

COPPER PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

PART 2 -- PRODUCTS

2.01 TYPE L COPPER PIPE AND FITTINGS

- A. Type L copper piping shall be seamless, hard drawn and shall conform to ASTM B 88. Solder fittings shall be wrought copper conforming to ANSI B.16.22 or cast brass conforming to ANSI B.16.18 95/5. All exposed copper pipe and fittings shall be Type L.

2.02 TYPE K COPPER PIPE AND FITTINGS

- A. Type K copper piping shall be seamless, soft temper and shall conform to ASTM B 88. Fittings used with this pipe shall be flare or compression type fittings as manufactured by Swagelok, or equal, and shall conform to ANSI B16.26. All buried copper pipe and fittings shall be Type K.

2.03 SOLDER

- A. Solder shall consist of 95 percent tin and 5 percent antimony. Silver solder shall consist of 15 percent silver, 80 percent copper, and 5 percent phosphorous in accordance with ASTM B260-62T. Soldering shall be in conformance with Section 3 of the C.A.B.R.A. Copper Tube Handbook.

2.04 SOFT COPPER TUBING

- A. Soft copper tubing in all sizes, shall conform to the appropriate ASTM Specifications; and fittings used with this tubing shall be compression or flare type, as manufactured by Swagelock, or equal.

- END OF SECTION -

SECTION 15020

PIPE SUPPORTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and design calculations required to provide pipe supports in accordance with the Contract Documents.

1.02 SUBMITTALS

- A. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements specified in Section 01300 – Submittals and Section 15000 - Basic Mechanical Requirements.

1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel-type supports.
2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.
3. With each piping support system Shop Drawing, the Contractor shall attach calculations prepared and sealed by a Professional Engineer licensed in the State of North Carolina showing that the piping support system complies with the specified requirements, including all building code and seismic code requirements pertaining to support of piping and other non-structural components. See Section 01350 – Seismic Anchorage and Bracing.
4. Table showing the manufacturer's recommended hanger support spacing for the pipe materials listed in Section 15390 - Schedules.

1.03 QUALITY ASSURANCE

- A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Professional Engineer licensed in the State of North Carolina.

PART 2 – PRODUCTS

2.01 GENERAL

- A. The Contractor shall be responsible for the design of all piping support systems not specifically designed by the Engineer and detailed on the Drawings. The Contractor shall design piping supports to resist resulting external thrust forces in addition to gravity, seismic and other applicable loads required by the governing building code.
- B. No attempt has been made to show all of the required pipe supports either on the main Drawings or on the standard detail drawings. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing them

throughout the project at no additional cost to the Owner.

- C. Where special pipe support fabrications are required, products and execution shall be as specified in Section 05500 - Metal Fabrications and other related and referenced Sections of the Specifications. .
- D. Existing piping support systems to support new piping shall only be used if the Contractor can show and demonstrate by submitting supporting calculations that they are adequate for the additional load imposed by the new piping, or if they are strengthened to support the additional load.
- E. Design Criteria for Piping Support Systems:
 - 1. Design pipe supports for dead loads imposed by the weight of the pipes filled with water.
 - 2. Design for the thermal expansion and contraction of the piping and its associated pipe support and pipe expansion systems and couplers.
 - 3. Design the pipe supports for all seismic loading requirements and conditions as specified in the governing building code and referenced seismic design codes. Refer to Section 01350 - Seismic Anchorage and Bracing and the structural code drawing for seismic design criteria to be used for this particular project.
 - 4. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.
 - 5. Support spacing shall be as recommended by the pipe and/or hanger manufacturer, but shall not exceed 10 feet on center for ductile iron pipe and 5 feet on center for PVC piping unless indicated otherwise herein or on the Drawings.
 - 6. Seismic and sway bracing shall be provided at maximum 10-foot centers.
 - 7. The design, sizing and spacing of anchor bolts, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each particular support. The minimum anchor bolt size shall be ½ inches in diameter. Refer to Section 05830 – Bearing Devices and Anchoring.

2.02 HANGERS AND SUPPORTS

- A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure.
 - 1. Metal pipe support materials shall be galvanized carbon steel meeting Section 05120 - Structural Steel and Section 05035 - Galvanizing unless indicated otherwise on the Drawings or in the specifications or by the Engineer.
 - 3. Metal pipe supports indicated as standard type pipe hangers are designed and

detailed for gravity loading only. Resulting lateral loads from wind, earthquake, or other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along pipe or at gravity supports using appropriate supplemental members and connections when required by calculations. The Contractor shall include design calculations and details with all pipe hanger and support submissions for review by the Engineer. The main structure and structural components that will support the pipe hangers and other appurtenant components of the facility have been designed to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads.

B. Hangers and supports shall conform to the following requirements:

1. All fabricated metal hangers and supports shall be capable of adjustment after installation. Different types of hangers and supports along a pipe length, including bends, shall be kept to a minimum.
2. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.
3. Vertical piping shall be properly supported at each floor and between floors by stays or braces to prevent rattling and vibration.
4. Supports and hangers for plastic piping shall include wide saddles or bands as recommended by the manufacturer and approved by the Engineer to distribute load and thus avoid localized deformation of the pipe.
5. Hanger and supports shall prevent contact between dissimilar metals by use of copper plated, rubber, vinyl coated or stainless steel hangers.
6. Ferrous pipes to be painted shall be painted in accordance with Section 09900 - Painting. Ferrous pipes that require painting or galvanizing shall be supported by galvanized hangers and supports.
7. Copper piping shall be supported by plastic coated or copper plated steel hangers and supports.
8. Plastic piping shall be supported by plastic coated steel hangers and supports.
9. Hangers and supports shall provide for thermal expansion throughout the full operating temperature range.
10. Expansion and adhesive type anchors used for pipe hangers and supports shall be Type 304 or 316 stainless steel.

C. Metallic hangers and supports may be standard make by Anvil International, Inc., "Witch" by Carpenter & Paterson, Ltd., B-Line Systems, Inc., or equal; and data on the types and sizes to be used shall be furnished to the Engineer for approval. Metallic support system brackets, rods, support clips, clevis hangers, hardware, etc. shall be cast iron or welded steel construction. All gravity type hangers and supports shall be restrained laterally to resist seismic loading and other loading as required by the governing code.

- D. Non-metallic support system shall be a heavy duty channel framing system. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinylester resins. All fiberglass construction shall include suitable ultraviolet inhibitors for UV exposure and shall have a flame spread rating of 25 or less per ASTM E84. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinylester or polyurethane resin. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal. The Contractor shall submit data on the types and sizes of approval. Unless otherwise shown or specified the Contractor shall provide support spacings in the conformance with the pipe and support system manufacturer's requirements.

PART 3 -- EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Support piping connections to equipment by pipe support and not by the equipment.
- B. Support large or heavy valves, fittings, flow meters and appurtenances independently of the connected piping.
- C. Support no pipe from the pipe above it.
- D. Support piping at changes in direction or in elevation, adjacent to flexible joints, expansion joints, and couplings, and where shown.
- E. The Contractor shall not install piping supports and hangers in equipment access areas or bridge crane runs.
- F. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.
- G. Install pipe anchors (fixed supports and/or guides) where shown and/or as may otherwise be required to withstand expansion thrust loads and to direct and control thermal expansion. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that complete details describing location, pipe supports and hydraulic thrust protection are submitted.

- 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 C504 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, Class 150 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.
- E. **The six (6) x 36" and twelve (12) x 24" buried butterfly valves shown on Contract Drawing Sheet C13 shall be furnished to the Contractor by the Owner.** The submittal, installation, and testing requirements specified herein apply to the Owner-furnished valves as well as valves furnished by the Contractor. Contractor shall be responsible for complying with all requirements except where such requirements are listed as a requirement for the manufacturer of the Owner-furnished valves to perform. Contractor shall coordinate work with the manufacturer of the Owner-furnished valves. Refer to Appendix D of the Project Manual for information on Owner-furnished butterfly valves.

1.02 SUBMITTALS

- A. The Contractor shall furnish to the Owner, through the Engineer, a Performance Affidavit utilizing the format specified in Section 11000, Equipment General Provisions. Performance tests shall be conducted in accordance with the latest revision of AWWA C504 and affidavits shall conform to the requirements of the Specifications
- B. Shop Drawings and Operations and Maintenance Manuals 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, weight, protection coating, actuator description/weight, actuator torque calculations, information on

support and anchoring where necessary, hydraulic characteristics, recommended spare parts, 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. Submit ANSI/NSF 61 certifications for all valves, components, and coatings used which will be in contact with potable water.

- 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. A minimum of two (2) non-consecutive 8-hour days (exclusive of travel time) shall be provided on-site.
- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.
- 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 GENERAL

- A. Valves shall have the name of the maker, nominal size, working pressure for which they are designed, and standard to which they are manufactured cast in raised letter on some appropriate part of the body.
- B. Unless noted otherwise on the Drawings, valves shall be of the same nominal diameter and be subjected to the same test pressure as the pipe for fittings to which they are connected.
- C. Special tools and the manufacturer's standard stock of spare parts, if required for normal operation and maintenance of the valve, shall be supplied with each distinct type or size of valve.
- D. Refer to Section 15100 for specifications for valve operators and electric valve actuators.

- E. All valves being furnished are for potable water service. All valve products, components, accessories, and coatings which are in contact with potable water shall be ANSI/NSF 61 approved.

2.02 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.

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.
9. See individual valve specifications for any supplemental testing requirements.

- END OF SECTION -

SECTION 15100

VALVE OPERATORS AND ELECTRIC VALVE ACTUATORS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Equipment shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions and Section 15000 – Basic Mechanical Requirements.
- B. Reference Section 15390 – Schedules for additional information on valves and operators/actuators.
- C. The electric valve actuators shall meet the signal requirements described in Section 17000.
- D. Valve operators and electric valve actuators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.
- E. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuator.
- F. The valve operators and electric actuators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

1.02 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. A Performance Affidavit shall be submitted for electric actuators in accordance with Section 11000, Equipment General Provisions.
 - 2. Certification that the force required to operate all valves is as specified herein.

1.03 WARRANTY AND GUARANTEE

- A. Warranty and Guarantee shall be as specified in Section 11000 with the exception that the warranty period shall be for two (2) years.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Electric actuators shall be provided where specified in the Valve Schedule in Section 15390 – Schedules.
- B. Manual operators shall be provided on all valves which do not receive electric actuators. Manual operator type shall be as specified herein and as shown on the Drawings.
- C. Quarter turn valves 8” and greater in size shall have geared operators. Gate valves 14” and greater in size shall have geared operators.
- D. Operators/actuators shall be furnished with conservatively sized extension bonnets, extension stems, or torque tubes, and all required appurtenances required for a complete installation. Operators furnished with extension bonnets shall include stainless steel extension stems, or stainless steel torque tubes.

2.02 MANUAL OPERATORS

- A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:
 - 1. Buried valves shall be equipped with nut operators, extended stems, and valve boxes. Where the depth of the operating nut is more than 4 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18-24 inches of the surface.
 - 2. Exposed valves, except gate valves, up to 6-inch shall be lever operated.
 - 3. Exposed valves 8-inches and larger shall be handwheel operated.
 - 4. Exposed gate valves shall be handwheel operated.
- B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.
- C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.
- D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed as shown in the Piping Schedule in Section 15390 – Schedules.
- E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24”.
- F. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504-94.

- G. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type except manual operators for butterfly valves 18-inch in diameter or larger which shall be worm gear, unless otherwise indicated in the individual valve specification. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.
- H. Manual operators on below grade (and vault installed) valves shall be permanently lubricated and watertight under an external water pressure of 10 psi.

2.03 ELECTRIC VALVE ACTUATORS

- A. Electric Actuators shall be open/close service and as manufactured by Rotork, AUMA SA Series, or EIM Control Series 2000.
- B. Performance Requirements
 1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.
 2. Torque capacity of the actuators shall be sufficient to operate the valves with the maximum pressure differential, as indicated in the Valve Schedule in Section 15390, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway of torque.
 3. Operating time for full limits of travel shall be adjustable through the electrical actuator between 60 – 180 seconds.
 4. Actuators shall be capable of operating in ambient temperatures ranging from 0 degrees F – 160 degrees F.
 5. The gearing, motor and, contactor shall be capable of 60 starts per hour without overheating.
- C. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for weatherproof protection. All external fasteners shall be stainless steel. Compartments shall be provided with moisture and dust-proof rigid cast covers meeting NEMA 6, certified to submergence in 6 ft of water for 30 minutes.
- D. The actuators shall be provided with externally operable and lockable 480VAC circuit breakers integral to the control housing.
- E. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion

operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the valve disc in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio. For quarter turn applications, overtravel of the operator shall be prevented by internal mechanical stops cast into the actuator.

- F. A mechanical dial position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.
- G. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 40 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.
- H. The drive motor shall be specifically designed for actuator service and shall be characterized by high starting torque and low inertia. Motors shall be 460 volts, three phase, 60 Hz AC reversible squirrel cage induction type motors. Motors shall be totally enclosed, non-ventilated, with NEMA Class F insulation minimum (Class H for modulating actuators) and a maximum continuous temperature rating of 120 degree C (rise plus ambient). A 120 VAC space heater shall be provided in the motor compartment. The electric motor shall have a time rating of at least 15 minutes at 104°F (40°C) or twice the valve stroking time, whichever is longer, at an average load of at least 33% of maximum valve torque. Motor bearings shall be permanently lubricated by premium lubricant. The motor shall have plug and socket electrical connection to facilitate easy removal and replacement. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator. The motor shall include single phase protection. A suitable thermal protection device shall be incorporated in the motor or motor starter circuits, connected to a tripping device. Fast acting fuses shall be provided to protect solid state components. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus ten (10) percent of nameplate rating. Actuators shall be furnished with electro-mechanical reversing starters.
- I. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. An adequately sized space heater shall be installed in the control circuit compartment to aid in the prevention of damage resulting in from condensation. The following items shall be located in the control circuit compartment.
 - 1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed valve and when torque is exceeded during valve travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be

mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator's assembly to the valve.

2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and "in step" with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six (6) contacts, three (3) normally open and three (3) normally closed, shall be supplied at each end of valve travel. Four (4) additional contacts shall be provided to report end of travel or any desired position between ends of travel.
- J. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be designed to operate from a single 480VAC, 3-phase source. The actuators shall be furnished with fuses inside of the terminal compartment. A quantity of two – ¾ inch NPT conduit entries shall be furnished.
- K. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 250VAC.
1. Open, Close, and Stop commands from external dry contacts (utilizing internal 120VAC power supply) and/or from an external signal of 12V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.
 2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.
 3. Four (4) unpowered contacts shall be provided for remote indication which can be selected to indicate valve "Opened" and "Closed" position, "Remote" status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.
- L. Local Controls
1. Actuators shall be furnished with a Local-Off-Remote selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.
 - a. When the LOR is in the "Local" position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.
 - b. When the LOR is in the "Off" position, the actuator shall not operate.

- c. When the LOR is in the "Remote" position, the actuator shall be controlled by remote inputs from the PLC.
- 2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

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 and shall include the following site visits for electric actuators:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	2	1
Startup and Training	1	1

3.02 INSTALLATION

- A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable specification sections for valves, and motor controls.
- B. Valve actuators shall be factory coated in accordance with the manufacturer's standard paint system.

3.03 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:
 - 1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
 - 2. Submit written certification that:
 - a. Shop tests for the electrical system and all controls were successfully conducted;
 - b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.
 - 3. Each actuator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical valve load and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at maximum torque setting
 - c. Flash Test Voltage

- d. Actuator Output Speed or Operating Time
- e. Record details of specification on the test certificate, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.
- f. Verification of actuator torque rating with valve.

3.04 FIELD TESTS

A. Field testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:

- 1. Valve actuators shall be field-tested together with the associated valves.
- 2. Test all valves at the operating pressures at which the particular line will be used.
- 3. Test all valves for control operation as directed.
- 4. Field testing shall include optimization of opening and closing times of the valves. 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.

B. Preliminary Field Tests

- 1. General: 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.
- 2. Scope: 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.
- 3. 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, as specified or otherwise directed.

C. Final Field Tests

- 1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.
- 2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps and surge tanks.
- 3. Final 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.

4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 11000.

- END OF SECTION -

SECTION 15101
BUTTERFLY VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish and install all butterfly valves shown on the drawings or indicated in the valve schedule in Section 15390, except valves being furnished by Owner, complete and in place in accordance with the specifications herein. Valves which are being furnished by Owner shall be installed by the Contractor. Refer to Section 15095.

1.02 SUBMITTALS

- A. Submit Shop Drawings and Performance Affidavit in accordance with the submittal requirements specified in Section 01300 and Section 15095.
- B. Provide certified test reports in accordance with Section 11000 and Section 15095.

1.03 WARRANTY AND GUARANTEE

- A. Warranty and Guarantee shall be as specified in Section 11000 with the exception that the warranty period shall be for two (2) years.

PART 2 -- PRODUCTS

2.01 BUTTERFLY VALVES

- A. Butterfly valves shall be of the rubber-seated, tight-closing type conforming to the latest revision of AWWA C504 and ANSI/NSF 61. Valves shall be bubble tight at rated pressures and flow velocities in either direction, be satisfactory for applications involving shutoff, throttling and modulating service, and capable of being actuated after a period of inactivity of 12 months. Valves shall be AWWA C504 Class 250B and suitable for potable water service, containing free and/or combined chlorine (chloramines). Valves shall be designed for a flow range of 0 – 3,000 gpm. Operators shall be sized for flow velocity direction as indicated on Drawings or as directed by Engineer. All butterfly valves shall be the product of one manufacturer. Butterfly valves shall be as manufactured by Golden Anderson, Pratt, Mueller, Val-Matic, or Rodney Hunt.
- B. Butterfly valves shall be of the short body design with AWWA C110 and AWWA C111 mechanical joint; ANSI B16.1, Class 150 flanged ends; or AWWA C207 flanged ends as scheduled and indicated on the Drawings. Where valves are installed in restrained joint piping, valves shall be restrained to maintain continuous restraint of the piping system.
- C. Both sides of each flange shall be machined to true plane surfaces within a tolerance limit of 0.005 inches. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per foot (0.017%) of flange diameter.

- D. Valve bodies shall be epoxy coated cast iron conforming to ASTM A-126, Grade B; ASTM A-48, Class 40; or Ductile Iron ASTM A536, Grade 65-45-12. Where required to meet design operating conditions, valve bodies shall be manufactured of higher strength materials. Valve bodies shall have integral hubs for housing shaft bearings and seals. Valves shall have the name of the manufacturer, nominal size, working pressure for which they are designed and standard to which they are manufactured cast in raised letters on the valve body.
- E. Valve discs shall be constructed of epoxy coated ductile iron meeting the materials requirements of the valve bodies. Discs shall provide a full 360 degree seating surface with no external ribs transverse to flow, and shall comply with the latest revision of AWWA C504 Specifications. The disc shall not have any hollow chambers that can entrap water. All surfaces shall be visually inspected and measurable to assure all structural members are at full disc strength. The valve manufacturer shall furnish Shop Drawings which include end clearance dimensions when the disc is in the full open position.
- F. The resilient seat shall be synthetic rubber and be suitable for bi-directional shut-off at the rated pressures. The seats shall be factory tested as per AWWA C504 at a test pressure of 250 psig and post adjusted for differential pressures specified herein.

The resilient seat shall be mechanically attached to the valve disc or valve body. Any required seat attachment hardware shall be stainless steel. The resilient seat shall be capable of being adjusted or replaced in the field without moving the valve disc along the shaft axis, or removing the valve from the line. The mating seat surface shall be stainless steel or monel.

- G. Valve shafts shall be turned, ground, and polished, one-piece or two-piece units of ASTM A-276 type 304 or 316 stainless steel; ASTM A564 type 630 or XM25, and shall be of a diameter not less than those listed in AWWA C504-06, Class 250B. Shafts shall be suitably sized with a factor of safety to transmit the torque required to operate the valve. The use of shafts having a hexagonal cross section will not be acceptable. Shafts shall be securely attached to valve disc by means of conservatively sized type 316 stainless steel taper pins, threaded at one end and secured with lockwashers and nuts (i.e. mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shafts shall be keyed for actuator connection. Keys shall be corrosion-resistant material. The use of set screws or other devices instead of the pins specified herein shall not be allowed.
- H. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of teflon or heavy-duty bronze. Bearing load shall not exceed 1/5 of the compressible strength of the bearing or shaft material. The valve assembly shall be furnished with a factory set two-way thrust bearing designed to center the valve disc in the valve seat at all times. End cover bolts shall be type 316 stainless steel.
- I. Shaft seals shall be stuffing box pulldown or removable bronze cartridge type.
 - 1. The shaft seal shall be of the type utilizing a stuffing box and pulldown packing gland. Packing shall be GARLOCK, Chevron Style 432, or equal. It shall be self-

adjusting, self-compensating type. Butterfly valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator or disturbing any part of the valve or operator assembly, except the packing gland follower. For buried valves with pull down packing the packing gland cover assembly shall be heavy duty, soil and water resistant. Stuffing boxes for pull down packing shall have a depth sufficient to accept at least four rings of self-compensating type packing specifically selected for the operating pressures to be encountered. Stuffing box bolts, studs and nuts shall be type 316 stainless steel.

2. The shaft seal shall be contained in a removable bronze cartridge. The bronze cartridge shall be manufactured from ASTM B505 copper alloy UNS #C93200 and shall meet the requirements of AWWA C504 for bronze, Grade E. The "O" ring material shall be nitrile, BUNA-N rubber, as intended for use with potable water or wastewater and per ASTM D-2000 with a hardness of 70 Shore A Durometer.
- J. Manual operators for butterfly valves 18-inches in diameter or larger shall be the worm gear type conforming to AWWA C504. Where specified or indicated on the Drawings, valves shall be furnished with extension bonnet and extension stems or torque tubes. Electric valve actuators shall be as specified in Section 15100.
- K. Material Quality: Minimum quality standards for valve components shall comply with MSS SP-55. Materials of construction shall be clean and free from defects that would weaken the structural integrity of the valve or affect the ability of the valve to withstand hydraulic pressure over the life of the valve. Surface defects greater than 1/8 inch in any direction and 1/8th of wall thickness will not be acceptable. Indication of shrinkage, cracks, hot tears, sand inclusions (on machined surfaces), or porosity caused during the casting process will not be acceptable. Valves determined to be defective in accordance with the above shall be replaced. Repair of defects will not be permitted. Previously repaired valves or discs will be rejected prior to testing.
- L. Casting Structure: Operator mounting surface must be primarily structurally cast to the outer perimeter of the flange ring as well as cast to the pressure boundary of the body to securely contain the shaft seal.
- M. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be painted with two coats of the manufacturer's NSF approved premium epoxy polyamide for potable water applications. Paint shall comply with the requirements of Section 09900, Painting. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The valve manufacturer shall provide a qualified technical representative in accordance with Section 11000.

3.02 FACTORY TESTING

- A. Each butterfly valve supplied shall be subject to performance testing consisting of an actuator operability test, leakage test, and hydrostatic test. The tests shall be performed as described in AWWA C504. Any valve in whole or in part which fails any or all of the performance tests shall be made satisfactory or replaced at the discretion of the Owner and/or Engineer.

- B. The actuator operability test shall be performed to demonstrate proper operation of the valve assembly consisting of the valve, valve actuator, and valve operator, including extended shafts. The actuator operability test will consist of the completed assembly from the fully closed to the fully open position a total of three (3) times. This test will immediately precede the leakage test and hydrostatic test.

- C. Leakage Test
 - 1. The leakage test shall be performed with the valve disc in a fully closed position. One side of the valve disc shall be fully visible during the test. Water shall be applied to one side of the valve disc at the rated pressure of the valve. Pressure will be applied for a duration of 10 minutes. Any indication of water passing around the disc will deem the test a failure. The leakage test will be performed in two steps with pressure being applied to the valve disc both in the direction of flow and against the direction of flow. No alternative to this procedure will be accepted.

 - 2. Valve disc deflection will be measured during the performance of the leakage test. Deflection will be measure by using dial indicators to measure disc position at the shaft ends and 90 degrees from the shaft ends prior to the application of pressure and while pressure is being applied. Once pressure is released, all dial indicators shall return to within 0.01 inches of their original readings. Any readings greater will indicate a failure of the test.

- D. The hydrostatic test will consist of applying an internal pressure equal to two (2) times the rated pressure to the valve for a period of ten (10) minutes. Any indication of leakage through the valve body will be considered a failed test.

- END OF SECTION -

SECTION 15105

CHECK VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish and install check valves as specified herein.

PART 2 -- PRODUCTS

2.01 FAST CLOSING CUSHIONED CHECK VALVES (POTABLE WATER SERVICE)

A. General

1. Check valves suitable for working pressure of 250 psig potable water service, containing free and/or combined chlorine (chloramines). Valves shall be designed for a flow range of 0 – 3,000 gpm. Check valves shall be of the tilted disc metal seated, full body type capable of accepting bottom mounted oil dashpots.
2. The valves shall be provided with drilled flanges in accordance with ANSI B16.1 for Class 125 for cast iron flanges and ANSI B42 for Class 150 ductile iron flanges. Flanges shall be flat faced. Flanged inspection ports shall be provided upstream and downstream of the valve disc for inspection of use with dashpots.
3. Valves shall comply with the latest revision of AWWA Standards and ANSI/NSF61.
4. The manufacturer shall have a minimum of five (5) years of experience in the manufacture of tilted disc check valves. Check valves shall be Series #9000, 9000B (with bottom oil dashpot), as manufactured by Val-matic Valve and & Mfg. Corporation, Elmhurst, IL, USA or equal.

B. Design and Materials of Construction

1. The valve body shall consist of two sections bolted together as a central diagonal flange include at an angle of 55 degrees. The inlet body section shall contain a seat ring positioned and captured by the diagonal flange. The outlet body section shall accept eccentrically located pivot pin trunnions with sealed covers and lubrication grease fittings. The valve body shall be constructed of ASTM A126 Class B cast iron for Class 150 and Class 250 valves up to 10 in. (250 mm). 12 inches (300 mm) and larger Class 250 and Class 150 valves shall be constructed of ductile iron ASTM A536 Grade 65-45-12. 6" and large valves shall be capable of accepting a field installed bottom mounted oil dashpot.
2. The eccentric pivot trunnions shall be located to divide the disc into approximately 1/3 and 2/3 proportions and also allow the seating surface of the disc to rotate away from the seating surface of the seat ring without contact. Clearance shall be provided between the pivot pin and bushing when the disc is seated to prevent binding and to ensure a tight seal. The disc in sizes up to 10 in. shall be one-piece

aluminum bronze. 12 in. and larger discs shall be ASTM A125 Class B cast iron and larger valve or ASTM A536 Grade 65-42-12 ductile iron. The disc seating ring shall be ASTM B271 Alloy C95500 centrifugally cast aluminum bronze. The mating seat ring located in the body shall be ASTM B271 Alloy C95400 centrifugally cast aluminum bronze. The valve disc and seat shall have a seating surface finish of 32 micro-inch or better to ensure positive seating at all pressure. The pivot pins shall be ASTM B505 Alloy C95500 aluminum bronze and shall be guided by a bushing constructed of ASTM B505 Alloy C95400 aluminum bronze. A position indicator shall be supplied on 6 in. and larger valves and visually show disc position.

3. The flow area through the valve body inlet and outlet shall be equal to the nominal pipe size and gradually increase to an area 40 percent greater at the valve seat. The valve flow way shall be contoured and unrestricted to provide full flow areas at all locations within the valve. Full flow shall be based on an open stroke of 40 degrees to ensure stabilization of the disc when open. Cv flow coefficients shall be equal to or greater than specified below and verified by an independent testing laboratory.

Valve Size (inches)	6	8	10	12	14	16	18	20	24	30	36
Cv Factor	1160	2200	3600	5400	7600	10300	13200	16800	25500	42000	63000

4. A bottom mounted oil dashpot shall be factory installed in the upstream inspection port to provide hydraulic control to the final 10% of valve closure and reduce water hammer associated with rapid flow reversal conditions on pump shut down. The dashpot shall consist of a high pressure hydraulic cylinder with a minimum bore size as shown below, adjustable external flow control valve, pressurized oil reservoir and piping designed to control the closing speed of the last 10% of travel in 1-5 seconds. A dashpot spacer which connects the cylinder to the valve shall have an air gap to prevent hydraulic fluid from entering the valve and contaminating the water system. A snubber rod with O-ring seals and rod wiper scrapers shall make contact with the lower portion of the disc during closure.

Valve Size (inches)	6-10	12-14	16-24	30-36	42-48	54-60
Minimum Cylinder Size (inches)	1.5	2	2.5	3.25	4	5

5. The exterior of the valve shall be coated with a universal alkyd primer. The valve interior shall be coated with an epoxy coating approved for potable water.

C. Painting

1. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be painted with two coats of the manufacturer's NSF approved premium epoxy polyamide for potable water applications. Paint shall comply with the requirements of Section 09900, Painting. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

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.

3.02 FACTORY TESTING

- A. Factory testing and certified test reports shall be provided in accordance with Section 11000.
- B. One valve furnished shall be proof of design cycle tested through 250,000 cycles in the horizontal position and leak tested at the rated pressure. The leakage rate shall be less than 1 fluid ounce per hour per inch of valve size after the test.

- END OF SECTION -

SECTION 15114

MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.
- B. Valves shall be approved for use in potable water service and conform to ANSI/NSF 61.

PART 2 -- PRODUCTS

2.01 PRESSURE REDUCING VALVES

- A. Pressure reducing and regulating valves (water service) 1/2-inch and under shall be bronze and above 1/2-inch shall have cast iron bodies bronze fitted. Valves shall be constructed with full openings and capable of supplying a full flow of water at reduced pressure. Valves shall be so constructed that repairs can be made without removing the valves from the line. The valves shall be equipped with a sedimentation chamber and stainless steel or bronze strainer. Pressure reducing and regulating valves shall be the back pressure sustaining type and shall operate over a range at differential pressures from 5 to 120 psi. Reducing and regulating valves shall meet or exceed the requirements of ASSE 1003 (ANSI A112.26.2) and shall be Model 616R, as manufactured by Fisher Controls, WATTS Series 25 AUB, GA, or equal.

2.02 PRESSURE AIR RELEASE / VACUUM VALVES

- A. The pumping equipment manufacturer shall furnish pressure air release / vacuum (AR/V) valves for Contractor to install.
- B. AR/V valves to be installed on pump can connection shall be 1" Series 33A valves manufactured by Cla-Val. A total of eight (8) valves of this type will be furnished.
- C. AR/V valves to be installed on the pump discharge lines shall be 2" Series 37 Well Service valves manufactured by Cla-Val. A total of eight (8) valves of this type will be furnished.

2.03 BALL VALVES

- A. Products and Manufacturers: Provide ball valves as made by one of the following:
 - 1. Watts, Series S-FBV-1
 - 2. Nibco, Model T-585-S6-R-66-LL
 - 3. Or approved equal
- B. 2-piece full port type 304 stainless steel ball valve.

- END OF SECTION -

SECTION 15290

INSULATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install insulation as indicated on the Drawings or otherwise specified. Insulation shall not be installed until piping and tanks have been field tested, painted (where required) and approved by the Owner. The Contractor shall protect the insulation from moisture at all times.
- B. Reference Section 15000, Basic Mechanical Requirements.
- C. Submittals for weatherproof jacketing systems shall include available colors to be selected by Owner. Available colors shall include at least white and/or silver.

PART 2 -- PRODUCTS

2.01 EXTERIOR INSULATION AND WEATHERPROOF JACKETING SYSTEM FOR PIPING, VALVES AND FITTINGS (<=8-INCH NOMINAL DIAMETER)

- A. Flexible unicellular, closed-cell elastomeric piping insulation: ASTM C 534, Type I. AP Armaflex by Armacell Company or approved equal.
- B. Insulation shall be mold-resistant and shall be non-wicking.
- C. Minimum insulation thickness shall be 1-1/2 inches for 4" diameter pipe and larger, and 1 inch for smaller pipe.
- D. Jackets for exterior insulation shall be either:
 - 1. Smooth or embossed ASTM C 921 Type I aluminum metal jacket with weather-proof construction. Minimum jacket thickness shall be 0.031 inches for exterior installations. Fastening shall use preformed "2"-lock seam with 2 inch butt strap with sealant. Bonds shall be 1/2 inch aluminum with wing seals. Fittings shall be prefabricated 0.031 inch thickness aluminum.
 - 2. For areas not susceptible to impact: ArmaTuff PLUS II self-adhesive, laminate polymeric membrane pipe covering with UV-, puncture- and tear-resistant surface by Armacell or approved equal. Membrane shall be minimum 16 mil thickness with 3-mil pressure sensitive acrylic adhesive and kraft release liner. Membrane shall serve as a vapor retarder and shall be waterproof. Laminate polymeric membrane pipe covering shall be by the same manufacturer as flexible elastomeric piping insulation.
- E. Insulation for valves, fittings and flanges shall be mitered segments of the same product used as pipe insulation. As an alternative to insulation with separate jackets, flexible elastomeric insulation with laminated polymeric membrane covering as specified for larger piping may be used for valves, fittings and flanges.

- F. Pipe insulation jackets shall be at least 36" long as measured along the pipe.
- G. Special care shall be taken to make all exterior insulation jackets completely waterproof by the use of appropriate sealants at all joints, etc.
- H. Staples, Bands, Wires, Adhesives, Cement, Tapes and Sealers: As recommended by insulation manufacturer for applications indicated.

2.02 EXTERIOR INSULATION AND WEATHERPROOF JACKETING SYSTEM FOR SURGE TANKS AND LARGE PIPING (>8-INCH NOMINAL DIAMETER)

- A. Flexible unicellular, closed-cell elastomeric insulation with a 16 mil thickness laminated polymeric membrane covering that is UV-, puncture- and tear-resistant—i.e. a UV protective blended polymeric top surface and a puncture-resistant blended polymeric base, around a scrim reinforced core. ArmaTuff PLUS II by Armacell Company or approved equal. Flexible elastomeric insulation shall be by the same manufacturer as flexible elastomeric piping insulation provided for smaller piping.
- B. Insulation shall be mold-resistant and shall be non-wicking.
- C. Minimum insulation thickness shall be 2 inches.
- D. The membrane shall have a 10-year warranty against breakdown due to UV radiation. Insulation layer between outer layer of duct and exterior jacket shall be a mold-resistant flexible elastomeric thermal insulation.
- E. Insulation for valves, fittings and flanges shall be mitered segments of the same product used as pipe insulation.
- F. Pipe insulation jackets shall be at least 36" long as measured along the pipe.
- G. Special care shall be taken to make all exterior insulation jackets completely waterproof by the use of appropriate sealants at all joints, etc.
- H. Staples, Bands, Wires, Adhesives, Cement, Tapes and Sealers: As recommended by insulation manufacturer for applications indicated.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The Contractor shall insure that surfaces of tanks, pipes, valves, heat tracing, and fittings are clean and dry prior to installation of insulation. Insulation shall be installed so as to make surfaces smooth, even, and substantially flush with the adjacent insulation.
- B. The Contractor shall follow the manufacturer's application instructions for the materials used.

- END OF SECTION -

SECTION 15390

SCHEDULES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Provide piping and valves according to the schedules contained herein.
- B. 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 51	(1)
		Restrained (Buried)	Pressure Class 250	
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., shall be tested if required by local building inspections.

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. Electrically operated valves are listed in the valve schedule. Valves not listed in the valve schedule shall be manually operated and provided as indicated on the Drawings and specified in other sections.

PIPING SYSTEM SCHEDULE

PIPE DESIGNATION	DIAMETER	LOCATION	MATERIAL	TYPE OF JOINT	CLASS / SCHEDULE	RESTRAINT SYSTEM DESIGN ⁽¹⁾ PRESSURE	TEST PRESSURE
D	≥ 4"	ALL	DI	PO	PC 350	N/A	N/A
	< 4"	ALL	PVC	SW	SCH 80	N/A	N/A
NPW	ALL	ALL	PVC	SW	SCH 80	250 PSI	150 PSI
PW	< 4"	ALL	PVC	SW	SCH 80	250 PSI	225 PSI
	≥ 4"	EXPOSED	DI	FL	PC 250	250 PSI	225 PSI
	≥ 4"	BURIED	DI	RJ	PC 250		
SPD, V	ALL	ALL	PVC	SW	SCH 80	N/A	N/A

(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.

PIPING SYSTEM DESIGNATIONS

D DRAIN
 NPW NON-POTABLE WATER
 PW POTABLE WATER
 SPD SUMP PUMP DISCHARGE
 V VENT

MATERIAL ABBREVIATIONS

PVC POLYVINYL CHLORIDE
 DI DUCTILE IRON

JOINT TYP ABBREVIATIONS

SW SOCKET WELD
 FL FLANGE
 RJ RESTRAINED JOINT
 PO PUSH ON

CLASS/SCHEDULE ABBREVIATIONS

SCH SCHEDULE
 PC PRESSURE CLASS

ELECTRICALLY ACTUATED VALVE SCHEDULE

TAG NO.	VALVE TYPE	OPERATOR TYPE	SIZE (in)	MAXIMUM FLOW (gpm)	MAX DIFFERENTIAL PRESSURE (psi)	SERVICE	LOCATION
GAV-1	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
GAV-2	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
GAV-3	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
GAV-4	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
GAV-5	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
WV-1	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
WV-2	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
WV-3	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
WV-4	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED
WV-5	BUTTERFLY	OPEN/STOP/CLOSE	16	3,000	225	PW	PUMP BUIDLING – EXPOSED

- END OF SECTION -

SECTION 15391

HEAT TRACING SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install heat tracing and insulation systems as shown and required by notes on the drawings or as required by the Section 15390 - Schedules. All heat tracing components shall be supplied by the same manufacturer. The heat tracing and insulation system shall include but shall not be limited to self regulating heater cables, grommet end termination kits, power connection kits, splice kits, NEMA 4X enclosed thermostats, piping insulation and jacket and installation tape. The intent of this specification is for the contractor to supply all appurtenances needed for a complete and fully operational system at each location that a heat tracing system is required. The heat tracing system supplier shall be completely responsible for the design of the system such that the entire system meets all aspects of this specification and the system functions in the environment where it will be installed. All parameters of the system shall be sized and as recommended by the supplier.
- B. The heat tracing system(s) shall be provided where indicated on the Drawings.
- C. Piping insulation and jacket shall be supplied with all heat traced systems and shall be in conformance with Section 15290 - Insulation.
- D. The minimum design ambient temperature for the heat tracing system design shall be -10°F.
- F. All the components of the heat tracing system shall be individually Underwriters Laboratory (UL) listed. The system as supplied shall conform to all applicable parts of the following:
 - 1. National Fire Protection Association (NFPA)
 - 2. National Electric Code (NEC)
 - 3. Local and State Building Codes

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. Heat tracing system for surge tanks shall have a cable heat rating of 8 Watts per foot.
- B. Heat tracing system conductors for METAL piping shall be supplied as follows:

Pipe Diameter Range	Cable Heat Rating (Watts per foot)
0.75" – 3'	3
4" – 8"	5
10" – 24"	8

- C. Heat tracing system conductors for NONMETALIC Piping shall be supplied as follows:

Pipe Diameter Range	Cable Heat Rating (Watts per foot)
0.75" – 2"	3
2.5"	5
3" – 12"	8 ⁽¹⁾

(1) Two conductors shall be provided and shall be placed on top and bottom of pipe.

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:
1. Submittal data on all components of the heat trace system and any other data recommended by the manufacturer
 2. Installation and maintenance instructions
 3. List of replacement parts for the entire system in table format
 4. Bill of materials list of the system as supplied in table format

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Each heat trace system shall be supplied by Thermon Manufacturing Company, Raychem Corporation or Chromalox. All system components shall be supplied by a single manufacturer.

2.02 MATERIALS

- A. The self regulating heater cable assembly shall consist of two parallel copper bus wires, minimum size 16 AWG, connected through a semi-conductive heating matrix. This heating element shall be covered with a cross-linked polyolefin insulation jacket. This insulation shall be covered by a tinned copper braid and then covered with a fluoropolymer insulating jacket. All heat cables shall be rated for 277 V, single phase supply voltage. The heating cable shall be suitable for installation on metallic and nonmetallic pipe. All heating cable shall be properly marked by the manufacturer's number or nomenclature for ease of future maintenance.
- B. Each heat tracing circuit shall be supplied with a power connection and end seal kit. Each end seal kit shall include a lighted end termination kit Chromalox model UESL or equal. It shall be the Contractor's responsibility to make sure that no circuit in the system be longer than as recommended by the heat tracing system manufacturer. All terminations, splices, junctions and tee's in the circuit shall be made using manufacturer recommended and supplied kits. Junction boxes shall be provided where required for access to all circuit appurtenances.

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

- A. A thermostat shall be furnished and installed for each heat trace circuit. The thermostat for each circuit shall be an adjustable ambient sensing thermostat designed for controlling the heating cable to provide freeze protection of pipes. The thermostat shall have an adjustable range of 15°F to 140°F. The enclosure for the thermostat shall be NEMA 4X. The Thermostat shall be rated to match the voltage of the heating cable and shall have a switch rating of 20 amps (minimum). Thermostat shall be suitable for use in Class 1 (Division 1 and 2) or Class 2 (Division 1 and 2) hazardous locations where thermostat is shown to be installed in hazardous locations.

2.04 SPARE PARTS

- A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following:
 - 1. 100 ft. of self-regulating cable for each cable wattage provided for the system(s)
 - 2. One (1) spare ambient thermostat controller for each heat tracing system
 - 3. One (1) spare ambient temperature RTD
 - 4. Two (2) each of the following: cable termination kits, cable splice kits and cable tee kits

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 and shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1

3.02 INSTALLATION

- A. The installation of all heat tracing and insulation components shall conform to all instructions and requirements recommended by the heat tracing system manufacturer. All installation and terminations shall conform to the National Electric Code.
- B. All piping shall be pressure tested prior to installation of any heat tracing or insulation components. Thermal insulation shall only be installed when all heat tracing components are in place and satisfactorily tested as indicated herein. Once tested, the insulation shall be installed immediately to prevent damage to the heat tracing system components.

- C. No insulation shall be installed using staples. Insulation jackets shall be installed as recommended by the insulation system supplier such that no damage is done to the heat tracing system components.
- D. The installation of heat tracing cable on nonmetallic pipe shall be done in strict conformance with the heat tracing manufacturer's recommendations. Requirements shall include heat shielding tape or wrap as recommended by the heat tracing manufacturer
- E. Contractor shall install weather proofing for all outdoor piping. The field applied jacket with moisture barrier shall be slipped around pipe into preformed 2-lock position. Butt next jacket section adjacent to previous section leaving 3/8 inch gap. Place preformed 2 inch butt strap with sealant over the seam and secure with 1/2 inch aluminum band and wing seal. Contractor shall install preformed fittings identical in composition to pipe jacketing at all fittings
- F. The Contractor shall insure that surfaces of pipes, valves, heat tracing, and fittings are clean and dry prior to installation of insulation. Insulation shall be installed so as to make surfaces smooth, even, and substantially flush with the adjacent insulation. The Contractor shall follow the manufacturer's application instructions for the materials used
- G. A label shall be installed on the piping insulation jacket every 15 feet and readily visible from ground level: ELECTRIC HEAT TRACING: CAUTION

3.03 FIELD TESTING

- A. All heating cable shall be tested using a megohmmeter (megger) between the heating cable bus wires and the metallic ground braid. A 2,500 VDC megger test is required and the minimum acceptable resistance value shall be 20 megaohms regardless of the circuit length. Any cables found to be less than this value shall be replaced at no additional cost to the Owner. The megger tests shall be performed as follows:
 - 1. After installation of the cable and all fabrication kits but prior to installing any of the insulation system components.
 - 2. After installation of the insulation system components but prior to energizing the cables.
 - 3. All test reading for each megger test shall be recorded by the installer and submitted with the maintenance instructions.

- END OF SECTION -

SECTION 15400

PLUMBING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. This Section consists of plumbing fixtures, drains, and accessories as required for complete installations as indicated on the Drawings and in accordance with the Specifications.

1.02 GENERAL INFORMATION AND DESCRIPTION

- A. The Drawings are schematic in nature, and do not necessarily show in detail or to scale all of the equipment or minor items.
- B. Arrange piping containing fluids to drain at the lowest point so the entire system may be emptied.
- C. Install all piping with proper slope and in the most direct straight and mechanical manner possible, true to line, plumb and level without sags, traps, or pockets, with a minimum of bends, turns and elbows.
- D. Protect installation from damage and foreign objects with plugs, caps, and covers. Similarly close open ends of pipe at the end of each day's work.
- E. Ream pipe ends after cutting and remove dirt, scale, etc. before using. Use plugs or caps to keep pipe clean before use.
- F. Make all connections to floor and equipment drains with 45-degree wye, or with 45-degree wye bend and straight pieces of pipe.
- G. Locate and install valves for easy service, access, and operation.
 - 1. Stemmed valves shall not be installed with stems below horizontal or in a position where parts of the building structure prevents their operation.
 - 2. All valves shall be installed with sufficient clearances to permit adequate room for servicing.
- H. The Contractor shall inform himself fully regarding the peculiarities and limitations of the space available for the installation of all materials and equipment. He shall see that all of his equipment such as valves, traps, cleanouts, and similar items shall be readily accessible and wherever required, he shall provide a suitable sized Milcor access door. The foregoing shall also apply in general to all parts of the systems that require access from time to time for maintenance and operation.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work or other mechanical and air conditioning work required, all in accordance with the requirements of Section 01300, Submittals.

- B. Data to be submitted shall include but not be limited to:
1. Catalog data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various parts and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.
 2. Complete assembly and installation drawings with clearly marked dimensions. This information shall be in sufficient detail to serve as a guide for assembly and disassembly and for ordering parts. Piping layout drawings shall indicate the following information: pipe supports, location, support type, hanger rod size, insert type, and load on hanger in pounds.
 3. Weight of all component parts and assembled weight.
 4. Electrical characteristics, wiring, diagrams, etc.
 5. Sample data sheet of equipment nameplate(s) including information contained thereon.
 6. Insulation materials, coating, jackets, detail density, thermal conductivity and thickness of all insulation materials to be furnished.
 7. Details of special fasteners and accessories.
 8. Type of adhesives, binders, joint cement, mastics.
 9. Proposed insulation procedures and installation methods.
 10. Spreadsheet or chart identifying piping systems type and pipe size, model numbers of hangers to be used, special coatings for pipe supports etc.
 11. Sample data sheet of piping and valves including information contained thereon.
 12. Spare parts list
 13. Special tools list
- C. The Contractor shall obtain from the manufacturer and submit to the Engineer copies of the results of all certified shop tests.
- D. The Contractor shall obtain from the manufacturer and submit to the Engineer copies of certified letters of compliance in accordance with the Section 01300.
- E. The Contractor shall submit operation and maintenance manual in accordance with the procedures and requirements set forth in the General Conditions and Division 1. Operation and Maintenance Manuals shall be submitted for all equipment.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to the Project Site under provisions of Division 1.
- B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures and finish.
- D. Protect openings in casing and seal them with plastic wrap to keep dirt and debris. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.05 DRAWINGS

- A. In general, all capacities of equipment and fixtures characteristics are shown on the Drawings. Variations of the equipment supplied under this Contract from requirements shown or specified will be permitted only with the written direction of the Engineer.

1.06 MANUFACTURER'S INSTRUCTIONS

- A. Installation of all equipment shall be in accordance with manufacturer's data.
- B. All changes from the installation procedures in manufacturers' data shall be submitted for approval in accordance with the requirements for shop drawings.
- C. Keep all manufacturers' data provided in a secure manner at the job site at all times. Catalog and index this data for convenient reference.
- D. Manufacturers' data shall be available for the information of the Owner, Engineer, and the use of other trades.
- E. Turn over all data to the Owner through the Owner's representative at completion of the Work and final testing.
- F. Submit all instruction books and manuals in accordance with Section 01300.

1.07 CODES, PERMITS AND STANDARDS

- A. The Contractor shall obtain and pay for all permits and shall comply with all laws and codes that apply to the Work.
- B. The Contractor shall be responsible for all added expense due to his choice of equipment, materials or construction methods.
- C. All work and materials shall be in full accordance with the latest State rules and regulations or publications including those of the State Fire Marshall, the North Carolina Plumbing and Energy Codes, and all local codes. Nothing in the Plans and/or Specifications shall be construed to permit work not conforming to the above codes, rules and regulations.
- D. All equipment, materials and installations shall conform to the requirements of the most recent edition with latest revisions, supplements and amendments of the following, as applicable:
 - 1. American National Standards Institute (ANSI).
 - 2. American Society for Testing and Materials (ASTM).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. Factory Mutual (FM).

5. National Electric Code (NEC).
6. Occupational Safety and Health Standards (OSHA).
7. State and local codes, ordinances and statutes.
8. Underwriters Laboratories (UL).
9. Others as designated in the specifications.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three (3) years documented experience, who issues complete catalog data on total product.
- B. All material and equipment shall be the latest design, new, not deteriorated, and the first quality standard product of manufacturers regularly engaged in the production of such material and equipment.
- C. When two or more units of the same class of material or equipment are required, they shall be products of a single manufacturer.
- D. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.
- E. Touch up and/or repaint to match original finishes all factory finished or painted equipment and materials which are scratched or marred during shipment or installation.
- F. Each plumbing fixture shall be provided with an approved P-trap, which shall be set as close to the outlet as practicable, all water supply connections shall be provided with loose key stops.
- G. Fixture trim, traps, faucets, escutcheons, and waste pipes that are exposed to view shall be brass with polished chromium plating over nickel finish. Exposed supplies shall be brass pipe plated in the same manner.
- H. All fixtures designated for use by the disabled shall fully conform and shall be installed per the requirements of the American Disabilities Act.
- I. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Each item of equipment shall be furnished and installed complete with all supports, mounting frames, piping, electrical work, insulation and appurtenances ready for operation.
- B. All equipment and appurtenances shall be anchored or connected to supporting members as specified or as indicated on the Drawings.

- C. The Plans shall be taken as diagrammatic. The Contractor shall check the Structural Plans and sections for detail dimensions and clearances. Sizes of ducts and their locations are indicated, but not every offset, fitting, or structural obstruction is shown.
- D. All supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided, unless specifically noted otherwise. Equipment shall be supported on spring type vibration isolators.

2.02 MATERIALS

- A. Materials shall be as indicated in the Pipe Schedule in Section 15390 or on the Drawings.

2.03 PIPING

- A. The piping shall be installed complete, of the size and arrangement shown on the drawings. All piping shall be installed to allow for expansion, and parallel or perpendicular to the building construction. When pipe is installed underground, the ground shall be excavated to a minimum depth to accomplish the grade shown or required by code. The pipe shall have bearing along its entire length and if installed on fill, shall be supported by concrete cradles to firm earth.
- B. All pipe shall be supported from the building structure in a neat manner, in compliance with current trade practices and wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Single runs of horizontal piping shall be supported with clevis type hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. The use of wire or perforated metal to support pipe will not be permitted. In concrete construction, approved inserts will be carefully set to support the piping. Soil and waste pipe shall be supported at intervals of not more than five feet on horizontal runs and at the base of every stack.
- C. Pipe sleeves and escutcheons:
 - 1. Sleeves shall be provided for all piping passing through masonry or concrete walls and floors. Sleeves for walls and floors shall be indicated, made watertight and extend above floor lines. Sleeves shall conform to the requirements of Division 15.
 - 2. Escutcheon plates shall be polished chrome. Provide for all wall penetrations in finished areas.
- D. Hangers and Supports shall be epoxy-coated Dura-Green by Cooper B-Line, Inc., Perma-Green III by Unistrut, Inc. or Approved Equal.

2.04 PRESSURE GAGES

- A. Pressure gages shall be selected so that normal operating pressures fall at approximately midscale and so that continuous operation does not exceed 75 percent of full scale.
- B. Pressure gages shall be 4-1/2" dial type with bold black markings on white background, aluminum or steel pressure relieving case, phosphor bronze brazed Bourdon tube, bronze and stainless steel movement, provision for zero shift calibration without removing or bending the pointer. Accuracy shall be ANSI Grade A per ANSI B40.1

1980. Acceptable products: AMETEK/U. S. Gage 5000 Series, Marshall Town Figures 42 and 224, or A. A. Weiss & Sons #PG-1 Series.

2.05 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventers (3/4 to 2-inch):

1. Provide reduced pressure zone backflow preventers in the size shown on the Drawings. Backflow preventers shall be rated for 175 psig and temperatures up to 140 degrees F. Backflow preventers shall be tested and certified in accordance with ASSE 1013 and AWWA C506.
2. Provide with bronze body construction, FDA epoxy coated bronze body check valve and relief valve assemblies, and bronze seats, stainless steel trim.
3. Provide isolation valves on the inlet and outlet of each backflow preventer. Valves shall be quarter-turn, full port, resilient seated, bronze ball valves.
4. Provide bronze body valve test cocks.
5. Backflow preventers shall be Watts Series 909, Wilkins, or approved equal.

2.06 PIPE HANGERS AND SUPPORTS

- A. Pipe hangers, supports, and anchors shall be as specified in Section 15020.

2.07 PIPE IDENTIFICATION

- A. Piping shall be identified by means of card mounted, self-bonding pipe markers. Markers shall be made of nonporous, color fast, nonabsorbent vinyl plastic. Letters shall be black or white for easy readability.
- B. Markers for pipe having an outside diameter of 3-inches or more (including insulation) shall have 2-inch high letters. Markers for pipe having an outside diameter of less than 3-inches (including insulation) shall have 1-inch high letters.
- C. Provide matching 3/4-inch wide banding tape.
- D. Acceptable Manufacturers: Seton Name Plate Corporation, W. H. Brady Company, or Westline Products Company.

2.08 VALVE TAGS AND NUMBERING

- A. All valves shall be tagged with 1-1/4-inch diameter, 0.040-inch thick brass or laminated plastic tags with numbers and letters. A complete directory of valves, pump motors, controls, devices, and other equipment, giving use, location, size, and manufacturer's number of each shall be prepared with permanent ink, framed under glass, and hung in the mechanical equipment room where directed by Using Agency/Owner.

2.09 STAINLESS STEEL HOSE REEL (HR-1):

- A. Manual crank rewind with cam-lock brake and spring actuated pin lock.
- B. 90 degree inlet with stainless steel ball bearing swivel joint and 1-inch female NPT threads.

- C. Heavy duty stainless steel angle mounting bracket for column or wall mounting.
- D. Storage for up to 75 feet of 5/8" or 3/4" I.D. hose.
- E. Pressure rated for up to 4000 psi.
- F. Unit shall be Steel Eagle, Hannay Reels, Inc., Reelcraft, or approved equal.

2.10 FLOOR DRAINS

- A. Floor drains shall be located as shown on the drawings. They shall have seepage flanges and nickel brass tops.
- B. Refer to plumbing fixture schedule for floor drain variations, basis of design manufacturer and type.
- C. Verify floor finish and type of proper top configuration.
- D. Acceptable manufacturers: Zurn, Wade, or J.R. Smith.

2.11 CLEANOUTS

- A. Cleanouts shall be flush with floor with adjustable round or square nickel brass top, and shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required.
- B. Adjustable Top Assemblies: Top assemblies shall vary with the floor finish where it is applied. Verify floor finishes for proper top configuration with General Contractor.
- C. Yard cleanouts shall be flush with grade with poured concrete anchoring/encasement, troweled smooth all around
- D. Acceptable products:
 - 1. Floor cleanout: Zurn #ZN-1400-K-BP, J.R. Smith 4020, or Wade.
 - 2. Yard cleanout: Zurn #Z-1449, J.R. Smith 4280, or Wade.

PART 3 - EXECUTION

3.01 FLOOR DRAIN AND CLEANOUT INSTALLATION

- A. Floor drains shall be installed perfectly plumb and level with elevation to provide for proper floor pitch.
- B. Verify that the floor drains are not disturbed during floor or concrete installation.
- C. Cleanouts installed in connection with cast iron soil pipe shall consist of a long sweep 1/4 bend or one or two 1/8 bends extended to place of access or as shown on the drawings. An extra heavy cast brass ferrule with countersunk head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe shall be tee pattern, 90-degree branch drainage fittings with screw cast brass plugs of the same size as the pipe up to and including 4-inches.
- D. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste

stacks and on each building drain outside the building. Cleanouts on pipe concealed in partitions and walls shall be provided with chromium plated cast brass covers secured to plugs.

- E. The access covers shall be installed to provide easy and complete access to the cleanout plug. Due consideration of wall construction must be given to allow for proper installation of frame and the installation shall be coordinated with the GC.
- F. Each cleanout, unless installed under an approved cover plate, shall be above grade, readily accessible, and so located as to serve the purpose for which it is intended. Cleanouts located under cover plates shall be so installed as to provide the clearances and accessibility required by the local plumbing code.
- G. Each cleanout in piping 2- inches or less in size shall be so installed that there is a clearance of not less than 12-inches in front of the cleanout. Cleanouts in piping larger than 2-inches shall have a clearance of not less than 18-inches in front of the cleanout.

3.02 TESTING

- A. Notify Owner and Engineer one week in advance that the items are ready for testing.
 - 1. Perform testing before work is concealed with construction or insulation, or before backfilling if piping is to be buried.
 - a. Concealed piping shall be installed in time so as not to delay work of other trades and to allow ample time for tests and inspection.
- B. Test pressures shall be as follows:
 - 1. Hose Water Supply Line - 100 psig hydrostatic.
 - 2. Drain - 15 psig hydrostatic or as required by building inspector.
 - 3. All tests shall be held for at least 4 hours and until each joint has been inspected.
 - 4. At conclusion of testing remove special test fittings, caps, blanking plates, etc. and replace damaged gaskets and place systems in operation.
- C. If inspection or tests show defects or failure, such defective work, materials or failure shall be replaced without delay and inspection and tests repeated. Repairs to piping and equipment shall be repaired or replaced with new material or equipment. Caulking of screw joints or plugging leaks shall not be permitted.
- D. All water piping shall be hydraulically tested at 100 psig and proven tight for a period of not less than 4 hours with no loss of pressure. Tests for each section shall be repeated at no additional cost to the Owner until the piping is proven tight at the specified test pressure. Upon completion of work, inspection shall be made by the Engineer. All corrections, changes or removal of defective work shall be made by the Contractor at no cost to the Owner prior to approval of installation.

- E. Water and Drain Pipe Testing: Shall be hydrostatic tested as follows, except where more stringent tests are required by the codes.
 - 1. Slowly fill with water each valved section in pipe, and apply the specified test pressure by means of a portable positive displacement pump connected to the piping in an acceptable manner.
 - 2. Make taps if necessary, at points of highest elevation, and plug tightly afterwards.
 - 3. Carefully examine all exposed pipe, fittings, valves and joints during the tests.
 - 4. Where joints show seepage or slight leaks repair as requested.
 - 5. Remove and replace any cracked or damaged pipe, fittings, valves, or other defective materials discovered during the test.
 - 6. After replacements and repairs have been made, repeat tests until work is satisfactory and approved.
- F. All drain piping shall be tested before fixtures are installed, by capping or plugging the openings and filling the entire system with water and allowing it to stand thus filled for three hours.
- G. All water supply piping shall be tested before fixtures or faucets are connected.
- H. Disinfection of potable water systems shall be performed in accordance with the procedures described in AWWA C651 or AWWA C652.

3.03 PIPE IDENTIFICATION

- A. Pipe markers shall be located as follows:
 - 1. On straight runs of pipe at intervals not exceeding 100 feet.
 - 2. At every sectionalizing or main shut off valve.
 - 3. On each riser at a point 5 feet above floor or platform.
 - 4. On both sides of a wall or partition through which pipe passes.
- B. Markers shall be applied so they can be read from the floor.
- C. Markers shall be applied only after all insulating and painting has been completed.
- D. Surfaces shall be clean and free of dust, oil, or loose paint before applying markers.
- E. Before applying markers on insulated surfaces, smooth the surface with sandpaper. Clean surface of all dust after sanding.

- F. After applying each marker, wrap one turn of pipe banding tape completely around the circumference of the pipe at each end of the marker. Overlap ends of marker with the tape and overlap the tape upon itself a minimum of 1-inch. The pipe banding tape shall match the background color of the marker.
- G. Where a service is indicated on the drawings as a circulating system, the pipe marker legend for the particular service shall be followed by either the word "supply" or "return" to clarify the line function. An arrow designating direction of flow shall follow the legend on each marker.

3.04 CLEANING

- A. Clean dirt and marks and other debris from exterior of equipment weekly.
- B. Remove debris and waste material resulting from installation weekly.
- C. Properly protect all plumbing fixtures and trim at all times and temporarily close all openings to prevent obstruction and damage.
- D. Maintain protective covers on all units until final clean-up time and, at that time, remove covers, clean and polish all fixture and trim surfaces.

END OF SECTION

SECTION 16000

ELECTRICAL - GENERAL

PART 1 -- GENERAL

1.01 DESCRIPTION

- A. This section of the specifications includes the furnishing and installation of all labor, materials, tools, equipment, and operations necessary for the proper execution and completion of all electrical work indicated on the drawings and specified herein.
- B. The Contractor shall furnish and install all conduit, cable, systems for power, and shall furnish and install raceways for special systems as specified herein and as indicated on the electrical drawings, complete and ready to operate in every respect, including connection of Owner furnished equipment, if applicable.

1.02 CODES AND ORDINANCES

- A. All electrical work and materials shall comply with the National Electrical Code (NEC), the National Electrical Safety Code (NESC), American Society for Testing and Material (ASTM), Insulated Cable Engineers Association (ICEA), National Electrical Manufacturers Association (NEMA), National Fire Protection Association (NFPA), Underwriters' Laboratories (UL) and applicable local codes and regulations.
- B. All electrical equipment shall be UL listed.
- C. If discrepancies occur between laws, codes, ordinances, rules and regulations, and the specifications or drawings, each discrepancy shall be called to the attention of the Engineer in writing before the bids are submitted. That work which is shown or specified in violation of these rules and regulations shall be done in compliance with the regulations, and no claim for additional cost required to make implied systems complete will be accepted.

1.03 UTILITY COORDINATION, PERMITS AND FEES

- A. The Contractor shall obtain all permits and inspections required for the completion of this contract. The local utility is Duke Energy and the contact is indicted below:

Donnell Corbett
M-336-416-0712
W-336-632-3655
Toll-Free 800-738-8561
Donnell.corbett@duke-energy.com

Contractor responsible for transformer pad per Duke Energy requirements, grounding, meter conduit, and secondary cables and conduit.

1.04 WORKMANSHIP

- A. Workmanship in the fabrication, preparation, and installation of materials and equipment shall conform to the best standards of practice of the trades involved. Experienced and skilled electricians and mechanics under the supervision of a competent foreman shall perform

work. Substandard workmanship will be cause for rejection of work and replacement by Contractor.

1.05 DRAWINGS AND SPECIFICATIONS

- A. The drawings show the location and arrangement of conduits, ducts, and equipment, together with details of connections of certain principal items. The layout shown shall be followed as closely as circumstances will permit, but the Contractor shall lay out his work so as to avoid conflict with other contractors and trades, and to avoid any unnecessary cutting or damage to walls, floors, and supporting structural members. The Contractor shall install at the proper time all necessary sleeves, hangers and inserts that will be required for the completion of his work, and shall be solely responsible for the accurate and proper location of the above items.
- B. The Contractor shall refer to the general drawings and cooperate fully with other contractors and trades while installing electrical equipment because of close space limits. In case of conflict, the Engineer shall be notified before proceeding with installation.
- C. The drawings and specifications complement each other and together are intended to give a complete description of the work. Any item of equipment or note of work to be done as shown on plans and not mentioned in the specifications, or mentioned in specifications and not shown on plans, shall be furnished the same as if mentioned or shown in both places. If conflicts exist, then the most stringent method shown or described should apply.
- D. Any discrepancy, omission, or conflict found in plans or specifications shall be called to the immediate attention of the Engineer, prior to receipt of bids.
- E. The drawings are not intended to show complete details. It is the Contractor's responsibility to comply with the evident intent for centering and symmetric arrangement. The Contractor shall take all field measurements and be responsible therefore. Exact locations are to be defined in the field.

1.06 CUTTING AND PATCHING

- A. The Contractor shall do any cutting of walls or structures required for the installation of work under this section. Holes through walls for passage of conduits shall be properly and neatly sleeved and grouted. Sleeves through exterior walls shall be effectively sealed against passage of water. All disturbed areas shall be refinished and left in a finished and matching condition and shall meet the approval of the Engineer.

1.07 ALLOWANCE FOR ADDITIONAL WORK

- A. Before proceeding with any work for which compensation may be claimed or the Owner may claim credit, a detailed estimate shall be submitted and approved in writing. No claim for addition to the contract will be valid unless so ordered and approved by the Owner and Engineer.

1.08 AS INSTALLED PRINTS

- A. The Contractor shall maintain a set of prints, showing exact location of all relocated equipment, concealed equipment, service accesses, hand holes, underground duct banks, and all other changes to the plans. This set of prints shall be kept current and turned over to

the Engineer upon completion of the job. Dimensions shall be shown to locate all underground conduit duct banks from permanent reference points.

1.09 INCIDENTAL CONSTRUCTION WORK

- A. The Contractor shall provide all openings as required for the electrical work. The Contractor shall do all cutting and fitting of his work and of other work that may be required to make the several parts come together properly and to fit his work to receive or be received by the work of other Contractors as shown upon, or reasonably implied by the drawings and specifications. He shall properly complete and finish up his work after other contractors have finished as the Engineer may direct. All excavating required for the installation of the system shall be done by the Contractor. Backfill shall be accomplished as specified in the appropriate section of the specifications.

1.10 CLEANING AND PAINTING

- A. The Contractor shall at all times keep the Owner's premises, adjoining driveways and streets clean of rubbish caused by the Contractor's operations and at the completion of the work shall remove all the rubbish from and about the premises, all his tools, equipment, temporary work, surplus material and shall leave the area clean and ready for use.
- B. The Contractor shall be required to perform touch-up painting on factory-finished equipment installed under this contract where necessary to repair damaged areas. All metal exposed to weather shall be properly painted. Any equipment installed where exposed to weather shall have all damaged areas cleaned, primed, and painted by the Contractor.

1.11 GUARANTEE

- A. The Contractor shall guarantee all materials, equipment, and workmanship in this contract against defects and failures of any nature for a period of one year from date on which the system is accepted. Apparatus furnished by the Contractor shall be guaranteed to be satisfactory when operated under rated conditions in accordance with manufacturer's instructions and to be of size, function, and capacity as indicated on the drawings or in the specifications. Upon notice from the Engineer or Owner, the Contractor shall immediately check the system, make necessary repairs or adjustments as required due to faulty workmanship, materials, faults, operation, or equipment, without cost to the Owner, and instruct the Owner in proper operation, adjustment, and care of the systems.

1.12 IDENTIFICATION

- A. All equipment shall be identified and properly marked. All marking must meet the Engineer's approval. All markers shall be of appropriate size. Each panel, transformer, contactor, starter, and other piece of electrical equipment shall be identified as to their service.
- B. All disconnect switches, junction boxes, motor controllers, and other equipment requiring electrical owner connection shall be marked with voltage present, as appropriate to designate 120, 208, 240, 277, or 480 volts and single or three-phase, as applicable.

1.13 MAINTENANCE AND OPERATING INSTRUCTIONS

- A. The Contractor shall furnish to the Engineer five (5) complete sets of applicable drawings, instructions and parts lists on all equipment furnished, providing names and addresses of

manufacturers or subcontractors and suppliers. Two (2) copies of manufacturer's warranties on all equipment shall be provided to the Owner and one (1) copy to the Engineer.

- B. The one-year warranty period on all equipment and systems installed by this Contractor shall start upon final approval and acceptance following the installation and commissioning of the equipment.

1.14 SHOP DRAWINGS

- C. Upon award of the contract, the Contractor shall submit to the Engineer for approval, a list of all proposed subcontractors and materials he proposes to utilize and five (5) sets of shop drawings consisting of detailed drawings or manufacturer's cuts of all manufactured equipment he proposes to use on the job. The drawings or cuts shall show details of construction and arrangement of all pertinent data pertaining to equipment proposed to be furnished. Where manufacturer's cut sheets include more than one option or model number, the Contractor must clearly indicate the proposed option or model number. The approval of the Engineer shall be obtained before equipment is ordered for delivery. It will be the duty of the Contractor to verify quantities, dimensions, and details, and determine suitability of equipment for installation in space provided. Approval of shop drawings by the Engineer does not relieve the Contractor of the responsibility for coordination, dimensions, quantities or conformance with contract documents.
- D. The Contractor shall check and initial shop drawings making such notations and corrections as may be appropriate or necessary to comply with contract documents before submission to the Engineer.

1.15 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

- A. The Contractor shall be responsible for furnishing suitable shelter and protection for all materials and equipment stored on the job. Equipment shall be protected from damage from any source both during storage and after installation until completion of the job. No damaged equipment will be accepted. Existing equipment removed from service shall be protected from damage and loss of parts until turned over to the owner.

PART 2 -- MATERIALS

2.01 ELECTRICAL MATERIALS AND METHODS

- A. Materials and workmanship on all work installed under this contract shall be new and of the best quality and shall conform to the best practice for such work and be installed in accordance with manufacturer's recommendations and instructions, including all hardware and accessories recommended or appropriate. Any work or materials not specifically mentioned in these plans and specifications, but required to make this job a complete and workable system shall be furnished and installed by the Contractor.
- B. Substitution for equipment specified must be equal in every respect and the Contractor shall base his proposal on the quality of materials and equipment covered in these specifications and shown on the drawings.
- C. Where substitutions alter the design or space requirements indicated on the plans, the Contractor shall include all items of cost for the revised design and construction, including the

cost of any changes or modifications in structural or mechanical details and electric service resulting from substitution of electrical equipment, and the cost of all allied trades involved.

- D. All manufactured and fabricated assemblies of electrically operated equipment furnished under this contract shall have Underwriter's Laboratories approval or UL Re-examination listing in every case where such approval has been established for the particular type of materials or devices in question.

2.02 CONDUITS AND RACEWAYS

- A. All wiring shall be in conduit or other approved raceways except as shown on the drawings or otherwise specified, and shall be concealed unless otherwise noted. Conduit shall be one of the types listed below.

1. Conduit Types

- PVC-Coated Rigid Steel Conduit. The conduit shall be rigid steel, hot-dip galvanized, with a 40 mil thick PVC coating on the pipe outer diameter and a 2-mil thick PVC coating on the pipe inner diameter. PVC coated rigid steel conduit shall be as manufactured by Ocal, Perma-Cote, or Robroy Industries.
- Rigid Steel Conduit. Rigid steel conduit shall be heavy wall, hot-dip galvanized, and shall conform to Fed Spec WW-C-581, ANSI C80.1, and UL 6.
- Intermediate Metal Conduit (IMC). IMC shall be hot-dip galvanized and shall conform to Fed Spec WW-C-581 and UL 1242.
- Rigid PVC Conduit. The conduit shall be Schedule 80 PVC, 90 deg C rated conforming to NEMA TC-3 and UL514, 651. Conduit shall be as manufactured by Carlon, Indian head, Robroy, Ocal or equal.
- Liquid Tight Flexible Metal Conduit. Liquid tight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moisture proof polyvinyl chloride jacket, and shall be UL labeled.

2. Conduit Installation

- Intermediate metal conduit shall be installed in exposed indoor applications unless otherwise noted.
- Rigid steel conduit shall be installed in masonry walls, concrete slabs, and cast-in-place walls.
- Intermediate and rigid steel conduit shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts. Terminations and connections shall be taper threaded. Conduits shall be reamed, free of burrs, and terminated with conduit bushings.
- PVC-coated rigid steel conduit shall be installed in all exposed outdoor locations and where indicated on the drawings. PVC-coated mounting hardware and framing materials shall rigidly support conduit. Nuts and bolts shall be stainless

steel. All damaged coatings shall be repaired according to the manufacturer's instructions. PVC-coated rigid steel conduit shall be threaded and installed as recommended by the conduit manufacturer. Threading tools used for steel conduit shall not be used to thread PVC-coated rigid steel conduit.

- Liquid tight flexible metal conduit with watertight connectors shall be installed for final connections to dry type transformers, motors, equipment with moving parts, and where indicated on the drawings. Conduit shall be installed without sharp bends and in minimum lengths required for the application but not longer than 4'-0", unless acceptable to the Engineer.
- Unless otherwise noted, direct buried underground conduit shall be PVC schedule 80. Turn-ups outdoors shall be PVC coated rigid steel. Turn-ups indoors shall be rigid steel.
- Underground conduits shall be concrete encased under roadways and where indicated on the drawings.
- Locknuts inside and outside shall securely fasten conduit connections to sheet metal enclosures. Conduits shall be installed between the reinforcing steel in walls or slabs that have reinforcement in both faces. In slabs that have only a single layer of reinforcing steel, conduits shall be placed under the reinforcement. Conduit shall be neatly grouted into any openings cut into concrete and masonry structures. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.
- All conduits that enter enclosures shall be terminated by fittings that ensure that the NEMA rating of the enclosure is not affected or changed. A corrosion-resistant coating shall be applied to all conduits that turn out of concrete, masonry, or earth indoors. The coating shall consist of a heavy coat of thixotropic coal tar paint extending six inches on each side of the point of turnout.
- Concrete encased conduit shall have minimum concrete thickness of 2 inches between conduits, six inches above and below conduits. Underground conduit bend radius shall be not less than 2 feet at vertical risers or less than 3 feet elsewhere. Underground conduits and conduit banks shall have 2-foot minimum earth cover except where indicated otherwise. Underground conduits shall be sloped to drain to the handholes.
- After cable has been installed and connected, conduit ends shall be sealed by non-hardening duct sealing compound forced into conduits to a minimum depth equal to the conduit diameter. This shall apply for all conduits at handholes and building entrance junction boxes, and for all conduit connections to equipment.
- All exposed conduit runs shall be so located that pull or junction boxes will not be made inaccessible due to inadequate clearance with piping or equipment.
- All conduits used for service entrance feeders from supply point to first overcurrent device shall be bonded with suitable bonding locknuts and/or bonding insulating bushings, or by separate copper bonding conductor.

2.03 600 VAC CABLE

A. General

The Contractor shall furnish and install all wire and cable necessary to complete the work herein outlined and as shown on drawings, except such items as are specifically noted as being furnished by others. All wiring in the entire system must be color-coded and all conductors shall have their size, voltage, manufacturer, and type clearly marked on the outer covering. All wire and cable shall be as herein specified or as shown on the drawings. Wire and cable shall be as manufactured by Okonite, Belden, Anaconda, Rome, General Cable, Pirelli or equal.

B. 600 Vac Conductors

Conductors shall consist of annealed copper wire of size indicated on drawings or as may be specified herein. No conductors smaller than #12 AWG copper shall be used unless otherwise indicated on the drawings. All conductors #12 AWG and larger shall be of Class B concentric stranded construction, unless specified otherwise herein or on drawings.

C. 600 Vac Wire Insulation

All wire and cable unless otherwise specified shall be single conductor type THWN or THHN 600-volt insulation. Conductors for circuits T21: and T22: shall be RHH/RHW-USE type insulation. Conductors shall be color coded as follows:

- black, blue, red, white, and green on 120/208 volt wye systems
- black, orange, red, white, and green on 120/240 volt delta systems
- brown, orange, yellow, gray, and green on 277/480 volt wye systems.

Instrument Cable. Cable for electronic circuits to instrumentation, metering, and other signaling and control equipment shall be two- or three-conductor instrument cable twisted for magnetic noise rejection and protected from electrostatic noise by a total coverage shield. Cable shall be used where indicated on the drawings.

D. 600 Vac Cable Installation

Care shall be taken to protect the cable and avoid kinking of conductors, cutting or puncturing the jacket, contamination by oil or grease, or damaging in any manner. Cable installation shall conform with the following requirements:

1. Stranded conductor cable shall be terminated by lugs or pressure type connectors. Stranded cables shall not be wrapped around screw type terminals.
2. Stranded conductor cable shall be spliced by crimp type connectors. Twist-on wire connectors shall not be used on stranded cable.
3. Cables may be spliced only at readily accessible locations.
4. Cable shall not be pulled tight against bushings nor pressed heavily against enclosures.
5. Cable pulling lubricant shall be compatible with all cable jackets; shall not contain wax, grease, or silicone.

6. Spare cable ends shall be taped, coiled, and identified.
7. Cables shall not be bent to a radius less than the manufacturer's recommended minimum bending radius. For cables rated higher than 600 volts, the minimum radius shall be 12 diameters for shielded cable.
8. All cables in one conduit, over one foot long, or with any bends, shall be pulled in or out simultaneously.

E. 600 Vac Splices And Terminations

Splices shall be made by use of mechanical connectors of the following manufacturers' types, T & B Sta-Kon, Burndy Crimpit, Minnesota Mining and Manufacturing Company Scotchlock, and Ideal Wire-Nut. Conductors size #8 AWG and larger shall be spliced and connected with suitable, solderless, mechanical lugs and connectors. All splices, taps, and connections shall be insulated with Scotch electrical tape as made by Minnesota Mining & Manufacturing Company as applicable to installation.

2.04 CABLE IDENTIFICATION

- A. Except for lighting and receptacle circuits, each individual wire in power, control, indication, and instrumentation circuits shall be provided with identification markers at the point of termination.
- B. The wire marker shall be of the heat shrinkable tube design with custom typed identification numbers.
- C. The wire numbers shall be as shown on the equipment manufacturer's drawings.
- D. Wire markers shall be positioned to be readily visible for inspection.
- E. Power wires not having individualized identification numbers shall be color coded with electrical tape or colored wire jacket.

2.05 SUPPORTING DEVICES

A. General

All secondary electrical devices such as outlet boxes, poles, bases, switches, and receptacles shall be located generally as shown on the drawings. No device utilized by the handicapped shall be located higher than 4'-0" from the finished floor level to the top of the device.

B. Outlet and Switch Boxes

Boxes exposed, in masonry walls and cast-in-place walls shall be cast metal with conduit hubs, Crouse Hinds Type FS or equal. Intermediate oversize type cover plates shall be used where standard cover plates will not cover opening. All adjacent plates shall match in material, size, design, and color.

- C. All exterior mounted boxes shall have approved weather-proof plates and/or covers.

D. Outlet Locations

All outlets for receptacles or switches shall be installed in the location indicated on the drawings. When necessary, the Contractor shall relocate outlets to coordinate with other equipment.

E. Unless otherwise indicated on the drawings, electrical devices shall be placed at the following distances from finished floors:

- Light Switches – center of switch 45" above finished floor (45" AFF).
- Duplex receptacles – center of receptacle 18" above finished floor (18" AFF).
- Power Panelboards - top of cabinet 6'-6" above finished floor.
- Safety switches and/or circuit breakers - handle not over 6'-6" above finished floor.

F. The Electrical Contractor is cautioned to review general drawings to confirm location of equipment and to adjust the exact installed location of receptacles and devices accordingly to avoid interference between electrical devices and equipment. Responsibility for locating devices in the field is the Contractor's. The Engineer should be contacted for clarification before installation.

G. Structural Steel

The Contractor shall provide miscellaneous structural steel necessary to mount electrical equipment to walls, beams and joists. All structural steel furnished shall be standard shapes and sizes and shall be stainless steel. All interior steel shall be firmly and rigidly welded or bolted in place. All structural steel shall be structural quality conforming to ASTM A7-497.

H. Tap and Pull Boxes

Boxes shall be of code gauge galvanized sheet steel but not less than 14 gauge metal. Holes for raceways shall be drilled on the job. Where necessary for boxes to be supported away from the ceiling or beams, strap iron or threaded rod shall be used for supports. Outdoor boxes shall be Nema 4X stainless steel unless otherwise noted.

I. Boxes shall have covers fastened on with screws. Sizes of boxes shall be determined by NEC requirements.

J. Secondary Systems

The Contractor shall furnish and install all conduit, junction boxes, outlet boxes, and plates for conduit systems as indicated on the drawings.

2.06 GROUNDING

A. Electrical system grounding and equipment grounding shall be installed in compliance with the National Electrical Code and shall conform with the following applicable requirements:

1. All ground conductors shall be bare or green insulated in accordance with the National Electrical Code, soft drawn copper cable or bar, not smaller than 12 AWG.

2. Ground cable splices and joints which will be inaccessible upon completion of construction shall meet the requirements of IEEE Standard 837, and shall be Cadweld "Exothermic" or Burndy "Hyground" type.
3. Ground cable through building exterior walls shall enter within 3 feet below finish grade and shall be prepared with a water stop. Unless otherwise indicated, the water stop shall include filling the space between the strands with solder and soldering a 12 inch copper disc over the cable.
4. Ground cable near the base of a structure shall be in earth and as far from the structure as the excavation permits but not closer than 6 inches.
5. The main grounding conductor, when exposed within a building, shall be copper bar supported with suitable spacers at 1/2 to one inch from the structure. Unless otherwise indicated on the drawings, the ground bus shall be not smaller than 1/4 by one inch rectangular.
6. Lighting fixtures and convenience outlets shall be grounded through the conduit system.
7. Convenience outlet receptacles shall be grounded by a copper ground conductor in addition to the conduit connection.
8. Ground connections to equipment and ground buses shall be by copper or high conductivity copper alloy ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be by clamp type lugs added under permanent assembly bolts or under new bolts drilled and added through enclosures other than explosion-proof, or by grounding locknuts or bushings.
9. The grounding system shall be bonded to station piping by connection to the first flange inside the building on either a suction or discharge pipe which will form a good ground connection. The connection shall be made with a copper bar or strap by drilling and tapping the flange and providing a bolted connection.
10. Ground conductors on equipment shall be formed to the contour of the equipment and firmly supported.
11. All ground connection hardware, bolts, and nuts shall be high strength, high conductivity copper alloy.
12. Ground rods not described elsewhere shall be 5/8 inch diameter by 8 feet long, with a copper jacket bonded to a steel core.
13. Ground cables with encased underground conduit banks shall be in earth at least 3 inches below one corner of the concrete.

2.07 DISCONNECT SWITCH (CIRCUIT BREAKER TYPE)

- A. Unless otherwise specified, each circuit breaker type disconnect switch shall be 3 phase, heavy-duty, with a voltage and continuous current rating as indicated on the drawings.
- B. Each disconnect switch shall have an enclosure rating as indicated on the drawings.

- C. Circuit breakers shall be 3 phase, 480 volt, molded-case circuit breakers of not less than 65,000 amperes interrupting rating at 480 volts ac, complete with thermal and instantaneous trip elements. Breakers shall be manually operated with quick-make, quick-break, trip-free toggle mechanism. Bimetallic thermal elements shall withstand sustained overloads and short-circuit currents without injury and without affecting calibration. Circuit breakers shall have "On", "Off", and "Tripped" indication and pad-lockable handles.
- D. Where required, disconnect switches shall be service entrance rated.
- E. Disconnect switches shall have nameplates identifying related equipment, and unit numbers where applicable. Nameplates shall be laminated black-over-white plastic, with 1/8 inch engraved letters, and shall be securely fastened to the enclosure.

2.08 LUMINARIES

- A. The Contractor shall furnish and install all lighting fixtures as called for on the drawings or as herein specified. All fixtures shall be new, industrial grade, and as specified on the drawings.
- B. Ballasts supplied with fluorescent fixtures shall be electronic, premium grade, approved by Underwriters' Laboratories, and properly applied for each installation.
- C. The neutral conductor of lighting systems must be of the same size as the other conductors or larger. On three wire systems the load shall be divided as evenly as possible on each "outside" or phase conductor. Neutral conductors shall be identified throughout.
- D. The Contractor shall furnish and install all lamps required for all fixtures. All lamps shall be of size and type specified; manufactured by General Electric, Westinghouse, or Sylvania. Fluorescent lamps shall be cool white. All lamps shall be warranted by the Contractor for the published rated life. Four weeks after acceptance of the system, the Contractor shall check all lighting fixtures and replace lamps and/or ballasts that have failed during this period of time.

2.09 SWITCHES

- A. Wall switches specification grade and shall be 20 amperes, 120/277 volts, Arrowhart 1221 through 1224, Hubbell 1221 through 1224, Eagle 1221 through 1224, or equal and shall be mounted 3'-6" AFF unless otherwise indicated on the drawings.

2.10 RECEPTACLES

- A. Receptacles shall be specification grade, duplex, three-wire, grounding, 20 amperes, 125 volts, Arrowhart 5362, Hubbell 5362, Eagle 5362, or equal for 120 volt circuits. Ground fault receptacles shall be duplex, 20 amperes, 125 volts, Arrowhart GF5352, Hubbell GF5352, Eagle GF5352, or equal. Receptacles shall be mounted eighteen inches AFF unless otherwise indicated on the drawings.

2.11 CONTROL STATIONS

- A. Control stations shall be provided as indicated on the one-line diagrams or schematics or as required by the equipment furnished. Pilot devices shall be heavy-duty, oil tight, and shall perform the functions indicated. Indoor control stations shall have NEMA Type 13 enclosures. Control stations outdoors or indicated to be weatherproof shall have NEMA Type 4 stainless

steel enclosures with protective caps on the control devices. Control stations in Class I, Division 2, Group D hazardous areas shall be NEMA Type 7 enclosures.

- B. Control stations shall have engraved or etched legends ("Start", "Stop", etc.) as described on the drawings. Control stations shall have nameplates identifying related equipment, and unit numbers where applicable. Nameplates shall be laminated black-over-white plastic, with 1/8 inch engraved letters, and shall be securely fastened to the control station.
- C. Emergency stop control stations shall be mushroom type.

2.12 RUBBER MATS

- A. Three-foot wide rubber mats shall be furnished and installed on the floor and in front of the main switchgear, and each MCC. The mats shall be long enough to cover the full length of the equipment. The mats shall be ½ inch thick with beveled edges, canvas back, solid type with corrugations running the long way, and shall be guaranteed extra quality, free from cracks, blow holes, or other defects detrimental to their mechanical or electrical strength. The mats shall meet the requirements of ASTM D 178 for Type II, Class 4 insulating matting.

2.13 MOTORS

- A. The Contractor shall furnish power wiring and disconnect switches for all equipment furnished and shall install disconnect switches where indicated or required. All contacts shall be inspected and cleaned, if required, in control panels, starters, and miscellaneous control devices and all necessary adjustments and wiring changes as may be required for proper adjustments shall be made.
- B. Running tests shall be made on all equipment connected by the Contractor to check proper operation of equipment and verify installation of properly sized overcurrent relays. Such tests shall not be made; however, without the permission of a responsible party designated by the Owner and equipment supplier. The Contractor shall connect and test all other equipment and shall provide cords and mating caps for receptacles where equipment is cord connected.

2.14 ELECTRIC UNIT HEATERS

- A. Electric unit heaters shall be heavy duty and shall include fan and motor assembly, built-in contactor, built-in thermostat, disconnect switch, control transformer as required. Unit heater shall be suitable for use with power supply indicated on the drawings. Heater elements shall be steel plate, fin type with elements brazed to common fins for maximum strength and heat transfer. Each unit heater fan motor shall be provided with automatic reset thermal overload protection. Unit heater shall be provided with suitable mounting hardware.
- B. Each unit heater shall have a capacity as indicated on the drawings. Electric unit heaters shall be as manufactured by Markel, Chromalux, Brasch or equal.

2.15 THERMOSTATS

- A. Thermostats for exhaust fans and ventilators shall be provided as indicated on the drawings and specified herein. Wall-mounted thermostat shall be mounted 5'-6" above finished floors. Insulating spacers for thermostats mounted on exterior building walls shall be provided. Thermostats shall be two-position line voltage thermostats. The thermostats shall have a dpdt switch rated for 1 HP at 120 VAC. The thermostats shall have a range of 35 F to 100 F

with a non-adjustable differential of 2 degrees F, and shall be Honeywell, Penn Controls, Greenheck or equal.

2.16 EXHAUST FANS

- A. Exhaust shall be provided as indicated on the drawings and specified herein. Fans shall be rated in accordance with AMCA standards, or shall bear the AMCA Certified Rating Label, and shall be UL listed.
- B. Fan noise level tests and ratings shall be made and published in accordance with AMCA Standards 300 and 301. Fan sound ratings and sound test verifications shall be furnished with each fan submittal.
- C. Exhaust shall include accessories shall include gravity damper with louver, personnel safety guard, and insect screen. The propeller fans shall have steel aluminum blades, shall be statically and dynamically balanced to ensure quiet, vibration-free operation, and shall be suitable for mounting as indicated. Fan motors shall be open drip-proof, with permanently lubricated, double-sealed ball bearings.
- D. Fans shall include back draft damper with linked blades and fan guard. Provide each fan motor and drive shall be isolated from fan enclosure by rubber-in-shear or spring type isolators standard with manufacturer.
- E. Capacities shall be as indicated on the drawings.
- F. Propeller fans shall be Greenheck, Penn Ventilator, Loren Cook, or equal.

2.17 GENERATOR TERMINATION CABINET

- A. Contractor shall provide generator termination cabinet as indicated on the drawings and specified herein. Cabinet shall be 480/277 Vac, 3 Phase, 4 wire, 2500A meeting the following requirements:
- B. Cabinet shall be free standing NEMA 3R, aluminum.
- C. Supporting structure for bus bars is bolted to framework such as that any phase bar can be relocated vertically as required to meet job requirements.
- D. Bus bars shall be electrical grade plated copper.
- E. Bus bars shall be braced for 85,000A RMS amperes short circuit rating.
- F. Connection to main switchgear shall be provided with lugs for connection of up to seven (7) 600 MCM cables. Connection for portable generator shall be cam locks for up to seven (7) 600 MCM cables.
- G. Cabinet shall be the following standards:
 - ETL listed and labeled per UL standard 1773 termination box
 - NEMA standards
 - National Electrical Code
- H. Cabinet shall be as manufactured by American Midwest (Mr. Scott Koch at 783.551.9275) or equal.

2.18 MAIN SWITCHGEAR, MSWGR INSTALLATION

- A. The main switchgear, MSWGR will be furnished under separate contract by TDX Global, LLC. Contact information is indicated below:

Richard W. Porter, Jr.
Cell: (907) 229-1370
Alt: (610) 357-3780
Office: 856-467-1213
richardp@tdxcorp.com
www.tdxgloballlc.com

- B. Under this contract, MSWGR shall be installed as indicated on the contract drawings and in accordance with the manufacturer's recommendations and installation instructions. One (1) copy of these instructions will be included with the equipment at time of shipment. The equipment will be located at Owner's facility in Welcome, NC and shall be transported from Welcome, NC and installed on site by the Contractor.
- C. MSWGR is 480/277 Vac, 3 Phase 2500A, paralleling switchgear.
- D. Contractor shall furnish and install structural mounting channels in accordance with manufacturer's recommendations and as indicated on the drawings to provide proper alignment of the units.
- E. Contractor shall provide cable and conduit and all terminations for conductors indicated on the drawings. Terminations will be per TDX Global, LLC drawings.
- F. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include, but not be limited to:
- Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
 - Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
 - Secure assemblies to foundation to floor channels.
 - Measure and record High-Pot reading phase-to-phase, and phase-to-ground.
 - Inspect and install all circuit breakers in their proper compartments.
- G. MSWGR and Generator startup will be provided by TDX Global, LLC with assistance from Contractor.
- H. Preliminary MSWGR shop drawings are attached in Appendix C. As-built drawings will be made available after contract award.

2.19 MOTOR CONTROL CENTERS, MCC1 AND MCC2 INSTALLATION

- A. The Motor Control Centers will be furnished under separate contract by Womack. Contact information is indicated below:

Mark Jones

Womack Electric Supply
3707 Alliance Drive #A
Greensboro, NC 27407
Phone: (336) 854-7111
Email: mjones@womackelectric.com

- B. Under this contract, MCC1 and MCC2 shall be installed as indicated on the contract drawings and in accordance with the manufacturer's recommendations and installation instructions. One (1) copy of these instructions will be included with the equipment at time of shipment. The equipment will be located at Owner's facility in Welcome, NC and shall be transported from Welcome, NC and installed on site by the Contractor.
- C. MCC1 and MCC2 are 480/277 Vac, 3 Phase 2000A, motor control centers.
- D. Contractor shall furnish and install structural mounting channels in accordance with manufacturer's recommendations and as indicated on the drawings to provide proper alignment of the units.
- E. Contractor shall provide cable and conduit and all terminations for conductors indicated on the drawings. Terminations will be per manufacturers drawings.
- F. The equipment shall be installed and checked in accordance with the manufacturer's recommendations. This shall include, but not be limited to:
 - Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
 - Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
 - Secure assemblies to foundation to floor channels.
 - Measure and record High-Pot reading phase-to-phase, and phase-to-ground.
 - Inspect and install all circuit breakers in their proper compartments.
- G. MCC1, 2 startup will be provided by Womack Electric Supply with assistance from the Contractor.
- H. Preliminary MCC1 and 2 shop drawings are attached in Appendix B. As-built drawings will be made available after contract award.

2.20 COORDINATION STUDY

- A. A coordination study of relays, fuses, circuit breakers, and all other protective devices will be provided under separate Contract.

- END OF SECTION -

SECTION 17000

INSTRUMENTATION AND CONTROL

PART 1 – GENERAL

1.01 SCOPE

- A. This section covers all labor, materials, tools, and equipment necessary for the complete furnishing, installation, and commissioning of the instrumentation and control systems indicated on the drawings and specified herein.
- B. Principal components of the instrumentation and control systems shall be as indicated on the drawings and as contained herein. The instrument device schedule indicates instruments to be provided under this section.
- C. Supplementing this section, the drawings indicate locations and arrangement of panels and instruments, and provide functional diagrams and schematics regarding connection and interaction with other equipment.
- D. Principal components shall be the following:
 - Installation of the Pump Station Control Panel, (PSCP) antenna and associated appurtenances.
 - Flowmeters, FE/FIT-201, 401
 - Intrusion Switches, three (3) total
 - Room Temperature transmitter, TIT-101
 - Discharge pressure transmitters, PIT-201, 401
 - Suction pressure transmitters, PIT-101,102 and PIT-301,302
 - Surge tank differential pressure monitoring
 - Smoke Detector, SD-101
 - PRV station pressure indicating control system
 - Installation, Calibration, and start-up as required for instruments

1.02 CODES AND PERMITS

- A. All work performed and all materials used shall be in accordance with the National Electrical Code, the National Electrical Safety Code, and applicable local regulations and ordinances. All electrical equipment and panel assemblies shall be listed or labeled by Underwriters' Laboratories or other testing organization as required by the State of North Carolina. The Contractor shall, at his own expense, arrange for and obtain all necessary permits, inspections, and approval by the proper authorities in the local jurisdiction of such work.

1.03 SUPPLIER'S QUALIFICATIONS

- A. The complete instrumentation and controls system shall be designed, coordinated, and supplied by a qualified system supplier who is regularly engaged in the business of designing, building, installing, commissioning, and supporting instrument and control systems for municipal water and wastewater projects.

1.04 COORDINATION

- A. Instrumentation and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications, under other contracts, and to related existing equipment. All instrumentation and control devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufacturer and the related equipment manufacturer.
- B. Review of drawings submitted prior to the final determination of related equipment shall not relieve the Contractor from supplying systems in full compliance with the specific requirements of the related equipment.
- C. Related equipment and materials may include, but will not be limited to, primary flow measuring devices, pumps, valve actuators, chemical feeders, analytical measuring devices, SCADA equipment, telemetry, conduit, cable, and piping as described in other specifications associated with this project.
- D. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
- E. The Contractor shall provide supervision of installation during construction and coordination with other contractors.

1.05 INSTALLATION REQUIREMENTS

- A. The Contractor or his subcontractors shall install the instrumentation and controls equipment. The services of the system supplier's technical representative shall be provided as necessary to calibrate, test, and advise others of procedures for adjustment and operation in accordance with the requirements of the quality control section.

1.06 FIELD WIRING

- A. Field wiring materials and installation shall conform to the requirements of the electrical specifications.

1.07 INSTRUMENT FIELD PIPING

- A. Instrument tubing shall be ASTM B280, soft annealed, copper unless otherwise noted or required.

1.08 FIELD-MOUNTED INSTRUMENTS

- A. Instruments shall be mounted so that they may be easily read and serviced and so that all appurtenant devices may be easily operated. Installation details for some instruments are indicated on the drawings. Unless otherwise indicated on the drawings, instruments which include local indicators shall be mounted so that the indicator is approximately 5'-0" above the floor. Indicators shall be oriented for ease of viewing and

shall be provided with sunshields where exposed to direct sunlight. Transmitters shall be mounted on corrosion-resistant pipe supports suitable for floor, wall, or bracket mounting.

1.09 FIELD CALIBRATION

- B. A technical representative of the system supplier shall calibrate each instrument and shall provide a written calibration report for each instrument indicating the results and final tuning adjustment settings. The adjustments of each calibrated instrument shall be sealed or marked, insofar as possible, to discourage tampering. Instrument calibration shall be accomplished prior to checkout of the operations of a system.

1.10 SYSTEMS CHECK

- A. A technical representative of the system supplier shall participate in the checkout of instrumentation systems. If interrelated devices furnished by other suppliers, such as valve actuators, motor controls, chemical feeders, and primary measuring devices, do not perform properly when placed in service, the technical representative shall use suitable test equipment to introduce simulated signals to verify or measure signals from those devices as may be required to locate the source of trouble or malfunction. A written report stating the results of such tests shall be furnished, if requested by the Engineer, as necessary to assign responsibility for corrective measures.

1.11 INSTALLATION TEST EQUIPMENT

- A. The system supplier shall provide all test equipment necessary for calibration and checking of system components for the duration of the testing work. Test equipment shall remain the property of the system supplier, unless otherwise specified.

1.12 PUMP STATION CONTROL PANEL

- A. The Pump Station Control Panel shall be provided by Micro-Comm under this contract. The quality shall be similar to other systems provided to Davidson Water, Inc. Micro-Comm shall furnish PSCP and antenna cable for Contractor installation. Existing antenna shall be reused. Contact information is indicated below:

Micro Comm, Inc.
Olathe, KS 66062
Local Contact:
Robert L. Carlsen, Inc
Attn: Doug Carlsen
(704)905-7352

A fully functional Pump Station Control Panel shall be provided meeting the following requirements:

1. Nema 12 Enclosure
2. Motorola VHF or Owner acceptable I radio suitable for operation on the Davidson Water System.
3. PLC with Input/Output (I/O) as indicated on the attached Input/Output list.

4. Necessary hardware and software modification at the WTP and central to display new I/O.
5. Standard display capable of display all I/O points
6. Programming at the WTP to interface new PSCP
7. Coordination with other instrumentation provided in this section, including level transmitters, flow transmitters, temperature transmitters, and intrusion switches.
8. Coordination with MCC components including surge suppressors, motor starters and electronic motor monitors (Eaton Insight 440)
9. Coordination with existing PRV pressure control system.
10. Coordination with surge system
11. Coordination with generator control system

1.13 PROGRAMMING REQUIREMENTS:

1. PSCP PLC shall monitor the motor components and display on local display and WTP computer.
2. All I/O points shall be display at the WTP and on a local display screen.
3. All analog points shall be trended and have the capability of high and low level alarms, high and low level pre alarms.
4. All digital outputs shall be confirmed and an alarm issued if not confirmed.
5. The PSCP shall control pumps in typical Davidson Water fashion.
6. The PSCP shall monitor the tank level and prevent starting at a user adjustable level.
7. The PSCP shall monitor the suction pressure and prevent starting/operating at a user adjustable level.
8. The PSCP shall duplicate existing PRV Station pressure control system logic in new control system.
9. The PSCP PLC shall interface with the surge control system and alarm as recommended by surge system supplier
10. The PSCP shall interface with Generator System PLC similar to work at the WTP. Communications shall be via Ethernet port on Generator system VFD and allow monitoring and control of generator system including main switchgear circuit breakers.
11. Micro-Comm, Inc. shall coordinate a conference call with Owner and Engineer prior to beginning programming to discuss final sequence of operations.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. All equipment shall be new and selected for the application for superior quality and performance.
- B. The Contractor and System Supplier shall design the system and shall be responsible for performance of the system within these specified limitations.

- C. Signal converters, signal boosters, amplifiers, special power supplies, special cables, special grounding, and isolation requirements shall be furnished and installed as required for proper performance of the equipment.
- D. Instruments used for the same types of functions and services shall be of the same brand and model line insofar as possible. Similar components of different new and existing instruments shall be from the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.
- E. Instruments installed in the field shall be provided with a sunshield unless otherwise noted. There shall be at least a one-inch air gap between the sunshield and the instrument to minimize heat gain to the instrument from the sun. The sun shield shall prevent direct sunlight from shining on the face of indicating transmitters.
- F. Unless otherwise specified, instrument transmitters shall be enclosed in a stainless steel, cast aluminum, or fiberglass reinforced plastic housing with NEMA 4X rating. The housing shall be provided with stainless steel mounting brackets suitable for surface, post, or handrail mounting.
- G. Unless otherwise noted, instruments shall be provided with all mounting hardware and accessories for a professional installation. Mounting hardware shall be corrosion resistant and galvanically compatible with the mounting surface. Instruments that require movement for operation, periodic calibration, or maintenance shall be provided with tool-less quick-release handles and adjustment mechanisms.
- H. A programming or system-configuring device shall be provided for systems that contain any equipment which requires such a device for routine calibration, maintenance, and troubleshooting. The programming device shall be complete and in like-new condition and shall be turned over to the Owner at completion of startup.
- I. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.
- J. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the instrument device schedule and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered labels or tape labels will not be accepted.

2.02 TEMPERATURE INDICATING TRANSMITTERS (ELECTRICAL ROOM TEMPERATURE)

- A. Temperature Indicating Transmitters (TIT) shall be provided as indicated on the drawings and as specified herein. Transmitters shall be wall mounted, sense and indicate the ambient air temperature in degrees Fahrenheit, and transmit the temperature to a remote device. Transmitters shall be powered from 24 VDC and shall produce a linear 4-20 ma output proportional to the temperature. Range shall be 0 to

140°F. Accuracy shall be 3 percent minimum. Transmitters shall be industrial grade for long life and trouble-free service.

2.03 MAGNETIC FLOWMETERS (SEE SECTION 17701)

2.04 PRESSURE TRANSMITTERS

- A. Transmitters shall have all solid-state "smart" electronic circuitry and shall be of the two-wire type. Process fluid shall be isolated from the sensing elements by AISI Type 316 stainless steel or cobalt-chromium-nickel alloy diaphragms, and a silicone oil fluid fill. Transmitters shall have no mechanical fulcrum points. Transmitters shall have self-diagnostics and electronically adjustable span, zero, and damping. Transmitters shall be enclosed in a NEMA Type 4X housing and shall be suitable for operation at temperatures from 0 to 180 F, with relative humidity of 0 to 100 percent. All parts shall be cadmium-plated carbon steel, stainless steel, or other corrosion-resistant materials.
- B. Vents shall be provided on the sides of the diaphragm housing body. Transmitters shall have over range protection to maximum line pressure. Accuracy of the transmitter shall be 0.10 percent of span, and transmitter output shall be 4-20 mA dc without the need for external load adjustment. Transmitters shall not be damaged by reverse polarity. Transmitters shall have an elevated or suppressed zero as required by the application.
- C. Transmitters shall be factory calibrated to the required range and provided with the manufacturer's standard hand-held communications/ calibration device. One device shall be furnished for all transmitters provided by a single manufacturer. Where transmitters are tagged on the drawings or specified to be the indicating type, the transmitters shall be furnished with integral indicators with engineering units. Transmitters shall be Rosemount, Micro Comm, Inc or approved equal.

2.05 INTRUSION SWITCHES

- A. Intrusion switches shall be provided as indicated on the drawings and specified herein. Switches shall be the proximity type with magnetic actuator and contact rated for 1 ampere at 120 VAC. Switch provided shall be suitable for the doors installed.
- B. Switches shall be as manufactured by Microswitch, Square D, GE, or equal.

2.06 SMOKE DETECTOR

- A. The System Smoke Detector shall be standalone, photoelectric or ionization type suitable for area installed. Detector shall be 120 Vac supplied with battery backup. Detector shall provide an audible alarm and a dry contact, 1 amp at 120 Vac for remote monitoring by the PSCP.
- B. Detector shall be Gentex 9120TF or equal.

PART 3 - EXECUTIONS

3.01 DATA AND DRAWINGS

- A. Complete fabrication, assembly, and installation drawings; details, specifications, and data covering the materials used; and the parts, devices, and accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. Submittal data shall be grouped and submitted in three separate stages. The submittal for each stage shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Instrument tag numbers indicated on the contract drawings shall be referenced where applicable. Submittal data for multifunctional instruments shall include complete descriptions of the intended functions and configurations of the instruments.
- B. The submittal for design approval shall include the following items:
- Product catalog cut sheets clearly marked to show the applicable model number, optional features, and intended service of the device.
 - A detailed list of any exceptions, functional differences, or discrepancies between the Suppliers' proposed system and the contract requirements.

3.02 INSTALLATION

- A. Instrumentation shall be installed as shown on the drawings and in accordance with the manufacturer's installation instructions.
- B. Install control panels to allow 90 degree or greater door swing. If required, limit door swing to prevent damage to door mounted devices.
- C. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.

3.03 CLEANING AND PAINTING

- A. Clean interiors of control panels to remove all construction dirt and debris.

Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratched or marred exterior surfaces repainted to match original finish.

3.04 SPARE PARTS

- A. The following test equipment, spare parts, and miscellaneous devices shall be provided:
- One spare magmeter signal converter

3.05 OWNER TRAINING

- A. The System Supplier shall provide a qualified representative at the jobsite to train the Owner's personnel in operating and maintaining the equipment. The training session shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of one (1) full 8-hour day of training. The training schedule shall be coordinated with the Owner.

- END OF SECTION -

HYATTOWN PUMP STATION : I/O LIST									
POINT	NUMBE R	PNL	TYPE	DEVICE	DESCRIPTION	RANGE OR POS	SERVICE	LOCATION	Notes
AI	001	PSCP	4-20 mA	LIT-001	SUBMERSIBLE LEVEL TRANSDUCER	0-30 FT	TANK LEVEL	HYATTOWN STORAGE TANK	
AI	002	PSCP	4-20 mA	DPIT-201	DIFFERENTIAL PRESSURE TRANSMITTER	0-150 PSI	TANK LEVEL	GLENN ANNA SURGE TANK	
AI	003	PSCP	4-20 mA	PIT-201	PRESSURE IND. TRANSMITTER	0-200 PSI	DISCHARGE PRESSURE	DISCHARGE PIPING	
AI	004	PSCP	4-20 mA	FIT-201	FLOW IND. TRANSMITTER	0-10,000 GPM	DISCHARGE FLOW	METERING VAULT	
AI	005	PSCP	4-20 mA	DPIT-401	DIFFERENTIAL PRESSURE TRANSMITTER	0-150 PSI	TANK LEVEL	WELCOME SURGE TANK	
AI	006	PSCP	4-20 mA	PIT-401	PRESSURE IND. TRANSMITTER	0-200 PSI	DISCHARGE PRESSURE	DISCHARGE PIPING	
AI	007	PSCP	4-20 mA	FIT-401	FLOW IND. TRANSMITTER	0-10,000 GPM	DISCHARGE FLOW	METERING VAULT	
AI	008	PSCP	MBUS	MPR1	POWER	0-200 kW	GLENN ANNA PUMP NO. 1	MCC1	
AI	009	PSCP	MBUS	MPR1	ENERGY	0-100000 kWh	GLENN ANNA PUMP NO. 1	MCC1	
AI	010	PSCP	MBUS	MPR1	AMPERES	0-250 Amps	GLENN ANNA PUMP NO. 1	MCC1	
AI	011	PSCP	MBUS	MPR2	POWER	0-200 kW	GLENN ANNA PUMP NO. 2	MCC1	
AI	012	PSCP	MBUS	MPR2	ENERGY	0-100000 kWh	GLENN ANNA PUMP NO. 2	MCC1	
AI	013	PSCP	MBUS	MPR2	AMPERES	0-250 Amps	GLENN ANNA PUMP NO. 2	MCC1	
AI	014	PSCP	MBUS	MPR3	POWER	0-200 kW	GLENN ANNA PUMP NO. 3	MCC1	
AI	015	PSCP	MBUS	MPR3	ENERGY	0-100000 kWh	GLENN ANNA PUMP NO. 3	MCC1	
AI	016	PSCP	MBUS	MPR3	AMPERES	0-250 Amps	GLENN ANNA PUMP NO. 3	MCC1	
AI	017	PSCP	MBUS	MPR4	POWER	0-200 kW	GLENN ANNA PUMP NO. 4	MCC1	
AI	018	PSCP	MBUS	MPR4	ENERGY	0-100000 kWh	GLENN ANNA PUMP NO. 4	MCC1	
AI	019	PSCP	MBUS	MPR4	AMPERES	0-250 Amps	GLENN ANNA PUMP NO. 4	MCC1	
AI	020	PSCP	MBUS	MPR5	POWER	0-200 kW	WELCOME PUMP NO. 1	MCC2	
AI	021	PSCP	MBUS	MPR5	ENERGY	0-100000 kWh	WELCOME PUMP NO. 1	MCC2	
AI	022	PSCP	MBUS	MPR5	AMPERES	0-250 Amps	WELCOME PUMP NO. 1	MCC2	
AI	023	PSCP	MBUS	MPR6	POWER	0-200 kW	WELCOME PUMP NO. 2	MCC2	
AI	024	PSCP	MBUS	MPR6	ENERGY	0-100000 kWh	WELCOME PUMP NO. 2	MCC2	
AI	025	PSCP	MBUS	MPR6	AMPERES	0-250 Amps	WELCOME PUMP NO. 2	MCC2	
AI	026	PSCP	MBUS	MPR7	POWER	0-200 kW	WELCOME PUMP NO. 3	MCC2	
AI	027	PSCP	MBUS	MPR7	ENERGY	0-100000 kWh	WELCOME PUMP NO. 3	MCC2	
AI	028	PSCP	MBUS	MPR7	AMPERES	0-250 Amps	WELCOME PUMP NO. 3	MCC2	
AI	029	PSCP	MBUS	MPR8	POWER	0-200 kW	WELCOME PUMP NO. 4	MCC2	
AI	030	PSCP	MBUS	MPR8	ENERGY	0-100000 kWh	WELCOME PUMP NO. 4	MCC2	
AI	031	PSCP	MBUS	MPR8	AMPERES	0-250 Amps	WELCOME PUMP NO. 4	MCC2	
AI	032	PSCP	4-20 mA	PIT-101	PRESSURE IND. TRANSMITTER	-10-100PSI	SUCTION PRESSURE	SUCTION PIPING WELCOME	
AI	033	PSCP	4-20 mA	PIT-102	PRESSURE IND. TRANSMITTER	-10-100PSI	SUCTION PRESSURE	SUCTION PIPING WELCOME	
AI	034	PSCP	4-20 mA	PIT-301	PRESSURE IND. TRANSMITTER	-10-100PSI	SUCTION PRESSURE	SUCTION PIPING GLENN ANNA	
AI	035	PSCP	4-20 mA	PIT-302	PRESSURE IND. TRANSMITTER	-10-100PSI	SUCTION PRESSURE	SUCTION PIPING GLENN ANNA	
AI	036	PSCP	4-20 mA	PIT-002	PRESSURE IND. TRANSMITTER	0-200 PSI	HEADER PRESSURE	PRV STATION	4
AI	037	PSCP	4-20 mA	DPIT-003	DIFFERENTIAL PRESSURE TRANSMITTER	0-200 PSI	HEADER PRESSURE	PRV STATION	4
AI	038	PSCP	4-20 mA	ZIT-004	POSITION IND. TRANSMITTER	OPEN-CLOSE	HEADER PRESSURE	PRV STATION	4
AI	039	PSCP	4-20 mA	PIT-005	PRESSURE IND. TRANSMITTER	0-200 PSI	HEADER PRESSURE	PRV STATION	4
AI	040	PSCP	4-20 mA	DPIT-006	DIFFERENTIAL PRESSURE TRANSMITTER	0-200 PSI	HEADER PRESSURE	PRV STATION	4
AI	041	PSCP	4-20 mA	ZIT-007	POSITION IND. TRANSMITTER	OPEN-CLOSE	HEADER PRESSURE	PRV STATION	4
DI	001	PSCP	120 VAC	HS-101	IN REMOTE MODE	0=NOT, 1=REMOTE	GLENN ANNA PUMP NO. 1	MCC1	
DI	002	PSCP	120 VAC	YI-101A	PUMP RUNNING	0=NOT, 1=RUNNING	GLENN ANNA PUMP NO. 1	MCC1	1
DI	003	PSCP	120 VAC	YI-101D	PUMP FAULT	0=NOT, 1=FAULT	GLENN ANNA PUMP NO. 1	MCC1	1
DI	004	PSCP	120 VAC	GAV-1	VALVE OPEN	0=NOT, 1=OPEN	GLENN ANNA PUMP NO. 1	MCC1	
DI	005	PSCP	120 VAC	GAV-1	VALVE CLOSED	0=NOT, 1=CLOSED	GLENN ANNA PUMP NO. 1	MCC1	
DI	006	PSCP	120 VAC	GAV-1	IN REMOTE MODE	0=NOT, 1=REMOTE	GLENN ANNA PUMP NO. 1	MCC1	
DI	007	PSCP	120 VAC	HS	FAULT RESET	0=NOT, 1=RESET	GLENN ANNA PUMP NO. 1	MCC1	
DI	008	PSCP	120 VAC	HS-102	IN REMOTE MODE	0=NOT, 1=REMOTE	GLENN ANNA PUMP NO. 2	MCC1	
DI	009	PSCP	120 VAC	YI-102A	PUMP RUNNING	0=NOT, 1=RUNNING	GLENN ANNA PUMP NO. 2	MCC1	1
DI	010	PSCP	120 VAC	YI-102D	PUMP FAULT	0=NOT, 1=FAULT	GLENN ANNA PUMP NO. 2	MCC1	1
DI	011	PSCP	120 VAC	GAV-2	VALVE OPEN	0=NOT, 1=OPEN	GLENN ANNA PUMP NO. 2	MCC1	
DI	012	PSCP	120 VAC	GAV-2	VALVE CLOSED	0=NOT, 1=CLOSED	GLENN ANNA PUMP NO. 2	MCC1	
DI	013	PSCP	120 VAC	GAV-2	IN REMOTE MODE	0=NOT, 1=REMOTE	GLENN ANNA PUMP NO. 2	MCC1	
DI	014	PSCP	120 VAC	HS	FAULT RESET	0=NOT, 1=RESET	GLENN ANNA PUMP NO. 2	MCC1	
DI	015	PSCP	120 VAC	HS-103	IN REMOTE MODE	0=NOT, 1=REMOTE	GLENN ANNA PUMP NO. 3	MCC1	
DI	016	PSCP	120 VAC	YI-103A	PUMP RUNNING	0=NOT, 1=RUNNING	GLENN ANNA PUMP NO. 3	MCC1	1
DI	017	PSCP	120 VAC	YI-103D	PUMP FAULT	0=NOT, 1=FAULT	GLENN ANNA PUMP NO. 3	MCC1	1
DI	018	PSCP	120 VAC	GAV-3	VALVE OPEN	0=NOT, 1=OPEN	GLENN ANNA PUMP NO. 3	MCC1	
DI	019	PSCP	120 VAC	GAV-3	VALVE CLOSED	0=NOT, 1=CLOSED	GLENN ANNA PUMP NO. 3	MCC1	
DI	020	PSCP	120 VAC	GAV-3	IN REMOTE MODE	0=NOT, 1=REMOTE	GLENN ANNA PUMP NO. 3	MCC1	
DI	021	PSCP	120 VAC	HS	FAULT RESET	0=NOT, 1=RESET	GLENN ANNA PUMP NO. 3	MCC1	
DI	022	PSCP	120 VAC	HS-104	IN REMOTE MODE	0=NOT, 1=REMOTE	GLENN ANNA PUMP NO. 4	MCC1	
DI	023	PSCP	120 VAC	YI-104A	PUMP RUNNING	0=NOT, 1=RUNNING	GLENN ANNA PUMP NO. 4	MCC1	1
DI	024	PSCP	120 VAC	YI-104D	PUMP FAULT	0=NOT, 1=FAULT	GLENN ANNA PUMP NO. 4	MCC1	1
DI	025	PSCP	120 VAC	GAV-4	VALVE OPEN	0=NOT, 1=OPEN	GLENN ANNA PUMP NO. 4	MCC1	
DI	026	PSCP	120 VAC	GAV-4	VALVE CLOSED	0=NOT, 1=CLOSED	GLENN ANNA PUMP NO. 4	MCC1	
DI	027	PSCP	120 VAC	GAV-4	IN REMOTE MODE	0=NOT, 1=REMOTE	GLENN ANNA PUMP NO. 4	MCC1	
DI	028	PSCP	120 VAC	HS	FAULT RESET	0=NOT, 1=RESET	GLENN ANNA PUMP NO. 4	MCC1	

POINT	NUMBER	PNL	TYPE	DEVICE	DESCRIPTION	RANGE OR POS	SERVICE	LOCATION	Notes
DI	029	PSCP	120 VAC	HS-301	IN REMOTE MODE	0=NOT, 1=REMOTE	WELCOME PUMP NO. 1	MCC2	
DI	030	PSCP	120 VAC	YI-301A	PUMP RUNNING	0=NOT, 1=RUNNING	WELCOME PUMP NO. 1	MCC2	1
DI	031	PSCP	120 VAC	YI-301D	PUMP FAULT	0=NOT, 1=FAULT	WELCOME PUMP NO. 1	MCC2	1
DI	032	PSCP	120 VAC	WV-1	VALVE OPEN	0=NOT, 1=OPEN	WELCOME PUMP NO. 1	MCC2	
DI	033	PSCP	120 VAC	WV-1	VALVE CLOSED	0=NOT, 1=CLOSED	WELCOME PUMP NO. 1	MCC2	
DI	034	PSCP	120 VAC	WV-1	IN REMOTE MODE	0=NOT, 1=REMOTE	WELCOME PUMP NO. 1	MCC2	
DI	035	PSCP	120 VAC	HS	FAULT RESET	0=NOT, 1=RESET	WELCOME PUMP NO. 1	MCC2	
DI	036	PSCP	120 VAC	HS-302	IN REMOTE MODE	0=NOT, 1=REMOTE	WELCOME PUMP NO. 2	MCC2	
DI	037	PSCP	120 VAC	YI-302A	PUMP RUNNING	0=NOT, 1=RUNNING	WELCOME PUMP NO. 2	MCC2	1
DI	038	PSCP	120 VAC	YI-302D	PUMP FAULT	0=NOT, 1=FAULT	WELCOME PUMP NO. 2	MCC2	1
DI	039	PSCP	120 VAC	WV-2	VALVE OPEN	0=NOT, 1=OPEN	WELCOME PUMP NO. 2	MCC2	1
DI	040	PSCP	120 VAC	WV-2	VALVE CLOSED	0=NOT, 1=CLOSED	WELCOME PUMP NO. 2	MCC2	1
DI	041	PSCP	120 VAC	WV-2	IN REMOTE MODE	0=NOT, 1=REMOTE	WELCOME PUMP NO. 2	MCC2	1
DI	042	PSCP	120 VAC	HS	FAULT RESET	0=NOT, 1=RESET	WELCOME PUMP NO. 2	MCC2	1
DI	043	PSCP	120 VAC	HS-303	IN REMOTE MODE	0=NOT, 1=REMOTE	WELCOME PUMP NO. 3	MCC2	
DI	044	PSCP	120 VAC	YI-303A	PUMP RUNNING	0=NOT, 1=RUNNING	WELCOME PUMP NO. 3	MCC2	1
DI	045	PSCP	120 VAC	YI-303D	PUMP FAULT	0=NOT, 1=FAULT	WELCOME PUMP NO. 3	MCC2	1
DI	046	PSCP	120 VAC	WV-3	VALVE OPEN	0=NOT, 1=OPEN	WELCOME PUMP NO. 3	MCC2	1
DI	047	PSCP	120 VAC	WV-3	VALVE CLOSED	0=NOT, 1=CLOSED	WELCOME PUMP NO. 3	MCC2	1
DI	048	PSCP	120 VAC	WV-3	IN REMOTE MODE	0=NOT, 1=REMOTE	WELCOME PUMP NO. 3	MCC2	1
DI	049	PSCP	120 VAC	HS	FAULT RESET	0=NOT, 1=RESET	WELCOME PUMP NO. 3	MCC2	1
DI	050	PSCP	120 VAC	HS-304	IN REMOTE MODE	0=NOT, 1=REMOTE	WELCOME PUMP NO. 4	MCC2	
DI	051	PSCP	120 VAC	YI-304A	PUMP RUNNING	0=NOT, 1=RUNNING	WELCOME PUMP NO. 4	MCC2	1
DI	052	PSCP	120 VAC	YI-304D	PUMP FAULT	0=NOT, 1=FAULT	WELCOME PUMP NO. 4	MCC2	1
DI	053	PSCP	120 VAC	WV-4	VALVE OPEN	0=NOT, 1=OPEN	WELCOME PUMP NO. 4	MCC2	1
DI	054	PSCP	120 VAC	WV-4	VALVE CLOSED	0=NOT, 1=CLOSED	WELCOME PUMP NO. 4	MCC2	1
DI	055	PSCP	120 VAC	WV-4	IN REMOTE MODE	0=NOT, 1=REMOTE	WELCOME PUMP NO. 4	MCC2	1
DI	056	PSCP	120 VAC	HS	FAULT RESET	0=NOT, 1=RESET	WELCOME PUMP NO. 4	MCC2	1
DI	089	PSCP	TBD	TVSS-MCC1	SURGE ALARM	0=NOT, 1=ALARM	MCC1	MCC1	
DI	090	PSCP	TBD	TVSS-MCC2	SURGE ALARM	0=NOT, 1=ALARM	MCC2	MCC2	
DI	091	PSCP	TBD	TVSS-PP1	SURGE ALARM	0=NOT, 1=ALARM	MPP1	MPP1	
DI	092	PSCP	TBD	TVSS-PP2	SURGE ALARM	0=NOT, 1=ALARM	MPP2	MPP2	
DI	093	PSCP	120 VAC	ZS1	INTRUSION SWITCH	0=NOT, 1=ALARM	INTRUSION ALARM	WEST SIDE SINGLE DOOR	
DI	094	PSCP	120 VAC	ZS2	INTRUSION SWITCH	0=NOT, 1=ALARM	INTRUSION ALARM	WEST SIDE DOUBLE DOOR	
DI	095	PSCP	120 VAC	ZS3	INTRUSION SWITCH	0=NOT, 1=ALARM	INTRUSION ALARM	EAST SIDE SINGLE DOOR	
DI	096	PSCP	120VAC	SD101	SMOKE DETECTOR	0-ALARM, 1=NOT	SMOKE ALARM	ABOVE MSWGR	
DO	001	PSCP	120 VAC	GAP-1	PUMP RUN	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 1	MCC1	
DO	002	PSCP	120 VAC	GAP-2	PUMP RUN	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 2	MCC1	
DO	003	PSCP	120 VAC	GAP-3	PUMP RUN	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 3	MCC1	
DO	004	PSCP	120 VAC	GAP-4	PUMP RUN	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 4	MCC1	
DO	005	PSCP	120 VAC	GAP-5	PUMP RUN	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 5	MCC1	3
DO	006	PSCP	120 VAC	WP-1	PUMP RUN	0=NOT, 1=RUN	WELCOME PUMP NO. 1	MCC2	
DO	007	PSCP	120 VAC	WP-2	PUMP RUN	0=NOT, 1=RUN	WELCOME PUMP NO. 2	MCC2	
DO	008	PSCP	120 VAC	WP-3	PUMP RUN	0=NOT, 1=RUN	WELCOME PUMP NO. 3	MCC2	
DO	009	PSCP	120 VAC	WP-4	PUMP RUN	0=NOT, 1=RUN	WELCOME PUMP NO. 4	MCC2	
DO	010	PSCP	120 VAC	WP-5	PUMP RUN	0=NOT, 1=RUN	WELCOME PUMP NO. 5	MCC2	3
DO	011	PSCP	120 VAC	GAP-1	PUMP RESET	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 1	MCC1	
DO	012	PSCP	120 VAC	GAP-2	PUMP RESET	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 2	MCC1	
DO	013	PSCP	120 VAC	GAP-3	PUMP RESET	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 3	MCC1	
DO	014	PSCP	120 VAC	GAP-4	PUMP RESET	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 4	MCC1	
DO	015	PSCP	120 VAC	GAP-5	PUMP RESET	0=NOT, 1=RUN	GLENN ANNA PUMP NO. 5	MCC1	3
DO	016	PSCP	120 VAC	WP-1	PUMP RESET	0=NOT, 1=RUN	WELCOME PUMP NO. 1	MCC2	
DO	017	PSCP	120 VAC	WP-2	PUMP RESET	0=NOT, 1=RUN	WELCOME PUMP NO. 2	MCC2	
DO	018	PSCP	120 VAC	WP-3	PUMP RESET	0=NOT, 1=RUN	WELCOME PUMP NO. 3	MCC2	
DO	019	PSCP	120 VAC	WP-4	PUMP RESET	0=NOT, 1=RUN	WELCOME PUMP NO. 4	MCC2	
DO	020	PSCP	120 VAC	WP-5	PUMP RESET	0=NOT, 1=RUN	WELCOME PUMP NO. 5	MCC2	3

NOTES:

1. DEVICE WIRED THROUGH MCC RELAY.
2. MBTCP DENOTES MODBUS TCP/IP - ETHERNET
3. FUTURE PUMP/EQUIPMENT PROVIDE I/O NOW
4. DEVICE IS EXISTING TO REMAIN AS IS AND CONNECTED TO NEW EQUIPMENT

HYATTOWN PUMP STATION: INSTRUMENT DEVICE SCHEDULE					
TAG	SERVICE	LOCATION	DESCRIPTION	SCALE	NOTES
LIT-001	TANK LEVEL	HYATTOWN STORAGE TANK	SUBMERSIBLE LEVEL TRANSMITTER	0-30 FT	3
PIT-002	PRESSURE	PRV STATION	PRESSURE IND. TRANSMITTER	0-200 PSI	6
DPIT-003	PRESSURE	PRV STATION	DIFFERENTIAL PRESSURE TRANSMITTER	0-200 PSI	6
ZIT-004	POSITION	PRV STATION	POSITION IND. TRANSMITTER	OPEN-CLOSE	6
PIT-005	PRESSURE	PRV STATION	PRESSURE IND. TRANSMITTER	0-200 PSI	6
DPIT-006	PRESSURE	PRV STATION	DIFFERENTIAL PRESSURE TRANSMITTER	0-200 PSI	6
ZIT-007	POSITION	PRV STATION	POSITION IND. TRANSMITTER	OPEN-CLOSE	6
PIT-101	PRESSURE	GLENN ANNA PUMP HEADER	PRESSURE IND. TRANSMITTER	-10 - 100 PSI	
PIT-102	PRESSURE	GLENN ANNA PUMP HEADER	PRESSURE IND. TRANSMITTER	-10 - 100 PSI	
HS-101	PUMP CONTROL	GLENN ANNA PUMP NO. 1	HAND-OFF-REMOTE SELECTOR SWITCH		2
YI-101A	PUMP CONTROL	GLENN ANNA PUMP NO. 1	PUMP RUNNING INDICATING LIGHT	0=NOT, 1=RUNNING	2
YI-101B	PUMP CONTROL	GLENN ANNA PUMP NO. 1	PUMP STOPPED INDICATING LIGHT	0=NOT, 1=STOPPED	2
YI-101D	PUMP CONTROL	GLENN ANNA PUMP NO. 1	COMMON FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-101G	VALVE CONTROL	GLENN ANNA PUMP NO. 1	VALVE OPEN INDICATING LIGHT	0=NOT, 1=OPEN	2
YI-101H	VALVE CONTROL	GLENN ANNA PUMP NO. 1	VALVE CLOSED INDICATING LIGHT	0=NOT, 1=CLOSED	2
YI-101I	VALVE CONTROL	GLENN ANNA PUMP NO. 1	VALVE FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
HS-102	PUMP CONTROL	GLENN ANNA PUMP NO. 2	HAND-OFF-REMOTE SELECTOR SWITCH		2
YI-102A	PUMP CONTROL	GLENN ANNA PUMP NO. 2	PUMP RUNNING INDICATING LIGHT	0=NOT, 1=RUNNING	2
YI-102B	PUMP CONTROL	GLENN ANNA PUMP NO. 2	PUMP STOPPED INDICATING LIGHT	0=NOT, 1=STOPPED	2
YI-102D	PUMP CONTROL	GLENN ANNA PUMP NO. 2	COMMON FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-102G	VALVE CONTROL	GLENN ANNA PUMP NO. 2	VALVE OPEN INDICATING LIGHT	0=NOT, 1=OPEN	2
YI-102H	VALVE CONTROL	GLENN ANNA PUMP NO. 2	VALVE CLOSED INDICATING LIGHT	0=NOT, 1=CLOSED	2
YI-102I	VALVE CONTROL	GLENN ANNA PUMP NO. 2	VALVE FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
HS-103	PUMP CONTROL	GLENN ANNA PUMP NO. 3	HAND-OFF-REMOTE SELECTOR SWITCH		2
YI-103A	PUMP CONTROL	GLENN ANNA PUMP NO. 3	PUMP RUNNING INDICATING LIGHT	0=NOT, 1=RUNNING	2
YI-103B	PUMP CONTROL	GLENN ANNA PUMP NO. 3	PUMP STOPPED INDICATING LIGHT	0=NOT, 1=STOPPED	2
YI-103D	PUMP CONTROL	GLENN ANNA PUMP NO. 3	COMMON FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-103G	VALVE CONTROL	GLENN ANNA PUMP NO. 3	VALVE OPEN INDICATING LIGHT	0=NOT, 1=OPEN	2
YI-103H	VALVE CONTROL	GLENN ANNA PUMP NO. 3	VALVE CLOSED INDICATING LIGHT	0=NOT, 1=CLOSED	2
YI-103I	VALVE CONTROL	GLENN ANNA PUMP NO. 3	VALVE FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
HS-104	PUMP CONTROL	GLENN ANNA PUMP NO. 4	HAND-OFF-REMOTE SELECTOR SWITCH		2
YI-104A	PUMP CONTROL	GLENN ANNA PUMP NO. 4	PUMP RUNNING INDICATING LIGHT	0=NOT, 1=RUNNING	2
YI-104B	PUMP CONTROL	GLENN ANNA PUMP NO. 4	PUMP STOPPED INDICATING LIGHT	0=NOT, 1=STOPPED	2
YI-104D	PUMP CONTROL	GLENN ANNA PUMP NO. 4	COMMON FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-104G	VALVE CONTROL	GLENN ANNA PUMP NO. 4	VALVE OPEN INDICATING LIGHT	0=NOT, 1=OPEN	2
YI-104H	VALVE CONTROL	GLENN ANNA PUMP NO. 4	VALVE CLOSED INDICATING LIGHT	0=NOT, 1=CLOSED	2
YI-104I	VALVE CONTROL	GLENN ANNA PUMP NO. 4	VALVE FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
PIT-201	DISCHARGE PRESSURE	GLENN ANNA PUMPS	PRESSURE IND. TRANSMITTER	0-250 PSI	
FIT-201	DISCHARGE FLOW	GLENN ANNA PUMPS	MAGNETIC FLOW IND. TRANSMITTER	0-10,000 GPM	
DPIT-201	SURGE TANK LEVEL	GLENN ANNA SURGE TANK	DIFFERENTIAL PRESSURE TRANSMITTER	0-150 PSI	5
PIT-301	SUCTION PRESSURE	GLENN ANNA HEADER	PRESSURE IND. TRANSMITTER	-10-100 PSI	
PIT-302	SUCTION PRESSURE	GLENN ANNA HEADER	PRESSURE IND. TRANSMITTER	-10-100 PSI	
HS-301	PUMP CONTROL	WELCOME PUMP NO. 1	HAND-OFF-REMOTE SELECTOR SWITCH		2
YI-301A	PUMP CONTROL	WELCOME PUMP NO. 1	PUMP RUNNING INDICATING LIGHT	0=NOT, 1=RUNNING	2
YI-301B	PUMP CONTROL	WELCOME PUMP NO. 1	PUMP STOPPED INDICATING LIGHT	0=NOT, 1=STOPPED	2
YI-301D	PUMP CONTROL	WELCOME PUMP NO. 1	COMMON FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-301E	PUMP CONTROL	WELCOME PUMP NO. 1	LEVEL FAIL INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-301H	VALVE CONTROL	WELCOME PUMP NO. 1	VALVE CLOSED INDICATING LIGHT	0=NOT, 1=CLOSED	2
YI-301I	VALVE CONTROL	WELCOME PUMP NO. 1	VALVE FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
HS-302	PUMP CONTROL	WELCOME PUMP NO. 2	HAND-OFF-REMOTE SELECTOR SWITCH		2
YI-302A	PUMP CONTROL	WELCOME PUMP NO. 2	PUMP RUNNING INDICATING LIGHT	0=NOT, 1=RUNNING	2
YI-302B	PUMP CONTROL	WELCOME PUMP NO. 2	PUMP STOPPED INDICATING LIGHT	0=NOT, 1=STOPPED	2
YI-302D	PUMP CONTROL	WELCOME PUMP NO. 2	COMMON FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-302G	VALVE CONTROL	WELCOME PUMP NO. 2	VALVE OPEN INDICATING LIGHT	0=NOT, 1=OPEN	2
YI-302H	VALVE CONTROL	WELCOME PUMP NO. 2	VALVE CLOSED INDICATING LIGHT	0=NOT, 1=CLOSED	2
YI-302I	VALVE CONTROL	WELCOME PUMP NO. 2	VALVE FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
HS-303	PUMP CONTROL	WELCOME PUMP NO. 3	HAND-OFF-REMOTE SELECTOR SWITCH		2
YI-303A	PUMP CONTROL	WELCOME PUMP NO. 3	PUMP RUNNING INDICATING LIGHT	0=NOT, 1=RUNNING	2
YI-303B	PUMP CONTROL	WELCOME PUMP NO. 3	PUMP STOPPED INDICATING LIGHT	0=NOT, 1=STOPPED	2
YI-303D	PUMP CONTROL	WELCOME PUMP NO. 3	COMMON FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-303G	VALVE CONTROL	WELCOME PUMP NO. 3	VALVE OPEN INDICATING LIGHT	0=NOT, 1=OPEN	2
YI-303H	VALVE CONTROL	WELCOME PUMP NO. 3	VALVE CLOSED INDICATING LIGHT	0=NOT, 1=CLOSED	2
YI-303I	VALVE CONTROL	WELCOME PUMP NO. 3	VALVE FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
HS-304	PUMP CONTROL	WELCOME PUMP NO. 4	HAND-OFF-REMOTE SELECTOR SWITCH		2
YI-304A	PUMP CONTROL	WELCOME PUMP NO. 4	PUMP RUNNING INDICATING LIGHT	0=NOT, 1=RUNNING	2
YI-304B	PUMP CONTROL	WELCOME PUMP NO. 4	PUMP STOPPED INDICATING LIGHT	0=NOT, 1=STOPPED	2
YI-304D	PUMP CONTROL	WELCOME PUMP NO. 4	COMMON FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
YI-304G	VALVE CONTROL	WELCOME PUMP NO. 4	VALVE OPEN INDICATING LIGHT	0=NOT, 1=OPEN	2

TAG	SERVICE	LOCATION	DESCRIPTION	SCALE	NOTES
YI-304H	VALVE CONTROL	WELCOME PUMP NO. 4	VALVE CLOSED INDICATING LIGHT	0=NOT, 1=CLOSED	2
YI-304I	VALVE CONTROL	WELCOME PUMP NO. 4	VALVE FAULT INDICATING LIGHT	0=ALARM, 1=NOT	2
PIT-401	DISCHARGE PRESSURE	WELCOME PUMPS	PRESSURE IND. TRANSMITTER	0-250 PSI	
FIT-401	DISCHARGE FLOW	WELCOME PUMPS	MAGNETIC FLOW IND. TRANSMITTER	0-10,000 GPM	
DPIT-401	SURGE TANK LEVEL	WELCOME SURGE TANK	DIFFERENTIAL PRESSURE TRANSMITTER	0-150 PSI	5
ZS1	INTRUSION ALARM	WEST SIDE SINGLE DOOR	INTRUSION SWITCH	0=ALARM, 1=NOT	
ZS2	INTRUSION ALARM	WEST SIDE DOUBLE DOOR	INTRUSION SWITCH	0=ALARM, 1=NOT	
ZS3	INTRUSION ALARM	EAST SIDE SINGLE DOOR	INTRUSION SWITCH	0=ALARM, 1=NOT	
SD-101	PUMP STATION SMOKE	ABOVE ELECTRICAL GEAR	SMOKE DETECTION	0=ALARM, 1=NOT	
TIT-101	TEMPERATURE	PUMP ROOM	TEMPERATURE INDICATING TRANSMITTER	-0 deg F to 120 deg F	

NOTES:

1. DEVICE PROVIDED WITH PROCESS EQUIPMENT.
2. DEVICE PROVIDED AS PART OF MOTOR CONTROL CENTER
3. EXISTING DEVICE TO BE REPLACED.
4. DEVICE PROVIDED WITH MOTOR
5. DEVICE PROVIDED WITH SURGE TANK
6. DEVICE IS EXISTING TO REMAIN AS IS AND CONNECTED TO NEW CONTROL PANEL

SECTION 17701

MAGNETIC FLOW METERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the magnetic flow meters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17700 – Powered Instruments, General

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Furnish one spare signal converter.

PART 2 -- PRODUCTS

2.01 MAGNETIC FLOW METER SYSTEMS

- A. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.
- B. Each meter shall be furnished with a 316 stainless steel or carbon steel metering tube and carbon steel flanges with a polyurethane, ceramic, neoprene, hard rubber, or Teflon liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be provided on all flow tubes.
- C. The flow tube shall be provided with flush mounted electrodes.
- D. Grounding rings shall be provided for both ends of all meters.
- E. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.

- F. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65°C. Meter and transmitter housings shall meet NEMA 6P/IP68 requirements as a minimum. The flow tube assembly shall be rated NEMA 6P/IP68 and electronics shall be factory sealed against moisture intrusion.
- G. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.
- H. The transmitter's preamplifier input impedance shall be a minimum of 10^9 - 10^{11} ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.
- I. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.
- J. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An output hold feature shall be provided to maintain a constant output during configuration changes.
- K. The transmitter shall be capable of communicating digitally with a remote configuration device via a frequency-shift-keyed, high frequency signal superimposed on the 4-20 mA output signal. The remote configuration device shall be capable of being placed anywhere in the 4-20 mA output loop. The remote configuration device shall be as specified under Section 17700. A password-based security lockout feature shall be provided to prevent unauthorized modification of configuration parameters.
- L. Accuracy shall be 0.30% of rate over the flow velocity range of 1.0 to 10.0 m/s (3.0 to 33 ft/sec) and 0.5% between 0.1 m/s and 1.0 m/s (1-3 ft/s). Repeatability shall be $\pm 0.1\%$ of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50°C. Power supply shall be 115 VAC, 60 Hz.
- M. Flow tubes shall be 150-lb flange mounted unless otherwise noted. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted integrally on flow tube, wall, or 2-inch pipe mounted as shown in the Drawings and/or as specified.
- N. Magnetic flow meter systems shall be Model 8750W with optional high accuracy as manufactured by Rosemount, or equivalent by ABB, Endress + Hauser, Foxboro, Krohne, Siemens, Toshiba or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Ground magnetic flow meter flow tubes and grounding rings in strict accordance with the manufacturer's recommendations.
- B. Refer to Section 17700, Part 3, for further requirements.

- END OF SECTION -

APPENDIX A

OWNER-FURNISHED VERTICAL PUMP INFORMATION

Charles R. Underwood Inc.

Municipal Pump Sales & Service

2000 Boone Trail Road
Sanford, North Carolina 27330

Phone: (919) 775-2463

Fax: (919) 708-7232

February 9, 2016

Quote # CP-020916

Project: Hyattown Pump Station

Owner: Davidson Water, Inc.

Engineer: Hazen and Sawyer

Notes:

- **CRU, Inc. is providing equipment per Specification Sections 11120 and 15170**
- **Price does not include any items not listed below**

Bid Item #1 – Glen Anna Pumps

Conditions: 1,545 GPM @ 300' TDH

- 4 EA – Underwood Vertical Turbine Pumps w/ Layne 14RL Bowl Assembly, Cast Iron Bowls, Cast Iron Suction Bell, Aluminum Bronze Bowl Wear Ring, 316 SS Keyed Impellers, Aluminum Bronze Impeller Wear Ring, Impeller Statically and Dynamically Balanced, Bronze Bowl Bearings, 416 SS Bowl Shaft, Bowl ID Coated w/ Scotchkote 134, Bowl OD Coated w/ Tnemec Series 140, Standard Underwood Pump Warranty (24 months from start-up)
- 4 EA – 316 SS Basket Strainer w/ Anti-Vortex Vanes
- 4 EA – 200 HP Vertical Hollow Shaft US Motor, 1,800 RPM, 460 Volts, 3 Phase, 60 Hz, H445TPA Frame, WP1 Enclosure, Premium Efficiency, Non-Reverse Ratchet, Special Balance, Steel Conduit Box, Grounding Lug, Class F Insulation, Extended Warranty (60 months from start-up, 66 months from shipment)
- 4 EA – 16" Fabricated Steel Three Piece Mitered Discharge Head with a Cast Iron Water Flush Packed Stuffing Box, 150 LB Flange, Coated ID/OD with Tnemec Series 140 Epoxy Coating
- 12" Flanged Column Pipe Schedule 40 ASTM Grade 53 B, Max Length: 5', Bronze Bearing Retainers w/ Rubber Bearings, Coated ID/OD with Tnemec Series 140 Epoxy Coating
- 1-1/2" 416 SS line Shafting with Replaceable 304 SS Shaft Sleeves
- 5 EA – 36" Fabricated Steel Pump Cans, Length: 239", 54" Square Top Plate, Top Plate and Bottom Plate Thickness: 2.25", 24" Suction Flange, 150 LB Connections, Straightening Vanes, Anti-Vortex Cross, Leveling Brackets, O-Ring Groove, Coated ID/OD with Tnemec Series 140 Epoxy Coating
- 4 EA – 3 Piece Coupling
- 316 SS Hardware for Pump Cans, Discharge Heads, Column Pipe, and Bowls
- Air Release/Vacuum Valves and Pressure Gauges
- Lid for Spare Pump Can
- Synthetic Motor Oil for Electric Motors
- Hydrostatic Testing – Pump Cans, Discharge Heads, and Column Pipe
- Non-Witnessed Performance Testing – Pump Assembly and Electric Motors
- Can Installation Inspection Services – Installation by others
- Pump and Motor Installation
- Pump Start-Up and Training
- Field Testing
- Vibration Testing
- O&M Manuals
- Freight
- Storage of materials until delivery is required
- Applicable Taxes – 7%

Charles R. Underwood Inc.

Municipal Pump Sales & Service

2000 Boone Trail Road
Sanford, North Carolina 27330

Phone: (919) 775-2463

Fax: (919) 708-7232

Bid Item #2 – Welcome Pumps

Conditions: 1,717 GPM @ 238' TDH

- 4 EA – Underwood Vertical Turbine Pumps w/ Layne 14RL Bowl Assembly, Cast Iron Bowls, Cast Iron Suction Bell, Aluminum Bronze Bowl Wear Ring, 316 SS Keyed Impellers, Aluminum Bronze Impeller Wear Ring, Impeller Statically and Dynamically Balanced, Bronze Bowl Bearings, 416 SS Bowl Shaft, Bowl ID Coated w/ Scotchkote 134, Bowl OD Coated w/ Tnemec Series 140, Standard Underwood Pump Warranty (24 months from start-up)
- 4 EA – 316 SS Basket Strainer w/ Anti-Vortex Vanes
- 4 EA – 200 HP Vertical Hollow Shaft US Motor, 1,800 RPM, 460 Volts, 3 Phase, 60 Hz, H445TPA Frame, WP1 Enclosure, Premium Efficiency, Non-Reverse Ratchet, Special Balance, Steel Conduit Box, Grounding Lug, Class F Insulation, Extended Warranty (60 months from start-up, 66 months from shipment)
- 4 EA – 16" Fabricated Steel Three Piece Mitered Discharge Head with a Cast Iron Water Flush Packed Stuffing Box, 150 LB Flange, Coated ID/OD with Tnemec Series 140 Epoxy Coating
- 12" Flanged Column Pipe Schedule 40 ASTM Grade 53 B, Max Length: 5', Bronze Bearing Retainers w/ Rubber Bearings, Coated ID/OD with Tnemec Series 140 Epoxy Coating
- 1-1/2" 416 SS line Shafting with Replaceable 304 SS Shaft Sleeves
- 5 EA – 36" Fabricated Steel Pump Cans, Length: 239", 54" Square Top Plate, Top Plate and Bottom Plate Thickness: 2.25", 24" Suction Flange, 150 LB Connections, Straightening Vanes, Anti-Vortex Cross, Leveling Brackets, O-Ring Groove, Coated ID/OD with Tnemec Series 140 Epoxy Coating
- 4 EA – 3 Piece Coupling
- 316 SS Hardware for Pump Cans, Discharge Heads, Column Pipe, and Bowls
- Air Release/Vacuum Valves and Pressure Gauges
- Lid for Spare Pump Can
- Synthetic Motor Oil for Electric Motors
- Hydrostatic Testing – Pump Cans, Discharge Heads, and Column Pipe
- Non-Witnessed Performance Testing – Pump Assembly and Electric Motors
- Can Installation Inspection Services – Installation by others
- Pump and Motor Installation
- Pump Start-Up and Training
- Field Testing
- Vibration Testing
- O&M Manuals
- Freight
- Storage of materials until delivery is required
- Applicable Taxes – 7%

Charles R. Underwood Inc.

Municipal Pump Sales & Service

2000 Boone Trail Road
Sanford, North Carolina 27330

Phone: (919) 775-2463

Fax: (919) 708-7232

TOTAL PRICE FOR ALL ABOVE ITEMS: _____

Notes:

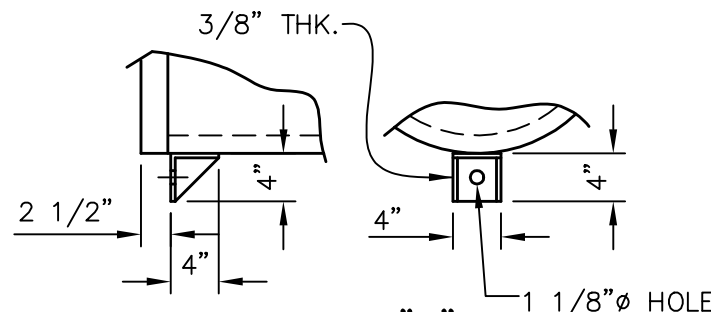
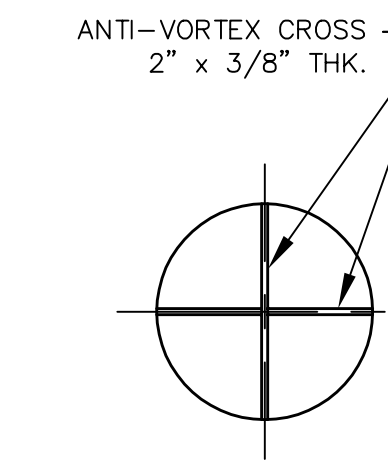
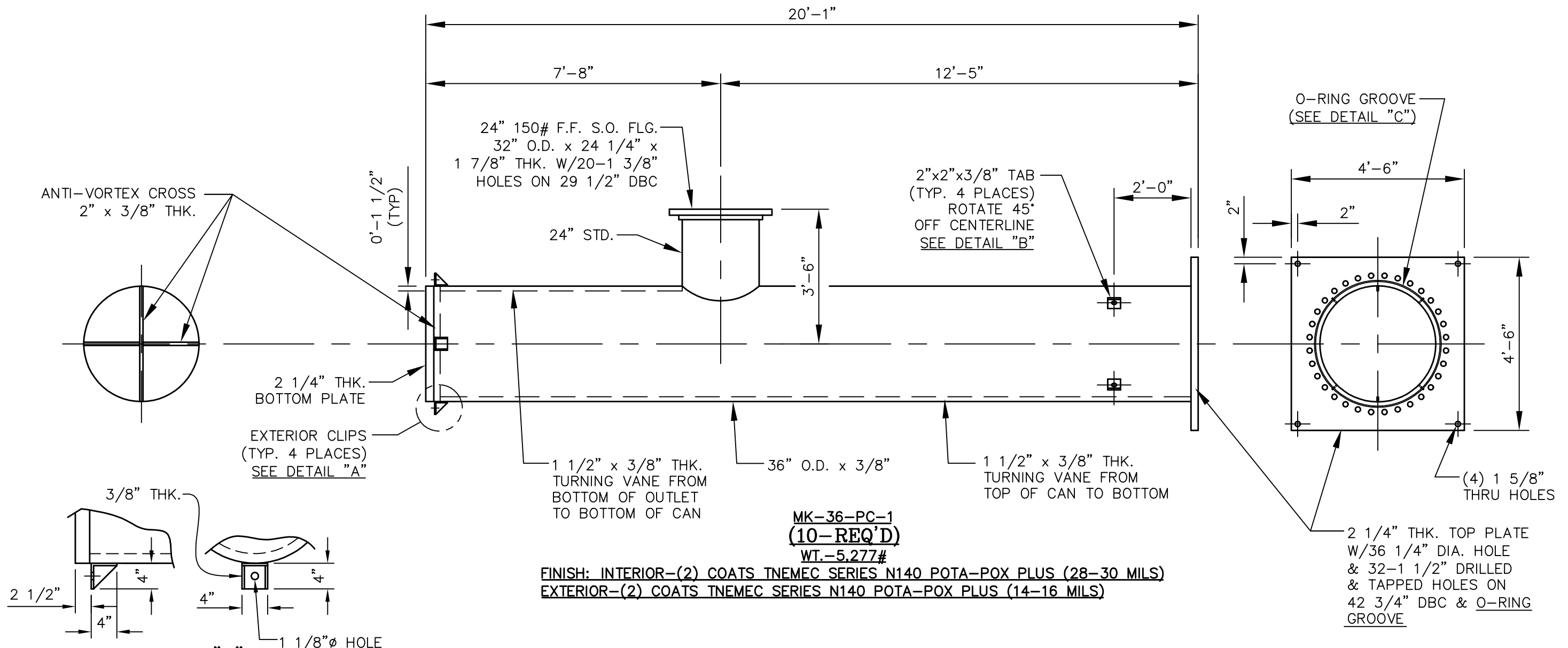
- 1. No equipment, goods or services are included unless specifically mentioned herein.**
- 2. Prices above include start-up for all pumps.**

Price includes freight to job site, unloading, and installation by CRU, Inc. See attached terms and conditions of sale. Purchase Orders shall be written as described by CRU, Inc.

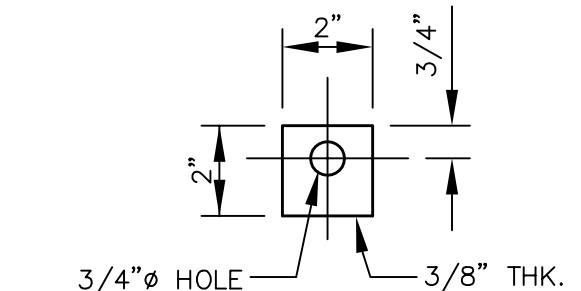
As always we appreciate the opportunity to work with you. If we can be of further service, or if you have any questions, please contact us.

Best regards,

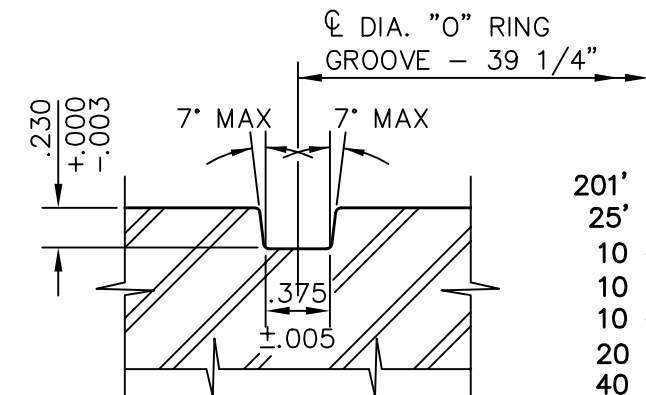
Clay Phillips
Sales Manager
(919) 775-2463
cphillips@crupumps.com



DETAIL "A"
EXTERIOR CLIPS



DETAIL "B"
TABS



DETAIL "C"
"O" RING GROOVE

MK-36-PC-1
(10-REQ'D)
WT.-5.277#
FINISH: INTERIOR-(2) COATS TNE MEC SERIES N140 POTA-POX PLUS (28-30 MILS)
EXTERIOR-(2) COATS TNE MEC SERIES N140 POTA-POX PLUS (14-16 MILS)

GENERAL NOTES

1. PUMP CANS WILL BE HYDROSTATIC TESTED AT 150 PSI FOR 5 MIN. DURATION.

BILL OF MATERIALS

- 201' - 36" O.D. x 3/8" PIPE
- 25' - 24" STD. PIPE
- 10 - 24" 150# F.F. S.O. FLG.
- 10 - 54" SQ. x 2 1/4" THK. TOP PLATE W/O-RING GROOVE
- 10 - 2 1/4" THK. BOTTOM PLATE
- 20 - 1 1/2" WIDE x 3/8" THK. TURNING VANE
- 40 - EXTERIOR CLIPS
- 40 - 2" x 2" x 3/8" THK. TABS
- 10 - 2" x 3/8" THK. ANTI-VORTEX CROSS

CHARLES R. UNDERWOOD, INC. SANFORD, NC		
DAVIDSON WATER, INC. HYATTOWN PUMP STATION		
36" PUMP CAN DRAWING		
REV.	DATE	REMARKS
	ENGINEER	CONTRACTOR
	HAZEN AND SAWYER	
	DRAWN BY	DATE
	K. ROWLAND	2/23/16
	SCALE	CUSTOMER P.O. NO.
	3/8"=1'-0"	14743
	T.M.F. DRAWING NO.	
	16-026 1 OF 1	



Series 33A

Sizes ~~1"~~ - ~~2"~~ - ~~3"~~ - ~~4"~~ - ~~6"~~

High Performance Combination Air Release & Vacuum Breaker Valve



Threaded



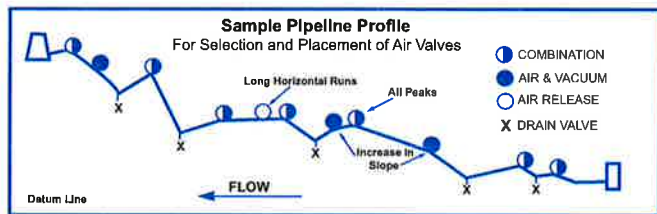
Flanged

- Standard Maximum Operating Pressure 300 psi
- Standard Epoxy Coated Ductile Iron Body
- Automatically Eliminates Air Pockets
- Easily Serviced Without Removal from System
- Engineered For Lasting Service

Designed to protect pipelines and vertical turbine pump applications from air lock and vacuum collapse, the Cla-Val Model 33A High Performance Combination Air Release and Vacuum Breaker Valve eliminates air and prevents vacuum formations in pipelines. A large venting orifice and large float clearances freely exhaust or admits air during pipeline filling or draining.

During normal pipeline operation, air accumulation and buoyancy cause the float ball to lower or lift. As the water level lowers inside the valve, small amounts of accumulated air are released through the small orifice. Once air is released, the float poppet system closes drip tight.

Valve servicing is simple because the entire float poppet system can be replaced without removal of the valve body from the pipeline.



Typical Applications

- Transmission Pipeline High Points
- Water Treatment Plant Piping High Points
- Vertical Turbine Pump Discharge

Installation

Series 33A Combination Air Release and Vacuum Breaker Valves are typically installed at high points in pipelines for air release, or at anticipated pipeline vacuum occurrence locations. Install Series 33A at regular intervals (approximately 1/2 mile) along uniform grade line pipe. Mount the unit in the vertical position on top of the pipeline, and include an isolation/shutoff valve.

Series 33A is often installed upstream of check valves in pump discharges to vent air during start-up and to allow air reentry when the pump stops.

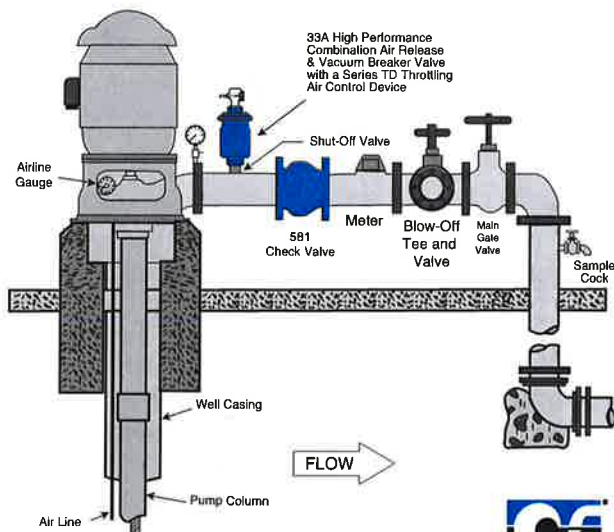
Operation

Air Release Mode— Valve is normally open.

When line is filled or pump started, air is exhausted through the normally open 33A valve. As liquid fills the valve, float ball rises to form a drip-tight closure and remaining air is exhausted through small orifice.

Vacuum Prevent Mode When line pressure drops below positive pressure and the liquid level lowers, the float drops, unseating the valve and allowing air into the line, thus preventing a vacuum.

Note: Available for Sea Water Service See Material Specifications



Dimensions (In Inches)

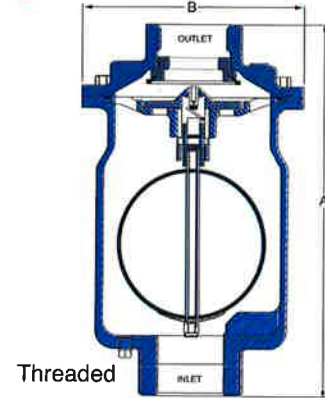
MODEL 33A - 1", 2", 3", 4" and 6" Sizes

Valve Size	33A Pressure Class 300 Lb Threaded				33A Pressure Class 150 Lb Flanged (INLET)			
	1"	2"	3"	4"	2"	3"	4"	6"
A	9.10	12.44	12.75	12.75	13.88	16.56	16.75	16.38
B	6.25	7.50	9.00	9.00	7.50	9.25	9.25	11.00
E	—	—	—	—	.62	.75	.94	1.00
Inlet (ANSI)	1" NPT	2" NPT	3" NPT	4" NPT	2"	3"	4"	6"
Outlet (NPT)	1" NPT	2" NPT	3" NPT	4" NPT	2"	3"	4"	6"
Number of Holes	—	—	—	—	4	4	8	8
Diameter of Bolts	—	—	—	—	.63	.63	.75	.75
Shipping Wt. (Lb.)	25	29	38	40	39	48	50	70

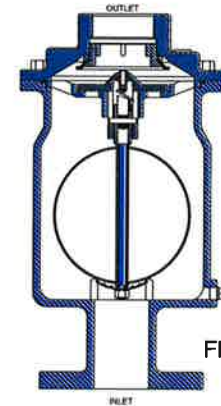
Pressure Ratings

Valve Size	Orifice Dia.	Standard Maximum Pressure	Materials of Construction
1"	.076"	300 psi	• Epoxy Coated Ductile Iron ASTM A536 65-45-12
2"	.076"	500 psi	• Epoxy Coated Cast Steel ASTM A 216WCB
3" & 4"	.125"	300 psi	• ASTM B61 Naval Bronze
3" & 4"	.076"	300 psi	• ASTM B 148 NI Aluminum Bronze
6"	.076"	300 psi	• 316 Stainless Steel
			• Duplex Stainless Steel
			• Super Duplex Stainless Steel

Note: Higher Pressures Available upon Request for sizes 3" & 4"



Threaded



Flanged

Specifications

Standard Internals

Float: Stainless Steel 304SS Standard, T316 or Monel optional (extra cost)

Balance internals parts Stainless Steel and Delrin

Seals Nitrile Rubber or Viton® (extra cost)

When Ordering, Please Specify

1. Catalog No.
2. Valve Size
3. Pressure Rating
4. Materials

Temperature Range

Water to 180° F

Optional:

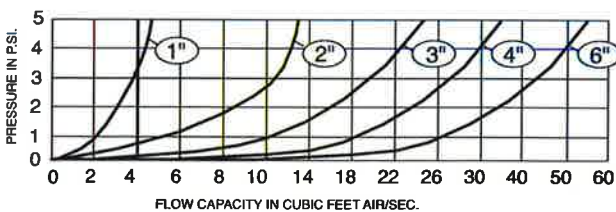
1. Well Service Throttling Device - Model TD

Valve Sizing Selection

Large Orifice Air-Vacuum Capacity

Determine anticipated water flow and allowable pressure differential for the pipeline application. Select valve from chart to exhaust or admit air at the same rate as water filling or draining (in CFS). For larger flows, two or more Model 33A's may be installed in parallel

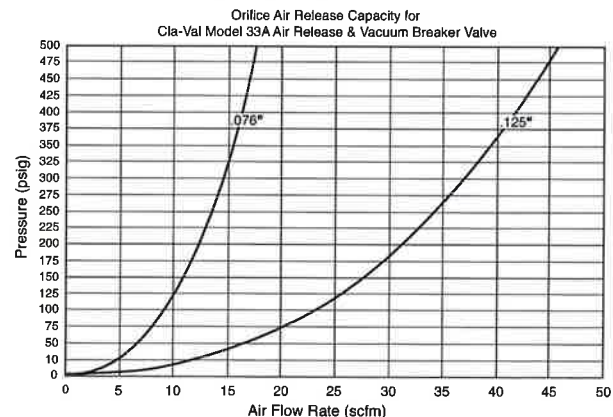
Large Orifice



Note: For sizing made easy request:
Cla-Val Selector Slide Rule

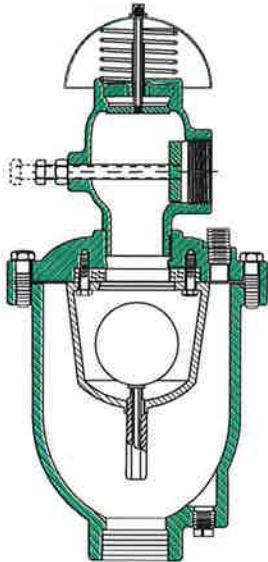
Small Orifice Capacity

During pressurized pipeline operation, small pockets of entrapped air will be released through the float actuated 0.076 or .125 inch orifice. Use chart to determine discharge capacity.

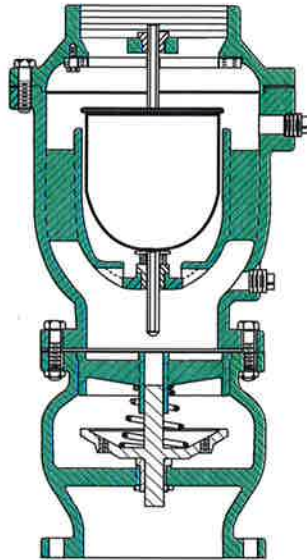




AIR AND VACUUM VALVES FOR VERTICAL TURBINE (WELL SERVICE) PUMP STATIONS AND PIPELINE SERVICE



1/2" - 3"



4" and Larger

- Stainless Steel T316 Trim Standard
- Stainless Steel T316 Floats Guaranteed
- Air Throttling Device (Double Port)
- Arrestor Check Device (Anti-Shock)
- 100% Vacuum Protection - No Restrictions
- Engineered For Drip Tight Seal At Low Pressures

Series 37 Well Service Air Valves regulate air discharge from the pump column to prevent shock and air entering the system with each start. Conversely with each pump stop, full flow unrestricted air, is allowed back into the column preventing vacuum forming, which can damage pump seals, but also to prevent the pump restarting against a full head in the column because vacuum will prevent the pump column to drain. Under this condition severe damage to the pump, controls and piping can occur.

All the preceding is accomplished by means of a unique air throttling device (double port) and an arrestor check with built in anti-shock feature.

Well service air vacuum valves, once closed and pressured do not open to air release under pressure.

See series 34 Air Release Valves page 5.

Installation

The Series 37 Well Service Valve is typically installed between the pump discharge and check valve. Mount the unit in the vertical position on top of the pipeline with an isolation valve installed below the valve in the event servicing is required. Provide adequate air venting inside the pump station and from air valve vaults on pipelines.

General Specifications

Sizes

1/2", 1", 2", 3" Threaded Inlet
with double port throttling device
~~4" through 16"~~

125 lb. flanged Inlet or
250 lb. flanged Inlet
with arrestor check

Pressure Ratings

150 psi
300 psi
specify when operating pressure
below 10 PSI

Temperature Range

Water to 180°F

Materials:

Body and Cover:
Cast Iron ASTM
A 126, Class B

Float:

Stainless Steel T316

Air Valve Internal Parts:

Stainless Steel T316

Arrestor Check:

Stainless/Bronze

Seal:

Buna-N® Rubber

Design / Purchase Specifications

The Well service air valves shall automatically exhaust large quantities of air in the pump column during pump start-up and allow air to re-enter the column during pump shut-down. The air valve shall be designed for installation between outlet of vertical turbine pumps and the inlet of the pump check valve.

The inlet and outlet area of the air valve shall be equivalent to the valve pipe size same cross-section area. The valve shall have NPT Threaded or ANSI Flanged inlet and outlet. The float shall be guided by a hexagonal stainless steel guide shaft and seal drip-tight against a synthetic rubber seal. 4" and larger valve float shall be double guided and a protective steel discharge hood provided.

The float shall be of all stainless steel construction and capable of withstanding maximum system surge pressure without failure. The body and cover shall be concentrically located and of cast iron and the valve all internal parts shall be T316 stainless steel with Buna-N® rubber seat.

1/2", 1", 2" and 3" Well Service Air Valves to be supplied with a double ported throttling device to regulate the discharge of air from the pump column to prevent shock to the pump with each start. 4" and larger well service valves to be supplied with an arrestor check to prevent shock to the pump with each pump start. All Well Service Air Valves shall allow full un-restricted air flow into the pump column, to prevent any vacuum from forming, with each pump stop.

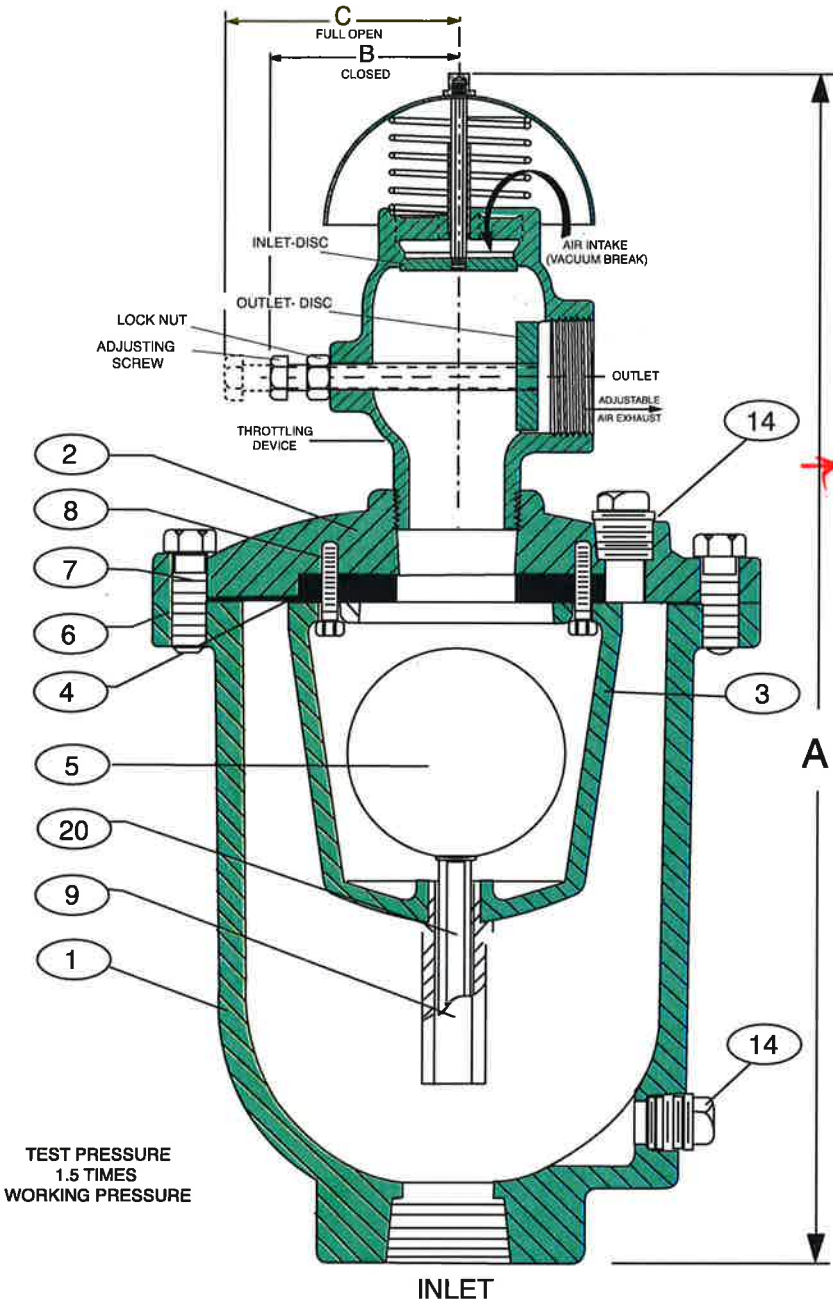




1/2" thru 3"

Series 37

Air And Vacuum Valves with Double Port Throttling Device (For Well Service)



TEST PRESSURE
1.5 TIMES
WORKING PRESSURE

Model 37 Well Service Valves

No Head Pump Capacity GPM	Model No.	Valve Size	A	Major Diameter	WT.
	300 MWP				
0-350	370-WS	1/2"	18"	7"	16
351-1350	371-WS	1"	22"	9 1/2"	26
1351-4000	372-WS	2"	29 1/2"	12"	50
4001-7000	373-WS	3"	31 1/2"	12"	60

Detail No.	Part Name	Material
1	Body	Cast Iron ASTM A126, Class B
2	Cover	Cast Iron ASTM A126, Class B
3	Baffle	Ductile Iron ASTM A536-51T
4	Seat	Buna-N®
5	Float	Stainless Steel T316 ASTM A276
6	Gasket	Garlock #3000 (Non-Asbestos)

Detail No.	Part Name	Material
7	Cover Bolt	Alloy Steel ASTM A449, Grade 5
8	Retaining Screw	Stainless Steel T316 ASTM A276
9	Guide Bushing	Stainless Steel T316 ASTM A276
14	Pipe Plug	Malleable Iron
20	Guide Shaft	Stainless Steel T316 ASTM A276

Note: Manufactured to meet ANSI/AWWA C512-04

SECTION 11120

VERTICAL TURBINE PUMPS – MODIFIED RADIAL FLOW

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Manufacturer shall furnish all equipment, motors, anchorage systems, and incidentals required to install, test, and place into operation complete vertical turbine pumps in coordination with the Installation Contractor.
- B. For the purposes of this Section, “Manufacturer” shall mean the designer, manufacturer, supplier and tester of the pump equipment, including selection and assembly of motor. The Manufacturer shall have sole-source unit responsibility for the design, coordination, installation, testing, and satisfactory performance of all the components.
- C. For the purposes of this Section, “Installation Contractor” shall mean the construction contractor retained by the Owner to construct the Hyattown Pumping Station which will incorporate the equipment furnished by the Manufacturer. The Installation Contractor shall provide all supports, stiffeners, etc., that may be required to provide systems that operate reliably and within tolerances and vibration limits specified by the Manufacturer.
- D. The Manufacturer shall have unit responsibility for coordinating the proper pump mounting system with the Installation Contractor to ensure a vibration free, stable pump operation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. 15170 – Low-Voltage Electric Motors

1.03 SUBMITTALS

- A. Each submittal shall be transmitted with five (5) copies, and be submitted as a single complete package for the pumping equipment, including all ancillary components, by the Manufacturer.
- B. Submit Performance Affidavit for pumping equipment being furnished.
 - 1. By these affidavits, the Manufacturer must certify to the Owner that he has examined the specifications accompanying the Owner’s purchase order and that the pumping equipment he offers to furnish will meet in every way the performance requirements set forth or implied in the specifications.
 - 2. Transmit three (3) original copies of the affidavit along with the initial shop drawings.
 - 3. The Performance Affidavit shall be signed by an officer of the Manufacturer and witnessed by a notary public.

4. The Performance Affidavit shall have the following format:

Addressed to: Davidson Water, Incorporated

Reference: Hyattown Pumping Station

Text: (Manufacturer's Name) has examined the specifications accompanying Purchase Order No. _____ from Davidson Water, Incorporated, and hereby states that the pumping equipment meets in every way the performance requirements set forth or implied therein.

Signature: Corporate Officers shall be Vice President or higher, unless statement authorizing signature is attached.

- C. Submit the following items with the Pump shop drawings:

1. Performance Affidavit
2. Manufacturer's literature, data sheets, fabrication information, installation instructions, assembly views.
3. Pump performance curves at rated speed. Curves shall indicate flow, head, efficiency, brake horsepower, NPSH required, and minimum submergence. Curves shall include limits (minimum and maximum) for stable operation without cavitation, overheating, recirculation, and excessive vibration. Curves shall be for the entire pump assembly, including efficiency corrections and losses.
4. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.
5. General cutaway sections, materials, and dimension for 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.
6. Impeller and shaft diameter, including connection details.
7. Identify each component by tag number to which the catalog data and detail sheets pertain.
8. Certified installation drawings showing all details of construction, dimensions, and anchor bolt requirements.
9. The weight of each component, and total static and dynamic loads imparted by the equipment to the supporting structure.
10. Complete motor data including size, make, type and characteristics along with wiring diagrams.
11. Downthrust versus capacity curve and upthrust value when pump is started.
12. Description of coating system, surface preparation and shop painting, including

certification that the shop paint is compatible with the finish paint.

13. Lateral critical speed calculations and comparison to operating speed.
 14. Spare parts list and manufacturer recommended spare parts.
 15. Complete lubrication instructions and lubricant schedule, including manufacturers of recommended lubricants. All lubricants shall be Food-Grade, NSF61 approved. Schedule shall include frequency of lubricant application, type of lubricant, and instructions regarding lubricant application.
 16. Details of the shaft sealing system.
 17. Written documentation of equipment pre-installation storage recommendations.
- D. Submit the following items with the pump can shop drawings:
1. Materials of construction and associated specifications (such as AISI, ASTM, SAE, etc.), including grade and type.
 2. Certified installation drawings showing all details of construction, dimensions, and anchor bolt requirements.
 3. The weight of the can.
 4. Positive pressure and vacuum ratings.
 5. Description of coating system, surface preparation and shop painting, including certification that the shop paint is compatible with the finish paint.
- E. Submit results of factory tests, field tests, and start up reports.
- F. Submit 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 one (1) electronic copy 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 weeks prior to equipment start-up.

1.04 WARRANTY AND GUARANTEE

- A. Warranty and guarantee shall be 24-months for the pumping equipment and 60-months for the motors from the date of acceptance by the Owner after start-up, testing run-in period, and certification has been successfully completed.

1.05 DEFINITIONS

- A. Terms shall be as defined in ANSI / AWWA E103 Standard for Horizontal and Vertical Line-Shaft Pumps.
- B. Additional terms are defined below:
 1. Submergence: Vertical distance in feet between the pumping water level and the bottom of the first stage impeller.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All equipment for the pumps, including motors, cans, and bases, shall be provided as a complete unit by the pump Manufacturer. The pumps, and components thereof, shall be uniform in manufacturer and model within each pumping service.
- B. Provide guards in accordance with OSHA requirements for all rotating assemblies that would otherwise be exposed at the operating deck level.
- C. All equipment shall be suitable for potable water service, continuous operation (24 hours per day, 365 days per year).
- D. Provide access to couplings and oil drains.
- E. Anchor bolts and baseplates shall be provided and set per the requirements of the

Manufacturer. The Manufacturer shall supply templates for setting the anchor bolt layout.

- F. All anchor and assembly bolts, washers, and fasteners shall be Type 316 stainless steel. Nuts shall be brass.

2.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

- A. When operating at the maximum output speed each pump shall have a characteristic performance curve which meets all the minimum conditions listed in the pump schedule. The pumps and drive motors shall be capable of operating satisfactorily under the full-range of speed, flow and pressure conditions as defined by the pump schedule. Pump efficiency and total head as defined herein shall include all losses from the pump intake suction bell to the pump discharge flange. Losses through blank bowls (if any) for initial conditions shall also be considered.
- B. The impeller diameter required for the specified operating conditions shall not exceed 95% of the maximum impeller diameter for the pump provided to provide flexibility in meeting specified head within required tolerance and allow increased duty for future conditions.
- C. Primary and secondary operating flows shall be between -15% and +7.5% of the flow rate corresponding to the best efficiency point (BEP).
- D. Pump Operating Conditions

	Description	Glen Anna Pumps	Welcome Pumps
1	Pump Identification Numbers	GAP-1; GAP-2; GAP-3; GAP-4	WP-1; WP-2; WP-3; WP-4
2	Number of Units	4	4
4	Nominal Pump Operating Speed (rpm)	1,800	1,800
5	Number of Stages	4	3
6	Primary Operating Point: a. Flow (gpm) b. Total Head (feet) c. Minimum Pump Efficiency (%)	a. 1,545 b. 30 c. 80%	a. 1,770 b. 238 c. 82%
7	Secondary Operating Point: a. Flow (gpm) b. Total Head (feet) c. Minimum Pump Efficiency (%)	a. 1,900 b. 240 c. 82%	a. 1,962 b. 216 c. 82%
8	Maximum Operating Point: a. Flow (gpm) b. Total Head (feet)	a. 2,308 b. 134 c. 65%	a. 2,450 b. 130 c. 70%

	c. Minimum Pump Efficiency (%)		
9	Maximum NPSH Required at Maximum Operating Point at centerline of impeller of first stage (feet)	25	29
10	Maximum NSPH Available at Maximum Operating Point at centerline of impeller of first stage (feet)	40	40
11	Maximum Shut Off Head (feet)	478	405
12	Motor Type	Hollow Shaft	Hollow Shaft
13	Power Supply	480 V, 3 phase, 60 Hz	480 V, 3 phase, 60 Hz
14	Fluid Pumped	Drinking Water	Drinking Water
15	Fluid Temperature (degrees F)	68	68
16	Fluid Specific Gravity	1.0	1.0
17	Fluid pH range	6.5 – 8.5	6.5 – 8.5
18	Fluid Viscosity (absolute centipoises at 60 degrees F)	1.129	1.129

E. Pump and Can Dimensions

Dimension Description	Glen Anna Pumps	Welcome Pumps
Pump Can Diameter (inches)	36	36
Pump Can Suction Pipe diameter (inches)	24	24
Pump Column Diameter (inches)	12	12
Discharge Diameter (inches)	16	16
Can Flange to Suction Bell Length (inches)	221	221
Can Flange to Bottom of Can (inches)	239	239
Can Flange to Can Suction Centerline (inches)	149	149

2.03 DISCHARGE HEAD

- A. The discharge head shall have bolted register or rabbet-fit connections for the motor. Discharge head shall have connections for the pump column and shall support the loadings that it imposes as well as hydrostatic and hydrodynamic heads.
- B. Design columns and discharge heads for 100% of the pump discharge pressure (suction pressure plus pump differential pressure) at shutoff. Hydrostatically test columns and discharge heads at 130% of design pressure.
- C. Access to the stuffing box shall be through windows placed 90 degrees from the discharge. Fit handholes or windows with stainless steel, expanded metal guards in stainless steel frames to protect the exposed shaft and coupling.
- D. The discharge head base and outlet pipe shall be Class 150 flanges, complying with ANSI B16.5. If cast iron discharge heads are specified, flange shall be Class 125.
- E. Discharge outlet flange shall not protrude past the outer edge of the can top plate.
- F. Provide the following connections on the discharge head:

Connection	Location	Size and Type
Relief Port Drain Discharge	Discharge Head Base	¾-inch NPT
Pressure Gauge ³	Discharge Head Base	½-inch NPT
Air Release/Vacuum Valve ³	Discharge Head Base	1-inch NPT
Spare Tap	Discharge Head Base	¾-inch NPT
Stuffing Box Relief Port Drain	Discharge Head	¾-inch NPT
Stuffing Box Leak Drain	Discharge Head	¾-inch NPT
Manual ball valve ¹	Discharge Outlet	½-inch NPT
Spare Tap ²	Discharge Outlet	½-inch NPT
Spare Tap	Discharge Outlet	1-inch NPT

1 – Compatible with Owner's portable pressure gauge

2 – Connection for future pressure transducer

3 – Valve/instrument shall be furnished by Manufacturer but installed by Installation Contractor

2.05 PACKING WITH LANTERN RING

- A. The discharge head shall include a cast iron lineshaft stuffing box. Lineshaft stuffing box housing shall contain a bronze bearing, bypass water passage to the bearing terminating in a bronze lantern ring or an annular port for relieving pressure on the stuffing box. The lantern ring shall be opposite a grease fitting for lubricating the packing. The bypass line shall contain a throttling valve for adjusting the leakage rate at the gland. The stuffing box shall be equipped with a minimum of six (6) rings of packing. Packing shall be braided graphite containing 97% graphite.
- B. Packing gland shall be Type 316 Stainless Steel, split type secured using at least two stainless steel packing studs.
- C. Bronze bearings length shall be a minimum of 2.5 times the shaft diameter.

2.06 COLUMN

- A. Column pipe section joints shall be flange.

- B. Column pipe flanges shall be welded inside and out. Minimum finished flange thickness shall be 1.25 inches.
- C. First column section above bowl assembly shall not be longer than 5 feet. First column section below discharge head shall not be longer than 5 feet.

2.07 SHAFTS

- A. Shafting shall be polished over its full length. Support the shafting by bearings at intervals of 10 feet or less. The shaft diameter shall be the size calculated using the formulas given in AWWA E103 for the pump shutoff head.
- B. Shafts shall be supported by no fewer than three bearings (not including stuffing box bushing). Lineshaft bearings shall be supported by bearing retainers of the material listed in the subsection on "Pump Materials of Construction" and clamped between column pipe flanges for open lineshaft pumps.
- C. Shaft couplings for shaft diameters 2 inches or larger shall be of the key and thrust-ring types or other nonthreaded design.
- D. Hollow shaft motors shall be provided with a shaft adjusting nut. Provide two-piece top shafts.

2.08 BOWL ASSEMBLY

- A. Each bowl assembly shall consist of the discharge case, impeller, impeller shafting, and a bearing above the impeller. A bearing below the first stage impeller shall be located in the suction case or bell.
- B. Pump bowls shall be of the material listed under the subsection on "Pump Materials of Construction". Bowls shall be sufficiently rigid to prevent adverse changes in bearing alignment and to maintain the running clearances of seal rings. Bowls shall be flanged with male and female rabbets for joining to the suction bell and the discharge column. Waterways and the diffusion vanes shall be smooth and free from nodules, bumps, and dips. Provide the bowls with a renewable wear ring adjacent to the impeller, made of materials as indicated under "Pump Materials of Construction". Cast iron bowls shall be internally lined with vitreous enamel or coated with 12 mils of fusion bonded epoxy. All fusion bonded epoxy shall be heat-cured.
- C. The impeller shaft stick up shall not exceed 12 inches.
- D. The bowl assembly shall be fitted with an anti-vortex basket.

2.09 SUCTION BELL

- A. The suction bell shall have, as an integral part, vanes supporting a central hub in which the bottom bearing is carried below the impeller. The outer suction bell entrance shall be at least the size of the maximum pump bowl dimension and as much larger as is practical. Maximum entrance velocity shall not exceed 5 fps based on the outside diameter of the suction bell. The contour between the outer edge and the impeller suction eye shall be smooth, continuous, and bell shaped.

2.10 IMPELLERS

- A. Pump impellers shall be of the enclosed type, cast in one piece of the material listed in the subsection on "Pump Materials of Construction". Impellers shall incorporate a close fitting annular clearance with the case at the suction eye and be equipped with replaceable wear rings. Impellers shall be positively secured to the shaft in such a manner that they cannot become loose under any operating condition or under reverse rotation or torque. For pumps having bowl diameters greater than 15 inches and all pumps with stainless steel impellers and shafts, impellers shall be keyed to the shaft and positively secured against axial movement. Dynamically balance impellers to the tolerances specified by ISO 1940-1, grade G-6.3. Provide for adjustment of the axial position of the impellers at the pump shaft connection to the motor shaft to obtain proper clearance between bowls and impellers.

2.11 VIBRATION

- A. The maximum vibration level measured on the top of the discharge head for any speed and operating point within the Preferred Operating Region shall not exceed that shown in Figure 9.6.4.2.5.16 of the Hydraulic Institute Standards as measured on the installed pump during field testing.
- B. The pump and motor assembly shall be designed so that its lateral critical speed is at least 15% above or 25% below the operating speed, assuming a rigid foundation.
- C. Provide the Installation Contractor with pump installation requirements to ensure a vibration free and stable installation.
- D. The Manufacturer shall have unit responsibility for coordinating and fabricating the proper pump mounting design. If, in the opinion of the Manufacturer, the openings or other aspects of the pump mounting design must be revised to allow for vibration free, stable pump operation, submit said revisions to the ENGINEER for review, comment and acceptance.

2.12 PUMP CAN

- A. Furnish 10 pump cans. Two (2) shall be installed for future pumps not being procured with this purchase order.
- B. Pump can shall be fabricated of the material listed in the subsection on "Pump Materials of Construction". Cans shall be designed for the maximum internal pressure of 150 psi. Cans shall also be designed to withstand full vacuum. The pressure design of the can shall meet ASME Code for Pressure Piping or Code for Unfired Pressure Vessels. The wall thickness of steel cans, shall not comply with the schedule listed in the subsection on "Pump Materials of Construction", but in no case shall be less than that of Schedule 10 pipe of equivalent diameter.
- C. Provide a flange at the top of the pump can so the pump discharge head can be bolted onto the can. Flanges shall have an O-ring groove and an EPDM O-ring. Flange face shall be flat within 0.15% of the nominal can diameter after installation to allow a tight seal with the discharge head.

- D. Can shall be equipped with straightening vanes in accordance with the Hydraulic Institute Standard ANSI/HI 9.8 for Pump Intake Design.
- E. The pump can inlet pipe flange and top flange shall be Class 150 flanges, complying with ANSI B16.5. If cast iron discharge heads are specified, flanges shall be Class 125.
- F. Provide leveling brackets the base of the can and clips at the top of the can for installation.
- G. Minimum can top plate and base plate thicknesses shall be 2.25 inches.

2.13 DISCHARGE HEAD, CAN, AND COLUMN FABRICATION

- A. Welding shall conform to the following:
 - 1. Welding procedures and performance qualifications shall be in accordance with AWWA Standards with written certification from the manufacturer.
 - 2. The minimum number of passes for welded joints shall be as follows:

Steel Cylinder Thickness (inch)	Minimum Number of Passes for Welds
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

- 3. Welds shall be full circumferential.
- B. Beveled ends for butt welding shall conform to ANSI B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding.
- C. Test the seams by the dye-penetrant method per ASTM E 165, Method B.
- D. Welded stainless steel components shall be pickled and passivated following fabrication. All surfaces shall be free of heat tint, scale and slag. Manufacturer shall provide written certification that passivation has been completed prior to shipment of equipment.
- E. Provide full penetration weld to attach the can bottom to the side wall.

2.14 PUMP MATERIALS OF CONSTRUCTION

- A. Materials of construction shall conform to the requirements listed below.

Component	Material

Component	Material
Pump shafts and line shafts	Stainless steel, Type 416
Bowl wear rings	Bronze
Bowl impellers	Aluminum Bronze ASTM B148 alloy C95200
Pump bowls, discharge case, and suction bell	Cast Iron
Impeller keys and thrust rings	Stainless steel, Type 416
Pump columns	Carbon Steel Pipe, ASTM A53, Sch 40
Pump can	Carbon Steel Pipe, ASTM A53, Sch 40
Discharge heads	Carbon Steel, ASTM A53 or A36, Sch 40
Sole plate	Carbon Steel, ASTM A36, ground finish
Sleeve bearings	Bronze, ASTM B148 alloy C95500
Lineshaft bearings	Rubber
Bearing Retainers	Bronze
Basket type suction strainer	Stainless Steel, Type 316L
Bolts, washers, and nuts	Stainless Steel, Type 316
Sand Collar	Bronze, ASTM B148 alloy C95400 or Stainless Steel Type 416
Lineshaft	Stainless Steel Type 416 with Type 304 Sleeve

B. The impeller and bowl wearing rings shall not be constructed of the same material.

Impeller and bowl wearing rings materials shall have a minimum Brinell hardness difference of 50.

2.15 ELECTRICAL MOTORS

A. The motor for the pump shall be of the vertical hollow shaft Type 1 weather-protected, squirrel cage induction type in accordance with Section 15170 – Low Voltage Electric Motors. The motor shall be designed to accept all downthrust and upthrust loads imposed by the pump during starting and running. The maximum speed and horsepower of each motor shall be as specified. The rated horsepower shall be such that the motors will not be overloaded nor the motor nameplate horsepower exceeded when the pumps are operated at any point on the pump performance curve.

B. Motor Data

Motor Data	Glen Anna Pumps	Welcome Pumps
Type	Direct Coupled – Vertical	Direct Coupled – Vertical
Horsepower	200 hp	200 hp
Voltage	460v	460v
Phase	3	3
Frequency	60 Hz	60 Hz
Speed, rpm	1800	1800
Enclosure Type	WP1	WP1
Inverter Duty	No	No
Thermal Protection	No	No
Motor Speed Control	Constant	Constant
Non-reverse ratchet	Yes	Yes
Maximum Sound at 3 feet	dBA	dBA
Space Heater	Yes, 120 V, single phase	Yes, 120 V, single phase

C. Thrust bearings and guide bearings shall be anti-friction type and oil lubricated. Bearings shall have a minimum ABMA L10 life of 100,000 hours. Water cooling of thrust bearings shall not be used.

2.16 SHOP PAINTING

A. Shop painting of pumping equipment and ancillary items shall comply with the following table.

Surface	Painting System & No. of Coats	Product Reference	Total Minimum Dry Film Thickness (mils)

Pump Can, Exterior	Polyamidoamine Epoxy	Tnemec 140	30
Pump Can, Interior	Polyamidoamine Epoxy	Tnemec Series 140	14 – 16
Column Pipe and Discharge Head, all sides	Polyamidoamine Epoxy	Tnemec Series 140	12 – 14
Bowl Assembly, Interior	Fusion Bonded Epoxy	Scotchkote 134	15
Bowl Assembly, Exterior	Polyamidoamine Epoxy	Tnemec Series 140	12 – 14

2.17 SPECIAL TOOLS AND SPARE PARTS

- A. Provide the following spare parts for each model of pump:

Quantity	Description
One	Packing Assemblies

- B. Pack spare parts in wooden boxes; label with manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained therein.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

A. Manufacturer shall be responsible for the following services:

1. Install pumps and motors, including pump delivery and off-loading. Provide a crane and operator for pump installation.
2. Inspect, and assist as required, pump can placement and alignment prior to concrete pour.
3. Provide and install plywood covers for the cans to protect the inside prior to pump installation.
4. Furnish air release/vacuum valves and pressure gauges for Installation Contractor to install.
5. Provide start-up and Owner training services.
6. Conduct pump field testing.
7. Conduct pump vibration testing.
8. Furnish pump and motor O&M manuals.
9. Furnish services of a Technical Representative as described herein.

B. During pump installation, the Manufacturer shall provide a qualified Technical Representative 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, multiple Technical Representatives shall 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 Installation 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 supervise installation and inspect the installed equipment to verify that installation is in accordance with the Manufacturer's requirements.
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 Installation Contractors 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 Installation Contractor. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment is installed properly 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 Manufacturer 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.
 - 5. Services after Startup: 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. For each pump, field services shall include the site visits in the following table. The times specified for services 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.

Service	Number of Trips per pump	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 SHOP TESTS

- A. All pumps 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 from the Manufacturer's shop until the Engineer has been notified, in writing, that the shop tests results are acceptable. The notification shall be accompanied with a certified copy of test data and interpreted results.
- C. Shop testing of electric motors shall be in accordance with applicable requirements of Section 15170, Electric Motors.
- D. One pump for each model shall be witness tested in the factory by the Owner. The remaining pumps shall be non-witness shop tested. 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.
- E. Pumps shall be within the tolerances specified for Acceptance Grade 1U, in accordance with Hydraulic Institute Standard 2.6.
- F. All tests shall be run at minimum pump submergence.
- G. All pump cans shall be hydrotested for leaks at a test pressure of 150 psi prior to delivery.

3.03 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of this specifications section shall be promptly corrected by the Manufacturer with replacements or otherwise.
- B. If the Manufacturer 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 Manufacturer to remove it from the premises at the Manufacturer's expense.
- C. The Manufacturer shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the purchase order price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Manufacturer hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment.

- END OF SECTION -

SECTION 15170

LOW VOLTAGE ELECTRIC MOTORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Manufacturer shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all low voltage electric motors as shown on the Drawings and specified herein. All pump motors shall comply with this Section unless otherwise noted.
- B. For the purposes of this Section, "Manufacturer" shall mean the designer, manufacturer, supplier and tester of the motor.
- C. For the purposes of this Section, "Installation Contractor" shall mean the construction contractor retained by the Owner to construct the Hyattown Pumping Station which will incorporate the equipment furnished by the Manufacturer.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. 11120 – Vertical Turbine Pumps – Modified Radial Flow

1.03 SERVICE CONDITIONS

- A. Unless otherwise specified, pump motors shall be suitable for operation in accordance with their rating under the following service conditions:
 - a. Ambient Temperature Range: -29 – 40 degC (-20 – 104 degF)
 - b. Maximum altitude: 1,000 meters (3,300 feet) above sea level
 - c. Indoor or outdoor installations
 - d. Full voltage, across-the-line starting

1.04 SUBMITTALS

- A. The equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Spare Parts List.
 - 3. Special Tools List.

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 Manufacturer without review for resubmittal.
- C. Shop drawings for electric motors shall be submitted as a part of the shop drawings for the driven equipment.
- D. Shop drawings for electric motors shall include:
 - a. Motor data sheets
 - b. Dimensioned drawings
 - c. Wiring diagrams (space heaters, temperature devices, etc.)
 - d. Identifying electric characteristics and design
 - e. Mechanical construction
 - f. Manufacturer's name
 - g. Type and pertinent specifications for the use intended
 - h. Manufacturer's type and frame designation
 - i. Horsepower rating
 - j. Time rating (per NEMA Standards)
 - k. Ambient temperature rating
 - l. Insulation system designation
 - m. RPM at rated load
 - n. Frequency
 - o. Number of phases
 - p. Rated-load amperes
 - q. Voltage
 - r. Code letter (starting KVA per horsepower)
 - s. Design letter for integral horsepower induction motors (per NEMA Standards)
 - t. Service factor
 - u. Temperature rise at full load and at service factor load
 - v. Efficiency at 1/4, 1/2, 3/4 and full load
 - w. Power factor at 1/4, 1/2, 3/4 and full load
 - x. Motor outline, dimensions and weight
 - y. Insulation system description
 - z. Horsepower required by connected machine at specified conditions (load curves) shall be supplied for all compressors, propeller and positive displacement pumps.

The foregoing data shall also be verified after manufacture and shall be included with the information to be furnished in the operation and maintenance manuals specified.

- E. 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 intended to be provided are acceptable and shall be submitted.

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. Electric motors shall be manufactured by Nidec Motors, General Electric Company, or equal.

2.02 MATERIALS AND CONSTRUCTION

- A. Motors shall be built in accordance with the latest standards of NEMA, including, but not limited to MG-1 and MG-2, IEEE, ANSI and to the requirements specified herein.

B. Type

- 1. Unless otherwise noted, motors specified herein shall be polyphase squirrel cage, NEMA Design B, or single phase capacitor or repulsion start induction motors. Special equipment requiring a motor drive with unusual characteristics shall be equipped with a definite purpose motor to meet the necessary requirements.
- 2. Unless otherwise shown or specified, all motors shall be three- phase, 60 Hertz, NEMA Design B, squirrel cage induction motors designed for operation at 480 volts.
- 3. Unless otherwise specified in the individual equipment specification for the driven equipment, or as required by the dynamic characteristics of the load as determined by the manufacturer of the machine to be driven, all polyphase squirrel cage motors shall be designed to withstand the starting voltage and shall have torque and locked rotor current characteristics as specified for NEMA Design B motors.
- 4. All motors shall have stator windings vacuum impregnated with a polyester insulation compound.
- 6. Motors shall be vertical hollowshaft type, designed to carry the motors', pumps', and associated equipment's full thrust. The motors shall be equipped with grease lubricated spherical roller thrust bearings and lower radial guide bearings. Vertical hollowshaft motors shall be fitted with ball-type nonreversing ratchet assemblies where specified. Vertical adjustment shall be provided by means of a lockable nut at the top of the shaft.
- 8. Vertical hollowshaft motors shall have adequate thrust bearings to carry all motor loads and any other operating equipment loads.

C. Rating

- 1. Each motor shall develop ample torque for its required service through its acceleration range and throughout its rated load range. The rating of the motors offered shall in no case be less than the horsepower specified in the specification section for the driven equipment. It should be noted that the motor sizes specified are motor sizes required to operate the specific equipment specified. Higher rated motor sizes may be determined from the actual equipment submitted, approved, purchased, and installed. Overload protection, starters, disconnect switches, and

other necessary equipment shall be furnished and installed for the actual motor sizes required at no additional cost.

2. Motor ratings shall be based on continuous operation under the service conditions stipulated in Paragraph 1.02.

D. Insulation

1. Insulation shall be as specified for each particular type or class of motor. The insulation system shall provide a high dielectric strength, long life covering for the windings which may be required to operate in a continually damp and chemically contaminated environment. The insulation shall be resistant to attack by moisture, acids, alkalies, abrasives, and mechanical and thermal shock. Leads shall be sealed with a non-wicking, non-hydroscopic insulation material.
2. Motor insulation resistance may be checked at any time after delivery to the job site or during the warranty period. Encapsulated motor stators may be subjected to insulation testing while completely submerged in water. Any motor not meeting the requirements specified herein will be rejected and shall be promptly replaced at no cost to the Owner.
3. Torque and locked rotor current characteristics for three phase motors shall be NEMA Design B. The locked rotor KVA/HP input at full voltage for 10 horsepower motors and larger shall not exceed that permitted for Code Letter "J", except for specialized equipment requiring a motor drive with special definite characteristics.
4. Unless otherwise specified, all motors shall be furnished with a Class F insulation system. Temperature rise shall be limited to that for Class B insulation. Output torque and speed characteristics of each motor shall be suitable to operate the driven equipment through the full range of acceleration and operating load conditions without exceeding the nameplates current rating, and/or temperature rise.

E. Nameplates

1. The motor manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor frame with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall include as a minimum, Items h through t as listed in Article 1.03 in addition to that required by NEMA standards. The nameplate shall be positioned so as to be readily visible for inspection in the completed machine.

F. Design

1. Motors shall be designed to accelerate and drive the connected equipment under all normal operating conditions without exceeding nameplate ratings.
2. Unless otherwise specified, all motors shall be furnished with service factors of 1.15 in accordance with NEMA MG-1.
3. Design selection with respect to the driven machine shall be such that the requirements do not exceed 85 percent of the motors' maximum rating modified by service factor, ambient temperature, enclosure, altitude and electrical service. The electrical service conditions shall be assumed to be 10 percent undervoltage,

5 percent underfrequency, and 3 percent voltage unbalance. Altitude shall be assumed to be the project site elevation plus 10 percent. Ambient temperature shall be assumed to be 95 degrees F in exterior locations, 104 degrees F (40 degrees C) in interior locations, and 122 degrees F (50 degrees C) within housings or enclosures; except where higher temperatures may be encountered within or on individual items of equipment. The applicable paragraphs of NEMA MG-1 shall be used in making the design selection.

4. Terminal boxes shall be of sufficient size to accommodate the required quantity and size of conduits. Gasketed terminal boxes shall be furnished with all splash-proof and totally enclosed motors. Terminal boxes shall be NEMA type 4 enclosures. Terminal boxes shall be sized to accommodate accessory equipment such as motor differential current transformers.
5. Terminal boxes for horizontal motors shall be located on the left-hand side when viewing the motor from the drive shaft end and shall be so designed that conduit entrance can be made from above, below, or either side of the terminal box.

G. Construction

1. Frames, mounting means, and shafts shall meet NEMA Standards for the horsepower, RPM, and enclosure selected. Enclosures shall be selected according to the degree of mechanical protection required and shall not be of aluminum construction. All motors shall have a manufacturer's standard shop machinery finish, consisting of a rust-resisting priming coat of zinc chromate and a finish coat of alkyd machinery enamel.
2. Motors shall have cast iron frames and a heavy gauge steel terminal box, with neoprene gaskets between the frame and the box and between the box and its cover. A grounding lug(s) shall be provided inside the terminal box.
3. Motors shall be equipped with at least one lifting eye. All lifting hardware shall be corrosion resistant.
4. Unless otherwise specified in the equipment specifications, motors shall be furnished with space heaters and embedded motor winding high temperature switches with leads brought out of the motor terminal box. Space heaters shall be suitable for 120VAC operation and for a maximum surface temperature of less than 200 degrees C. Spare heaters shall be of sufficient wattage to maintain the internal temperature of the motor at approximately 10 degrees C above the ambient temperature when the motor is not running.

Embedded motor winding temperature switches shall operate at temperatures well below the temperature rating of the motor winding insulation system. Motor winding temperature switches are not required where other temperature monitoring devices (e.g. RTD's) are required.

10. Motors shall be furnished with bearings of the grease lubricated, antifriction ball type with conveniently located grease fittings and drain plugs. A means of preventing bearings from becoming overgreased shall be provided. Bearings shall have a minimum B-10 life of 20,000 hours.

12. Rotors shall be statically and dynamically balanced. Rotor windings shall be one-piece cast aluminum. Where applicable, rotors shall be constructed with integral fins.

H. Power Factor and Efficiency

1. All motors shall be designed specifically for energy efficiency and high power factor. The motor efficiency and power factor shall meet or exceed the values listed in the table below when the motors are tested in accordance with the NEMA preferred test method IEEE 112, Method B, Dynamometer. Each motor shall meet the minimum guaranteed efficiency value indicated in the table below. All tests shall be performed in accordance with the procedures contained in NEMA Standard MG1-12.58. Efficiency calculations shall include friction losses due to high thrust bearings.

TABLE 12-11 FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS ENCLOSED MOTORS								
HP	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	75.5	72	82.5	80	80	77	74	70
1.5	82.5	80	84	81.5	85.5	82.5	77	74
2	84	81.5	84	81.5	86.5	84	82.5	80
3	85.5	82.5	87.5	85.5	87.5	85.5	84	81.5
5	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91	89.5	90.2	88.5	89.5	87.5
25	91	89.5	92.4	91	91.7	90.2	89.5	87.5
30	91	89.5	92.4	91	91.7	90.2	91	89.5
40	91.7	90.2	93	91.7	93	91.7	91	89.5
50	92.4	91	93	91.7	93	91.7	91.7	90.2
60	93	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93	91.7	94.1	93	93.6	92.4	93	91.7
100	93.6	92.4	94.5	93.6	94.1	93	93	91.7
125	94.5	93.6	94.5	93.6	94.1	93	93.6	92.4
150	94.5	93.6	95	94.1	95	94.1	93.6	92.4
200	95	94.1	95	94.1	95	94.1	94.1	93
250	95.4	94.5	95	94.1	95	94.1	94.5	93.6
300	95.4	94.5	95.4	94.5	95	94.1		
350	95.4	94.5	95.4	94.5	95	94.1		
400	95.4	94.5	95.4	94.5				
450	95.4	94.5	95.4	94.5				
500	95.4	94.5	95.8	95				

**TABLE 12-12
FULL-LOAD EFFICIENCIES FOR NEMA PREMIUM™ EFFICIENCY ELECTRIC MOTORS
RATED 600 VOLTS OR LESS (RANDOM WOUND)
OPEN MOTORS**

HP	2 POLE		4 POLE		6 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77	74	85.5	82.5	82.5	80
1.5	84	81.5	86.5	84	86.5	81.5
2	85.5	82.5	86.5	84	87.5	81.5
3	85.5	82.5	89.5	84	88.5	86.5
5	86.5	84	89.5	84	89.5	87.5
7.5	88.5	86.5	91	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93	91.7	91.7	90.2
20	91	89.5	93	91.7	92.4	91
25	91.7	90.2	93.6	92.4	93	91.7
30	91.7	90.2	94.1	93	93.6	92.4
40	92.4	91	94.1	93	94.1	93
50	93	91.7	94.5	93.6	94.1	93
60	93.6	92.4	95	94.1	94.5	93.6
75	93.6	92.4	95	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95	94.1
125	94.1	93	95.4	94.5	95	94.1
150	94.1	93	95.8	95	95.4	94.5
200	95	94.1	95.8	95	95.4	94.5
250	95	94.1	95.8	95	95.4	94.5
300	95.4	94.5	95.8	95	95.4	94.5
350	95.4	94.5	95.8	95	95.4	94.5
400	95.8	95	95.8	95	95.8	95
450	95.8	95	96.2	95.4	96.2	95.4
500	95.8	95	96.2	95.4	96.2	95.4

NOTES:

- (1) Motor data for continuous duty, NEMA Design B, 1.15 service factor, 40 degrees Celsius ambient, Class F insulation, 3 phase, 460 volt, at listed speed rating.
 - (2) TEFC efficiencies apply to both horizontal and vertical motors.
2. Motors shall be individually tested at the factory before shipment, with a copy of test results provided for the Engineer, to assure compliance with the efficiency and power factor specifications.

I. Power Factor Correction

1. The power factor shall be corrected as necessary to achieve 85% (minimum) with capacitors sized and installed per manufacturer's recommendations. Capacitors shall be installed such that the motor shall not be damaged by overvoltage or excessive transient electrical torque. The capacitor(s) shall be connected as close as possible or directly to the motor terminals. Any power factor corrections shall not decrease the motor efficiency below the stated minimum requirement of this Specification. All power factor corrections shall be noted on the Shop Drawings submitted to the Engineer for approval. POWER FACTOR CORRECTION, TO ACHIEVE 85%, SHALL BE PROVIDED ON ALL MOTORS.
2. When required, power factor correction capacitors shall be connected on the line side of any type of reduced voltage starting motor controller (e.g. RVAT, RVSS, Part-Winding, Wye-Delta, etc.).

2.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Each motor shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment.
- B. Provide a spare set of sight glasses for each motor.

PART 3 -- EXECUTION

3.01 INSTALLATION AND TESTING

- A. Manufacturer shall install and test motors furnished with pumping equipment specified in Section 11120.

3.02 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer shall store motors until delivery to project site is required.

3.03 TESTING

A. Shop Tests

1. All motors shall be shop tested and inspected in accordance with the equipment manufacturer's standard procedures. The manufacturer's testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified, all other applicable requirements, and shall be approved by the Engineer. At least 10 days notice shall be given the Engineer prior to tests and inspection dates.
2. In addition to the efficiency and power factor testing specified herein, each motor shall be tested to determine compliance with the applicable requirements of the IEEE, ANSI and NEMA. Each motor shall be furnished with certified test results. Each motor shall be subjected to a complete test consisting of full load heat run, percent slip, running load current, locked rotor current, breakdown torque (calculated), starting torque, winding resistance, high potential, secondary current

and voltage at collector rings (wound rotor), efficiencies at 100, 75 and 50 percent of full load, power factors at 100, 75 and 50 percent of full load and bearing inspection.

3. All test results for motors over 100 horsepower shall be submitted to the Engineer for approval. Copies of witnessed test raw data shall be submitted to the Engineer immediately upon completion of such tests.

- END OF SECTION -

APPENDIX B

OWNER-FURNISHED MOTOR CONTROL CENTER INFORMATION



DAVIDSON WATER, INC
HYATTOWN PUMPING STATION MCC

MOTOR CONTROL CENTERS
MCC1 AND MCC2
PROCUREMENT

CONTRACT DOCUMENTS & TECHNICAL SPECIFICATIONS

Supplier: _____

Equipment Manufacturer: _____

STURGILL
ENGINEERING
P.A.

One South Main Street
Lexington, NC 27292
Phone: (336) 238-1249
Fax: (336) 236-6393



Hazen

December 1, 2015

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Davidson Water, Inc.
BID REQUEST
Water Treatment Plant MCC Upgrade
December 1, 2015

Davidson Water, Inc. request a quote/bid for the Low Voltage Motor Control Center (MCC1 and MCC2) to be installed in the Hyattown Pumping Station under a separate contract.

Informal bids will be received by DAVIDSON WATER, INC., until Friday, December 18, 2015 at 4:30 PM. Bids may be hand-delivered to 7040 Old U.S. Highway 52, Lexington, North Carolina, **faxed** to (336-731-3195), emailed to rwalters@davidsonwater.com or mailed to attention **Robert Walters** 7040 Old U.S. Highway 52, Lexington, North Carolina 27295. Results will be faxed, emailed or mailed after the bids are tabulated. Randall Sturgill – rsturgill@sturgilleng.com, (336-238-1249), will answer technical questions.

All equipment shall comply with current NEMA, ANSI, NEC, state and local codes and Davidson Water, Inc. Contract Specifications.

Immediately after receipt of notice to award, the Engineer and the Supplier will establish a mutually agreeable date on which the shop drawings will be reviewed.

MCC1,2 shall be delivered no later than July 22, 2016.

Each bid should be submitted upon the bid form provided in the Specifications. The method of award will be to the lowest responsible bid.

Davidson Water, Inc. reserves the right to reject any or all proposals.

Robert Walters
Vice-President

Mailing Address
Davidson Water Inc.
P.O. Box 969
Welcome, NC 27374
Lexington (336) 731-2341
Winston-Salem (336) 764-2534
Thomasville (336) 475-8229



Shipping Address
Davidson Water Inc.
7040 Old Highway 52
Lexington, NC 27295
Water Plant (336) 787-5800
Office Fax (336) 731-3195
www.davidsonwater.com
email info@davidsonwater.com

BID SHEET
Hyattown Pumping Station MCC1,2 Procurement

BID DATE: December 18, 2015

MCC1, MCC2 Cost _____

Supplier/Company Name _____

Contact Name _____

Address _____

Contact Phone # _____

Signed by _____

Title _____

Anticipated Job Award Date: January 4, 2016

MCC1,2 Delivery Date: July 22, 2016

AGREEMENT FOR SERVICES

Between

DAVIDSON WATER, INC.

And

For

Hyattown Pumping Station MCC1,2 Procurement

THIS AGREEMENT by and between DAVIDSON WATER, INC., 7040 Old U.S. Highway 52, Welcome, North Carolina (hereinafter "Owner") and

_____ . ' .
(hereinafter "Supplier"),

WHEREAS, Owner desires to **purchase Low Voltage Motor Control Centers, MCC1,2, for the Hyattown Pumping Station** as described in Section 1100 Scope of Work; and,

WHEREAS, Owner desires to engage Supplier to perform the services in order to complete the project as described herein;

NOW, THEREFORE, Owner and Supplier do mutually agree as follows:

ARTICLE I

Description of Project

Owner desires to **purchase Low Voltage Motor Control Centers, MCC1,2, for the Hyattown Pumping Station.**

ARTICLE II

Items to be provided by Supplier

Supplier shall furnish new **MCC1,2** and specified field services after installation by others.

ARTICLE III

Schedule of Performance by Supplier

The equipment to be provided under each this Agreement shall commence as directed by Owner. In the absence of further direction, MCC's shall be delivered to

:

**Davidson Water, Inc.
7040 Old US Highway 52
Lexington, NC 27295**

On or Before:

July 22, 2016

ARTICLE IV
Compensation

For the services rendered under Article II and the project described under Article I, the Supplier shall be compensated as indicated on: **Bid Sheet**

ARTICLE V
Payment for Services

Partial payments shall be made to Supplier as follows:

- After approval of shop drawings 30 percent
- After delivery 60 percent
- After installation by others and start-up 10 percent

Supplier shall submit written statements requesting payment, supplemented or accompanied by such data as may be required by Owner or its engineers or consultants. Owner shall submit such written requests for payment to its Board of Directors for payment approval or disapproval within thirty (30) calendar days after receipt. Upon Board approval of such payment requested by Supplier, payment shall be made by Owner to Supplier within Fifteen (15) calendar days.

If a dispute arises as to payment, the dispute will be reviewed by both parties, and if a resolution cannot be reached, Owner and Supplier agree to submit such dispute to mediation (utilizing a mutually agreed upon mediator certified by and through the Superior Courts of North Carolina) in an attempt to settle the matter prior to the institution of legal action in a court of competent jurisdiction.

ARTICLE VI
Supplier's Personnel and Facilities

The Supplier now has or will secure at its expense, including sub-consultants, all personnel and facilities required to perform the services to be rendered under this Agreement. Such personnel are not employees, nor do they have any contractual relationship with the Owner.

ARTICLE VII
Responsibilities of Owner

It is understood that certain services will be performed and/or furnished by Others. These services include the following:

1. **Owner will take delivery and unload and store MCC1,2.**
2. **Installation of MCC1,2 including wire terminations will be performed by Others under a separate contract. (MCC1,2 checkout and start-up provided by Supplier)**

ARTICLE VIII

Assignment of Agreement

Neither the Owner nor the Supplier will assign, sublet, or transfer their interest, duties, or obligations under this Agreement without the prior written consent of the other party. Nothing herein shall be construed as creating any personal liability on the part of any officer, director, or agent of any party hereto, nor shall it create any rights or benefits to parties other than the Owner and the Supplier, except such other rights as may be specifically called for herein.

ARTICLE IX Equal Employment Opportunity

During the performance of this contract, Supplier agrees as follows:

1. The Supplier will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age, handicap, or veteran status. The Supplier will take affirmative action to insure that applicants are employed that employees are treated during employment without regard to race, color, religion, sex, national origin, age, handicap, or veteran status. The Supplier agrees to post in conspicuous places, available to employees and applicants for employment, notices setting for the provisions for this non-discrimination clause.
2. The Supplier will, in solicitations or advertisement for employees placed by or on behalf of the Supplier, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, age, handicap, or veteran status.
3. In the event of Supplier's non-compliance with the non-discrimination clauses of this Agreement or with any such rules, regulations, or order, this Agreement may be cancelled, terminated, or suspended in whole or in part, and the Supplier may be declared ineligible for further owner contracts.

ARTICLE X Termination of Contract

This Agreement may be terminated by either party upon thirty (30) days' written notice in the event of substantial failure to perform in accordance with the terms hereof by the other party through no fault of the terminating party. If this Agreement is so terminated, the Supplier will be paid for services rendered through the date of such termination, as mutually agreed upon between the parties hereto, provided that all such services to date have been rendered in substantial compliance with the terms of this Agreement.

ARTICLE XI Standard of Care

Supplier shall perform for or furnish to Owner work and related services in all phases of the project to which this Agreement applies as hereinafter provided. The standard of care for all work and related services performed or furnished by Supplier under this Agreement will be the care and skill ordinarily used by Suppliers working or rendering services under similar conditions at the same time and in the same locality. All work or services performed shall be done in a good and workmanlike manner in accordance with such standard of care. Supplier shall further have the responsibility of controlling the job site, particularly with respect to implementing

procedures for the safety of Supplier's employees, invited guests, as well as establishing safety precautions applicable to the perimeter of the job site for members of the public.

ARTICLE XII
Indemnification

To the fullest extent permitted by law, Supplier shall defend, indemnify and hold harmless Owner, its engineers, agents, employees, officers and board members from and against all claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or relating from the performance of the work described herein provided that any such claims, damage, loss or expense is caused in whole or in part by any negligent act or omission of the Supplier, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by the Owner. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist to any party or person described in this paragraph.

Supplier's indemnification and defense obligations hereunder shall extend to Claims occurring after this Agreement is terminated as well as while it is in force, and shall continue until it is finally adjudicated that any and all actions against the Indemnified Parties for such matters which are indemnified hereunder are fully and finally barred by applicable laws.

ARTICLE XIII
Applicable Law

This Agreement, including but not limited to the interpretation thereof and the rights and remedies of the parties hereunder, shall be governed by the laws of the State of North Carolina. Except as this Agreement otherwise provides, all claims, counterclaims, disputes, and other matters in question between the Owner and Supplier arising out of, or relating to this Agreement or the breach of it, will be decided by resort to a court of competent jurisdiction within the State of North Carolina unless alternate means of dispute resolution are mutually agreed upon by the parties hereto.

ARTICLE XIV
Entire Agreement

This document states the entire agreement between the Owner and Supplier and shall not be modified except in writing and signed by authorized representatives of both parties.

OWNER:
DAVIDSON WATER, INC.

Robert Walters, Vice President (Seal)

SUPPLIER:

Owner (Seal)

NORTH CAROLINA
COUNTY OF DAVIDSON

I, _____, Notary Public, certify that _____ first came before me this day and acknowledged that he is Vice President of Davidson Water, Inc., a corporation, and that he as Vice President being authorized to do so, executed the foregoing on behalf of the corporation.

Witness my hand and notarial seal, this the ____ day of _____, 20__.

My commission expires: _____
Notary Public

NORTH CAROLINA
COUNTY OF _____

I, _____, Notary Public, certify that _____ first came before me this day and acknowledged that he is President of _____, a corporation, and that he as President being authorized to do so, executed the foregoing on behalf of the corporation.

Witness my hand and notarial seal, this the ____ day of _____, 20__.

My commission expires: _____
Notary Public

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 Work Covered By Contract Documents

The work includes furnishing Low Voltage Motor Control Centers (MCC1,2) for the Hyattown Pumping Station. This includes field checkout, testing, and start-up of MCC1,2 after installation by Others.

1.2 Checkout Testing and Startup

After all equipment installation by Others has been completed to the satisfaction of the Engineer and Owner all equipment has been inspected and certified to be operational by the Supplier, prior to equipment being placed in service.

This startup procedure shall be accomplished in the presence of the Engineer, operating personnel employed by the Owner and, where required or necessary, representatives of the major equipment manufacturers. This period shall be used as the specified instruction period for operating personnel in the proper operation and maintenance of the respective equipment.

The Supplier shall furnish the Owner with keys for all key operated locks, switches, etc. for the project.

All required Operation and Maintenance Manuals shall be submitted to the Engineer prior to startup and operation.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 Related Documents

Drawings and general provisions of the Contract, including Division 1 Specification Sections, apply to this Section.

1.2 Submittal Procedures

1.2.1 Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

- A. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
- B. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
- C. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, Supplier shall submit electronic copies to Engineer with 48 hours' notice. Engineer will return submittals with 48 hours. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

1.2.2 Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

- A. Provide a space approximately 4 by 5 inches on the label or beside the title block on Shop Drawings to record the Supplier's review and approval markings and the action taken.
- B. Include the following information on the label for processing and recording action taken.
 - Project name.
 - Date.
 - Name and address of the Engineer.
 - Name and address of the Supplier.
 - Name of the manufacturer.
 - Number and title of appropriate Specification Section.
 - Drawing number and detail references, as appropriate.

1.2.3 Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Supplier to the Engineer using a transmittal form.

- A. The Engineer will not accept submittals received from sources other than the Supplier.
- B. On the transmittal, note relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including variations and limitations. Include Supplier's certification that information complies with Contract Document requirements.

1.2.4 Supplier's Approval: All submittals shall be thoroughly checked by the Supplier for accuracy and conformance with the Contract Documents before submittal to the Engineer. The submittals must bear the Supplier stamp of approval. Submittals received without the Supplier's stamp of approval will not be reviewed by the Engineer and will be returned to the Supplier.

1.3 Supplier's Schedule

1.3.1 Schedule: Prepare a developed Supplier's schedule. Submit within 15 days after the date established for "Contract Award." Schedule shall include submittal schedule.

1.3.2 Revisions: When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

1.3.3 Schedule Updates: Revise the schedule after each meeting, event, or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.4 Shop Drawings

Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:

- Dimensions.
- Identification of products and materials included by sheet and detail number.
- Compliance with specified standards.
- Notation of coordination requirements.
- Notation of dimensions established by field measurement.
- Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 36 by 48 inches.
- Do not use Shop Drawings without an appropriate final stamp indicating action taken.

1.5 Product Data

Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

- A. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
 - Manufacturer's printed recommendations.
 - Compliance with trade association standards.
 - Compliance with recognized testing agency standards.
 - Application of testing agency labels and seals.
 - Notation of dimensions verified by field measurement.
 - Notation of coordination requirements.
- B. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
- C. Submittals: Submit 4 copies of each required submittal. The Engineer will retain one and will return the other marked with action taken and corrections or modifications required. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
- D. Distribution: Furnish copies of final submittal to installers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
 - Do not proceed with installation until a copy of Product Data is in the Installer's possession.
 - Do not permit use of unmarked copies of Product Data in connection with construction.

1.6 Quality Assurance Submittals

Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements. Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 16.

1.7 Operation and Maintenance Data and Manuals

Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention.

Operation and maintenance manuals are specially prepared for this project.

Operation and maintenance instructions and parts list include standard printed information on manufactured products.

The equipment supplier shall prepare an operation and maintenance manual for each type of equipment indicated in each specification section. Parts lists and operating and maintenance instructions shall be

furnished for other equipment which does not require full manuals.

Operation and Maintenance Manuals shall include the following:

- Equipment function, normal operating characteristics and limiting conditions.
- Assembly, installation, alignment, adjustment and checking instructions.
- Operating instructions for startup, routine and normal operation, regulation and control, shutdown and emergency conditions.
- Lubrication and maintenance instructions.
- Guide to "troubleshooting".
- Parts lists and predicted life of parts subject to wear.
- Outline, cross section and assembly drawings, engineering data and wiring diagrams.
- Test data and performance curves, where applicable.
- Computer disks of tables, drawings, etc. included in manual, if available.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Supplier.

Manuals and other data shall be printed on heavy, first quality paper, 8-1/2 by 11 inch size with standard 3-hole punching. Drawings and diagrams shall be reduced to 8-1/2 by 11 inches or 11 by 17 inches. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes which are bound into the manuals. Each envelope shall bear suitable identification on the outside.

One (1) preliminary manual shall be submitted no less than 30 days prior to equipment start-up for review. Four (4) final hard copies of each operation maintenance manual shall be submitted to Engineer not less than 2 weeks prior to the date of start-up of the equipment. Manuals, and all other parts lists and information, shall be bound in heavy binder notebooks bearing suitable identification. A table of contents and index tabs shall be furnished for all volumes containing data for three or more items of equipment. Two (2) electronic copies shall be provided on CD or DVD.

Three (3) copies of standard operation and maintenance instructions and parts lists shall be submitted for equipment not listed, where applicable or where required by the Engineer. These manuals shall be supplied prior to the date of shipment of the equipment.

All material shall be marked with Project identification, and inapplicable information shall be marked out or deleted.

Shipment of equipment will not be considered complete until all required manuals and data have been received. Engineer may withhold payment for equipment until manuals are received.

1.8 Record Drawings

Supplier shall keep one Record Set of all specifications, drawings, addenda, modifications and shop drawings at the site in good order and annotated to show all changes made during the construction process. The set shall be kept current, and the Engineer may inspect the Record Set at progress or pay request meetings. These shall be available to the Engineer and shall be delivered to the Engineer upon completion of the project.

Complete record drawings shall be submitted to the Engineer and then approved by the Engineer before final payment is approved. Annotations on the drawings shall include installed lengths, sizes and types of materials, locations, etc. Pipelines shall be measured from the edge of pavement at regular intervals. Underground manholes, vaults, valves, etc. shall be dimensioned from at least two permanent features (power poles, intersections, paved roads, corners, fences, etc.) For plant and electrical work, annotations on the drawings shall include any approved deviation from the contract drawings.

1.9 Engineer's Action

Except for submittals for the record or information, where action and return is required, the Engineer will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Supplier's responsibility.

Action Stamp:

The Engineer will stamp each submittal with a uniform action stamp. The Engineer will mark the stamp appropriately to indicate the action taken, as follows:

- A. Final Unrestricted Release: When marked "NO EXCEPTIONS," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
- B. Final-But-Restricted Release: When marked "EXCEPTIONS NOTED" the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
- C. Returned for Resubmittals: When marked "REVISE AND RESUBMIT" do not proceed with work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark. Do not use, or allow others to use, submittals marked "Revise and Resubmit".
- D. Rejected and not allowed: When marked "NOT APPROVED" do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Prepare a new submittal according to the notations and in compliance with the Contract Documents; resubmit without delay. Do not use, or allow others to use, any submittals marked "Not Approved" in any fashion.

Unsolicited Submittals:

The Engineer will return unsolicited submittals to the sender without action.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 Related Documents

Drawings and general provisions of the Contract and Division 1 Specification Sections, apply to this Section.

1.2 Summary

This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:

- Startup
- Project record document submittal.
- Submittal of warranties.

1.3 Substantial Completion

1.3.1 Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

- A. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
 - Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
- B. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents. Warranty period shall be 30 months from delivery of equipment. Date of startup is estimated to be in March, 2017.
- C. Submit record drawings, maintenance manuals, and similar final record information.
- D. Deliver tools, spare parts, extra stock, and similar items.
- E. Make final changeover of permanent locks and transmit keys to the Owner.
- F. Complete startup testing of systems and instruction of the Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with construction tools, and similar elements.
- G. Complete all electrical and control panel labeling, complete panel schedules, place schematics inside MCC1,2 as required.

1.3.2 On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the Supplier of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection or advise the Supplier of construction that must be completed or corrected before the certificate will be issued.

- A. The Engineer will repeat inspection when requested and assured that the Work is substantially complete.
- B. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 Final Acceptance

1.4.1 Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

- A. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
- B. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
- C. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, endorsed and dated by the Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Engineer.
- D. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

1.4.2 The Engineer will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Engineer.

- A. Upon completion of re-inspection, the Engineer will prepare a certificate of final acceptance. If the Work is incomplete, the Engineer will advise the Supplier of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
- B. If necessary, re-inspection will be repeated.

1.5 Record Document Submittal

1.5.1 Supplier shall modify shop drawings as marked by installing Contractor.

1.5.2 Record document shall be included in O & M.

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PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 16480

LOW VOLTAGE MOTOR CONTROL CENTER

PART 1 GENERAL

1.1 Scope

The Supplier shall furnish and deliver the motor control center as specified herein and indicated on the Drawings.

The Supplier shall obtain the motor control center from one manufacturer who shall also manufacture the enclosure and major equipment components, which includes, but is not limited to, starters, branch circuit breakers, main circuit breaker, power monitoring equipment, and other components of the equipment assembly. Subcontracting of wiring is not acceptable.

The motor control center shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not acceptable. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.

Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the drawings. Where not indicated, the control circuits shall be standard three-wire "start-stop" and the Supplier shall furnish wiring accordingly.

1.2 Testing

All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1.2.1 Certified Shop Tests and Reports

- A. Submit description of proposed testing methods, procedures, and apparatus. Submit notarized and certified copies of all test reports.
- B. As a minimum, the entire motor control center shall go through a quality inspection before shipment. This inspection shall include, but is not limited to, the following:
 - Physical inspection of the structure and the electrical conductors including bussing, general wiring, and units.
 - General electrical tests including power circuit phasing, control circuit wiring, instrument transformers, meters, ground fault system, and device electrical operation.
 - AC dielectric tests of the power circuits and control circuits.
 - Markings/labels, including instructional type, Underwriters Laboratory (UL), and inspector's stamps.

The manufacturer shall use integral quality control checks throughout the manufacturing process to maintain the correctness of the MCC1,2.

1.2.2 Field Tests

Field tests shall be performed in accordance with the requirements specified in the General Conditions and Division 1.

1.3 Submittals

In accordance with the procedures and requirements set forth in the Division 1, the Supplier shall obtain from the equipment manufacturer and submit the following:

- Shop Drawings.
- Spare Parts List.
- Special Tools List.
- Proposed Testing Methods and Reports of Certified Shop and Field Tests.
- Operation and Maintenance Manuals.

The applicable specification section shall identify each submittal.

1.4 Shop Drawings

Shop Drawings shall be submitted by February 11, 2016. 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.

Partial, incomplete or illegible submittals will be returned to the Supplier without review for re-submittal.

Shop drawings for each motor control center shall include but not be limited to:

- Equipment specifications and product data sheets identifying all materials used and methods of fabrication. Example equipment nameplate data sheet.
- Weights of all component parts, assembled weight of units, and approximate total shipping weight.
- Plan, front, and side view drawings, including overall dimensions of each motor control center. Identify shipping splits and show conduit stub-up area locations on the Drawings.
- Internal schematic and point-to-point wiring diagrams of each motor control unit including variable frequency drives integrated into the motor control center. One wiring diagram that is typical for an equipment group (e.g. screw pump) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Indicate on diagrams the specific device location symbols consistent with the symbols on the diagrams and their respective legend as indicated on the Drawings. Match identification numbers of motor starter, relay, timer coil, and respective contacts with those indicated on the Drawings. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.
- External connection diagram showing the wiring to the external controls and devices associated with the motor control center.
- Single-line diagrams for each motor control center showing circuit breakers, motor circuit protectors, motor starters, instrument transformers, meters, relays, timers, control devices, dry-type transformers, panelboards, and other equipment comprising the complete assembly. Indicate electrical ratings of equipment and devices on these single-line diagrams. Ratings include starter size and type, circuit breaker frame size and trip rating, transformer ratings, panelboard ratings, motor horsepower, and full load current, and similar information.
- Bill of material list for each motor control center and each motor control unit
- Nameplate schedule for each motor control center.
- Manufacturer's installation instructions.
- Manufacturer's standard warranty.
- Time-current curves for each type and size protective device.
- Detailed drawings showing plan, front, and side views as well as appropriate section views of the pre-engineered power distribution center. Include product data sheets for all appurtenances (e.g. exhaust fan, thermostat, etc.) to be furnished and installed in the center.

Drawings shall be of sufficient detail to assure proper installation by the Supplier.

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 Supplier intends to provide are acceptable and shall be submitted. Cut-sheets without identification of the specific model provided will be rejected.

Prior to completion and final acceptance of the project, the Supplier shall furnish and install "as-built" wiring diagrams for each MCC unit of each motor control center. These final drawings shall be plastic laminated and securely placed inside each MCC unit door and included in the O&M manuals.

1.5 Operation and Maintenance Manuals

The Supplier shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in Division 1.

1.6 Tools, Supplies and Spare Parts

Each motor control center and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. The Supplier shall furnish all spare parts as recommended by the equipment manufacturer to the Owner.

The Supplier shall furnish the following spare parts for each motor control center:

<u>No. Required</u>	<u>Description</u>
1 set	Fuses of each size provided
1	Starter coil and complete set of contacts for each size and type of starter provided.
1	Relay of each size and type used.
1	Control power transformer of each size used.
5	Lamps and lenses for indicating lights, each color.
1	Indicating lamp socket for each type used.
1	Overload relays with for each type, size, and rating used.
2	Pilot devices (e.g. pushbutton, selector switch, etc) complete with contact blocks and legend plates for each type, color, size and rating used.
1	Motor circuit protectors for each type, size, and rating used.
1	Molded case circuit breakers for each type, size, and rating used (except main circuit breakers).

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.

Spare parts shall be delivered at the same time as the equipment to which they pertain. The Supplier shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished.

Parts shall be completely identified with a numerical system to facilitate parts control and stocking. A separate number shall properly identify each part. Those parts that are identical for more than one size, shall have the same parts number.

1.7 Service of Manufacturer's Representative

The Supplier 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 Supplier's personnel and the Owner's operating personnel in its maintenance and operation as outlined elsewhere in Division 1. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

- Two trips of one (1) working day each during installation of the equipment for the MCC.
- One trip of one (1) working day after acceptance of the equipment.

Any additional time required to achieve successful installation and operation shall be at the expense of the Supplier. The manufacturer's representative shall sign in and out at the office of the Engineer's Field Representative on each day he is at the project.

1.8 Identification

Each motor control center shall be identified with the identification number indicated on the drawings. A nameplate shall be securely affixed in a conspicuous place on each motor control center.

1.9 Training

The Supplier shall provide for one 4-hour training session for the Owner's personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct the Owner's personnel in operation and maintenance of all equipment provided under this section.

PART 2 PRODUCTS

2.1 Manufacturers

The equipment covered by this Specification is intended to be the manufacturer's standard equipment with proven performance for at least the past five (5) years. 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.

Motor control centers shall be Model 6 as manufactured by Square-D, Freedom 2100 as manufactured by Cutler-Hammer, Evolution Series E9000 as manufactured by General Electric, Centerline as manufactured by Allen-Bradley, or equal.

2.2 Structure

2.2.1 Standards

The motor control centers and their components shall conform to the requirements of applicable standards of NEMA Part ICS 2-322 and Underwriters' Laboratories, Inc. UL-845. Motor control centers shall be service entrance rated.

2.2.2 Fault Current

The motor control centers shall be capable of withstanding the fault current available at its line terminals. Minimum bus bracing, withstand, and interrupting ratings are specified herein.

- 2.2.3 Wiring
Wiring shall be NEMA Class II, Type B. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type TEW rated for 105°C. Wire numbers shall not be repeated in a motor control center.
- 2.2.4 Vertical Sections
Each vertical section shall be NEMA 1A (gasketed) industrial use unless otherwise specified or indicated on the drawings. Each vertical section shall be approximately 20 inches wide, 90 inches high, 20 inches deep, and shall contain not more than six NEMA Size 1 starters unless otherwise specified or indicated on the Drawings,
- 2.2.5 Wireways
Continuous horizontal wiring troughs shall be provided at both the top and bottom of each section. These troughs shall line up to form a continuous wireway for the full length of the MCC. Each vertical section shall be provided with a large, continuous, full height vertical wiring trough in the right side of each section. Each vertical wiring trough shall be furnished complete with tie bars for conductor support.
- 2.2.6 Anchoring
Motor control centers shall be furnished with anchor bolts as required for aligning and mounting. Floor channels with end covers shall be of type recommended by the manufacturer and shall be furnished for installation in a concrete pad.
- 2.2.7 Paint
All steel parts of the MCC's shall be protected with a UL listed acrylic/alkyd baked enamel paint finish. The steel parts shall be pre-treated with an alkaline cleaner and an iron phosphate treatment. The primed parts shall be electrostatically coated with an acrylic powder coat and then baked. The finish shall be 2.5 mils or thicker. The paint finish shall withstand a salt spray test of at least 1000 hours. The MCC's exterior shall be ANSI 61 gray; the interior shall be white.
- 2.2.8 Power
The motor control centers will be supplied from a 480V, 3-phase, 4 wire, 60 Hz power source. The incoming power feeders shall be sized as shown on the drawings. All terminals for incoming and outgoing power cables shall be provided with compression lug solderless connectors or mechanical set screw type lugs.
- 2.2.9 Bus
Power shall be distributed by means of a continuous, tin plated copper horizontal bus, rated as indicated on the drawings. The bus shall be braced for 65,000 A symmetrical at 480V. The horizontal bus shall be effectively isolated from all wiring troughs and other working areas. Vertical bus extensions shall be tin plated copper, isolated by rigid, glass-polyester moldings so as to be a separate self-supported assembly. Silver plated vertical bus may be provided if specifically accepted by the Engineer. Full height vertical bus shall be installed in all sections including those containing spare units and "prepared" spaces. No extra safety jacks or similar devices shall be required to obtain an essentially dead-front condition. Access shall be provided for inspection and maintenance from the front. Minimum horizontal bus rating shall be 600A. Minimum vertical bus rating shall be 300A.
- 2.2.10 Ground Bus
The horizontal ground bus shall be tin plated copper and located in the bottom horizontal wireway. The minimum size of the horizontal ground bus shall be 1/4 inch x 1 inch (6.35mm x 25.4mm).

A pressure type ground lug(s) shall be mounted on the ground bus in the incoming line section, size, and quantity as required for the termination of system and equipment grounding conductors.

The vertical ground bus shall be tin plated copper and solidly connected to the horizontal ground bus. This ground bus, in combination with the unit ground bus stab, establishes unit grounding before the plug-in power stabs engage the power bus, and conversely, as the unit is withdrawn, grounding is maintained until after the plug-in power stabs are disengaged.

The vertical load ground bus shall be tin plated copper and solidly connected to the horizontal ground bus. The vertical load ground bus assembly, comprised of the vertical load ground bus and the unit load ground bus connector, shall provide a termination point for the load equipment grounding conductor at the unit. This fixed connection shall not have to be removed when the unit is withdrawn from the motor control center.

2.2.11 Isolation and Insulation

Horizontal bus access covers and vertical bus covers shall isolate the energized buses to guard against the hazard of accidental contact. These covers shall be molded of a glass polyester material.

The horizontal bus shall be isolated from the top horizontal wireway by a grounded steel barrier. This barrier shall be removable to allow access to the bus and connections for maintenance.

The vertical bus cover shall provide unit plug-in openings which shall permit unit plug-in stab assemblies to pass through and engage the vertical bus. The unit plug-in openings shall be sized to minimize the probability of inadvertent contact with the vertical bus.

Isolation of unused stab openings shall be accomplished by use of a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the motor control center.

All units shall be isolated from one another, above and below, by unit support pans or steel barriers, which can remain in place when the units are withdrawn.

Incoming line compartments shall be isolated from horizontal and vertical wireways by steel barriers.

Unit to vertical wireway isolation shall be available as a molded unit-isolating barrier.

2.2.12 Incoming Line Units

Each incoming line unit shall contain buswork and fittings as required with cable lugs for cables of sizes and quantities shown on the Drawings. Cable lugs shall be suitable for their respective conductors.

2.2.13 Unit Compartments

Each unit compartment shall be provided with an individual front door hinged to the vertical structure. Each plug-in unit shall be supported and guided by a removable unit support pan, so that the unit rearrangement is easily accomplished. The rearrangement of the unit support pan from one location to the other shall be accomplished without use of tools. After insertion, each plug-in unit shall be held in place by latches located at the front of the unit.

The unit plug in power stabs shall be electromagnetically tin plated copper to yield a low resistance connection and designed to tighten during heavy current surges and short circuits. The stab shall be backed by spring steel clips to provide and maintain a high pressure, two point connection to the vertical bus. They shall be free floating and self-loading plug-in. Wiring from the unit disconnecting

means to the plug-in stab shall be exposed at the rear of the unit. The power cable terminations at the plug-in stab shall be mounted in a two-piece, glass polyester support assembly. This support assembly shall provide a separate isolated pathway for each phase, minimizing the probability of a unit fault condition reaching the power bus system.

NEMA Size 1 through Size 5 non-reversing starters shall be plug-in units. Size 1, 2, and 3 shall utilize stab assembly rated 100A. Size 4 shall utilize stab at 225A, Size 5 starters shall utilize dual stab assemblies rated at 225A each, effective capacity of 450A.

An industrial, heavy-duty flange handle mechanism shall be supplied for the control of each disconnecting means. This mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of the unit door position. The operator handles shall have an up-down motion with the down position as off. The ON-OFF condition of the disconnecting means shall be permanently marked on the handle operator. It shall be possible to lock the handle in the "OFF" position with up to three (3) 3/8 inch diameter shackle padlocks and in the "ON" position with one (1) 3/8 inch diameter shackle padlock.

The operator handle of all units shall be interlocked with the door units so that the disconnect means cannot be switched unless the door unit is closed. A means shall be provided for purposely defeating the interlock during maintenance or testing. This interlock shall also prevent opening the unit door unless the disconnecting means is in the off position. An externally operated defeater requiring the use of a screwdriver shall provide access to the unit without interrupting service.

The overload relays shall be re-settable from the outside of the enclosure by means of an insulated bar or button. Shaft from button to overload relay shall be metal; plastic is not acceptable.

Each combination motor controller unit shall be equipped with an individual, fused, control power transformer of sufficient capacity to power all connected devices.

Starter units shall contain the number of auxiliary contacts, unit-mounted pilot devices and indicating lights, control relays, elapsed time meters, and other devices as shown on the Drawings and required for the applications. A minimum of two (2) normally open (NO) and two (2) normally closed (NC) spare contacts shall be provided for each magnetic starter. These spare contacts shall be shown on the submittal wiring diagrams.

2.2.14 Terminal Blocks

Terminal blocks shall be mounted within the unit insert and in the front for accessibility. Control terminal blocks shall be pull-apart style; Type K - NEMA terminal block as manufactured by Square D Company, Buchanan equivalent, General Electric Company equivalent, or equal.

The pull-apart terminal block assembly shall consist of a male and female component held together with captive screws. The terminal block assembly shall be designed to withstand the effects of vibration, yet able to be pulled apart without difficulty. The terminals of the assembly shall be recessed to isolate them from accidental contact. Terminal markings shall be provided for the purpose of identifying terminations.

For starters of Size 2 and smaller, terminate starter wiring (power and control) and external field wiring on terminal strips provided in each unit.

For starters of Size 3 and larger, terminate control wiring and external field control wiring on the terminal strips. Terminal strips shall be as specified herein and shall be:

- Pull-apart type to facilitate wiring connections for disconnecting factory or field conductors.
- Rated to accept conductor sizes as specified and as indicated on the Drawings.

- Rate terminal strips as disconnecting means for foreign interlock voltages.
- Provide with a minimum of 25 percent spare terminals.

2.2.15 Pushbuttons, Selectors Switches, Pilot Lights, and Other Pilot Devices

Pushbuttons and selector switches shall be of the heavy-duty type, 30.5 mm, rated NEMA A600. All pilot devices shall be rated for NEMA Type 13 applications. Pilot lights shall be of the 120VAC transformer type with LED type bulbs. Pilot devices shall be Type K as manufactured by Square D Company, Type 10250T as manufactured by Eaton/Cutler-Hammer, Type 800T as manufactured by Allen-Bradley, or equal.

Elapsed time indicators shall be furnished and installed for each pump starter and other starter units as indicated on the drawings.

2.2.16 Control Relays

Control relays indicated to be provided under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall have 120 Vac coils and 5A contacts at 120Vac. Relays shall be UL recognized and shall have not less than double-pole, double-throw contacts. Control relays shall have an indicator light and check button. Time-delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of plus or minus 2.0 percent of setting. Relays shall be as manufactured by Eagle Signal, Potter & Brumfield, Timemark, Struthers-Dunn or equal.

2.2.17 Nameplates

The MCC's shall be furnished complete with engraved phenolic nameplates for each unit compartment and device. Circuit numbers and equipment names and numbers as indicated on the single line diagrams shall be used as the basis to engrave the nameplates.

2.2.18 Warning Labels

The motor control centers shall be furnished with warning signs to notify maintenance personnel of multiple sources of power within the motor control units. Reference Article 430-74 of the NEC.

2.3 Main Circuit Breaker

Where specified herein, indicated on the drawings, or required, the main circuit breaker shall be rated and labeled for service entrance. Main circuit breakers shall have ground fault protection where indicated on the drawings and/or required by code.

2.4 Circuit Breakers

Unless otherwise indicated, circuit breakers shall be manually operable and shall provide thermal-magnetic, inverse-time-limit overload, and instantaneous short-circuit protection.

Breakers shall be molded case types, rated 480 VAC, 2 or 3 pole. The minimum interrupting rating shall be 65,000 amperes symmetrical at 480V.

Overload protection shall be provided on all poles with trip settings as indicated on the drawings. Breakers of 100-ampere frames and larger shall have interchangeable trip units and adjustable magnetic trip elements.

Time-current characteristic curves and other necessary information and data for each size of breaker furnished shall be provided in the submittal.

2.5 Transient Voltage Surge Suppressor (TVSS)

- 2.5.1 Definition
Each MCC shall include a transient voltage surge suppressor (TVSS), also referred to as a Surge Protective Device (SPD)
- 2.5.2 TVSS in MCC
TVSS at the main power entrance for each MCC shall be suitable for use on a 480Y/277V 3-phase 4-wire grounded wye system. Maximum Suppressed Voltage Rating (SVR) per UL1449 2nd Edition shall not exceed 800 volts for L-N, N-G, & L-G and 1500 volts for L-L. The TVSS shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage. The total surge current based on an 8 x 20 microsecond waveform that the device is capable of surviving shall not be less than 160kA per mode.
- 2.5.3 TVSS in Lighting Panels
TVSS at each 208Y/120 volt circuit breaker panel shall be suitable for use on a 208Y/120V 3-phase 4-wire grounded wye system. Maximum Suppressed Voltage Rating (SVR) per UL1449 2nd Edition shall not exceed 400 volts for L-N, N-G, & L-G and 800 volts for L-L. The TVSS shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 125% of nominal RMS voltage. The total surge current based on an 8 x 20 microsecond waveform that the device is capable of surviving shall not be less than 100kA per mode.
- 2.5.4 General Requirements:
- Minimum life shall be 2000 current surges of 5,000 amperes on a 10 x 20 microsecond waveshape, and the subsequent power-follow current, per mode.
 - TVSS shall be integral to the MCC/panel, listed for installation in the MCC/panel, and connected through a disconnecting means to the bus. Overcurrent protection shall be as recommended by the manufacturer.
 - TVSS shall have visual and audible status indication plus form "C" relay contacts that change state when the TVSS has been damaged or is no longer providing protection.
 - TVSS shall be UL1449 Second Edition listed.
 - Transient Voltage Surge Suppression shall be GE Tranquell, Sq-D Surgelocic, Siemens TPS, or equal.

2.6 Motor Circuit Protectors

Motor branch circuits shall be protected by a motor circuit protector (MCP).

The motor circuit protector shall be operated by a toggle type handle and shall have a quick make, quick break overcenter switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.

Motor circuit protectors shall be completely enclosed in a molded case. Motor circuit protectors shall have the trip unit sealed to prevent tampering. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes, consisting of metal grids mounted in a insulating support.

Each pole of these motor circuit protectors shall provide instantaneous short circuit protection by means of an adjustable magnetic only element.

Motor circuit protectors shall be applied in circuits with available fault currents not exceeding those listed by the control manufacturer for the motor circuit protectors in combination with a contactor and overload relay. Motor circuit protectors interrupting capacity shall be a minimum of 65kA rms symmetrical at 480V.

Motor circuit protector's ratings, modifications, etc., shall be as specified herein and as indicated on the Drawings.

Motor circuit protectors shall be completely enclosed molded case devices with a current sensing coil in each of the 3 poles and have an adjustable magnetic trip setting by means of a single knob on the front. The motor circuit protector shall be manually operable. The protector shall be designed to meet the NEC requirement concerning motor full load and locked-rotor current.

2.7 Full Voltage Combination Starters

2.7.1 Standards

Motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment.

2.7.2 Size

The size of the starter shall be as required for the particular load. Minimum starter size shall be NEMA Size 1. Size 1 and 2 starters shall be completely drawout type, so that units may be withdrawn without disconnecting any wiring. Size 3 and 4 full-voltage, non-reversing starters shall be drawout type after disconnecting power leads only. Starters over three-space units high may be bolt-on type. A positive guidance system shall be provided to assure proper alignment of wedge-shaped power stabs in dead front openings in vertical power bus.

2.7.3 Disconnecting Means

A suitable disconnect device(s) to comply with the requirements of the NEC shall be provided. Motor branch circuits shall be protected by a Motor Circuit Protector (MCP). Provisions shall be provided for locking all disconnects in the OFF position with up to three padlocks.

2.7.4 Contactors

Magnetic starters and contactors shall be electromagnetic vertical or horizontal lift design with double break cadmium oxide silver contacts. Design shall meet or exceed the requirements of UL and NEMA Standards. Coils shall be hot molded construction to protect the coils from mechanical and environmental damage. The magnetic starter should be able to withstand 20 million operations.

2.7.5 Auxiliary Contacts

Each starter shall be able to accommodate a minimum of seven (7) auxiliary contacts in addition to the hold-in contact. Auxiliary contacts shall be provided as indicated on the drawings.

2.7.6 Surge-Suppression Device (SPD)

Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid-state equipment (e.g. programmable logic controller) wired as part of the control circuit.

2.7.7 Overload Relay

Each starter unit shall be supplied with 3-pole, manual reset electronic overload relays, providing Class 20 operation. The overload relay shall be supplied with an auxiliary contact which is operated when a tripped condition has occurred. Overload relays shall be equipped with one additional normally open (NO) and one additional normally closed (NC) isolated contact for use as specified herein and indicated on the Drawings. These contacts shall be shown on the submittal wiring diagrams.

2.7.8 Control Relays

Control relays with 120VAC coils shall be furnished for the motor control circuits as specified herein, indicated on the drawings, and as required. Control relays shall have an indicator light and check button. The contact ratings of the relays shall be coordinated with the burden of the motor starter

coil. If the burden or other electrical requirements exceed the contact rating of general purpose, plug-in relays, machine tool type relays with adequate contact ratings shall be provided.

2.7.9 Control Power Transformers (CPT)

The minimum control power transformer requirements are as follows:

Size 1	75 VA
Size 2	75 VA
Size 3	200 VA
Size 4	250 VA
Size 5	350 VA
Size 6	400 VA

Additional transformer capacity shall be provided when required. The Supplier and MCC manufacturer are advised to review the Contract Documents for additional requirements for space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings.

2.8 Reduced Voltage Auto-Transformer (RVAT) Starters

2.8.1 Reduced Voltage Auto-Transformer Starters shall provided as an integral part of the MCC if indicated on the drawings and specified herein. The drive system shall contain a, circuit breaker combination, reduced voltage autotransformer type, closed transition, non-reversing, motor starter as indicated on the drawings and specified herein. Starter shall include the following components as a minimum:

- Disconnecting means and short circuit protection device
- Start and Run contactors
- Reduced voltage autotransformer
- Motor overload relay, electronic type
- Output contactors
- Current sensor and digital display
- Output terminals
- Control power transformer
- Timers, relays, and controls as indicated on the drawings, as specified herein and as required for a properly functioning system.

2.8.2 The complete starter shall have an interrupting rating of at least 65,000 amperes at 480 volts. The motor circuit protector shall be 3 phase, 600 volt, molded case circuit breaker with adjustable instantaneous trip element. The motor circuit protector shall be operated by a toggle type handle and shall have a quick make, quick break over center switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be constructed so as to open, close, and trip simultaneously. The flange-mounted operator handle shall be lockable in the OFF position. The operator shall have a defeatable door interlock that prevents the doors from opening when the handle is in the ON position. The drive system disconnecting means with over-current protection may also serve as the RVAT starter disconnecting means and short circuit protection device if it is properly sized to meet code requirements and meets the requirements of this specification.

- 2.8.3 Magnetic starters and contactors shall be electromagnetic vertical or horizontal lift design with double break cadmium oxide silver contacts. Design shall meet or exceed the requirements of UL and NEMA Standards. IEC rated contactors are not acceptable. Coils shall be hot molded construction to protect the coils from mechanical and environmental damage. Magnetic starters shall be rated for 20 million operations. Magnetic starters and contactors shall be able to accommodate a minimum of seven (7) auxiliary contacts in addition to the hold-in contact.
- 2.8.4 The autotransformer shall be of three-coil construction and shall provide reduced voltage to the motor terminals during starting. Taps on the autotransformer shall provide selection of 50, 65, or 80 percent of line voltage for starting. The starter shall be wired at the 65% tap at the factory.
- 2.8.5 The RVAT starter shall be provided with a 3 pole, manually reset, solid state overload relay providing Class 20 operation with adjustable phase loss/unbalance, ambient insensitive within the stated operating temperature range of -20°C to +70°C, built-in thermal memory, visual trip indication, self powered at 50 percent of minimum current range. The overload relay shall be supplied with an auxiliary contact that is operated when a tripped condition has occurred. Two additional sets of normally open (NO) and normally closed (NC) isolated contacts shall be provided for use as specified herein and indicated on the drawings. These contacts shall be shown on the submittal wiring diagrams.
- 2.8.6 Control power transformer, fuses, timers and interposing relays shall be furnished for the motor control circuits as specified herein, as indicated on the drawings, and as required for an operational system. The control power transformer shall be sized for 125% of the expected load. The minimum rating shall be 350VA. Over-current protection shall be provided on the primary and secondary of the control power transformer. One leg of the secondary shall not be fused and shall be bonded to ground. The contact ratings of the relays shall be coordinated with the burden of the motor starter coils. If the burden or other electrical requirements exceed the contact rating of general purpose plug-in relays, machine tool type relays with adequate contact ratings shall be provided.
- 2.8.7 Each starter unit shall be supplied with 3-pole, solid-state overload relays for motor protection. Relays shall be microprocessor-based Overload Relay (OLR) in each starter for protection, control and monitoring of the motors. The overload relay shall have the following motor control functions:
- Fault relay, Form C, NO/NC contact with a rating code of B300 per UL 508.
 - Ground fault relay, Form A, NO contact with a rating code of B300 per UL 508.
 - External remote reset terminal
 - Trip status indicator

The relay shall draw its power from the line-voltage input for the motor with selectable trip classes 5-30 and an operator-interface (OI)/ display interface panel. The display shall allow programming, monitoring, and alarming functions without opening the MCC cover.

The relay shall annunciate the following conditions:

- Thermal overload
- Jam protection
- Current unbalance
- Current phase loss
- Ground fault
- Phase reversal
- Under-current
- Low power (kW)
- High power (kW)
- Over-voltage

- Under-voltage
- Voltage unbalance
- Voltage phase unbalance

The relay shall have the following monitoring capabilities:

- Current—Average and Phase RMS
- Voltage—Average and Phase RMS
- Power—Motor kW
- Power Factor
- Frequency
- Thermal capacity
- Run hours
- Ground fault current
- Current unbalance %
- Voltage unbalance %

The Relay shall have the following remote-mounted display/operator-interface option for use with motor control centers. The relay shall be communicate using Modbus RTU over Ethernet.

- 2.8.8 All push buttons, selector switches, and indicator lights shown on the schematics and specified herein shall be heavy-duty, oil tight, NEMA 4/13 rated. Push buttons shall be provided with protective caps when starters are located outdoors. Controls shall be provided with engraved nameplates.
- 2.8.9 Components within the RVAT starter enclosure shall be identified with engraved nameplates. The identification shall match component designations on the drive supplier's schematics. Nameplates shall be laminated black-over-white plastic, with 1/8 inch engraved letters, and shall be securely fastened adjacent to the device.

2.9 Power Factor Correction Capacitors

Capacitors shall be furnished and installed for the motors indicated on the drawings. They shall be rated 3 phase delta and for the voltage of the system to which they will be connected. Capacitors shall not contain PCBs.

The KVAR sizes indicated on the drawings are only approximate and shall be as recommended by the motor manufacturer to improve the power factor to 95 percent. They shall be complete with discharge resistors and fuses. Galvanized angle iron mounting stands shall be provided to mount the capacitors at least 4 inches above the mounting surface. Motor overload relays shall be sized taking into account the reduced motor current when capacitors are connected to the load side of starters.

Capacitors shall not be connected to the load side of solid-state starters, reduced-voltage autotransformer starters with open transition, multispeed starters, or variable frequency drives.

PART 3 EXECUTION

3.1. Installation

The motor control centers (MCC1,2) shall be delivered to Davidson Water where it will be unloaded and stored by Davidson Water, Inc. . Supplier shall provide written storage instructions for use by Owner.

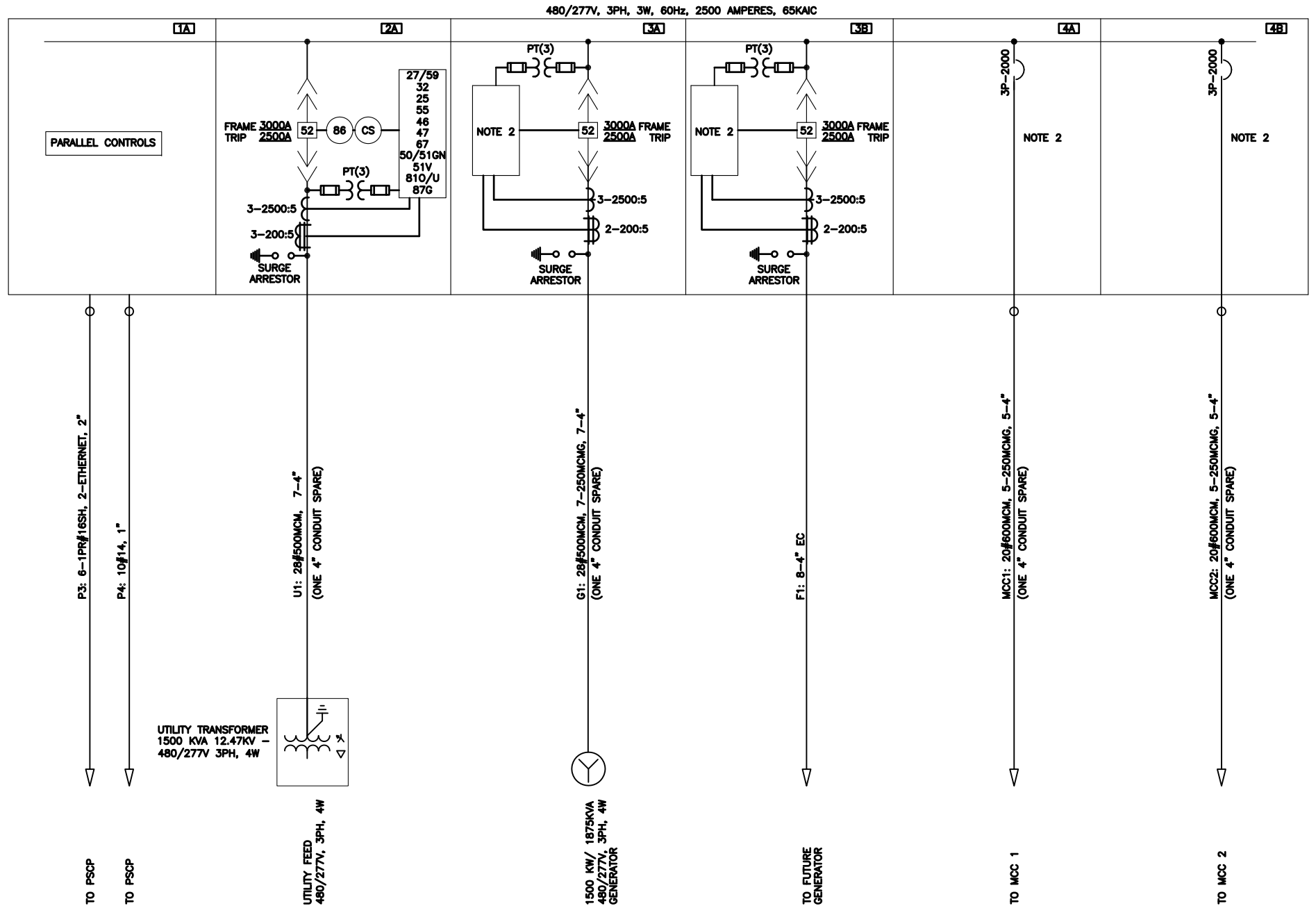
The MCC's will be installed under a separate contract. Supplier shall provide written installation instructions, including stub-up drawings for use by the installing Contractor. The Supplier shall provide checkout and start-up services as indicated herein and as required by the manufacturer.

Estimated MCC1,2 installation and startup will be March 2017.

3.2. Warranty

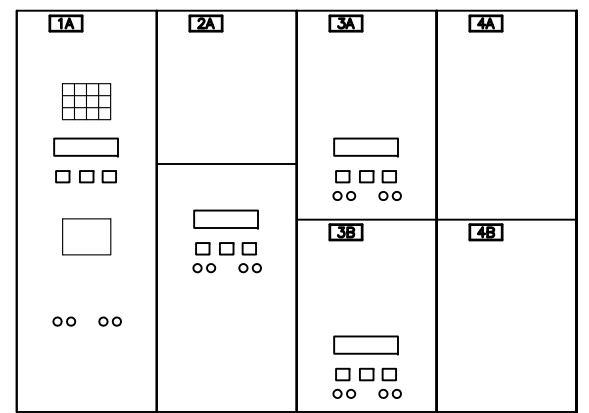
The Supplier shall warranty MCC1,2 for a 30 month period from delivery of equipment.

END OF SECTION



MAIN SWITCHGEAR, MSWGR ONE-LINE DIAGRAM
NOT TO SCALE

- NOTES:**
1. SYSTEM WILL INCLUDE AN INTEGRATED FEEDER CONTROL PACKAGES.
 2. MCC1 AND MCC2 FEEDERS SHALL BE MOLDED CASE WITH LSIG ADJUSTMENTS.



MSWGR FRONT ELEVATION
NOT TO SCALE

FILE: \\SERVER\ENGINEERING\VAZAR & SAWYER\HATTOWN PS IMPROVEMENTS\ELECTRICAL\DWGS\E101.dwg
 PLOT DATE: 2015/12/01 1:55:20 PM
 BY: RHINGS

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
DRAWN BY:	J. W. COOK
CHECKED BY:	-
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 	

PROCUREMENT DRAWING FOR PRICING ONLY

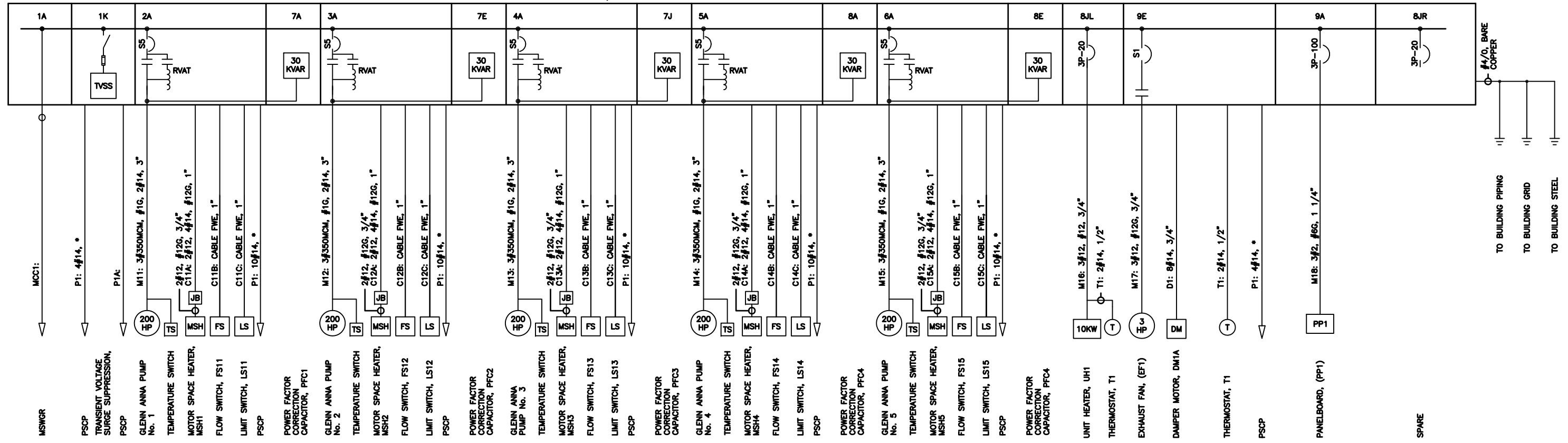
STURGILL ENGINEERING PA
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 ONE SOUTH MAIN ST.
 LEXINGTON, NC 27292
 (336) 238-1249 PH.
 (336) 236-6393 FAX

DAVIDSON COUNTY
 NORTH CAROLINA

 DAVIDSON WATER INC.
 HYATTOWN PUMP STATION IMPROVEMENTS

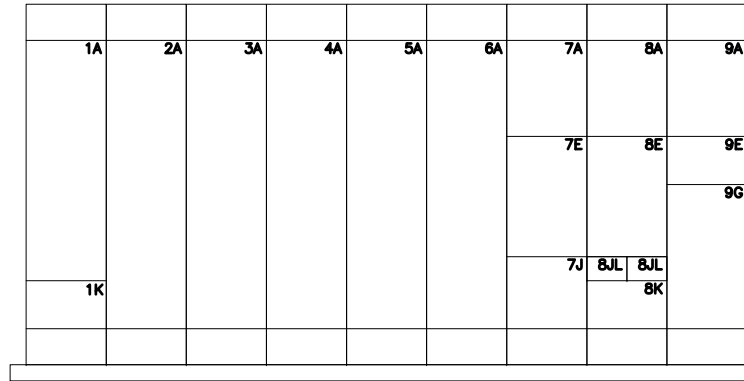
SYSTEM ONE-LINE DIAGRAM

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E101



MCC1 ONE-LINE DIAGRAM

NOT TO SCALE



MCC1 FRONT ELEVATION

NOT TO SCALE

NOTES:

1. CONTRACTOR RESPONSIBLE FOR ROUTING ALL CONDUITS.
2. CONTRACTOR SHALL VERIFY EQUIPMENT STUB-UP PRIOR TO INSTALLATION.

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
DRAWN BY:	J. W. COOK
CHECKED BY:	-
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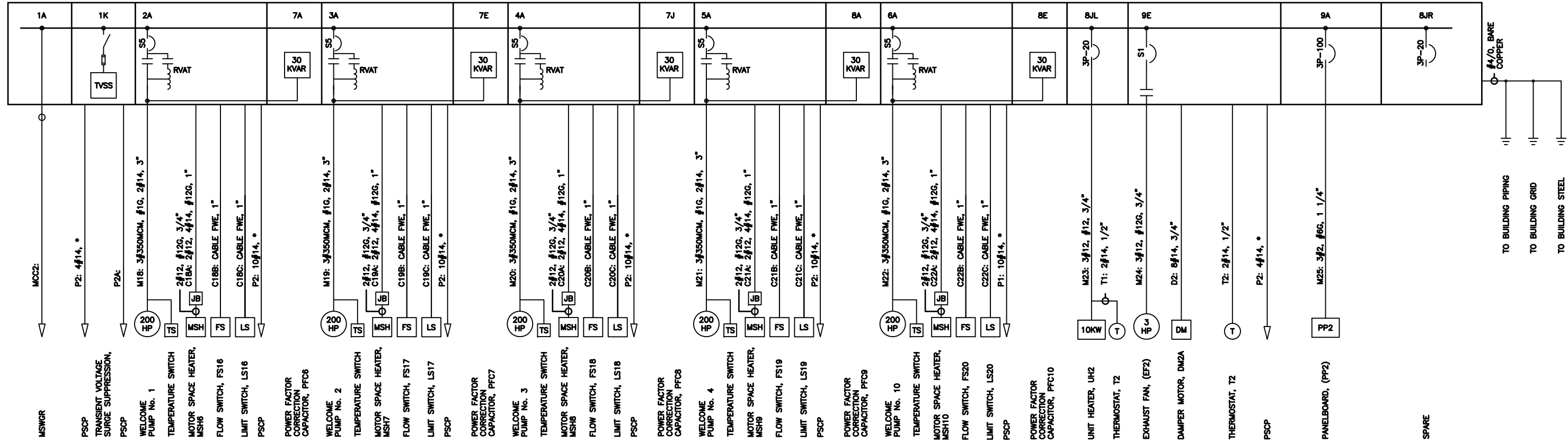
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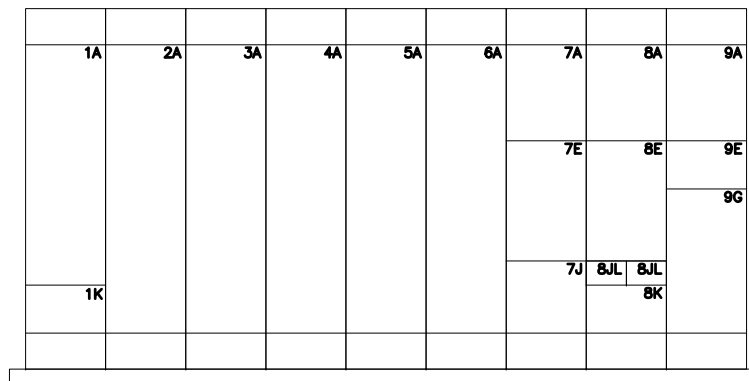
MCC1 ONE-LINE DIAGRAM

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E102



MCC2 ONE-LINE DIAGRAM

NOT TO SCALE



MCC2 FRONT ELEVATION

NOT TO SCALE

NOTES:

1. CONTRACTOR RESPONSIBLE FOR ROUTING ALL CONDUITS.
2. CONTRACTOR SHALL VERIFY EQUIPMENT STUB-UP PRIOR TO INSTALLATION.

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 BY: RHINDS

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
DRAWN BY:	J. W. COOK
CHECKED BY:	-
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	

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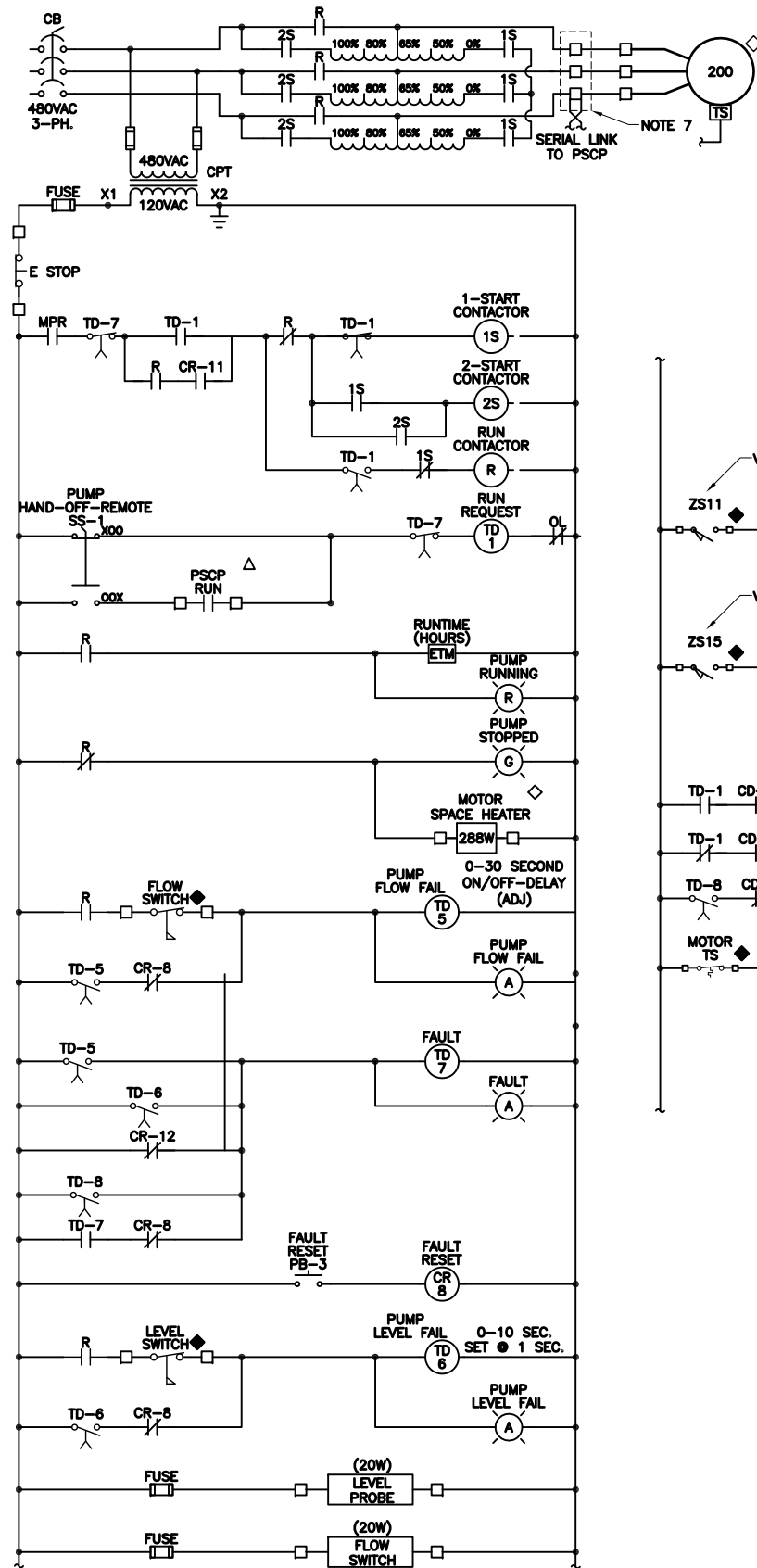


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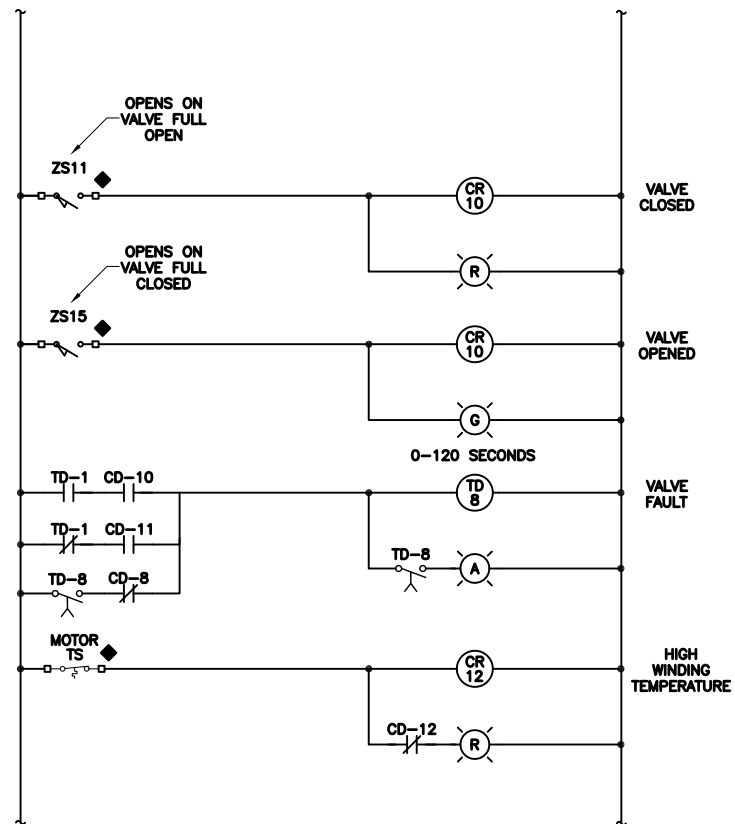
DAVIDSON WATER INC.
HYATTOWN PUMP STATION IMPROVEMENTS

MCC2
FRONT ELEVATION

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E103

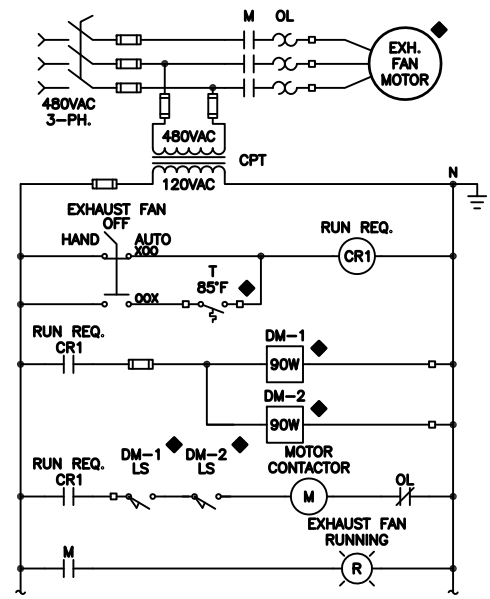


PUMP CONTROL SCHEMATIC (TYP. OF 10)
NOT TO SCALE TYPICAL FOR ALL WATER PUMPS



CONTACTS SHALL BE PROVIDED FOR CONNECTION TO PUMP STATION CP (PSCP)

◇	PUMP HAND-OFF-REMOTE SS-1
◇	PUMP RUNNING
◇	PUMP FLOW FAIL TD-5
◇	PUMP LEVEL FAIL
◇	PUMP FAULT CR-7
◇	FAULT RESET CR-8
◇	VALVE FAULT TD-8
◇	CR-12



EF AND DAMPER CONTROL
NO SCALE

SYM	LOCATION LEGEND
◇	LOCATED AT DRIVEN EQUIPMENT
◆	REMOTE FROM STARTER AND DRIVEN EQUIPMENT
△	LOCATED IN REMOTE PUMP STATION CONTROL PANEL(PSCP)

NOTES:

- SEE SHEET E001 FOR ELECTRICAL LEGEND AND ABBREVIATIONS.
- UNLESS OTHERWISE NOTED, DEVICES INDICATED ON THIS DRAWING SHALL BE SUPPLIED AS AN INTEGRAL PART OF THE PUMP DRIVE (VFD, RVAT, CONTACTORS, CONTROLS, ETC.) DEVICES LOCATED REMOTELY SHALL BE IDENTIFIED BY A LOCATION SYMBOL AS DEFINED IN THE DEVICE LOCATION LEGEND.
- RELAY AND TIMER DESIGNATIONS APPLY TO THE INDIVIDUAL SCHEMATIC ONLY.
- CONTROL SETTINGS, ALARM LIMITS, TIMER SETTINGS AND ADJUSTABLE PARAMETERS ARE INTENDED TO BE FOR THE INITIAL START-UP. ADJUSTABLE SETTINGS SHALL BE TESTED AND CHANGED BY THE CONTRACTOR, IF REQUIRED FOR PROPER OPERATION.
- MOTOR STARTER SCHEMATICS INDICATE GENERAL CONTROLS AND SEQUENCING. EQUIPMENT SUPPLIER SHALL ADAPT THE SPECIFIC PACKAGE TO PROVIDE A FULLY FUNCTIONAL SYSTEM.
- CONTROL SCHEMATICS ARE A DIAGRAMMATIC REPRESENTATION TO INDICATE THE MINIMUM ACCEPTABLE CONTROL FUNCTIONS. ACTUAL CONTROL LOGIC WILL DEPEND ON DRIVE MANUFACTURER'S CONTROL.
- MOTOR PROTECTION RELAY, MPM SHALL PROVIDE MOTOR PROTECTION FOR OVERLOAD, LOSS-OF-PHASE AND PHASE REVERSAL. IN ADDITION, SHALL PROVIDE KW, KWHR AMPS TO PSCP VIA MODBUS LINK.

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 DATE: 2015/10/01 11:30 AM

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
DRAWN BY:	J. W. COOK
CHECKED BY:	-

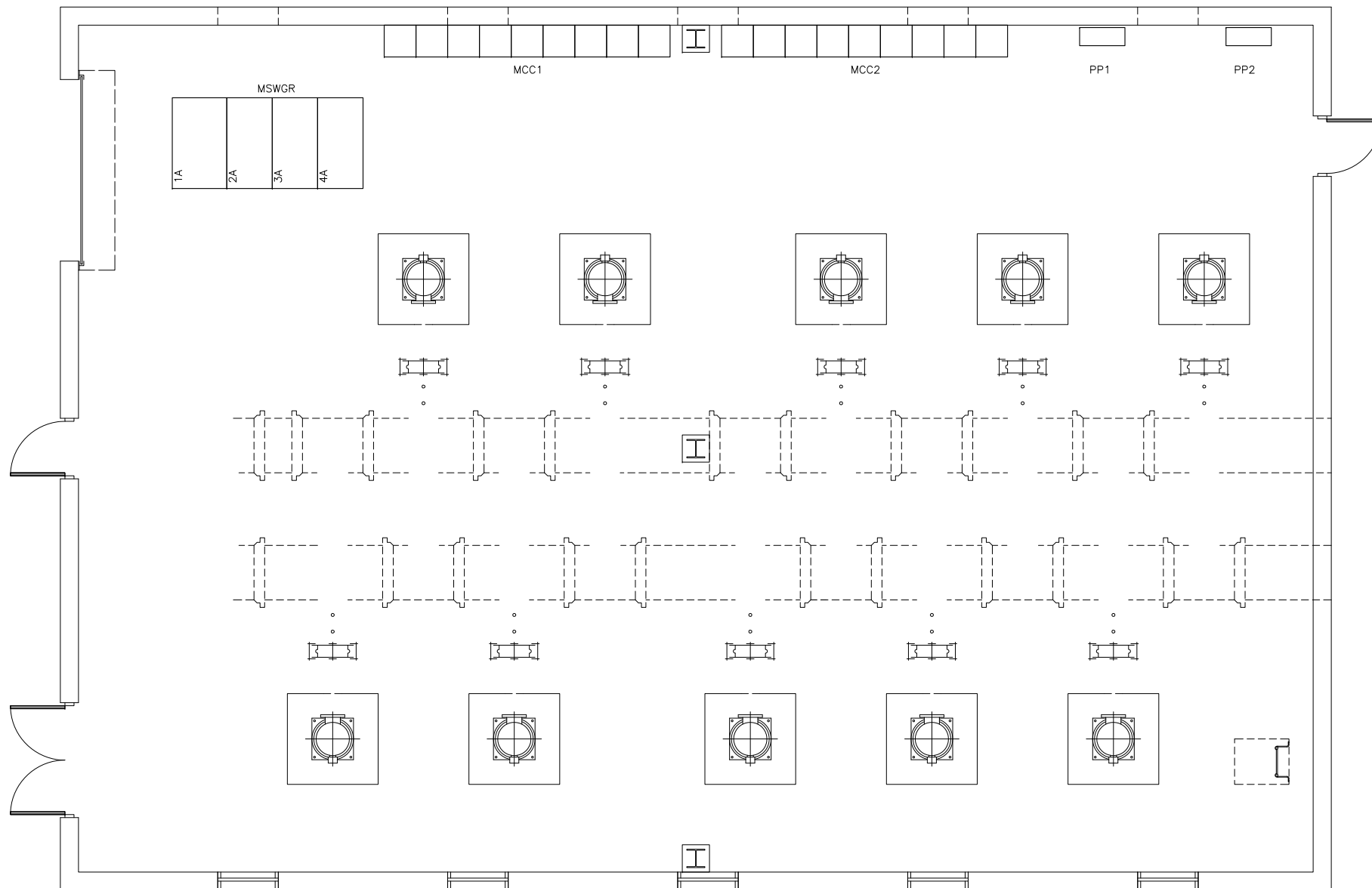
PROCUREMENT DRAWING FOR PRICING ONLY

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DAVIDSON COUNTY NORTH CAROLINA
 DAVIDSON WATER INC.
 HYATTOWN PUMP STATION IMPROVEMENTS

MISCELLANEOUS CONTROL SCHEMATIC
 E201

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E201



BOOSTER PUMP STATION POWER PLAN

SCALE 1/4" = 1'-0"

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PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
DRAWN BY:	J. W. COOK
CHECKED BY:	-
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 NORTH CAROLINA

 DAVIDSON WATER INC.
 HYATTOWN PUMP STATION IMPROVEMENTS

BOOSTER PUMP STATION
 POWER PLAN

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E301



Powering Business Worldwide

EATON

Powering Business Worldwide

Supersedes Selling Policy 25-000,
Pages 1-4, dated
February 20, 2006

**DOMESTIC U.S.A.
GENERAL TERMS AND
CONDITIONS OF SALE**

**Distribution and
Control Products
and Services
25-000**

TERMS AND CONDITIONS OF SALE

The Terms and Conditions of Sale set forth herein, and any supplements which may be attached hereto, constitute the full and final expression of the contract for the sale of products or services (hereinafter referred to as Product(s) or Services by Eaton Corporation (hereinafter referred to as Seller) to the Buyer, and supersedes all prior quotations, purchase orders, correspondence or communications whether written or oral between the Seller and the Buyer. Notwithstanding any contrary language in the Buyer's purchase order, correspondence or other form of acknowledgment, Buyer shall be bound by these Terms and Conditions of Sale when it sends a purchase order or otherwise indicates acceptance of this contract, or when it accepts delivery from Seller of the Products or Services. **THE CONTRACT FOR SALE OF THE PRODUCTS OR SERVICES IS EXPRESSLY LIMITED TO THE TERMS AND CONDITIONS OF SALE STATED HEREIN. ANY ADDITIONAL OR DIFFERENT TERMS PROPOSED BY BUYER ARE REJECTED UNLESS EXPRESSLY AGREED TO IN WRITING BY SELLER.** No contract shall exist except as herein provided.

Complete Agreement

No amendment or modification hereto nor any statement, representation or warranty not contained herein shall be binding on the Seller unless made in writing by an authorized representative of the Seller. Prior dealings, usage of the trade or a course of performance shall not be relevant to determine the meaning of this contract even though the accepting or acquiescing party had knowledge of the nature of the performance and opportunity for objection.

Quotations

Written quotations are valid for 30 days from its date unless otherwise stated in the quotation or terminated sooner by notice.

Verbal quotations, unless accepted, expire the same day they are made.

A complete signed order must be received by Seller within 20 calendar days of notification of award, otherwise the price and shipment will be subject to re-negotiation.

Termination and Cancellation

Any order may be terminated by the Buyer only by written notice and upon payment of reasonable termination charges, including all costs plus profit.

Seller shall have the right to cancel any order at any time by written notice if Buyer breaches any of the terms hereof, becomes the subject of any proceeding under state or federal law for the relief of debtors, or otherwise becomes insolvent or bankrupt, generally does not pay its debts as they become due or makes an assignment for the benefit of creditors.

Prices

All prices are subject to change without notice. In the event of a price change, the effective date of the change will be the date of the new price or discount sheet, letter or telegram. All quotations made or orders accepted after the effective date will be on the new basis. For existing orders, the price of the unshipped portion of an order will be the price in effect at time of shipment.

Price Policy – Products and Services

When prices are quoted as firm for quoted shipment, they are firm provided the following conditions are met:

1. The order is released with complete engineering details.
2. Shipment of Products are made, and Services purchased are provided within the quoted lead time.
3. When drawings for approval are required for any Products, the drawings applicable to those Products must be returned within 30* calendar days from the date of the original mailing of the drawings by Seller. The return drawings must be released for manufacture and shipment and must be marked "APPROVED" or "APPROVED AS NOTED." Drawing re-submittals which are required for any other reason than to correct Seller errors will not extend the 30-day period.

If the Buyer initiates or in any way causes delays in shipment, provision of Services or return of approval drawings beyond the periods stated above, the price of the Products or Services will be increased 1% per month or fraction thereof up to a maximum of 18 months from the date of the Buyer's order. For delays resulting in shipment or provision of Services beyond

18 months from the date of the Buyer's order, the price must be renegotiated.

Price Policy – BLS

Refer to Price Policy 25-050.

Minimum Billing

Orders less than \$1,000 will be assessed a shipping and handling charge of 5% of the price of the order, with a minimum charge of \$25.00 unless noted differently on Product discount sheets.

Taxes

The price does not include any taxes. Buyer shall be responsible for the payment of all taxes applicable to, or arising from, the transaction, the Products, its sale, value or use, or any Services performed in connection therewith regardless of the person or entity actually taxed.

TERMS OF PAYMENT

Products

Acceptance of all orders is subject to the Buyer meeting Seller's credit requirements. Terms of payment are subject to change for failure to meet such requirements. Seller reserves the right at any time to demand full or partial payment before proceeding with a contract of sale as a result of changes in the financial condition of the Buyer. Terms of Payment are either Net 30 days from the date of invoice of each shipment or carry a cash discount based on Product type. Specific payment terms for Products are outlined in the applicable Product discount schedules.

Services

Terms of payment are net within 30 days from date of invoice for orders amounting to less than \$50,000.00.

* 60 days for orders through contractors to allow time for their review and approval before and after transmitting them to their customers.

Terms of payment for orders exceeding \$50,000.00 shall be made according to the following:

1. Twenty percent (20%) of order value with the purchase order payable 30 days from date of invoice.
2. Eighty percent (80%) of order value in equal monthly payments over the performance period payable 30 days from date of invoice.

Except for work performed (i) under a firm fixed price basis or (ii) pursuant to terms of a previously priced existing contract between Seller and Buyer, invoices for work performed by Seller shall have added and noted on each invoice a charge of 3% (over and above the price of the work) which is related to Seller compliance with present and proposed environmental, health and safety regulations associated with prescribed requirements covering hazardous materials management and employee training, communications, personal protective equipment, documentation and record keeping associated therewith.

Adequate Assurances

If, in the judgment of Seller, the financial condition of the Buyer, at any time during the period of the contract, does not justify the terms of payment specified, Seller may require full or partial payment in advance.

Delayed Payment

If payments are not made in accordance with these terms, a service charge will, without prejudice to the right of Seller to immediate payment, be added in an amount equal to the lower of 1.5% per month or fraction thereof or the highest legal rate on the unpaid balance.

Freight

Freight policy will be listed on the Product discount sheets, or at option of Seller one of the following freight terms will be quoted.

F.O.B. – P/S – Frt./Ppd. and Invoiced

Products are sold F.O.B. point of shipment freight prepaid and invoiced to the Buyer.

F.O.B. – P/S – Frt./Ppd. and Allowed

Products sold are delivered F.O.B. point of shipment, freight prepaid and included in the price.

F.O.B. Destination – Frt./Ppd. and Allowed

At Buyer's option, Seller will deliver the Products F.O.B. destination freight prepaid and 2% will be added to the net price. The term "freight prepaid" means that freight charges will be prepaid to the accessible common carrier delivery point nearest the destination for shipments within the United States and Puerto Rico unless noted

differently on the Product discount sheets. For any other destination, contact Seller's representative.

Shipment and Routing

Seller shall select the point of origin of shipment, the method of transportation, the type of carrier equipment and the routing of the shipment.

If the Buyer specifies a special method of transportation, type of carrier equipment, routing or delivery requirement, Buyer shall pay all special freight and handling charges.

When freight is included in the price, no allowance will be made in lieu of transportation if the Buyer accepts shipment at factory, warehouse or freight station or otherwise supplies its own transportation.

Risk of Loss

Risk of loss or damage to the Products shall pass to Buyer at the F.O.B. point.

Concealed Damage

Except in the event of F.O.B. destination shipments, Seller will not participate in any settlement of claims for concealed damage.

When shipment has been made on an F.O.B. destination basis, the Buyer must unpack immediately and, if damage is discovered, must:

1. Not move the Products from the point of examination.
2. Retain shipping container and packing material.
3. Notify the carrier in writing of any apparent damage.
4. Notify Seller representative within 72 hours of delivery.
5. Send Seller a copy of the carrier's inspection report.

Witness Tests/Customer Inspection

Standard factory tests may be witnessed by the Buyer at Seller's factory for an additional charge calculated at the rate of \$2,500 per day (not to exceed eight (8) hours) per Product type. Buyer may final inspect Products at the Seller's factory for \$500 per day per Product type.

Witness tests will add one (1) week to the scheduled shipping date. Seller will notify Buyer fourteen (14) calendar days prior to scheduled witness testing or inspection. In the event Buyer is unable to attend, the Parties shall mutually agree on a rescheduled date. However, Seller reserves the right to deem the witness tests waived with the right to ship and invoice Products.

Held Orders

For any order held, delayed or rescheduled at the request of the Buyer, Seller may, at its sole option, (1) require payment to be based

on any reasonable basis, including but not limited to the contract price, and any additional expenses, or cost resulting from such a delay; (2) store Products at the sole cost and risk of loss of the Buyer; and/or (3) charge to the Buyer those prices under the applicable price policy. Payment for such price, expenses and costs, in any such event, shall be due by Buyer within thirty (30) days from date of Seller's invoice. Any order so held delayed or rescheduled beyond six (6) months will be treated as a Buyer termination.

Drawing Approval

Seller will design the Products in line with, in Seller's judgment, good commercial practice. If at drawing approval Buyer makes changes outside of the design as covered in their specifications, Seller will then be paid reasonable charges and allowed a commensurate delay in shipping date based on the changes made.

Drawing Re-Submittal

When Seller agrees to do so in its quotation, Seller shall provide Buyer with the first set of factory customer approval drawing(s) at Seller's expense. The customer approval drawing(s) will be delivered at the quoted delivery date. If Buyer requests drawing changes or additions after the initial factory customer approval drawing(s) have been submitted by Seller, the Seller, at its option, may assess Buyer drawing charges. Factory customer approval drawing changes required due to misinterpretation by Seller will be at Seller's expense. Approval drawings generated by Bid-Manager are excluded from this provision.

WARRANTY

Warranty For Products

Seller warrants that the Products manufactured by it will conform to Seller's applicable specifications and be free from failure due to defects in workmanship and material for one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

In the event any Product fails to comply with the foregoing warranty Seller will, at its option, either (a) repair or replace the defective Product, or defective part or component thereof, F.O.B. Seller's facility freight prepaid, or (b) credit Buyer for the purchase price of the Product. All warranty claims shall be made in writing.

Seller requires all non-conforming Products be returned at Seller's expense for evaluation unless specifically stated otherwise in writing by Seller.

This warranty does not cover failure or damage due to storage, installation, operation or maintenance not in conformance with Seller's recommendations and industry standard practice or due to accident, misuse, abuse or negligence. This warranty does not cover reimbursement for labor, gaining access, removal, installation, temporary power or any other expenses, which may be incurred in connection with repair or replacement.

This warranty does not apply to equipment not manufactured by Seller. Seller limits itself to extending the same warranty it receives from the supplier.

Extended Warranty for Products

If requested by the Buyer and specifically accepted in writing by Seller, the foregoing standard warranty for Products will be extended from the date of shipment for the period and price indicated below:

24 months – 2% of Contract Price
30 months – 3% of Contract Price
36 months – 4% of Contract Price

Special Warranty (In and Out) for Products

If requested by the Buyer and specifically accepted in writing by Seller, Seller will, during the warranty period for Products, at an additional cost of 2% of the contract price, be responsible for the direct cost of:

1. Removing the Product from the installed location.
2. Transportation to the repair facility and return to the site.
3. Reinstallation on site.

The total liability of Seller for this Special Warranty for Products is limited to 50% of the contract price of the particular Product being repaired and excludes expenses for removing adjacent apparatus, walls, piping, structures, temporary service, etc.

Warranty For Services

Seller warrants that the Services performed by it hereunder will be performed in accordance with generally accepted professional standards.

The Services, which do not so conform, shall be corrected by Seller upon notification in writing by the Buyer within one (1) year after completion of the Services.

Unless otherwise agreed to in writing by Seller, Seller assumes no responsibility with respect to the suitability of the Buyer's, or its customer's, equipment or with respect to any latent defects in equipment not supplied by Seller. This warranty does not cover damage to Buyer's, or its customer's, equipment, components or parts resulting in whole or in part from improper maintenance or operation or from their deteriorated condition. Buyer will, at its cost, provide Seller with unobstructed access to the defective Services, as well as adequate free working space in the immediate vicinity of the defective Services and such facilities and systems, including, without limitation, docks, cranes and utility disconnects and connects, as may be necessary in order that Seller may perform its warranty obligations. The conducting of any tests shall be mutually agreed upon and Seller shall be notified of, and may be present at, all tests that may be made.

Warranty for Power Systems Studies

Seller warrants that any power systems studies performed by it will conform to generally accepted professional standards. Any portion of the study, which does not so conform, shall be corrected by Seller upon notification in writing by the Buyer within six (6) months after completion of the study. All warranty work shall be performed in a single shift straight time basis Monday through Friday. In the event that the study requires correction of warranty items on an overtime schedule, the premium portion of such overtime shall be for the Buyer's account.

Limitation on Warranties for Products, Services and Power Systems Studies
THE FOREGOING WARRANTIES ARE EXCLUSIVE EXCEPT FOR WARRANTY OF TITLE. SELLER DISCLAIMS ALL OTHER WARRANTIES INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

CORRECTION OF NON-CONFORMITIES IN THE MANNER AND FOR THE PERIOD OF TIME PROVIDED ABOVE SHALL CONSTITUTE SELLER'S SOLE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR FAILURE OF SELLER TO MEET ITS WARRANTY OBLIGATIONS, WHETHER CLAIMS OF THE BUYER ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE.

Asbestos

Federal Law requires that building or facility owners identify the presence, location and quantity of asbestos containing material (hereinafter "ACM") at work sites. Seller is not licensed to abate ACM. Accordingly, for any contract which includes the provision of Services, prior to (i) commencement of work at any site under a specific Purchase Order, (ii) a change in the work scope of any Purchase Order, the Buyer will certify that the work area associated with the Seller's scope of work includes the handling of Class II ACM, including but not limited to generator wedges and high temperature gaskets which include asbestos materials. The Buyer shall, at its expense, conduct abatement should the removal, handling, modification or reinstallation, or some or all of them, of said Class II ACM be likely to generate airborne asbestos fibers; and should such abatement affect the cost of or time of performance of the work then Seller shall be entitled to an equitable adjustment in the schedule, price and other pertinent affected provisions of the contract.

Compliance with Nuclear Regulation

Seller's Products are sold as commercial grade Products not intended for application in facilities or activities licensed by the United States Nuclear Regulatory Commission for atomic purposes. Further certification will be required for use of the Products in any safety-related application in any nuclear facility licensed by the U.S. Nuclear Regulatory Commission.

Returning Products

Authorization and shipping instructions for the return of any Products must be obtained from Seller before returning the Products. When return is occasioned due to Seller error, full credit including all transportation charges will be allowed.

Product Notices

Buyer shall provide the user (including its employees) of the Products with all Seller supplied Product notices, warnings, instructions, recommendations and similar materials.

Force Majeure

Seller shall not be liable for failure to perform or delay in performance due to fire, flood, strike or other labor difficulty, act of God, act of any governmental authority or of the Buyer, riot, embargo, fuel or energy shortage, car shortage, wrecks or delays in transportation, or due to any other cause beyond Seller's reasonable control. In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended by a period of time reasonably necessary to overcome the effect of such delay.

Liquidated Damages

Contracts which include liquidated damage clauses for failure to meet shipping or job completion promises are not acceptable or binding on Seller, unless such clauses are specifically accepted in writing by an authorized representative of the Seller at its headquarters office.

Patent Infringement

Seller will defend or, at its option, settle any suit or proceeding brought against Buyer, or Buyer's customers, to the extent it is based upon a claim that any Product or part thereof, manufactured by Seller or its subsidiaries and furnished hereunder, infringes any United States patent, other than a claim of infringement based upon use of a Product or part thereof in a process, provided Seller is notified in reasonable time and given authority, information and assistance (at Seller's expense) for the defense of same. Seller shall pay all legal and court costs and expenses and court-assessed damages awarded therein against Buyer resulting from or incident to such suit or proceeding. In addition to the foregoing, if at any time Seller determines there is a substantial question of infringement of any United States patent, and the use of such Product is or may be enjoined, Seller may, at its option and expense: either (a) procure for Buyer the right to continue using and selling the Product; (b) replace the Product with non-infringing apparatus; (c) modify the Product so it becomes non-infringing; or (d) as a last resort, remove the Product and refund the purchase price, equitably adjusted for use and obsolescence. In no case does Seller agree to pay any recovery based upon its Buyer's savings or profit through use of Seller's Products whether the use be special or ordinary. The foregoing states the entire liability of Seller for patent infringement.

The preceding paragraph does not apply to any claim of infringement based upon: (a) any modification made to a Product other than by Seller; (b) any design and/or specifications of Buyer to which a Product was manufactured; or (c) the use or combination of Product with other products where the Product does not itself infringe. As to the above-identified claim situations where the preceding paragraph does not apply, Buyer shall defend and hold Seller harmless in the same manner and to the extent as Seller's obligations described in the preceding paragraph. Buyer shall be responsible for obtaining (at Buyer's expense) all license rights required for Seller to be able to use software products in the possession of Buyer where such use is required in order to perform any Service for Buyer.

With respect to a Product or part thereof not manufactured by Seller or its subsidiaries, Seller will attempt to obtain for Buyer, from the supplier(s), the patent indemnification protection normally provided by the supplier(s) to customers.

Compliance with OSHA

Seller offers no warranty and makes no representation that its Products comply with the provisions or standards of the Occupational Safety and Health Act of 1970, or any regulation issued thereunder. In no event shall Seller be liable for any loss, damage, fines, penalty or expenses arising under said Act.

Limitation of Liability

THE REMEDIES OF THE BUYER SET FORTH IN THIS CONTRACT ARE EXCLUSIVE AND ARE ITS SOLE REMEDIES FOR ANY FAILURE OF SELLER TO COMPLY WITH ITS OBLIGATIONS HEREUNDER.

NOTWITHSTANDING ANY PROVISION IN THIS CONTRACT TO THE CONTRARY, IN NO EVENT SHALL SELLER BE LIABLE IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE FOR DAMAGE TO PROPERTY OR EQUIPMENT OTHER THAN PRODUCTS SOLD HEREUNDER, LOSS OF PROFITS OR REVENUE, LOSS OF USE OF PRODUCTS, COST OF CAPITAL, CLAIMS OF CUSTOMERS OF THE BUYER OR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, REGARDLESS OF WHETHER SUCH POTENTIAL DAMAGES ARE FORESEEABLE OR IF SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

THE TOTAL CUMULATIVE LIABILITY OF SELLER ARISING FROM OR RELATED TO THIS CONTRACT WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE, SHALL NOT EXCEED THE PRICE OF THE PRODUCT OR SERVICES ON WHICH SUCH LIABILITY IS BASED.

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Project Name: DAVIDSON WATER, INC-
HYATTOWN PUMPING STATION
MCC

Negotiation No: GB751209X5K1

General Order No:

Alternate No: 0000

Item No.	Qty	Product	Description
001	1	Engineering Services	Start-up 3 days/ 3 trips of Engineering Service support.

Designation

Item No.	Qty	Product	Description
002	1	Motor Control Centers	60 Hz, Class 2B wiring, 480V 3-Phase Service, 65,000 Bracing, Top Incoming, NEMA 1 Gasketed 21" Front Mt Only enclosure, 2000A Copper Main Horizontal Bus, ANeutral, Main Lugs. Used X-Space: 91, Blank X-Space: 5, Future X-Space: 0, MCC Lead Time Code: C.

Designation MCC2

Qty List of Materials

- 1 #2-600 Kcmil 4/Ph Main Lugs (Screw)
- 1 FVNR Starter Size 1 [HMCP]
- 5 RVAT Starter Size 5 [HMCP]
- 1 HFD Bkr (100A trip)
- 1 HFDTwin Bkr (20A /20A trip)
- 5 250VA Individual CPT, Fused
- 1 100VA Individual CPT, Fused
- 20 N.O. Starter Aux Contacts, Size 5-6
- 1 N.O. Starter Aux Contacts, Size 1-4
- 1 N.C. Starter Aux Contacts, Size 1-4
- 10 N.C. Starter Aux Contacts, Size 5-6
- 6 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
- 6 Pilot Light-10250T - LED (Run)
- 6 C441 Motor Insight Overload Relay
- 6 Solid State Overload Relay (Standard)
- 6 Terminal Block - Latching Pull-Apart, Std.
- 6 #16awg, MTW Control Wire
- 5 Pilot Light-10250T - LED (Off, Stopped)
- 1 C-H Model D7, 300V, 4 Pole Socket Relay
- 5 1 Unit PB, 10250T (Emerg)
- 5 Panel Elapsed Time Meter (Standard)
- 5 Pilot Light-10250T - LED (Overload Trip)
- 2 Motor Load Block (100A)
- 5 Capacitor 30KVAR
- 1 160KA, SPD Standard Features Package, with Circuit Breaker
- 1 18" Door
- 1 12" Door
- 8 Labyrinth, Isolated/Insulated vertical bus barrier with shutters
- 1 2B Wiring
- 8 Tin Plated horizontal bus
- 8 65KA Bus Bracing
- 7 600A Vertical Bus (Tin-plated cu)
- 8 1000A Copper Full Length Neutral Bus
- 8 600A Horiz. Cu Gnd Bus, 1/4" x 2" Bar
- 8 2000A Copper Frnt Mtd 21" NEMA 1 Gasketed

Project Name: DAVIDSON WATER, INC-
HYATTOWN PUMPING STATION
MCC

Negotiation No: GB751209X5K1

General Order No:

Alternate No: 0000

Item No.	Qty	Product	Description
003	1	Motor Control Centers	MCC Spare Parts

Designation Advanced Parts MCC

Qty List of Materials

- 1 Pilot Light-10250T, 6V Xfmr
- 5 LED bulb, 10250T
- 1 C-H Model D7, 300V, 4 Pole Socket Relay
- 1 C-H Model D7 Relay Socket
- 2 Pushbutton, 10250T
- 2 NO Contact Block, 10250T
- 1 Size 3 Freedom Contactor, Coil Only
- 1 150VA Control Transformer
- 1 CPT - 150VA Secondary Fuse-2A Box of 10
- 1 CPT - 150VA Primary Fuse-1.5A Box of 10
- 1 3 Pos. Sel. Sw., 10250T
- 2 NC Contact Block, 10250T
- 2 Terminal Block - Latching Pull-Apart, Std.
- 1 HMCP Motor Circuit Protector, 400A
- 1 250VA Control Transformer
- 1 CPT - 250VA Secondary Fuse-3.5A Box of 10
- 1 CPT - 250VA Primary Fuse-2.5A Box of 10
- 1 Size 1 Freedom Starter, Coil Only
- 1 HMCP Motor Circuit Protector, 30A
- 1 HMCP Motor Circuit Protector, 100A

Item No.	Qty	Product	Description
004	1	Motor Control Centers	60 Hz, Class 2B wiring, 480V 3-Phase Service, 65,000 Bracing, Top Incoming, NEMA 1 Gasketed 21" Front Mt Only enclosure, 2000A Copper Main Horizontal Bus, ANeutral, Main Lugs. Used X-Space: 91, Blank X-Space: 5, Future X-Space: 0, MCC Lead Time Code: C.

Designation MCC1

Qty List of Materials

- 1 #2-600 Kcmil 4/Ph Main Lugs (Screw)
- 1 FVNR Starter Size 1 [HMCP]
- 5 RVAT Starter Size 5 [HMCP]
- 1 HFD Bkr (100A trip)
- 1 HFDTwin Bkr (20A /20A trip)
- 1 100VA Individual CPT, Fused
- 5 250VA Individual CPT, Fused
- 20 N.O. Starter Aux Contacts, Size 5-6
- 10 N.C. Starter Aux Contacts, Size 5-6
- 1 N.O. Starter Aux Contacts, Size 1-4
- 1 N.C. Starter Aux Contacts, Size 1-4
- 6 Terminal Block - Latching Pull-Apart, Std.
- 6 #16awg, MTW Control Wire
- 6 Solid State Overload Relay (Standard)
- 6 C441 Motor Insight Overload Relay
- 2 Motor Load Block (100A)
- 6 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
- 5 Panel Elapsed Time Meter (Standard)
- 5 Pilot Light-10250T - LED (Off, Stopped)
- 5 1 Unit PB, 10250T (Emerg)

Project Name: DAVIDSON WATER, INC-
HYATTOWN PUMPING STATION
MCC

Negotiation No: GB751209X5K1

**General Order
No:**

Alternate No: 0000

Qty	List of Materials
6	Pilot Light-10250T - LED (Run)
5	Pilot Light-10250T - LED (Overload Trip)
1	C-H Model D7, 300V, 4 Pole Socket Relay
5	Capacitor 30KVAR
1	160KA, SPD Standard Features Package, with Circuit Breaker
2	12" Door
1	6" Door
1	2B Wiring
8	Labyrinth, Isolated/Insulated vertical bus barrier with shutters
8	65KA Bus Bracing
8	600A Horiz. Cu Gnd Bus, 1/4" x 2" Bar
7	600A Vertical Bus (Tin-plated cu)
8	Tin Plated horizontal bus
8	1000A Copper Full Length Neutral Bus
8	2000A Copper Frnt Mtd 21" NEMA 1 Gasketed

Eaton Selling Policy 25-000 applies.

All orders must be released for manufacture within 90 days of date of order entry. If approval drawings are required, drawings must be returned approved for release within 60 days of mailing. If drawings are not returned accordingly, and/or if shipment is delayed for any reason, the price of the order will increase by 1.0% per month or fraction thereof for the time the shipment is delayed.

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Powering Business Worldwide

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Powering Business Worldwide



Detail Bill of Material

Page 1 of 1

Project Name: DAVIDSON WATER, INC-
HYATTOWN PUMPING STATION
MCC

Negotiation No: GB751209X5K1

**General Order
No:**

Alternate No: 0000

Item No.	Qty	Product	Description
001	1	Engineering Services	Start-up 3 days/ 3 trips of Engineering Service support.

Designation

Eaton Selling Policy 25-000 applies.

All orders must be released for manufacture within 90 days of date of order entry. If approval drawings are required, drawings must be returned approved for release within 60 days of mailing. If drawings are not returned accordingly, and/or if shipment is delayed for any reason, the price of the order will increase by 1.0% per month or fraction thereof for the time the shipment is delayed.

Comments & Clarifications

3 days/ 3 trips of Engineering Service support.

EATON

Powering Business Worldwide

EATON

Powering Business Worldwide

Project Name: DAVIDSON WATER, INC-
HYATTOWN PUMPING STATION
MCC

Negotiation No: GB751209X5K1

General Order No:

Alternate No: 0000

Item No.	Qty	Product	Description
002	1	Motor Control Centers	60 Hz, Class 2B wiring, 480V 3-Phase Service, 65,000 Bracing, Top Incoming, NEMA 1 Gasketed 21" Front Mt Only enclosure, 2000A Copper Main Horizontal Bus, ANeutral, Main Lugs. Used X-Space: 91, Blank X-Space: 5, Future X-Space: 0, MCC Lead Time Code: C.

Designation MCC2

Qty List of Materials

- 1 #2-600 Kcmil 4/Ph Main Lugs (Screw)
- 1 FVNR Starter Size 1 [HMCP]
- 5 RVAT Starter Size 5 [HMCP]
- 1 HFD Bkr (100A trip)
- 1 HFDTwin Bkr (20A /20A trip)
- 5 250VA Individual CPT, Fused
- 1 100VA Individual CPT, Fused
- 20 N.O. Starter Aux Contacts, Size 5-6
- 1 N.O. Starter Aux Contacts, Size 1-4
- 1 N.C. Starter Aux Contacts, Size 1-4
- 10 N.C. Starter Aux Contacts, Size 5-6
- 6 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
- 6 Pilot Light-10250T - LED (Run)
- 6 C441 Motor Insight Overload Relay
- 6 Solid State Overload Relay (Standard)
- 6 Terminal Block - Latching Pull-Apart, Std.
- 6 #16awg, MTW Control Wire
- 5 Pilot Light-10250T - LED (Off, Stopped)
- 1 C-H Model D7, 300V, 4 Pole Socket Relay
- 5 1 Unit PB, 10250T (Emerg)
- 5 Panel Elapsed Time Meter (Standard)
- 5 Pilot Light-10250T - LED (Overload Trip)
- 2 Motor Load Block (100A)
- 5 Capacitor 30KVAR
- 1 160KA, SPD Standard Features Package, with Circuit Breaker
- 1 18" Door
- 1 12" Door
- 8 Labyrinth, Isolated/Insulated vertical bus barrier with shutters
- 1 2B Wiring
- 8 Tin Plated horizontal bus
- 8 65KA Bus Bracing
- 7 600A Vertical Bus (Tin-plated cu)
- 8 1000A Copper Full Length Neutral Bus
- 8 600A Horiz. Cu Gnd Bus, 1/4" x 2" Bar
- 8 2000A Copper Frnt Mtd 21" NEMA 1 Gasketed

Item No.	Qty	Product	Description
003	1	Motor Control Centers	MCC Spare Parts

Designation Advanced Parts MCC

Project Name: DAVIDSON WATER, INC-
HYATTOWN PUMPING STATION
MCC

Negotiation No: GB751209X5K1

General Order No:

Alternate No: 0000

Qty	List of Materials
1	Pilot Light-10250T, 6V Xfmr
5	LED bulb, 10250T
1	C-H Model D7, 300V, 4 Pole Socket Relay
1	C-H Model D7 Relay Socket
2	Pushbutton, 10250T
2	NO Contact Block, 10250T
1	Size 3 Freedom Contactor, Coil Only
1	150VA Control Transformer
1	CPT - 150VA Secondary Fuse-2A Box of 10
1	CPT - 150VA Primary Fuse-1.5A Box of 10
1	3 Pos. Sel. Sw., 10250T
2	NC Contact Block, 10250T
2	Terminal Block - Latching Pull-Apart, Std.
1	HMCP Motor Circuit Protector, 400A
1	250VA Control Transformer
1	CPT - 250VA Secondary Fuse-3.5A Box of 10
1	CPT - 250VA Primary Fuse-2.5A Box of 10
1	Size 1 Freedom Starter, Coil Only
1	HMCP Motor Circuit Protector, 30A
1	HMCP Motor Circuit Protector, 100A

Item No.	Qty	Product	Description
004	1	Motor Control Centers	60 Hz, Class 2B wiring, 480V 3-Phase Service, 65,000 Bracing, Top Incoming, NEMA 1 Gasketed 21" Front Mt Only enclosure, 2000A Copper Main Horizontal Bus, ANeutral, Main Lugs. Used X-Space: 91, Blank X-Space: 5, Future X-Space: 0, MCC Lead Time Code: C.

Designation MCC1

Qty	List of Materials
1	#2-600 Kcmil 4/Ph Main Lugs (Screw)
1	FVNR Starter Size 1 [HMCP]
5	RVAT Starter Size 5 [HMCP]
1	HFD Bkr (100A trip)
1	HFDTwin Bkr (20A /20A trip)
1	100VA Individual CPT, Fused
5	250VA Individual CPT, Fused
20	N.O. Starter Aux Contacts, Size 5-6
10	N.C. Starter Aux Contacts, Size 5-6
1	N.O. Starter Aux Contacts, Size 1-4
1	N.C. Starter Aux Contacts, Size 1-4
6	Terminal Block - Latching Pull-Apart, Std.
6	#16awg, MTW Control Wire
6	Solid State Overload Relay (Standard)
6	C441 Motor Insight Overload Relay
2	Motor Load Block (100A)
6	3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
5	Panel Elapsed Time Meter (Standard)
5	Pilot Light-10250T - LED (Off, Stopped)
5	1 Unit PB, 10250T (Emerg)
6	Pilot Light-10250T - LED (Run)
5	Pilot Light-10250T - LED (Overload Trip)
1	C-H Model D7, 300V, 4 Pole Socket Relay
5	Capacitor 30KVAR
1	160KA, SPD Standard Features Package, with Circuit Breaker



Detail Bill of Material

Project Name: DAVIDSON WATER, INC-
HYATTOWN PUMPING STATION
MCC

Negotiation No: GB751209X5K1

**General Order
No:**

Alternate No: 0000

Qty	List of Materials
2	12" Door
1	6" Door
1	2B Wiring
8	Labyrinth, Isolated/Insulated vertical bus barrier with shutters
8	65KA Bus Bracing
8	600A Horiz. Cu Gnd Bus, 1/4" x 2" Bar
7	600A Vertical Bus (Tin-plated cu)
8	Tin Plated horizontal bus
8	1000A Copper Full Length Neutral Bus
8	2000A Copper Frnt Mtd 21" NEMA 1 Gasketed

Eaton Selling Policy 25-000 applies.

All orders must be released for manufacture within 90 days of date of order entry. If approval drawings are required, drawings must be returned approved for release within 60 days of mailing. If drawings are not returned accordingly, and/or if shipment is delayed for any reason, the price of the order will increase by 1.0% per month or fraction thereof for the time the shipment is delayed.

MCC General Information

MCC General Information

Wiring Diagram Type	Eaton Standard
MCC Quantity	
Standards	UL845, NEMA, NEC
Special Codes	UL
Service Voltage (3 Phase)	480
Frequency	60
System	3PH4W
Witness Testing	No

Enclosure Specifications

Total Structures	8
Type	NEMA 1 Gasketed
Depth	21" Front Mt Only
Height	90"
Horizontal Wireways	9" High, Top & Bottom
Vertical Wireways	4"
Channel Sills	No
Bottom Plates	None
150 Watt Space Heaters	No
Space Heater Thermostat	No
Master Terminal Block Location	None
IBC/CBC Seismic Qualified	No
ABS Certified	No

Bus System Specifications

Main Bus Amps	2000
Main Bus Material	Copper
Main Bus Bar Plating	Tin
Insulated Horiz. Bus	No
1000A/sq in. Cu Bus	No
Vertical Bus Amps	See Structure Schedule
Vertical Bus Material	Tin Plated Copper
Vertical Bus Barrier	Labyrinth, Isolated/ Insulated with shutters
Bus Bracing	65,000
Ground Bus	600
Ground Bus Location	Top
Ground Bus Lug Size	1-#6-350Kcmil
Ground Bus Lug Type	Screw
Plug-in 300A Vert. Gnd. Bus	No
Neutral	1000A
Neutral Bus Lug Location	Incoming Line
Neutral Bus Lug Size	1-#6-350Kcmil
Neutral Bus Lug Type	Screw
Horizontal Bus Temperature Rise	65 deg C
Bottom Vert. Bus Barrier	No
Vertical Ground Bus	No

Incoming Line Termination

Device: #2-600 Kcmil 4/Ph Main Lugs (Screw)	
Cable Entry	Top
Splice Kit / Transition	None

MCC Type Match Up	
MCC Type Match Up GO#	** None **

MCC Starter Specifications

Wiring Class	2B
Control Voltage	120
Control Voltage Src	Ind CPT
Nameplate Size	1" X 2.5"
Nameplate Color	Black / White Letters
Pilot Dev. Model	10250T
Ind. Light Type	6v Xfmr
PL Color (On)	Red
PL Color (Off)	Green
PL Color (O.L. Trip)	Blue

Structure Schedule

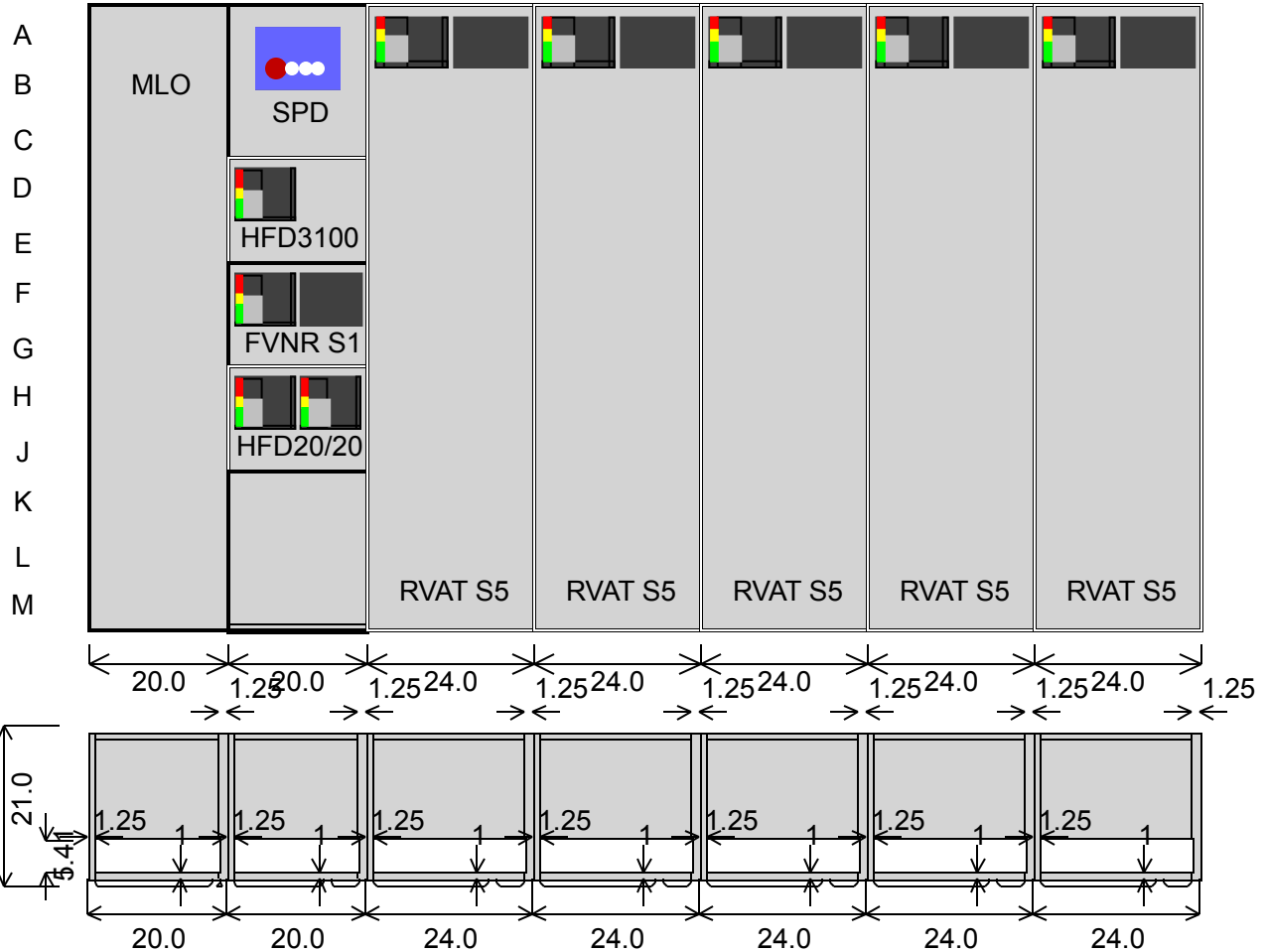
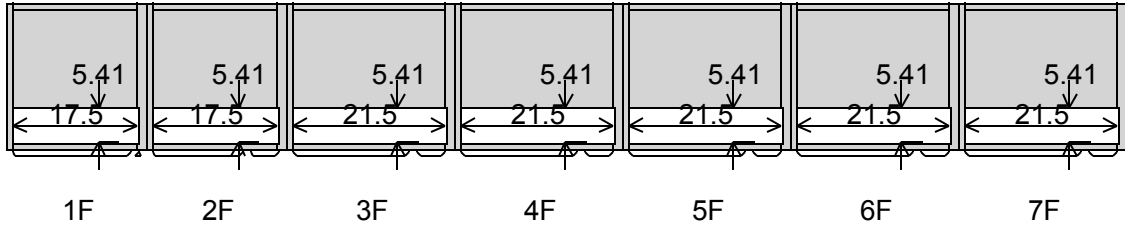
There are 8 structure(s).
 Structure(s) 2, 3, 4, 5, 6, 7, 8 have a 600 A Vertical Bus.
 Structure(s) 1 Have No Vertical Bus.
 Total width of all sections is 180"
 Height of all sections is 90"

Unit Modifications

Terminal Block - Latching Pull-Apart, Std.
 Solid State Overload Relay (Standard)
 #16awg, MTW Control Wire
 Solid State Overload Relay (Standard)

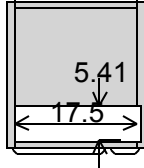
The information on this document is created by Eaton Corporation. It is disclosed in confidence and it is only to be used for the purpose in which it is supplied.	PREPARED BY	DATE	Eaton Fayetteville, NC		
	GARY LAW	2/23/2016			
	APPROVED BY	DATE	JOB NAME	DAVIDSON WATER, INC- HYATTOWN PUMPING STATION	
			DESIGNATION	MCC2	
	VERSION	TYPE	DRAWING TYPE		
	1.0.0.0		Customer Appr.		
NEG-ALT Number	REVISION	DWG SIZE	G.O.	ITEM	SHEET
GB751209X5K1-0000		A		002	1 of 5

Top View

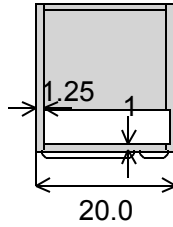
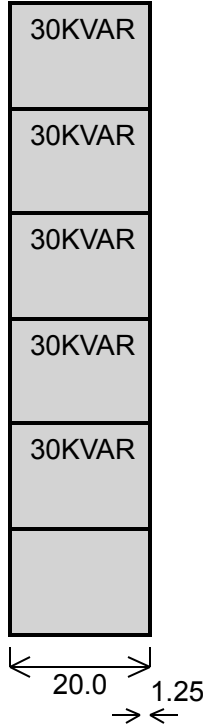


Floor View

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	APPROVED BY	DATE	JOB NAME DAVIDSON WATER, INC- HYATTOWN PUMPING STATION	DESIGNATION MCC2	
	VERSION 1.0.0.0	TYPE	DRAWING TYPE Customer Appr.		
NEG-ALT Number GB751209X5K1-0000	REVISION	DWG SIZE A	G.O.	ITEM 002	SHEET 2 of 5



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	APPROVED BY	DATE	JOB NAME DESIGNATION	DAVIDSON WATER, INC- HYATTOWN PUMPING STATION MCC2	
	VERSION 1.0.0.0	TYPE	DRAWING TYPE Customer Appr.		
NEG-ALT Number GB751209X5K1-0000	REVISION	DWG SIZE A	G.O.	ITEM 002	SHEET 3 of 5

Unit	Nameplate	Description	Class	Starter Size HP/FLA Wire Diag.	Bkr/Sw Poles Trip/Clip	Unit Features
1M	MLO	#2-600 Kcmil 4/Ph Main Lugs (Screw)				
2C	SPD	160KA, SPD Standard Features Package, with Circuit Breaker				
2E	PANELBOARD PP2	HFD Bkr (100A trip)			HFD 3P 100	1 Motor Load Block (100A)
2G	EXHAUST FAN EF2	FVNR Starter Size 1 [HMCP]	F206	1 3	HMCP 3P 15	1 100VA Individual CPT, Fused 1 N.O. Starter Aux Contacts, Size 1-4 1 N.C. Starter Aux Contacts, Size 1-4 1 C441 Motor Insight Overload Relay 1 Motor Load Block (100A) 1 Pilot Light-10250T - LED (Run) 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
2JL	UNIT HEATER UH2	HFD Twin Bkr (20A /20A trip)			HFD 3P 20	
2JR	SPARE	HFD Twin Bkr (20A /20A trip)			HFD 3P 20	
2M		18" Door				
3M	WELCOME PUMP 1	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P 400	1 250VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 5-6 4 N.O. Starter Aux Contacts, Size 5-6 1 C441 Motor Insight Overload Relay 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto) 1 Pilot Light-10250T - LED (Run)
4M	WELCOME PUMP 2	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P 400	1 250VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 5-6 4 N.O. Starter Aux Contacts, Size 5-6 1 C441 Motor Insight Overload Relay 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto) 1 Pilot Light-10250T - LED (Run)
5M	WELCOME PUMP 3	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P 400	1 250VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 5-6 4 N.O. Starter Aux Contacts, Size 5-6 1 C441 Motor Insight Overload Relay 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto) 1 Pilot Light-10250T - LED (Run)
6M	WELCOME PUMP 4	RVAT Starter Size 5	F606	5	HMCP	1 250VA Individual CPT, Fused

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	1.0.0.0		Customer Appr.		
NEG-ALT Number	REVISION	DWG SIZE	G.O.	ITEM	SHEET
GB751209X5K1-0000		A		002	4 of 5

<u>Unit</u>	<u>Nameplate</u>	<u>Description</u>	<u>Class</u>	<u>Starter Size</u> <u>HP/FLA</u> <u>Wire Diag.</u>	<u>Bkr/Sw</u> <u>Poles</u> <u>Trip/Clip</u>	<u>Unit</u> <u>Features</u>
		[HMCP]		200	3P	2 N.C. Starter Aux Contacts, Size 5-6
					400	4 N.O. Starter Aux Contacts, Size 5-6
						1 C441 Motor Insight Overload Relay
						1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
						1 Pilot Light-10250T - LED (Run)
7M	WELCOME PUMP 10	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P	1 250VA Individual CPT, Fused
					400	2 N.C. Starter Aux Contacts, Size 5-6
						4 N.O. Starter Aux Contacts, Size 5-6
						1 C441 Motor Insight Overload Relay
						1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto)
						1 Pilot Light-10250T - LED (Run)
8B	PUMP 1 CAP	Capacitor 30KVAR				
8D	PUMP 2 CAP	Capacitor 30KVAR				
8F	PUMP 3 CAP	Capacitor 30KVAR				
8H	PUMP 4 CAP	Capacitor 30KVAR				
8K	PUMP 10 CAP	Capacitor 30KVAR				
8M		12" Door				

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			DESIGNATION	MCC2		
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	1.0.0.0		Customer Appr.			
NEG-ALT Number	REVISION	DWG SIZE	G.O.	ITEM	SHEET	
GB751209X5K1-0000		A		002	5 of 5	

MCC General Information

MCC General Information

Wiring Diagram Type	Eaton Standard
MCC Quantity	
Standards	UL845, NEMA, NEC
Special Codes	UL
Service Voltage (3 Phase)	480
Frequency	60
System	3PH4W
Witness Testing	No

Enclosure Specifications

Total Structures	8
Type	NEMA 1 Gasketed
Depth	21" Front Mt Only
Height	90"
Horizontal Wireways	9" High, Top & Bottom
Vertical Wireways	4"
Channel Sills	No
Bottom Plates	None
150 Watt Space Heaters	No
Space Heater Thermostat	No
Master Terminal Block Location	None
IBC/CBC Seismic Qualified	No
ABS Certified	No

Bus System Specifications

Main Bus Amps	2000
Main Bus Material	Copper
Main Bus Bar Plating	Tin
Insulated Horiz. Bus	No
1000A/sq in. Cu Bus	No
Vertical Bus Amps	See Structure Schedule
Vertical Bus Material	Tin Plated Copper
Vertical Bus Barrier	Labyrinth, Isolated/ Insulated with shutters
Bus Bracing	65,000
Ground Bus	600
Ground Bus Location	Top
Ground Bus Lug Size	1-#6-350Kcmil
Ground Bus Lug Type	Screw
Plug-in 300A Vert. Gnd. Bus	No
Neutral	1000A
Neutral Bus Lug Location	Incoming Line
Neutral Bus Lug Size	1-#6-350Kcmil
Neutral Bus Lug Type	Screw
Horizontal Bus Temperature Rise	65 deg C
Bottom Vert. Bus Barrier	No
Vertical Ground Bus	No

Incoming Line Termination

Device: #2-600 Kcmil 4/Ph Main Lugs (Screw)	
Cable Entry	Top
Splice Kit / Transition	None

MCC Type Match Up	
MCC Type Match Up GO#	** None **

MCC Starter Specifications

Wiring Class	2B
Control Voltage	120
Control Voltage Src	Ind CPT
Nameplate Size	1" X 2.5"
Nameplate Color	Black / White Letters
Pilot Dev. Model	10250T
Ind. Light Type	6v Xfmr
PL Color (On)	Red
PL Color (Off)	Green
PL Color (O.L. Trip)	Blue

Structure Schedule

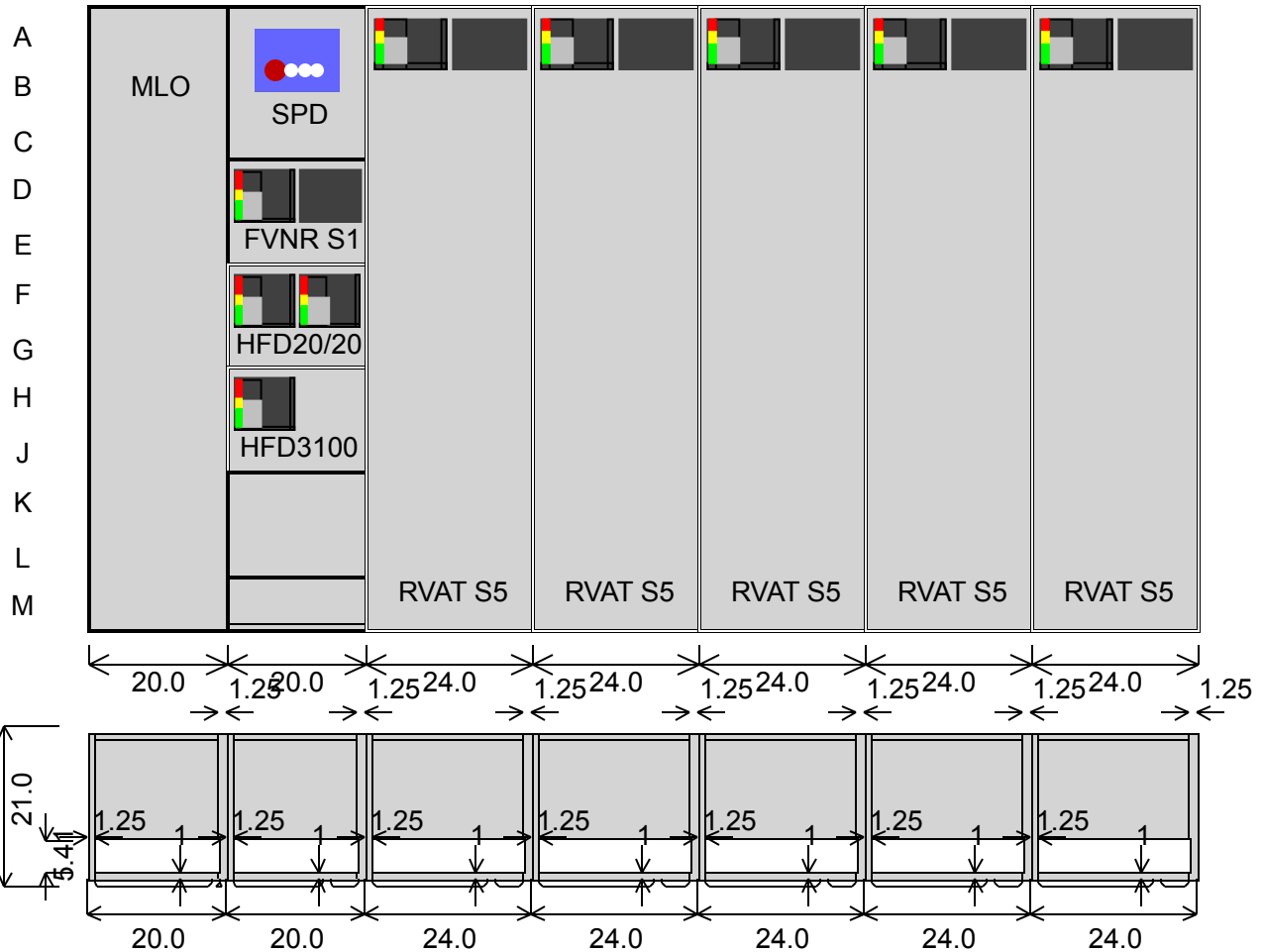
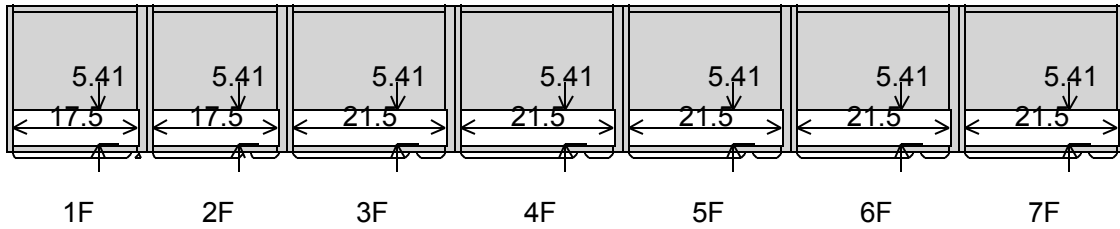
There are 8 structure(s).
 Structure(s) 2, 3, 4, 5, 6, 7, 8 have a 600 A Vertical Bus.
 Structure(s) 1 Have No Vertical Bus.
 Total width of all sections is 180"
 Height of all sections is 90"

Unit Modifications

Terminal Block - Latching Pull-Apart, Std.
 Solid State Overload Relay (Standard)
 #16awg, MTW Control Wire
 Solid State Overload Relay (Standard)

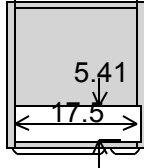
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	GARY LAW	2/23/2016			
	APPROVED BY	DATE	JOB NAME	DAVIDSON WATER, INC- HYATTOWN PUMPING STATION	
		DESIGNATION	MCC1		
	VERSION	TYPE	DRAWING TYPE		
	1.0.0.0		Customer Appr.		
NEG-ALT Number	REVISION	DWG SIZE	G.O.	ITEM	SHEET
GB751209X5K1-0000		A		004	1 of 5

Top View

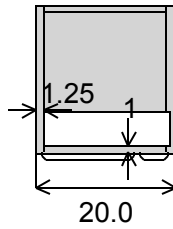
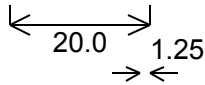
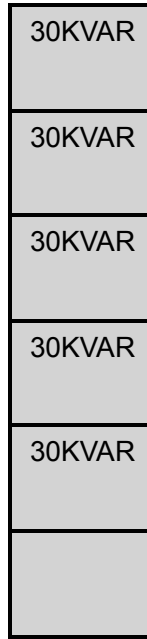


Floor View

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	VERSION 1.0.0.0	TYPE	DRAWING TYPE Customer Appr.		
NEG-ALT Number GB751209X5K1-0000	REVISION	DWG SIZE A	G.O.	ITEM 004	SHEET 2 of 5



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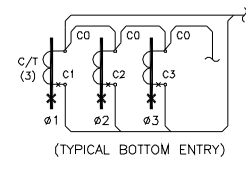
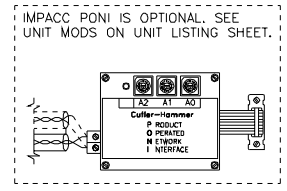
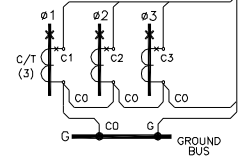
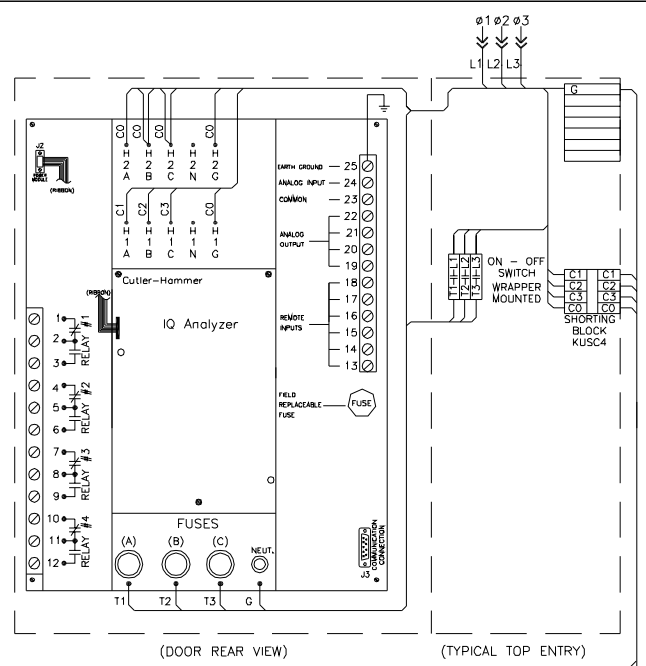
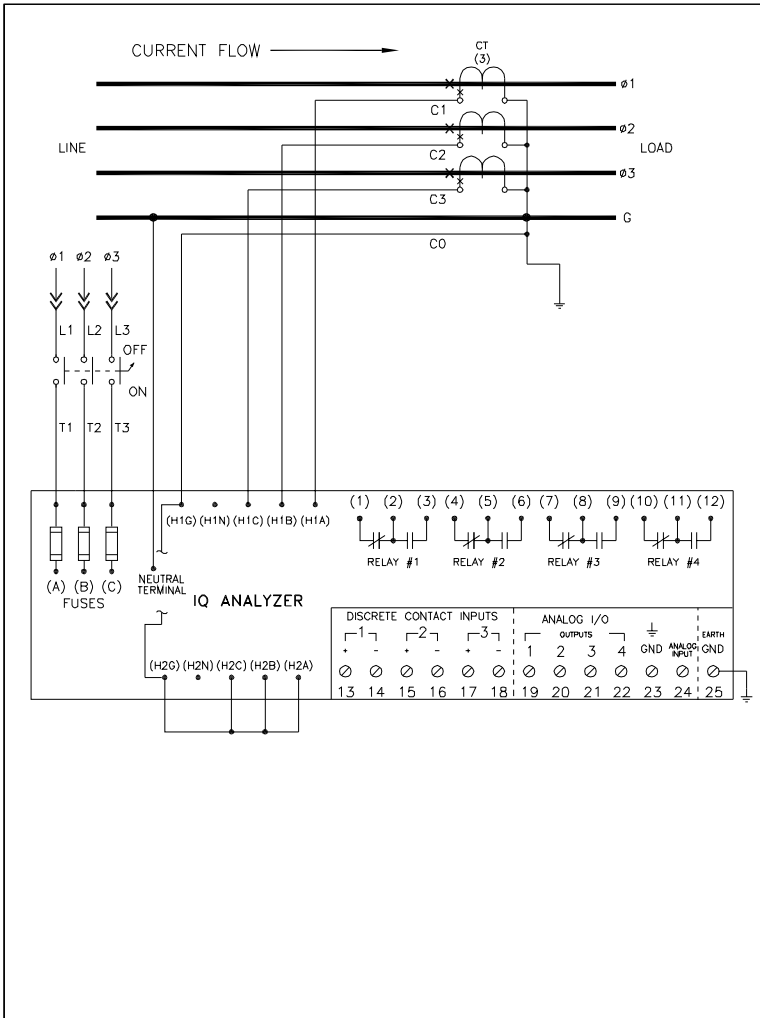
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	VERSION 1.0.0.0	TYPE	DRAWING TYPE Customer Appr.		
NEG-ALT Number GB751209X5K1-0000	REVISION	DWG SIZE A	G.O.	ITEM 004	SHEET 3 of 5

Unit	Nameplate	Description	Class	Starter Size HP/FLA Wire Diag.	Bkr/Sw Poles Trip/Clip	Unit Features
1M	MLO	#2-600 Kcmil 4/Ph Main Lugs (Screw)				
2C	SPD	160KA, SPD Standard Features Package, with Circuit Breaker				
2E	EXHAUST FAN EF1	FVNR Starter Size 1 [HMCP]	F206	1 10	HMCP 3P 30	1 100VA Individual CPT, Fused 1 N.O. Starter Aux Contacts, Size 1-4 1 N.C. Starter Aux Contacts, Size 1-4 1 C441 Motor Insight Overload Relay 1 Motor Load Block (100A) 1 Pilot Light-10250T - LED (Run) 1 3 Pos. Sel. Sw., 10250T (Hand-Off- Auto)
2GL	UNIT HEATER UH1	HFDTwin Bkr (20A /20A trip)			HFD 3P 20	
2GR	SPARE	HFDTwin Bkr (20A /20A trip)			HFD 3P 20	
2J	PANELBOARD PP2	HFD Bkr (100A trip)			HFD 3P 100	1 Motor Load Block (100A)
2L		12" Door				
2M		6" Door				
3M	GLENN ANNA PUMP 1	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P 400	1 250VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 5-6 4 N.O. Starter Aux Contacts, Size 5-6 1 C441 Motor Insight Overload Relay 1 3 Pos. Sel. Sw., 10250T (Hand-Off- Auto) 1 Pilot Light-10250T - LED (Run)
4M	GLENN ANNA PUMP 2	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P 400	1 250VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 5-6 4 N.O. Starter Aux Contacts, Size 5-6 1 C441 Motor Insight Overload Relay 1 3 Pos. Sel. Sw., 10250T (Hand-Off- Auto) 1 Pilot Light-10250T - LED (Run)
5M	GLENN ANNA PUMP 3	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P 400	1 250VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 5-6 4 N.O. Starter Aux Contacts, Size 5-6 1 C441 Motor Insight Overload Relay 1 3 Pos. Sel. Sw., 10250T (Hand-Off- Auto) 1 Pilot Light-10250T - LED (Run)

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			DESIGNATION	MCC1		
	VERSION	TYPE	DRAWING TYPE			
	1.0.0.0		Customer Appr.			
NEG-ALT Number	REVISION	DWG SIZE	G.O.	ITEM	SHEET	
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<u>Unit</u>	<u>Nameplate</u>	<u>Description</u>	<u>Class</u>	<u>Starter Size</u> <u>HP/FLA</u> <u>Wire Diag.</u>	<u>Bkr/Sw</u> <u>Poles</u> <u>Trip/Clip</u>	<u>Unit</u> <u>Features</u>
6M	GLENN ANNA PUMP 4	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P 400	1 250VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 5-6 4 N.O. Starter Aux Contacts, Size 5-6 1 C441 Motor Insight Overload Relay 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto) 1 Pilot Light-10250T - LED (Run)
7M	GLENN ANNA PUMP 5	RVAT Starter Size 5 [HMCP]	F606	5 200	HMCP 3P 400	1 250VA Individual CPT, Fused 2 N.C. Starter Aux Contacts, Size 5-6 4 N.O. Starter Aux Contacts, Size 5-6 1 C441 Motor Insight Overload Relay 1 3 Pos. Sel. Sw., 10250T (Hand-Off-Auto) 1 Pilot Light-10250T - LED (Run)
8B	PUMP 1 CAP	Capacitor 30KVAR				
8D	PUMP 2 CAP	Capacitor 30KVAR				
8F	PUMP 3 CAP	Capacitor 30KVAR				
8H	PUMP 4 CAP	Capacitor 30KVAR				
8K	PUMP 5 CAP	Capacitor 30KVAR				
8M		12" Door				

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			DESIGNATION	MCC1		
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NEG-ALT Number	REVISION	DWG SIZE	G.O.	ITEM	SHEET	
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	APPD	DATE					TITLE	IQ ANALYZER 3 PHASE 3 WIRE (UP TO 600V) CT'S ON LOAD
	FEDERAL ID NO	PRODUCT CODE	REVISION	2	G.O.	STANDARD	DWG	281734

The Eaton logo consists of the word "EATON" in a bold, blue, sans-serif font. The letter "O" is stylized as a white circle with a blue dot in the center, creating a visual effect of a power symbol or a stylized letter.

Powering Business Worldwide

C441 Motor Insight

C441 Motor Insight



C441 Motor Insight Overload and Monitoring Relay

General Description

Eaton's C441 Motor Insight®, the first product in the intelligent power control solutions family, is a highly configurable motor, load and line protection device with power monitoring, diagnostics and flexible communications, allowing the customer to save energy, optimize their maintenance schedules and configure greater system protection, thus reducing overall costs and downtime.

C441 Motor Insight is available in either a line-powered or 120 Vac control powered design, capable of monitoring voltages up to 660 Vac. Each of these units is available in a 1–9A or a 5–90A FLA model. With external CTs, C441 Motor Insight can protect motors up to 540A FLA. Available add-on accessories include communication modules for Modbus®, DeviceNet™ and PROFIBUS®, all with I/O options. For ease-of-use and operator safety, C441 Motor Insight offers a remote display that mounts easily with two 30 mm knockouts.

Features

Size/Range

- Broad FLA range of 1–540A
- Selectable trip class (5–30)
- Four operating voltage options
 - Line-powered from 240 Vac, 480 Vac, 600 Vac
 - Control-powered from 120 Vac

Motor Control

- Two output relays
 - One B300 Form C fault relay and one B300 ground fault shunt relay
 - Other relay configurations are available, including one Form A and one Form B SPST (fault and auxiliary relays) allowing programmable isolated relay behavior and unique voltages

- One external remote reset terminal
- Trip status indicator

Motor Protection

- Thermal overload
- Jam/stall protection
- Current level alarming
- Current imbalance
- Current phase loss
- Ground fault
- Phase reversal

Load Protection

- Undercurrent
- Low power (kW)
- High power (kW)

Line Protection

- Overvoltage
- Undervoltage
- Voltage imbalance
- Voltage phase loss

Monitoring Capabilities

- Current—average and phase rms
- Voltage—average and phase rms
- Power—motor kW
- Power factor
- Frequency
- Thermal capacity
- Run hours
- Ground fault current
- Current imbalance %
- Voltage imbalance %
- Motor starts
- Motor run hours

Options

- Type 1, 12 remote display
- Type 3R remote display kit
- Communication modules
 - Modbus
 - Modbus with I/O
 - DeviceNet with I/O
 - PROFIBUS with I/O
 - Modbus TCP with I/O (contact product line)
 - EtherNet/IP with I/O (contact product line)

Benefits

Reliability and Improved Uptime

- Advanced diagnostics allows for quick and accurate identification of the root source of a motor, pump or power quality fault; reducing troubleshooting time and the loss of productivity, reducing repeat faults due to misdiagnosis, and increasing process output and profitability

- Provides superior protection of motors and pumps before catastrophic failure occurs
- Increases profitability with greater process uptime and throughput, reduced costs per repair, reduced energy consumption and extended equipment life
- Adjustments to overload configuration can be made at any time

Safety

- IP 20 rated terminal blocks
- Terminal blocks are set back from the display to reduce operator shock hazard
- Remote display (optional) does not require that the operator open the panel to configure the device

Flexibility

- Communications modules
 - Offered in a variety of configurations
 - External snap-on modules provide support for multiple communications protocols
- Advanced power, voltage and current monitoring capabilities
- Communications modules and remote display can be used simultaneously
- Highly configurable fault and reset characteristics for numerous applications
- Fully programmable isolated fault and auxiliary relays

Ease of Use

- Bright LED display with easy-to-understand setting and references
- Powered from line voltage or 120 Vac control power
- Remote display powered from base unit
- Full word descriptions and units on user interface

Standards and Certifications

- cULus listed NKCR, NKCR7, 508
- UL 1053 applicable sections for ground fault detection
- CSA certified (Class 3211-02)
- CE
- NEMA
- IEC EN 60947-4-1
- RoHS

C441 Motor Insight

Product Selection

Table 30.3-25. C441 Motor Insight

Power Source	Monitoring Range	Current Range	Catalog Number
240 Vac (170–264)	170–264 Vac	1–9A 5–90A	C441BA C441BB
480 Vac (323–528)	323–528 Vac	1–9A 5–90A	C441CA C441CB
600 Vac (489–660)	489–660 Vac	1–9A 5–90A	C441DA C441DB
120 Vac (93.5–132)	170–660 Vac	1–9A 5–90A	C4410109NOUI C4410590NOUI

Table 30.3-26. C441 Motor Insight CT Multiplier and Wire Wrap Schedule

Catalog Number ①	Motor FLA	No. of Loops	No. of Conductors Through CT Primary	CT Multiplier Setting	External CT Kit Catalog Number ②
------------------	-----------	--------------	--------------------------------------	-----------------------	----------------------------------

Current Range: 5–90A

C441_B and C4410590NOUI	5–22.5A	3	4	4	—
	6.67–30A	2	3	3	—
	10–45A	1	2	2	—
	20–90A	0	1	1	—

Current Range: 1–9A

C441_A and C4410109NOUI	1–5A	1	2	2	—
	2–9A	0	1	1	—
	60–135A	0	1	150–(150:5)	C441CTKIT150
	120–270A	0	1	300–(300:5)	C441CTKIT300
	240–540A	0	1	600–(600:5)	C441CTKIT600

① Underscore indicates Operating Voltage Code required.

Operating Voltage Codes:

Code	Voltage
B	240 Vac
C	480 Vac
D	600 Vac
<empty>	120 Vac control power

② Any manufacturer's CTs may be used.

Accessories

Table 30.3-27. Communication Modules

Description	I/O	Catalog Number
Modbus		
Modbus communication module	None	C441M
Modbus communication module 4IN/2OUT	120 Vac	C441N
	24 Vdc	C441P
DeviceNet		
DeviceNet communication module 4IN/2OUT	120 Vac	C441K
	24 Vdc	C441L
PROFIBUS		
PROFIBUS communication module 4IN/2OUT	120 Vac	C441S
	24 Vdc	C441Q
EtherNet/IP and Modbus TCP		
Ethernet-based communication module 4IN/2OUT	120 Vac	C441R
	24 Vdc	C441T

Type 3R Kit with Remote Display Mounted Inside

C441 Motor Insight offers several accessories for the customer's ease of use and safety:

- Types 1 and 12 remote display
- Type 3R remote display kit
- Mounting plate adapter

Features and Benefits

- Remote display unit:
 - Same user interface as the overload relay
 - Enhanced operator safety—operator can configure the overload without opening the enclosure door
- Type 3R kit mounts with standard 30 mm holes
- Mounting plate for retrofit in existing installations

Table 30.3-28. Type 3R Kit with Remote Display Mounted Inside

Description	Catalog Number
Remote display Types 1 and 12 (UL 508) Type 3R kit for remote display (UL 508) Conversion plate	C4411 C4413 C441CMP1

Communication Cables

The remote display requires a communication cable to connect to the C441 Motor Insight overload relay:

Table 30.3-29. Communication Cable Lengths

Length in Inches (meters)	Catalog Number
9.8 (0.25) 39.4 (1.0)	D77E-QPIP25 D77E-QPIP100
78.7 (2.0) 118.1 (3.0)	D77E-QPIP200 D77E-QPIP300

Table 30.3-30. Current Transformer Kits

Description	Catalog Number
Three 150:5 CTs to be used with C441 Motor Insight Three 300:5 CTs to be used with C441 Motor Insight Three 600:5 CTs to be used with C441 Motor Insight	C441CTKIT150 C441CTKIT300 C441CTKIT600

For more information about technical data and specifications as well as dimensions, see Volume 5—Motor Control and Protection, CA08100006E, Section 31.

The Eaton logo consists of the word "EATON" in a bold, blue, sans-serif font. The letter "O" is stylized as a white circle with a blue dot in the center, creating a visual effect of a power symbol or a stylized letter.

Powering Business Worldwide

General Description

Freedom 2100 and
Freedom FlashGard®
Motor Control Center

Freedom 2100 Motor Control Center



Freedom FlashGard Motor Control Center

General Description

Freedom 2100

Introduction

Eaton's Freedom 2100 motor control centers (MCCs) provide a convenient method for grouping motor control, as well as associated distribution equipment. Freedom 2100 Series MCCs may be applied on electrical systems up to 600V, 50 or 60 Hz, having available fault currents of up to 100,000A rms. Enclosure designs include NEMA® 1 Gasketed, NEMA 2, 12 and 3R. All controllers are assembled with Eaton components of proven safety, quality and reliability. All components are wired in accordance with NEC® and UL® standards. A comprehensive range of communications options are available, including DeviceNet™, Modbus®, PROFIBUS®, Modbus TCP and EtherNet/IP.

Freedom 2100 Features

- UL 845 label
- 42, 65 and 100 kAIC ratings
- Molded-case and air power circuit breakers
- Across-the-line, reduced voltage and solid-state starters
- Variable frequency drives and VFD options
- Unit latch
- Spring-loaded door latches
- All standard industrial communication options
- Automatic transfer switches
- Panelboards and transformers

Freedom FlashGard

Introduction

Eaton's Freedom FlashGard MCCs are an industry first in addressing the dangers associated with an arc flash event by minimizing the risk of arc flash exposure, and lowering the PPE requirements as defined by the NFPA® 70E.2004, for low voltage applications. Freedom FlashGard offers features to help prevent injury from electric shock, arc-flash burn and arc-blast impacts. A retractable stab mechanism, 120V based electromechanical and solid-state motor control with communications capability enables these MCCs to provide the highest level of safety, quality and innovation for group motor control. A comprehensive range of communications options are available, including DeviceNet, Modbus, PROFIBUS and EtherNet/IP.

The new Freedom FlashGard MCC uses a "retractable stab" mechanism, called RotoTract™, which allows the electrical worker to connect and disconnect power to the bucket with the unit door closed. A visual indication is provided on the unit door on the "Connected" and "Disconnected" positions of RotoTract. A visual indication on the position of the shutters that enclose the stabs is also provided (open shutters indicates that stabs are extended and closed shutters indicate that the stabs are withdrawn). In addition, a number of safety interlocks prevents scenarios where removal or insertion of FlashGard bucket could compromise arc flash safety. A motorized tool, such as an electric screwdriver with a 3/8-inch (9.5 mm) square bit or standard 3/8-inch (9.5 mm) drive ratchet is required to operate RotoTract's "retractable stab" mechanism. An optional remote racking accessory with a pendant station is available

as to enable the operator to connect and disconnect starters safely behind the arc flash boundaries prescribed by National Fire Protection Agency (NFPA).

Freedom FlashGard Features

- UL 845 label
- 42, 65 and 100 kAIC ratings
- Retractable stab mechanism with "connected" and "disconnected" positions
- Molded-case and air power circuit breakers
- Unit latch
- Spring-loaded door latches
- Remote racking
- Across-the-line, reduced voltage and solid-state starters
- Variable frequency and solid-state reduced voltage starter options
- All standard industrial communication options
- Automatic transfer switches
- Panelboards and transformers

Product Description

MCCs provide the best method for grouping motor control as well as associated distribution equipment. Eaton's Freedom 2100 and Freedom FlashGard Series control centers are specially designed to operate machinery, industrial processes and commercial building systems.

The MCC enclosure consists of a strong and rigid steel channel framework assembled into standardized vertical sections and bolted together to form a complete shipping section of up to 80.00-inch (2032.0 mm) maximum, four structures each. Structures include horizontal and vertical bus, insulation and isolation barriers, horizontal and vertical isolated wiring troughs, cable entrance areas, and space for inserting starter and control equipment.

All control units, removable or fixed mounted, are assembled with Eaton components of proven safety, quality and reliability. All components are wired in accordance with NEC and UL standards. Specifically designed bus stabs, insertion guides, handle mechanisms and safety interlocks are added to form a standardized plug-in unit, which meets the highest safety standards.

General Description

Freedom 2100 and Freedom FlashGard Series MCCs may be applied on electrical systems up to 600V, 50 or 60 Hz having available fault currents of up to 100,000A rms. Enclosure designs include NEMA 1 Gasketed, 2, 12, 3R, 3R Walk-in and 3R Walk-in Tunnel. An ongoing temperature and short-circuit design test program, as required by UL 845, ensures a quality product that meets the latest safety codes.

Freedom DC motor control centers are available up to 250 Vdc, having available fault currents up to 22,000A rms.

NEMA Classifications (ICS 3, Part 1)

Class I Control Centers

A mechanical grouping of combination motor control, feeder tap and/or other units arranged in a convenient assembly. Connections from the common horizontal power bus to the units are included. Interwiring or interlocking between units or to remotely mounted devices is not included. Only diagrams of the individual units are supplied.

When master terminal blocks are specified, a sketch showing general location of terminals is provided.

Class II Control Centers

The same as Class I, but designed to form a complete control system. They include the necessary electrical interlocking and interwiring between units and interlocking provisions to remotely mounted devices. A suitable diagram illustrating operation of the control associated with the motor control center will be provided.

When master terminal blocks are specified, the terminal arrangement and required wiring connections are shown on the diagram.

NEMA Types of Wiring

Type A includes no terminal blocks. Combination line starters power wiring are factory wired and assembled in the structure in the most efficient arrangement. Auxiliary devices can be supplied, wired or unwired as specified. All feeder circuit breaker or fusible disconnect units are in this classification.

Type B duplicates Type A except that all control wires terminate at blocks on the side or near the bottom of each unit. Plug-in type terminal blocks are standard for all control wiring.

Type C-S all factory-supplied control terminals are brought to a master terminal block located in the structure.

Type C-M all factory-supplied control terminals are brought to a master terminal block located in a separate marshaling structure.

Structures



Standard Structure—Side View

Construction

The standard vertical structure is 90.00 inches (2286.0 mm) high and 20.00 inches (508.0 mm) wide. Front-mounted-only structures can be either 16.00 inches (406.4 mm) or 21.00 inches (533.4 mm) deep. Back-to-back unit mounting is 21.00 inches (533.4 mm) deep.

The structure framework is made of 12-gauge formed steel channels. The subframes for the front and rear of each structure are welded. These subframes are then bolted to longitudinal members to form the complete frame, which is rigid and self-supporting. Side, back and roof covers of 14-gauge steel are mounted with screw fasteners for quick and easy removal. All doors are 14-gauge steel with a 0.50-inch (12.7 mm) flange to provide a rigid,

secure closure for all openings. Doors mounted on removable pin hinges are provided on all unit compartments. Vertical wireways, top horizontal wireways and bottom horizontal wireways are standard.

The unit pan forms the top barrier of each unit space. In conjunction with the unit wrapper, this provides isolation between adjacent units and wireways. The guide rails are an integral part of this pan and provide precise alignment of the unit stabs on the vertical bus.

Standard Structure Arrangements

Standard structural height is 90.00 inches (2286.0 mm) with 9.00-inch (228.6 mm) horizontal wireways available at top and bottom for wiring. The balance of vertical compartments, 72.00 inches (1828.8 mm), is available for mounting of control units. This space can provide up to 12 6.00-inch (152.4 mm) high (X spaces) or any combination thereof.

Note: In the rear of common vertical bus back-to-back structures, the top horizontal wireway is 15.00 inches (381.0 mm) high and the bottom wireway is 9.00 inches (228.6 mm). This means that back-to-back structures have only 66.00 inches (1676.4 mm) 11X of usable space in the rear. 72.00-inch (1828.8 mm) 12X of mounting space is available with a 3.00-inch (76.2 mm) bottom wireway. Two front-mounted only structures can be supplied in a back-to-back configuration, allowing 12X rear usable space (depth dimension will increase).

Special Structures

In addition to the standard 20.00-inch (508.0 mm) wide structure, extra wide structures are available in 4.00-inch (101.6 mm) increments up to 40.00 inches (1016.0) wide.

Reduced height structures, in increments of 6.00 inches (152.4 mm) 1X from 90.00 to 54.00 inches (2286.0 to 1371.6 mm), are available for applications with limited access.

Another special structure is a transition section between Type W and the Freedom 2100 Series. This structure is 10.00 inches (254.0 mm) wide to provide for horizontal bus splicing.

General Description

Paint

All enclosure parts are thoroughly cleaned and given a phosphatizing treatment to inhibit rust and to prime the metal for the finish coating. A 2 mil thick electrostatic powder paint coat is applied to all surfaces. The paint type and process meets UL 1332 for electrical equipment steel enclosures. All exterior enclosure covers and doors are painted ANSI 61 gray (Munsell No. 8.3G/6.10/0.54). For improved interior visibility, the interior of the enclosure and plug-in units are painted white (Munsell No. N9.43/0.21B, 0.23).

Enclosures

The standard enclosure type is NEMA Type 1 Gasketed General Purpose—Indoor. This enclosure is appropriate for installations with normal atmospheric conditions.

The NEMA Type 2 Drip-proof—Indoor employs a special roof panel with a drip shield and water channels. This prevents liquid from dripping onto the front of the control center.

The NEMA Type 3R Rainproof and Sleet Resistant—Outdoor consists of a NEMA 1 gasketed enclosure mounted on a special base with an outdoor house erected around and over it. Non-walk-in, walk-in aisle and tunnel types are available.

The NEMA Type 12 Dust-tight and Driptight—Indoor has gasketed material around all doors, door cutouts, cover plates, side, top and back sheets. A gasketed bottom plate is provided with this enclosure. This construction provides maximum protection against airborne matter and dripping liquids.

Indoor enclosures comply with NEC UL 845's "Two Meter Rule" when the bottom of the MCC is at the same level as the operator's platform. MCCs elevated on a raised pad or installed on unembedded channel sills may require operator handle extensions for the uppermost operators. Handle extensions are optionally available and may be installed on-site.

Seismic Qualification

Refer to **Tab 1** for information on seismic qualification for this and other Eaton products.

Vertical Wireway

A vertical wireway is provided in each structure. Located on the right side, it extends the full 90.00-inch (2286.0 mm) height of the structure. The width of the wireway is 4-5/8 inches (117.5 mm) at the rear of the vertical frame members. Overall depth of the wireway is 8.00 inches (203.2 mm) providing a cross-sectional area of nearly 35 square inches (889 square mm) to easily accommodate control and load wiring. Supports are provided at suitable intervals to secure all wiring and cables.

The doors swing open 115° and opposite to the unit doors for maximum accessibility. The doors are mounted on concealed removable pin hinges for quick detachment and are secured in the closed position by spring-loaded quarter-turn indicating type fastener.

Horizontal Wireways*Top Horizontal Wireway**Bottom Horizontal Wireway*

The top front horizontal wireway is 9.00 inches (228.6 mm) high and 8.00 inches (203.2 mm) deep in front-mounted only structures and in the front of back-to-back mounted structures. It extends the full width of each structure and is totally isolated from the main horizontal bus. The bottom horizontal wireway is 9.00 inches (228.6 mm) high and extends the full depth of the structure. The entire floor area under the control center is open for unrestricted conduit entry. For top entry, the top wireway can be increased to 15.00 inches (381.0 mm) high, reducing the bottom wireway height to 3.00 inches (76.2 mm).

For back-to-back unit mounted, the rear top horizontal wireway is 15.00 inches (381.0 mm) high and 5.00 inches (127.0 mm) deep.

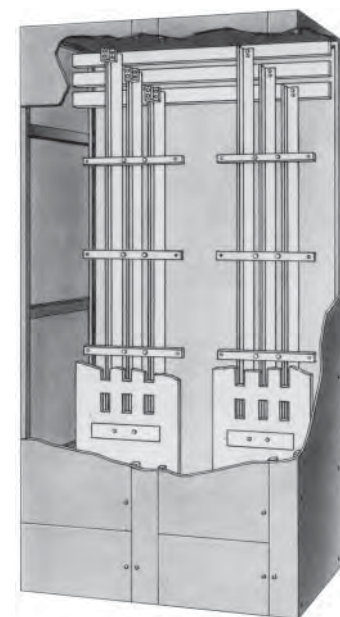
All horizontal wireway openings are covered by doors for increased accessibility. Each door is mounted with removable pin hinges to allow quick detachment.

Bus System

The bus system is designed to efficiently distribute power throughout the MCC and provides inherent mechanical strength in the event of faults.

Vertical Bus*Vertical Bus Configuration*

The vertical bus provides three-phase power distribution from the main horizontal bus into the vertical compartments. The bus is a unique angular configuration with a "Z" shape for front-mounted structures and for back-to-back. These shapes have the inherent mechanical strength to withstand fault stresses. They also provide a smooth stabbing surface for unit connection.

*MCC Bus Layout*

General Description

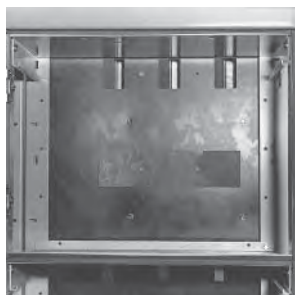
Due to the high-strength capability of the bus bars, bus bracing at 65,000 rms symmetrical amperes is standard. Optional bracing is available at 42,000 and 100,000A rms. Bus braces are molded from a glass-reinforced polyester material, which is non-tracking and impervious to moisture and other adverse atmospheric operating conditions.

The vertical bus is available in ratings of 600, 800 and 1200A for front-mounted only, and 600, 800 and 1200A for back-to-back mounted.

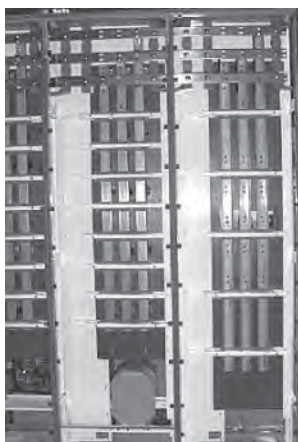
Vertical bus bars are tin-plated copper only. In addition to tin plating having environmental superiority over silver, its mechanical strength is better able to withstand the stresses of unit insertion and removal on and off the bus. Vertical bus of the incoming section will match the horizontal bus when applicable.

Isolation of the Freedom 2100 vertical bus compartment from the unit compartment is accomplished by a full height barrier.

This is a single sheet of glass-reinforced polyester with cutouts to allow the unit stabs to engage the vertical bus. Snap-in covers are available for the cutout openings to provide total isolation during maintenance procedures.



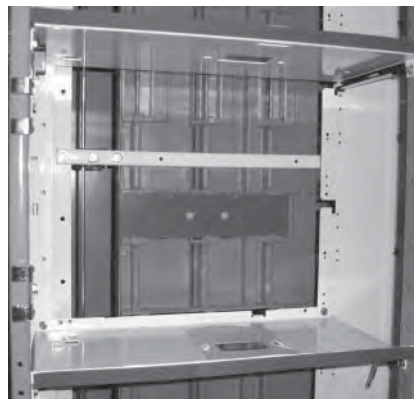
Standard Isolation Barrier



Standard Isolation Barrier Rear View

When insulation and isolation of the vertical bus is required, a **labyrinth design barrier**, as shown below, as an option for Freedom 2100 and as a standard for Freedom FlashGard. This barrier is molded glass-reinforced polyester and forms a labyrinth around the bus bars to prevent fault propagation. This design provides maximum protection against phase-to-phase insulation breakdown. Thermal efficiency is maintained by a close tolerance fit between the bus bars and the barrier, which minimizes air pockets.

An automatic shutter mechanism is standard with the labyrinth barrier to provide complete isolation of the vertical bus. The shutter moves automatically to cover the stab openings when a unit is removed. This provides maintenance personnel with maximum protection because the vertical bus is never exposed. As the unit is reinserted in the compartment, the shutter moves sideways to uncover the stab openings in the barrier.



Labyrinth Barrier with Automatic Shutter Mechanism

Horizontal Bus



Horizontal Bus

The main horizontal bus provides three-phase power distribution from the incoming line or primary disconnect device to each vertical structure in the motor control center. The bus bars are mounted in a vertical plane, edge to edge. This mounting produces an exceptionally strong assembly, able to withstand high fault current stresses.

The main horizontal bus is rated at 600A as standard with ratings of 800, 1200, 1600, 2000, 2500 and 3200A optionally available. Tin-plated copper horizontal bus bars are supplied as standard. Silver-plated copper horizontal bus bars are also available.

Note: 3200A horizontal bus available in NEMA 1A enclosure only and 65°C rise above 40°C ambient only.

The horizontal main bus is isolated from the top horizontal wireway compartment by a metal isolation barrier. This two-piece steel barrier extends to the full width of each vertical structure. The two-piece design allows access to bus connections without the removal of the entire barrier, for added maintenance convenience. The bus bar layout permits front access to all bus connections. This allows maintenance personnel to make splices and check splice bolt torques from the front of the structure.

General Description

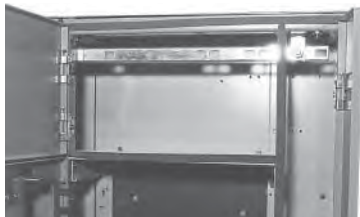
Neutral Assemblies



Neutral Bus (Bottom)

For three-phase, four-wire applications, a neutral landing pad is provided as standard. This is a 100% rated neutral. As an option, half or fully rated neutral bus can be supplied in the bottom of the entire MCC.

Ground Bus



Ground Bus (Top)

Copper ground bus, rated 300A 0.25-inch by 1.00-inch (6.4 mm by 25.4 mm) is supplied as standard. Mounting is across the top of each vertical structure in the horizontal wireway. The bus can also be mounted across the bottom when the bottom 9.00 inches (228.6 mm) are not occupied by units or master terminal blocks. A 0.25-inch by 2.00-inch (6.4 mm by 50.8 mm) optional copper ground bus rated 600 or 800A is also available.

An optional 300A vertical tin-plated only copper ground bus is available. Located in the vertical wireway, it provides direct starter unit grounding.

Units

General

Motor starter units are combination type employing a linestarter and a disconnect device of proven capability. The disconnect device can be a motor circuit protector, circuit breaker or fusible switch. Eaton's Type HMCP and HMCPE motor circuit protectors are furnished as standard.

All starters and soft starters through NEMA Size 5 are a drawout design except Size 5 electromechanical reduced voltage.

All feeder breakers through 400A are a drawout design.

All dimensions and ratings in the following tables are based on NEMA Design B, 1800 RPM motors.

The HMCP/HMCPE and starter combination has a 65,000 rms symmetrical ampere short-circuit current rating as standard at 480V.

Starter units are available with optional 100,000A short-circuit current rating. Series C thermal-magnetic circuit breakers (65 kAIC, or optional 100 kAIC) for starter units are also available.

Freedom 2100 and Freedom FlashGard starters meet or exceed IEC 947-4 Type II testing with HMCP, or R and J fuses.

The fusible switch disconnect device is the Type K. It is a quick-make, quick-break, visible blade switch with fuse clips for use with current-limiting or dual element, rejection type, NEMA Class J or R fuses. Rejection fuse clips for Class RK-5 fuses are standard. Fuses are not included as standard.

Both breaker and fuse selection must take into consideration the total short-circuit capacity of the system to which the control center is connected.

Typical starter units available include the following:

- Full voltage, non-reversing
- Full voltage, reversing
- Two-speed, single winding and two winding

- Reduced voltage, autotransformer, closed transition
- Reduced voltage, wye delta
- Reduced voltage, part winding
- Reduced voltage, solid-state
- Adjustable frequency drives

Each starter includes a stainless steel corrosion-resistant safety ground clip that makes connection before the power stabs engage the vertical bus.

Units—Freedom 2100 Starter

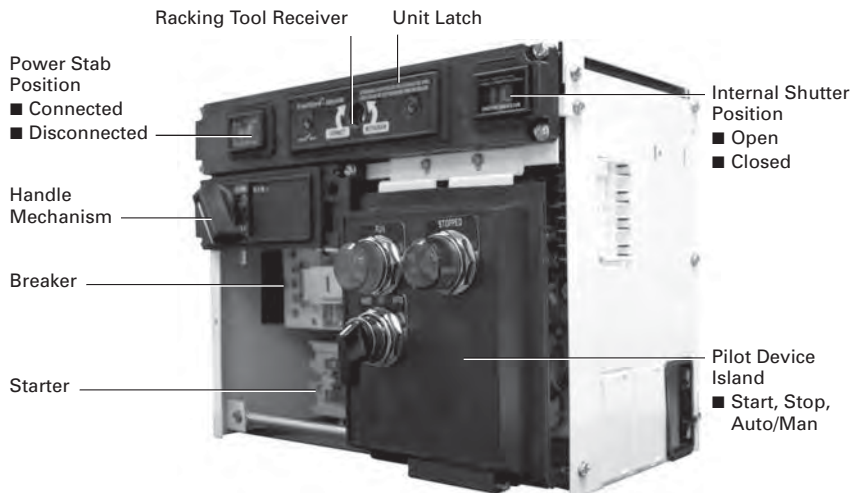


Freedom 2100 FVNR Starter

Freedom Series 2100 starter units are equipped with Eaton's Freedom starters and contactors NEMA Sizes 1 through 5. Size 6 and 7 starters are A200 type. These contactors have been successfully applied in thousands of the most demanding industrial applications. Overload protection is provided by a three-pole adjustable ambient compensated, bi-metallic thermal overload relay. The overload relay also provides single-phase sensitivity and isolated alarm contact. As an option, the overload relay can be upgraded to a standard solid-state overload or an advanced solid-state overload as described on **Page 29.1-20**. An insulated hand reset button extends through the compartment door. Additionally, motor running data and starter status/control are available through one of the many industrial communication protocols.

General Description

Units—Freedom FlashGard Starter



Freedom FlashGard FVNR Starter

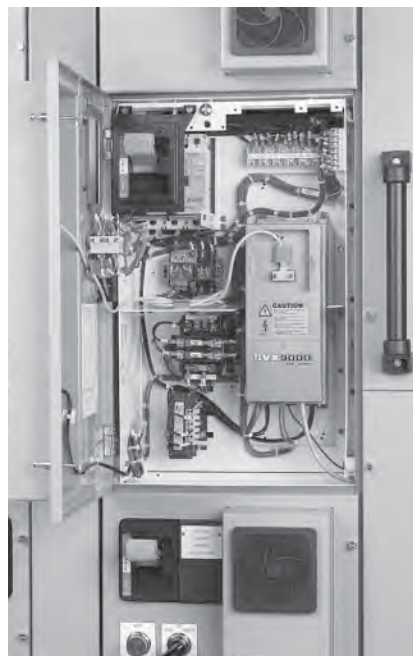
The Freedom FlashGard units are equipped with a “retractable stab” mechanism called RotoTract, that allows the electrical worker to connect and disconnect power to the bucket with the **unit door closed**, thereby minimizing exposure to arc flash. A visual indication is provided on the unit door on the “Connected” and “Disconnected” positions of RotoTract. A visual indication on the position of the shutters that enclose the stabs is also provided (open shutters indicate that stabs are extended and closed shutters indicate that the stabs are withdrawn). A motorized tool such as an electric screwdriver, drill with a 3/8-inch square drill bit or standard 3/8-inch drive ratchet is used to operate RotoTract through its racking tool receiver.

Additional safety features of a FlashGard unit include:

- **Unit Latch**—When the RotoTract is in “Connected” or “Test” position, this latch is mechanically interlocked to hook the bucket to the divider pan that separates the bucket from the unit above, thereby preventing physical removal of the bucket when it is connected to 480V and/or control power. The unit latch also prevents insertion of a bucket with the stabs extended
- **RotoTract racking tool receiver shutter**—When the breaker is in the “On” position, the shutter for the access hole in the RotoTract (access hole is needed for the motorized tool to retract the stabs) is closed, thereby not allowing the stabs to be retracted when the breaker is energized

Freedom FlashGard starters are equipped with electromechanical starters and contactors NEMA size 1–5.

Units—AC Drives



Adjustable Frequency Drive

Adjustable Frequency Drives are available from 0.5–1100 hp for control of standard AC motors in processes that benefit from the ability to change motor speed. Use of Inverter Duty motors is recommended. Controllers are available to handle constant torque applications, such as conveyors and crushers, and variable

torque applications, such as fans and pumps. Control schemes are available for volts/Hz, open loop vector and closed loop vector models. SVX9000 drive units include as standard: line reactors and a door-mounted keypad. Units up to 150 hp VT have a standard output reactor for dV/dT filtering. MVX drive units include as standard: a line reactor, viewing window for drive display and an output filter. All drive structures are bus connected, which allows for expansion of the MCC on both sides of the structure. A wide range of AFD features and options are available to meet the requirements of most applications. AFDs are available in NEMA 1A gasketed enclosures. AFDs are available in NEMA 3R MCC enclosures from 1–200 hp, constant torque.

Units—Solid-State Reduced Voltage Starters



S801 SSRV Starter 135A

S801/S811 Solid-State Reduced Voltage (SSRV) starters are designed to reduce the inrush current to a motor during starting and to limit the amount of available starting torque, thus reducing mechanical wear and utility demand requirements. The amount of starting current is field adjustable to match the specific requirements of all applications.

Eaton’s S801/S811 SSRV controllers are available with a wide variety of standard features: kick start, soft stop, phase loss and stall protection. S801/S811 SSRV starters are 30–70% smaller than competitive designs.

Typical applications include conveyors, compressors, machine tools, pumps and fans.

General Description

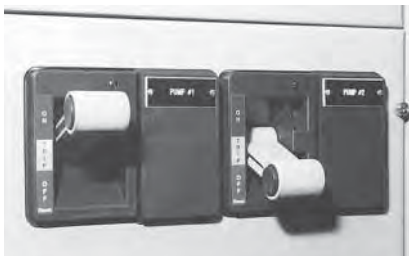
Units—DC Starters



DC Starter Unit

UL listed DC MCCs use combination circuit breaker DC starters suitable for motor starting duty only. Using Eaton's Type ME DC definite purpose contactors, all DC starters are suitable for up to 250 Vdc and have a 22 kA withstand rating. Class 135 starting resistors for reduced voltage starters are sized for 200% starting current. Typical applications include emergency lube oil pumps, emergency seal oil pumps and emergency turning gear motors.

Freedom 2100 Feeder Tap Units



Freedom 2100 Dual Feeder Tap Unit

Feeder tap units may contain either circuit breakers or fusible switches. Freedom 2100 drawout breaker units include the fixed trip Type HFD, single- or dual-mounted in ratings through 150A and the interchangeable trip Types HJD and HKD single-mounted through 250A and 400A respectively. Larger Series C® circuit breakers with ratings to 2500A are fixed-mounted.

Fusible feeder tap units use Eaton's Type K visible blade disconnect switch. Fused switches are mounted in drawout units through 400A with 30A and 60A ratings available in dual mountings. Fixed-mounted switch ratings of 600A and 800A are also available.

All switches are supplied with fuse clips for use with current-limiting or dual-element rejection type. Types of fuses include Class J, R or L, which are supplied by "others."

Freedom FlashGuard Feeder Tap Units



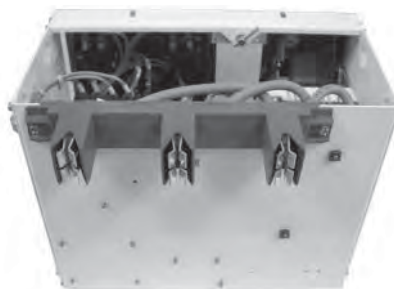
Circuit Breaker Handle Mechanism

Feeder tap units may contain either circuit breakers or fusible switches. Drawout breaker units include the fixed trip Type HFD, single-mounted in ratings through 150A and the interchangeable trip Type HJD single-mounted through 250A and Type HKD single-mounted through 400A. Larger Series C circuit breakers with ratings to 2500A are fixed-mounted.

Fusible feeder tap units use Eaton's Type K visible blade disconnect switch. Fused switches are mounted in drawout units through 400A with 30A and 60A ratings available in dual mountings. Fixed-mounted switch ratings of 600A and 800A are also available.

All switches are supplied with fuse clips for use with current-limiting or dual-element rejection type. Types of fuses include Class J, R or L supplied by "others."

Freedom 2100 Stab Assembly



Freedom 2100 Plug-in Unit Bus Stabs

A tin-plated copper alloy stab incorporates the ultimate in mechanical simplicity to provide precise control of contact pressure on the bus.

This ensures a positive connection yet permits easy unit insertion and withdrawal. Self-aligning stabs are mounted in a glass-reinforced plastic insulation block that totally shrouds each stab and absolutely ensures positive alignment of the stabs with the vertical bus. The insulation block is also an integral part of the phase-to-phase isolation system. Power wiring is welded to the stabs and is totally contained within the unit enclosure. This means the vertical bus compartment is completely free of wiring for maximum safety and reliability.

Stab assemblies are accurately matched to the electrical requirements of each individual unit and are provided in 60, 150, 300 or 400A ratings (plug-in through Size 5).

Freedom FlashGuard Stab Assembly

Stabs Extended



Stabs Withdrawn



Freedom FlashGuard Plug-in Unit Bus Stabs

The Freedom FlashGuard MCC uses a "retractable stab" mechanism, called RotoTract, that allows the electrician to connect and disconnect power to the bucket with the unit door closed. A visual indication is provided on the unit door on the "Connected" and "Disconnected" positions of RotoTract. A visual indication on the position of the shutters that enclose the stabs is also provided (open shutters indicate that stabs are extended and closed shutters indicate that the stabs are withdrawn). A motorized tool or standard 3/8-inch (9.5 mm) drive ratchet is used to operate RotoTract's "retractable stab" mechanism. A wired remote racking accessory is also available for operating RotoTract with a pendant station safely beyond the NFPA-prescribed flash protection boundaries.

General Description

The stabs are constructed from a tin-plated copper alloy, incorporating the ultimate in mechanical simplicity to provide precise control of contact pressure on the bus. This ensures a positive connection, yet permits easy unit insertion and withdrawal. The stabs are self-aligning and are mounted in a glass-reinforced plastic insulation block, which totally shrouds each stab and ensures positive alignment of the stabs with the vertical bus. The insulation block is also an integral part of the phase-phase isolation system. Power wiring is welded to the stabs and is totally contained within the unit enclosure. The wire is designed for a high level of flexibility to be suitable for RotoTract's retractable stab mechanism.

Stab assemblies are accurately matched to the electrical requirements of each individual unit and are provided in 60A, 150A, 300A or 400A ratings (plug-in through Size 5).

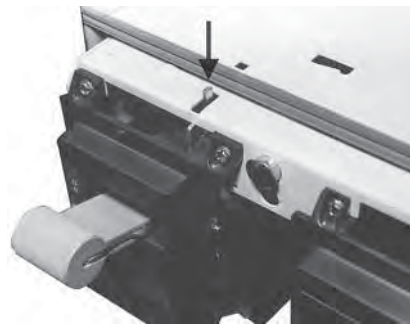
Freedom 2100 Handle Mechanism



Circuit Breaker Handle Mechanism

The handle mechanism is designed to provide a high mechanical leverage so that little effort is required to operate any device.

The standard handle mechanism is a vertical motion type device with four positions: ON, OFF, TRIPPED and RESET. Only circuit breaker types have tripped and reset positions. It is securely mounted to the front of the unit and mechanically connected to the breaker or fusible switch, eliminating alignment problems. It provides a positive indication of the breaker or switch position, even with the door open.



Unit Insertion Interlock

The handle and exterior front panel are molded from the same plastic material as the device panel. A textured surface preserves the appearance. The ON position indicator is at the top and is a bright red. The OFF/RESET position is at the bottom and is bright green. The TRIP position, a bright yellow, is in the middle, between the ON and OFF position. All position indicator colors contrast with the black background and are highly visible even at considerable distances. The operating handle is designed for rugged duty and solid operator feel.



Padlocking Bar

The handle mechanism provides several safety features:

- In the ON position, an interlock prevents the unit door from being opened. A door interlock defeater screw located above the handle is provided to enable authorized maintenance personnel access to the units when required
- With the unit door open and the operating handle in the ON position, an interlock slides into a slot in the divider pan above and prevents removal of the unit. This same interlock prevents insertion of the unit unless the handle mechanism is in the OFF position. The interlock also prevents the operating handle from being turned on with the unit door open

- To ensure that units are not energized accidentally or by unauthorized personnel, the handle mechanism can be padlocked in the OFF position. Sufficient space is available for a maximum of three padlocks. Where critical processes are involved and to prevent unauthorized shutdown, the handle mechanism can be modified to enable padlocking in the ON position

Freedom FlashGard Handle Mechanism



Circuit Breaker Handle Mechanism

The handle mechanism is designed to provide a high mechanical leverage, so that little effort is required to operate any device.

The standard handle mechanism is a vertical motion type device with four positions: ON, OFF, TRIPPED and RESET. Only circuit breaker types have tripped and reset positions. It is securely mounted to the front of the unit and mechanically connected to the breaker or fusible switch, eliminating alignment problems. It provides a positive indication of the breaker or switch position, even with the door open.



Unit Insertion Interlock

The handle and exterior front panel are molded from the same plastic material as the device panel. A textured surface preserves the appearance. The ON position indicator is at the top and is a bright red. The OFF/RESET position is at the bottom and is bright green.

General Description

The TRIP position, a bright yellow, is in the middle, between the ON and OFF position. All position indicator colors contrast with the black background and are highly visible even at considerable distances. The operating handle is designed for rugged duty and solid operator feel.



Padlocking Bar

The handle mechanism for Freedom FlashGard provides several safety features:

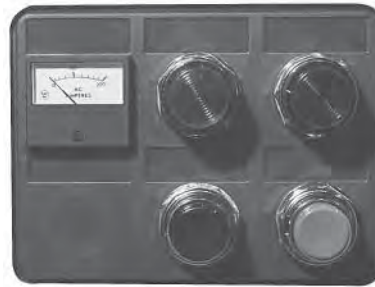
- In the ON position, an interlock prevents the unit door from being opened. A door interlock defeater screw located to the right of the handle is provided to enable authorized maintenance personnel access to the units when required
- The unit insertion interlock is located to the left of the operating handle. The interlock must be in the locked position in order to turn the disconnect on. When the interlock is in the locked position, the unit cannot be withdrawn or inserted
- To ensure that units are not energized accidentally or by unauthorized personnel, the handle mechanism can be padlocked in the OFF position. Sufficient space is available for a maximum of three padlocks. Where critical processes are involved and to prevent unauthorized shutdown, the handle mechanism can be modified to enable padlocking in the ON position

Each unit has a safe lock position. This interlock will lock the unit in a position off the 480V bus and ensure the unit cannot be inserted or withdrawn.



Freedom FlashGard Unit Wrapper Side Latch

Device Panel



Standard Device Panel

The device panel can accommodate up to six 1-3/16-inch (30.2 mm) Eaton's 10250T type pilot devices such as oiltight pushbuttons, indicating lights, selector switches and miniature meters.

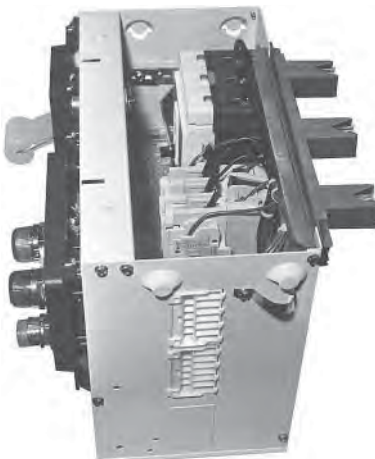
Molded into the panel is a knockout for each device location. This facilitates the future addition of devices to the panel.

The device panel is hinged on a horizontal pivot tube extending across the front of the unit. With the unit door open, loosening two captive retaining screws at the top of the panel and sliding it 0.50-inch (12.7 mm) left, permits it to swing down. This provides ready access to the rear of the panel and increased accessibility to the unit interior.

Nameplates

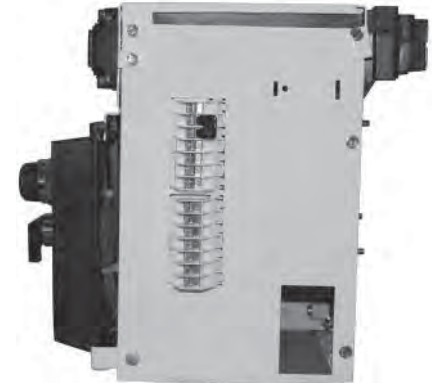
Unit nameplates are engraved with 3/16-inch (4.8 mm) high white lettering on a black background (black lettering on a white background optional). They are heat- and crack-resistant to eliminate the need for replacement. Nameplates are mounted with stainless steel self-tapping screws.

Freedom 2100 Unit Wrapper



Freedom 2100 Plug-in Unit Wrapper

Freedom FlashGard Unit Wrapper



Freedom FlashGard Plug-in Unit Wrapper

The unit wrapper is fabricated of 14-gauge steel. After fabrication, it is cleaned and given a rust inhibiting phosphatizing treatment. The finish on a unit wrapper is a baked Munsell No. N9.43/0.21B, 0.23 white. This is highly durable finish, gloss-white in color to increase visibility within the unit and to facilitate wiring and maintenance procedures.

The unit wrapper consists of a three-sided rugged steel shell including the mounting base for the unit components. The smallest unit measures 13-3/4 inches (349.3 mm) wide, 8.00 inches (203.2 mm) deep and 6.00 inches (152.4 mm) high. Units increase in 6.00-inch (152.4 mm) increments to a maximum height of 72.00 inches (1828.8 mm).

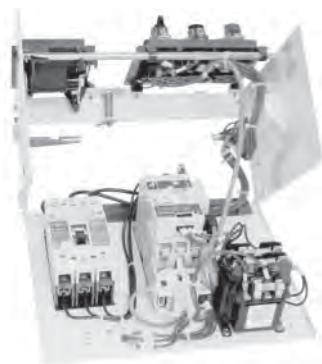
The unit wrapper is designed to provide ample space for cable entry from the wireway to the unit.

The unit wrapper has four mounting points, two on each side, which support the unit in the structure. They engage guide rails located near the top of each unit space. This mounting point guide rail system produces minimum friction and allows units to be inserted and withdrawn easily. The guide rails also give precise alignment to the unit for accurate stabbing on the vertical bus.

General Description

The FlashGard unit wrapper is equipped with a quarter-turn side wrapper latch that securely holds the unit in the compartment. The latch can only be engaged when the stabs are fully mated with the vertical bus. Upon release of the latch, the unit can be partially withdrawn such that the stabs disengage from the vertical bus. In this position, the latch can be re-engaged to prevent the unit from being returned to the fully stabbed position or from being removed from the structure. The latch can be padlocked in this position to ensure that the stabs remain disengaged during maintenance.

Unit Maintenance



Plug-in Unit Maintenance

The Freedom 2100 three-piece unit wrapper design facilitates easy work bench maintenance. When removed from the MCC, the unit top/side barrier assembly can easily be swiveled up and back for complete access to components and wiring.

Terminal Blocks

A side-mounted, seven-circuit, latching pull-apart terminal block is standard on units with NEMA Type B or C wiring. This industrial-grade Eaton MCC terminal block provides solid electrical connections while conserving space and making installation and maintenance easier.

Terminal blocks are mounted in knock-outs on the vertical wireway side of the unit housing affording greater access to the unit compartment and interior components. The two-piece terminal block snap-locks together to ensure permanent circuit continuity. To aid installation and wiring checks, the terminal marking strips for both sides of the terminal block are fully visible from the front of the starter compartment.



Side Mounted—Latched Pull-Apart Terminal Block

Heavy-duty saddle wire terminals are of the resilient collar design, which eliminates loose connections caused by expansion and contracting of the conductor as the current is switched on and off. This unique design maintains constant pressure as the wire expands and contracts. This 600V, 30A rated terminal block will accept 12 AWG stripped wires, as well as 14 AWG ring or spade wire lugs. All terminal block conductors are fully shielded for added safety and cleanliness.

A 12.00-inch (304.8 mm) high (2X space) starter unit accommodates up to three side-mounted terminal blocks providing a maximum of 21 points. Larger units accommodate two additional 7-point terminal blocks for every additional 6.00 inches (152.4 mm) 1X space of unit height. The 6.00-inch (152.4 mm) compact starter unit uses a 9-point pull-apart terminal block, which is installed along the top front of the starter unit.

Control wiring within each starter compartment consists of 16 AWG control wire for Freedom FlashGard MCCs and 2100 Series MCCs. Rated 105°C, the flame-retardant, thermo-plastic insulated wire is red. Power wiring is black and sized to carry the maximum full load current of the starter unit.

Front-Rail-Mounted Terminal Blocks

For special applications, other types of rail-mounted terminal blocks are also available. They are installed horizontally at the bottom front of the starter unit. Refer to Eaton for terminal block types available and space restrictions.

Unit Doors



Freedom 2100 12.00-Inch (304.8 mm) Unit Door



Freedom FlashGard 12.00-Inch (304.8 mm) Unit Door

Unit doors are formed of 14-gauge steel with a 0.50-inch (12.7 mm) flange on all four sides. The flange adds rigidity to the door and provides a surface to contain door gasketing. Cut-outs are made in the door as required to accommodate the operating handle and device panel. The doors are cleaned, phosphatized and given a finish of gray, baked-on enamel ANSI 61 (Munsell No. N9.43/0.21B, 0.23).

The doors will open 115° opposite to the wireway doors permitting optimum access to the unit compartment. The doors are mounted on removable concealed pin hinges. This permits quick removal of any door in a vertical structure without disturbing adjacent doors.

Doors 2X and larger are held closed with a minimum of two quarter-turn indicating-type fasteners. They securely hold the door in the closed position, yet allow quick and easy access to the unit when required. The fasteners provide a visual indication of the latched position. The head slot of the fastener is designed to prevent screwdriver slippage.

General Description



Spring-Loaded Unit Door Quarter-Turn Latch

Options

Eaton's starter and feeder tap units can be modified to meet a variety of specification requirements. Some typical components that can be added include: control power transformers with two primary and one secondary control fuses, control relays, solid-state overload relays, ground fault relays, current transformers, extra electrical interlocks, pushbuttons, selector switches, indicating lights, circuit breaker shunt trip or undervoltage release and auxiliary switches. In most cases, one of these modifications does not increase starter unit size.

Additional Equipment

In addition to motor starter and feeder units, additional equipment can be supplied including the following:

- Single-phase dry-type distribution transformers in ratings of 0.5, 0.75, 1, 1.5, 2, 3, 5, 7.5, 10, 15, 20, 25, 30 and 45 kVA
- Three-phase dry-type distribution transformers in ratings of 9, 15, 25, 30 and 45 kVA
- Lighting panelboards with up to 42 circuits with either plug-in branch breakers or bolt-on branch breakers, 120/240V, 120/208V or 480V, single- or three-phase
- Metering equipment including the IQ family of solid-state power monitors, voltmeters and ammeters
- PLC and DCS I/O racks
- S801/S811 family of solid-state reduced voltage starters
- SVX9000 and MVX9000 adjustable-frequency controllers

- Active harmonic correction units
- Surge protective device (SPD) units
- Size 4, 5 and 6 vacuum starters and contactors
- Power factor correction capacitors
- Automatic transfer switches
- DeviceNet, Modbus, PROFIBUS, Modbus TCP, EtherNet/IP Communications
- Power Xpert® communications
- Industrial Operator Interface
- Industrial PLCs and PCs

Control and Load Terminations

Master Terminal Blocks at Bottom
(Class C Wiring)

For NEMA Type A wiring, each unit is assembled and devices interwired. Terminal blocks are not supplied and control and load wiring is internal to the unit.

For NEMA Type B wiring, control wires are terminated at blocks within the unit. Refer to the discussion of units for types of terminal blocks available.

For NEMA Type C-S wiring, control and load wires are extended from the unit terminal blocks to master terminal blocks located at the top or bottom of each vertical structure.

The mounting location of the master terminal block in front-mounted only structures is in the existing horizontal wireway space at the top or at the bottom as shown above. When mounting is made in an incoming line section, 12.00 inches (304.8 mm) of unit space must be used. When mounting is made in the rear of back-to-back mounted structures, 6.00 inches (152.4 mm) of unit space must be used at the bottom and 12.00 inches (304.8 mm) used at the top.

Master terminal blocks are rack-mounted to permit removal of entire assembly for ease of wiring during installation and maintenance.

For NEMA Type C-M wiring, control and load wires are extended from the unit terminal blocks to master terminal blocks located in a separate marshaling structure.

Incoming Line

Incoming line cables entering the MCC from either the top or bottom can be easily terminated onto main lugs or connected to a main disconnect. All incoming line sections comply with NEC wiring bending requirements as adopted by UL.

Main Lugs Only (MLO)

Up to 1200A rated horizontal bus, cables, up to four per phase, are terminated on crimp or screw lugs mounted on adapters solidly bolted to fully rated vertical bus. Top entry cables are terminated at the top of the MCC and bottom entry cables are conveniently terminated near the bottom. **Table 29.1-84** shows spacing requirements for various cable configurations. MLO termination for 1600, 2000, 2500 and 3200A requires a full vertical section.

Note: 3200A main lugs only available in NEMA 1A enclosure only and 65°C rise above 40°C ambient only.

Main Disconnects

Incoming cables may also be easily terminated on a main circuit breaker or fused switch. A variety of main circuit breakers are available. **Tables 29.1-61** through **29.1-67** show spacing requirements for various main devices.

Metering



IQ 250/260 Electronic Power Meter

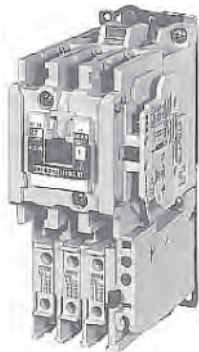
Eaton's IQ and Power Xpert family of metering and power monitors includes:

IQ 250 microprocessor-based three-phase power monitor replaces the traditional ammeter, voltmeter and instrument switches. Displays phase currents, voltage, L-L, L-N, power-real and reactive apparent, power factor, frequency, energy (watt-hours, VAR-hours and VA-hours).

The Eaton logo consists of the word "EATON" in a bold, blue, sans-serif font. The letter "O" is stylized as a white circle with a blue dot in the center, creating a visual effect of a power symbol or a stylized letter.

Powering Business Worldwide

NEMA Motor Starters Freedom Series



NEMA AN16DN0AB
NEMA Size 1

General Description

The Freedom Series starters and contactors listed in this catalog feature a compact, space-saving design and high strength, impact and temperature-resistant insulating materials. Starters and contactors are available in the NEMA (National Electrical Manufacturers' Association) style. The NEMA devices are sized based on traditional NEMA classifications.

Features

Freedom NEMA

- Adjustable bimetallic ambient compensated overload relays with interchangeable heater packs—available in three basic sizes, covering applications up to 900 hp—reducing the number of different contactor/overload relay combinations that have to be stocked. Fixed heater overloads are optional
- Electronic overload relay (C440) available as a stand-alone unit and assembled with a Freedom contactor
- A full line of snap-on accessories—top and side mounted auxiliary contacts, solid-state and pneumatic timers, etc.
- Straight-through wiring—line lugs at top, load lugs at bottom
- Horizontal or vertical mounting on upright panel for application freedom
- Screw type power terminals have captive, backed-out self-lifting pressure plates with \pm screws—reduced wiring time
- Accessible terminals for easy wiring. Optional fingerproof shields available to prevent electrical shock
- Top located coil terminals convenient and readily accessible. 45 mm contactor magnet coils have three terminals, permitting either top or diagonal wiring—easy to replace European or U.S. style starters or contactors without changing wiring layout
- Designed to meet or exceed NEMA, UL, CSA, VDE, BS and other international standards and listings
- American engineering—built by Eaton, using the latest in statistical process control methods to produce high quality, reliable products
- Sized based on standard NEMA classifications
- Easy coil change and inspectable/replaceable contacts
- Available in open and NEMA Type 1, 3R, 4/4X and 12 enclosures

Standards and Certifications

- Standard: Designed to meet or exceed UL, NEMA and CSA
- UL listed: UL File #E1491, Guide #NLDX—Open; UL File #E176513—Enclosed Combination Motor Controllers; UL File #E19224—Enclosed Non-Combination Motor Controllers; UL File #E195239—Enclosed Power Conversion Equipment
- CSA certified: CSA File #LR353, Class #321104 Open and NEMA 1 Enclosed

Certified Type 2 Coordination

Eaton's Freedom Series NEMA starters are now UL certified to achieve IEC 947 Type 2 coordination against 100,000A short-circuit fault currents. Any brand of properly selected fuse can be used. Type 2 coordination means that the starter will be suitable for further use following a short-circuit fault.

Short-Circuit Protection

Fuses and inverse-time circuit breakers may be selected per Article 430, Part D of the National Electrical Code® to protect motor branch circuits from fault conditions. If higher ratings or settings are required to start the motor, do not exceed the maximum as listed in Exception No. 2, Article 430.52.

NEMA Sizes 00-8

Table 30.3-1. AC Coil Data

NEMA Sizes	Motor Voltage	Maximum hp Rating	P.U. Volts		P.U.			Sealed			D.O. Volts		Maximum Operation Rate Operations/Hour	P.U. Time ms	D.O. Time ms
			Cold	Hot	VAR	VA	Watts	VAR	VA	Watts	Cold	Hot			
00	200 230 460 575	1-1/2 1-1/2 2 2	74%	78%	64	80	49	7.1	7.5	2.4	45%	46%	12,000	12	12
0	200 230 460 575	3 3 5 5	74%	78%	78	100	65	9.2	10	3.1	45%	46%	12,000	12	12
1	200 230 460 575	7-1/2 7-1/2 10 10	74%	78%	210	230	95	27	28	7.8	49%	50%	12,000	20	14
2	200 230 460 575	10 15 25 25	74%	78%	210	230	95	27	28	7.8	49%	50%	12,000	20	14
3	200 230 460 575	25 30 50 50	72%	76%	374	390	112	48	49.8	13	50%	52%	7200	14	11
4	200 230 460 575	40 50 100 100	73%	76%	1132	1158	240	96	100	27.2	54%	56%	2400	28	14
5	200 230 460 575	75 100 200 200	75%	77%	1132	1158	240	96	100	27.2	63%	64%	2400	25	13

General Coil Data

- **Coil Offering**—tape wound:
 - NEMA Sizes 00–0
 - UL insulation rating: Class 130 (B)
- **Coil Offering**—encapsulated:
 - NEMA Sizes 1–3
 - UL insulation rating: Class 130 (A)
- **Coil Offering**—encapsulated:
 - NEMA Sizes 4–5
 - UL insulation rating: Class 155 (F)
- **Operational Limits:**
 - 85% to 110% of rated voltage—AC
 - 80% to 110% of rated voltage—DC

Table 30.3-2. Coil Data Notes

Description	
P.U.	Pickup time is the average time taken from closing of the coil circuit to main contact touch.
D.O.	Dropout time is the average time taken from opening of the coil circuit to main contact separation.
Cold	Coil data with a cold coil.
Hot	Coil data with a hot coil.

All data is based on a standard contactor with no auxiliary devices and a 120 Vac or 24 Vdc magnet coil. Coil data has a $\pm 5\%$ range depending on the application, therefore specific data may vary.

Table 30.3-3. DC Coil Data

NEMA Sizes	Motor Voltage	P.U.			Sealed		D.O. Volts (Hot)	P.U. Time ms	D.O. Time ms	Maximum Operation Rate Operations/Hour	Mechanical Life Millions
		Amperes	Watts	Volts (Hot)	Amperes	Watts					
00 and 0	12	6.4	76.8	80%	0.28	3.36	60%	22	17	3600	5
	24	3.2	76.8	80%	0.14	3.36	60%	22	17	3600	5
	48	1.6	76.8	80%	0.07	3.36	60%	22	17	3600	5
	120	0.64	76.8	80%	0.028	3.36	60%	22	17	3600	5
1 and 2	12	15.4	126	68%	0.42	4.98	30%	21	12	3600	2
	24	6.2	88.4	60%	0.21	4.96	29%	20	13	3600	2
	48	2.9	76.2	56%	0.11	5.04	28%	20	14	3600	2
	120	1.1	67.3	53%	0.041	4.87	29%	20	16	3600	2
3	12	24	293	65%	0.40	4.84	23%	39	14	3600	2
	24	12	288	61%	0.20	4.75	22%	38	14	3600	2
	48	6.1	295	62%	0.097	4.67	22%	37	14	3600	2
	120	2.5	298	61%	0.038	4.57	22%	37	16	3600	2
4 and 5	24	18	400	67%	0.22	5.3	25%	53	14	2400	2
	48	9.0	400	67%	0.11	5.2	25%	49	16	2400	2
	120	3.3	450	65%	0.05	5.4	28%	56	19	2400	2
	240	1.7	440	64%	0.02	4.9	26%	49	21	2400	2

General Coil Data

- **Coil Offering**—tape wound:
 - NEMA Sizes 00–0
 - UL insulation rating: Class 130 (B)
- **Coil Offering**—encapsulated:
 - NEMA Sizes 1–3
 - UL insulation rating: Class 130 (A)
- **Coil Offering**—encapsulated:
 - NEMA Sizes 4–5
 - UL insulation rating: Class 155 (F)
- **Operational Limits:**
 - 85% to 110% of rated voltage—AC
 - 80% to 110% of rated voltage—DC

Table 30.3-4. Coil Data Notes

Description	
P.U.	Pickup time is the average time taken from closing of the coil circuit to main contact touch.
D.O.	Dropout time is the average time taken from opening of the coil circuit to main contact separation.
Cold	Coil data with a cold coil.
Hot	Coil data with a hot coil.

All data is based on a standard contactor with no auxiliary devices and a 120 Vac or 24 Vdc magnet coil. Coil data has a ±5% range depending on the application, therefore specific data may vary.

Freedom Line—Technical Data—NEMA
Table 30.3-5. Specifications—Sizes 00–3

Description	Contactor Catalog Number/Size				
	CN15A NEMA Size 00	CN15B NEMA Size 0	CN15D NEMA Size 1	CN15G NEMA Size 2	CN15K NEMA Size 3
Configuration Number of poles Auxiliary contacts, standard Add-on auxiliary contacts	2, 3, 4 4th pole NO (1) Top (4) or side (4)	2, 3 Side NO (1) Top (4) or side (3)	2, 3, 4, 5 Side NO (1) Top (4) or side (3)	2, 3, 4, 5 Side NO (1) Top (4) or side (3)	2, 3 Side NO (1) Left side (4) or right side (3)
Frame size	45 mm	45 mm	65 mm	65 mm	90 mm
Maximum voltage rating	600 Vac	600 Vac	600 Vac	600 Vac	600 Vac
Continuous ampere ratings (I)	9A	18A	27A	45A	90A
Maximum horsepower (hp) Single-phase 115V 230V	1/3 1	1 2	2 3	3 7-1/2	7-1/2 15
Three-phase 200V 230V 460V 575V	1-1/2 1-1/2 2 2	3 3 5 5	7-1/2 7-1/2 10 10	10 15 25 25	25 30 50 50
Coil operating range % of rated voltage	–15% to +10%	–15% to +10%	–15% to +10%	–15% to +10%	–15% to +10%
Operating temperature Maximum operating altitude in feet (m) Mechanical life	–20° to 65°C 6000 (1828) 20,000,000	–20° to 65°C 6000 (1828) 20,000,000	–20° to 65°C 6000 (1828) 10,000,000	–20° to 65°C 6000 (1828) 10,000,000	–20° to 65°C 6000 (1828) 6,000,000
Electrical life (480V/60 Hz) AC-3 AC-4	4,000,000 90,000	3,000,000 85,000	5,000,000 200,000	3,500,000 62,000	1,700,000 80,000
Wire range Power terminals	12–16 stranded, 12–14 solid Cu	8–16 stranded, 10–14 solid Cu	8–14 stranded or solid Cu	2–14 (upper) and/or 6–14 (lower) stranded or solid Cu	1/0–14 Cu
Control terminals	12–16 stranded, 12–14 solid Cu	12–16 stranded, 12–14 solid Cu	12–16 stranded, 12–14 solid Cu	12–16 stranded, 12–14 solid Cu	12–16 stranded 12–14 solid Cu
Power terminal torque Line and load—Ib-in	7	15	20	40 (14–8 AWG) 45 (6–4 AWG) 50 (3 AWG)	35 (14–10 AWG) 40 (8 AWG) 45 (6–4 AWG) 50 (3–1/0 AWG)
Auxiliary contact rating	A600, P300				

Table 30.3-6. Specifications—Sizes 4-5

Description	Contactor Catalog Number/Size	
	CN15N NEMA Size 4	CN15S NEMA Size 5
Configuration		
Number of poles	2, 3	2, 3
Auxiliary contacts, standard	Side NO (1)	Side NO (1)
Add-on auxiliary contacts	Left side (3) or right side (4)	Left side (3) or right side (4)
Frame size	180 mm	180 mm
Maximum voltage rating	600 Vac	600 Vac
Continuous ampere ratings (i)	135A	270A
Maximum horsepower (hp)		
Single-phase 115V	—	—
230V	—	—
Three-phase 200V	40	75
230V	50	100
460V	100	200
575V	100	200
Coil operating range % of rated voltage	-15% to +10%	-15% to +10%
Operating temperature	-20° to 65°C	-20° to 65°C
Maximum operating altitude in feet (m)	6000 (1828)	6000 (1828)
Mechanical life	5,000,000	5,000,000
Electrical life (480V/60 Hz)		
AC-3	800,000	500,000
AC-4	70,000	34,000
Wire range		
Power terminals	Open—3/0-8 Cu; Enclosed—250 kcmil-6 Cu/Al	750 kcmil—2 or (2) 250 kcmil-3/0 Cu/Al
Control terminals	12-16 stranded, 12-14 solid Cu	12-16 stranded, 12-14 solid Cu
Power terminal torque	200	550
Line and load—lb-in		
Auxiliary contact rating	A600, P300	

Freedom Line—Technical Data—NEMA

Table 30.3-7. 380V, 50 Hz Starters—Maximum hp Ratings

Description	NEMA Size					
	1	2	3	4	5	6
Maximum hp	10	25	50	75	150	300

Table 30.3-8. Motor FLA Current Ranges

Description	NEMA Size						
	1 ^①	1	2	3	4	5	6
1.15 to 1.25 S.F.	0.47–3.81	3.15–27.00	3.15–45.00	9.90–90.00	9.90–135.00	38.30–270.00	38.30–540.00
1.0 S.F.	0.51–4.14	3.43–27.00	3.43–45.00	10.80–90.00	10.80–135.00	41.70–270.00	41.70–540.00

^① Size 1 Lower Current Range for motor hp range 1/4 hp to 2 hp at 460V.

Table 30.3-9. Wire (75°C) Sizes—AWG or kcmil—NEMA Sizes 00–2—Open and Enclosed

NEMA Size	Cu Only
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Power Terminals—Line

00	#12–#16 stranded, #12–#14 solid
0	#8–#16 stranded, #10–#14 solid
1	#8–#14 stranded or solid
2	#3–#14 (upper) and/or #6–#14 (lower) stranded or solid ^②

^② Two compartment box lug.

Table 30.3-10. Overload Relay UL/CSA Contact Ratings Control Circuit^③

AC Volts	120V	240V	480V	600V
NC Contact B600				
Make and break amperes	30	15	7.5	6
Break amperes	3	1.5	0.75	0.6
Continuous amperes	5	5	5	5
NO Contact C600				
Make and break amperes	15	7.5	3.375	3
Break amperes	1.5	0.75	0.375	0.3
Continuous amperes	2.5	2.5	2.5	2.5

^③ DC ratings cover Freedom Series coils only.

Table 30.3-11. Electronic Overload Relays up to 1500A

Description	Specification	
	45 mm	55 mm
Capacity		
Load terminals	12–10 AWG (4–6 mm ²) 8–6 AWG (6–16 mm ²)	
Terminal capacity	20–25 lb-in (2.3–2.8 Nm) 25–30 lb-in (2.8–3.4 Nm)	
Tightening torque	25–30 lb-in (2.8–3.4 Nm)	
Input, auxiliary contact and remote reset terminals	2 x (18–12) AWG 5.3 lb-in (0.8–1.2 Nm)	
Terminal capacity	2 x (18–12) AWG	
Tightening torque	5.3 lb-in (0.8–1.2 Nm)	
Voltages		
Insulation voltage U _i (three-phase)	690 Vac	
Insulation voltage U _i (control)	500 Vac	
Rated impulse withstand voltage	6000 Vac	
Overvoltage category/pollution degree	III/3	

Table 30.3-12. Wire (75°C) Sizes—AWG or kcmil—NEMA Sizes 00–2 Open and Enclosed

Terminal	Wire Size ^④	Catalog Number
----------	------------------------	----------------

Power Terminals—Load—Cu Only (Stranded or Solid)

32A	14–6 AWG	C306DN38
75A	14–2 AWG	C306GN38
45A	14–6 AWG	C396A_

^④ Minimum per NEC. Maximum wire size: Sizes 00–0 to 8 AWG and Sizes 1–2 to 2 AWG.

Table 30.3-13. Wire (75°C) Sizes—AWG or kcmil—NEMA Sizes 3–8—Open and Enclosed

NEMA Size	Wire Size
-----------	-----------

C306 Power Terminals—Line and Load

3	10–14 AWG Al Cu
4	Open—#8–#3/0 Cu Enclosed—#6 250 kcmil–Al Cu
5	750 kcmil–#2 or (2) #3/0 250 kcmil–Al Cu

Table 30.3-14. C306 Control Terminals—Cu Only

Description
(2) #12–#16 stranded
(2) #12–#14 solid

**Electrical Life—AC-3 and AC-4
Utilization Categories**

Life Load Curves

Eaton’s Freedom Series NEMA contactors have been designed and manufactured for superior life performance in any worldwide application. All testing has been based on requirements as found in NEMA and UL standards and conducted by Eaton. Actual application life may vary depending on environmental conditions and application duty cycle.

Utilization Categories

AC-1—Non-inductive or slightly inductive loads, such as resistance furnaces and heating.

AC-2—Starting of slip-ring motors.

AC-3—Squirrel cage motors; starting, switching off motors during running.

AC-4—Squirrel cage motors; starting, plugging, inching or jogging.

Note: AC-3 tests are conducted at rated device currents and AC-4 tests are conducted at six times rated device currents. All tests have been run at 460V, 60 Hz.

Contactors Choice

- Decide what utilization category your application is and choose the appropriate curve
- Locate the intersection of the life-load curve of the appropriate contactor with the applications operational current (Ie), as found on the horizontal axis
- Read the estimated contact life along the vertical axis in number of operational cycles

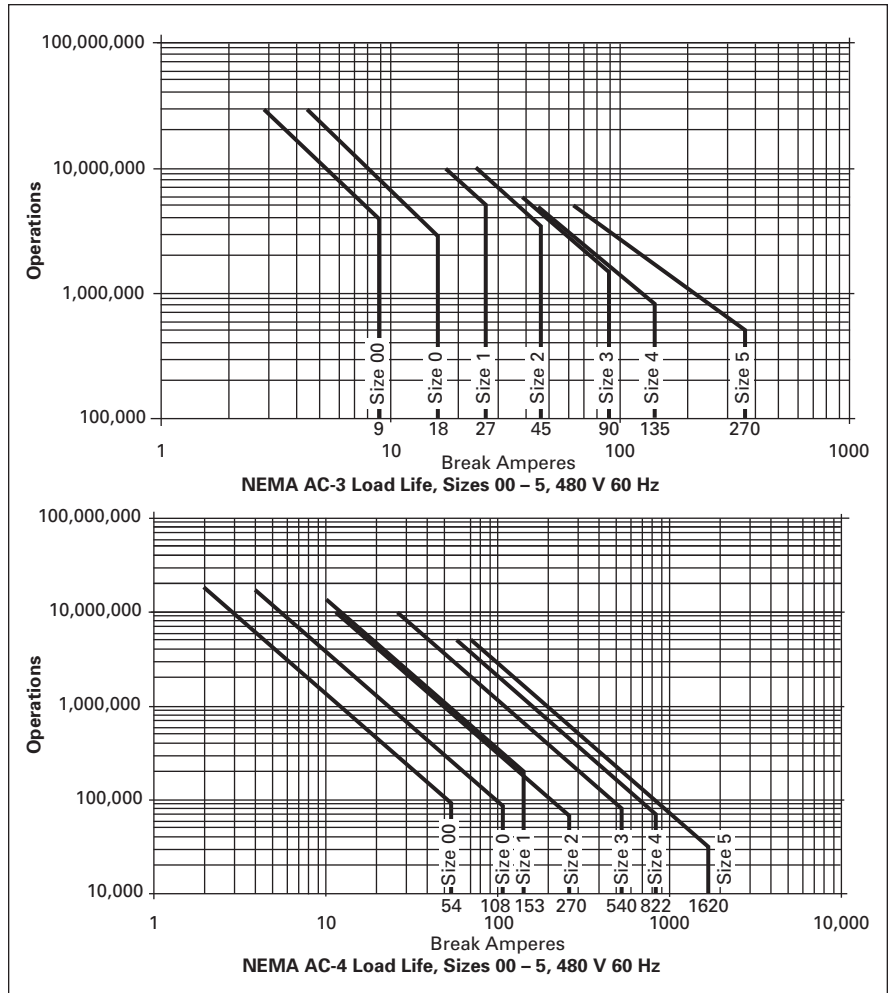


Figure 30.3-1. AC-3 and AC-4 Utilization Categories

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Powering Business Worldwide

C440/XT Electronic Overload Relay

C440/XT Electronic
Overload Relay

C440/XT Electronic Overload Relay

General Description

Eaton's electronic overload relay (EOL) is the most compact, high-featured, economical product in its class. Designed on a global platform, the new EOL covers the entire power control spectrum, including NEMA, IEC and DP contactors. The NEMA and DP versions are offered with the C440 designation while the IEC offering has the XT designation. The electronic design provides reliable, accurate and value-driven protection and communications capabilities in a single compact device. It is the flexible choice for any application requiring easy-to-use, reliable protection.

Eaton has a long history of innovations and product development in motor control and protection, including both traditional NEMA, as well as IEC control. It was from this experience that the C440 was developed, delivering new solutions to meet today's demands.

C440 is a self-powered electronic overload relay available up to 100A as a self-contained unit. With external CTs, C440 can protect motor up to 1500 FLA. Available add-on accessories include remote reset capability and communication modules with I/O for DeviceNet, PROFIBUS and Modbus.

Features

- Reliable, accurate, electronic motor protection
- Easy to select, install and maintain
- Compact size
- Flexible, intelligent design
- Global product offering—available with NEMA, IEC and DP power control

Size/Range

- Broad FLA range (0.33–1500A)
- Selectable trip class (10A, 10, 20, 30)
- Direct mounting to NEMA, IEC and DP contactors
- Most compact electronic overload in its class

Motor Control

- Two B600 alarm (NO) and fault (NC) contacts
- Test/Trip button

Motor Protection

- Thermal overload
- Phase loss
- Selectable (ON/OFF) phase imbalance
- Selectable (ON/OFF) ground fault

User Interface

- Large FLA selection dial
- Trip status indicator
- Operating mode LED
- DIP switch selectable trip class, phase imbalance and ground fault
- Selectable Auto/Manual reset

Feature Options

- Remote reset
 - 120 Vac
 - 24 Vac
 - 24 Vdc
- Tamper-proof cover
- Communications modules
 - Modbus RTU RS-485
 - DeviceNet with I/O
 - PROFIBUS with I/O
 - Modbus RTU with I/O (Q4 2010)
 - EtherNet/IP (planned)
 - Smartwire (planned)

Benefits

Reliability and Improved Uptime

- C440 provides the users with peace of mind knowing that their assets are protected with the highest level of motor protection and communication capability in its class
- Extends the life of plant assets with selectable motor protection features such as trip class, phase imbalance and ground fault
- Protects against unnecessary downtime by discovering changes in your system (line/load) with remote monitoring capabilities
- Status LED provides added assurance that valuable assets are protected by indicating the overload operational status

Flexibility

- Available with NEMA, IEC and DP contactors
- Improves return on investment by reducing inventory carrying costs with wide FLA adjustment (5:1) and selectable trip class
- Design incorporates built-in ground fault protection, thus eliminating the need for separate CTs and modules
- Flexible communication with optional I/O enables easy integration into plant management systems for remote monitoring and control
- Available as an open component and in enclosed control and motor control center assemblies

Monitoring Capabilities

- Individual phase currents rms
- Average three-phase current rms
- Thermal memory
- Fault indication (overload, phase loss, phase imbalance, ground fault)

Safety

- IP 20 rated terminal blocks
- Available in Eaton's industry-leading FlashGuard MCCs
- Tested to the highest industry standards, such as UL, CSA, CE and IEC
- RoHS compliant

Standards and Certifications

- UL
- CSA
- CE
- NEMA
- IEC/EN 60947 VDE 0660
- ISO 13849-1 (EN954-1)
- RoHS
- ATEX directive 94/9/EC
- Equipment Group 2, Category 2

C440/XT Electronic Overload Relay

Table 30.3-34. C440 Electronic Overload Relays for Direct Mount to Freedom Series Contactors

For Use with Freedom NEMA Contactor Size	For Use with Contactor ①	Overload Range (Amps)	Standard Feature Set Catalog Number	Standard Feature Set with Ground Fault Catalog Number
00	CN15AN3_B	0.33–1.65	C440A1A1P6SF00	C440A2A1P6SF00
		1–5	C440A1A005SF00	C440A2A005SF00
		4–20	C440A1A020SF00	C440A2A020SF00
0	CN15BN3_B	0.33–1.65	C440A1A1P6SF0	C440A2A1P6SF0
		1–5	C440A1A005SF0	C440A2A005SF0
		4–20	C440A1A020SF0	C440A2A020SF0
1	CN15DN3_B	0.33–1.65	C440A1A1P6SF1	C440A2A1P6SF1
		1–5	C440A1A005SF1	C440A2A005SF1
		4–20	C440A1A020SF1	C440A2A020SF1
		9–45	C440A1A045SF1	C440A2A045SF1
2	CN15GN3_B	1–5	C440A1A005SF2	C440A2A005SF2
		4–20	C440A1A020SF2	C440A2A020SF2
		9–45	C440A1A045SF2	C440A2A045SF2
3	CN15KN3_	20–100	C440B1A100SF3	C440B2A100SF3

① CN15 contactor listed is non-reversing with a 120 Vac coil. For more options, see Volume 5—Motor Control and Protection, CA08100006E, Tab 33, Section 33.1.

Table 30.3-35. C440 Electronic Overload Relays for Use with NEMA Contactors Sizes 4–8

Use CTs and 1-5A C440 overload relay. CT kit does not include overload relay (order separately).

For Use with NEMA Contactor Size	CT Range (Amps)	Description	CT Kit Catalog Number	Terminal Size	Overload Relay Catalog Number	Overload Relay with Ground Fault Catalog Number
4 and 5	60–300	300: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT300	750 kcmil (2) 250 kcmil 3/0 Cu/Al	C440A1A005SAX	C440A2A005SAX
6	120–600	600: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT600	(2) 750 kcmil 3/0 Cu/Al	C440A1A005SAX	C440A2A005SAX
7	200–1000	1000: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT1000	(3) 750 kcmil 3/0 Cu/Al	C440A1A005SAX	C440A2A005SAX
8	300–1500	1500: 5 panel-mount CT kit with integrated, pass-through holes	ZEB-XCT1500	(4) 750 kcmil 1/0 Cu/Al	C440A1A005SAX	C440A2A005SAX

Table 30.3-36. C440 Electronic Overload Relays for Separate Mount

Overload Range	Frame Size	Overload Relay Catalog Number	Overload Relay with Ground Fault Catalog Number
0.33–1.65	45 mm	C440A1A1P6SAX	C440A2A1P6SAX
1–5		C440A1A005SAX	C440A2A005SAX
4–20		C440A1A020SAX	C440A2A020SAX
9–45		C440A1A045SAX	C440A2A045SAX
20–100	55 mm	C440B1A100SAX	C440B2A100SAX

C440/XT Electronic Overload Relay

Table 30.3-37. Type AN19/59 Freedom Series Starters—Non-Reversing and Reversing

NEMA Size	Continuous Ampere Rating	Service Limit Current Rating (Amps)	Maximum UL Horsepower						Three-Pole Non-Reversing ^{①②} Catalog Number	Three-Pole Reversing ^{①②} Catalog Number
			Single-Phase		Three-Phase					
			115V	230V	208V	240V	480V	600V		

C440 Electronic Overload Relays

00	9	11	1/3	1	1-1/2	1-1/2	2	2	AN19AN0_5E_	AN59AN0_5E_
0	18	21	1	2	3	3	5	5	AN19BN0_5E_	AN59BN0_5E_
1	27	32	2	3	7-1/2	7-1/2	10	10	AN19DN0_5E_	AN59DN0_5E_
2	45	52	3	7-1/2	10	15	25	25	AN19GN0_5E_	AN59GN0_5E_
3	90	104	—	—	25	30	50	50	AN19KN0_5E_	AN59KN0_5E_
4 ^③	135	156	—	—	40	50	100	100	^③ AN19SN0_5E_	^③ AN59SN0_5E_
5 ^④	270	311	—	—	75	100	200	200		

C440 with Ground Fault Electronic Overload Relays

00	9	11	1/3	1	1-1/2	1-1/2	2	2	AN19AN0_5G_	AN59AN0_5G_
0	18	21	1	2	3	3	5	5	AN19BN0_5G_	AN59BN0_5G_
1	27	32	2	3	7-1/2	7-1/2	10	10	AN19DN0_5G_	AN59DN0_5G_
2	45	52	3	7-1/2	10	15	25	25	AN19GN0_5G_	AN59GN0_5G_
3	90	104	—	—	25	30	50	50	AN19KN0_5G_	AN59KN0_5G_
4 ^③	135	156	—	—	40	50	100	100	^③ AN19SN0_5G_	^③ AN59SN0_5G_
5 ^④	270	311	—	—	75	100	200	200		

① Underscore (_) indicates coils suffix required, see Coil Suffix table below.

② Underscore (_) indicates OLR designation required, see C440 FLA Range table below.

③ Starter not shipped as an assembled unit. Order NEMA Size 4 contactor (CN15NN3A) plus current transformers (ZEB-XCT300) and 1-5A C440 overload relay (C440A1A005SELAX or C440A2A005SELAX).

④ NEMA Size 5 starter available with 60–300A panel-mounted CTs. Starter shipped as an assembled unit with 1-5A C440 overload relay (C440A1A005SELAX or C440A2A005SELAX).

Table 30.3-38. Coil Suffix Codes

Suffix	Coil Volts and Hertz
A	120/60 or 110/50
B	240/60 or 220/50
C	480/60 or 440/50
D	600/60 or 550/50
E	208/60
H	277/60
J	208–240/60
K	240/50
L	380–415/50
N	550/50
T	24/60, 24/50
U	24/50
V	32/50
W	48/60
Y	48/50

Table 30.3-39. C440 FLA Range (FVNR and FVR Starters Only)

NEMA Size	OLR Code	FLA Range	OLR Code	FLA Rating
00	1P6	0.33–1.65A	020	4.0–20A
	005	1.0–5.0A	—	—
0	1P6	0.33–1.65A	020	4.0–20A
	005	1.0–5.0A	—	—
1	1P6	0.33–1.65A	020	4.0–20A
	005	1.0–5.0A	045	9.0–45A
2	005	1.0–5.0A	045	9.0–45A
	020	4.0–20A	—	—
3	100	20–100A	—	—
4 ^⑤	300	—	—	60–300A
5 ^⑤	300	60–300A	—	—

⑤ Starter not shipped as an assembled unit. Order NEMA Size 4 contactor (CN15NN3A) plus current transformers (ZEB-XCT300) and 1-5A C440 overload relay (C440A1A005SELAX or C440A2A005SELAX).

C440/XT Electronic Overload Relay

Accessories

Table 30.3-40. CT Kits

Description	Catalog Number
Safety Cover	
Clear Lexan® cover that mounts on top of the FLA dial and DIP switches when closed	ZEB-XSC
Reset Bar	
Assembles to the top of the overload to provide a larger target area for door-mounted reset operators	ZEB-XRB
Remote Reset	
Remote reset module (24 Vdc) ①	C440-XCOM
Remote reset module (120 Vac) ①	ZEB-XRR-120
Remote reset module (24 Vac) ①	ZEB-XRR-24

① Customer can wire remote-mounted button to reset module (i.e., 22 mm pushbutton, catalog number M22-D-B-GB14-K10).

Communication

The C440 is provided with two levels of communication capability.

Basic Communication via Expansion Module—Monitoring Only

Basic communication on the C440 is accomplished using an expansion module. The expansion module plugs into the expansion bay on the C440 overload relay, enabling communications with the overload via their Modbus RTU (RS-485) network. No additional parts are required.



Basic Communication—Modbus

Advanced Communication—Monitoring and Control

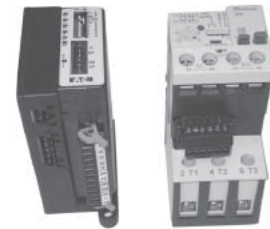
C440 also has the ability to communicate on industrial protocols such as DeviceNet, PROFIBUS, Modbus RTU and Modbus TCP, and Ethernet (planned) while providing control capability using I/O.

An expansion module (mentioned earlier) combined with a communication adapter and a communication module allows easy integration onto the customer's network.

Advanced Communication—Communication Module

The communication adapter comes standard with four inputs and two outputs (24 Vdc or 120 Vac) while providing the customer with flexible mounting options (DIN rail or panel).

For more information about technical data and specifications as well as dimensions, see Volume 5—Motor Control and Protection, CA08100006E, Section 31.



Advanced Communication—Communication Adapter with Communication Module

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Powering Business Worldwide

Series C Selection Data—F-Frame

Series C, F-Frame
Thermal-Magnetic 10–225A
Electronic RMS 15–225A



F-Frame Breaker

Table 27.4-55. Dimensions in Inches (mm)

Number of Poles	Width	Height	Depth
1	1.38 (34.8)	6.00 (152.4)	3.38 (85.7)
2	2.75 (69.9)	6.00 (152.4)	3.38 (85.7)
3	4.13 (104.8)	6.00 (152.4)	3.38 (85.7)
4	5.50 (139.7)	6.00 (152.4)	3.38 (85.7)

Table 27.4-56. Thermal-Magnetic Trip Ratings

Frame	Ratings
ED, EDH, EDC	100, 125, 150, 175, 200, 225
EHD, FDB, FD, HFD, FDC, HFDDC	10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 125, 150
FD, HFD, FDC	175, 200, 225

Table 27.4-57. Digitrip 310+ Electronic Trip Units

Types	Frame	Ratings
FDE, HFDE, FDCE	225	100, 110, 125, 150, 160, 175, 200, 225
	160	60, 70, 80, 90, 100, 125, 150, 160
	80	15, 20, 30, 40, 50, 60, 70, 80

Table 27.4-58. UL 489 Interrupting Capacity Ratings

Circuit Breaker Type	Number of Poles	Trip Type ①	Interrupting Capacity (Symmetrical Amperes)					
			Volts AC (50/60 Hz)				Volts DC	
			240	277	480	600	125	250 ②③
EDB	2, 3	N.I.T.	22,000	—	—	—	10,000	—
EDS	2, 3	N.I.T.	42,000	—	—	—	10,000	—
ED	2, 3	N.I.T.	65,000	—	—	—	10,000	—
EDH	2, 3	N.I.T.	100,000	—	—	—	10,000	—
EDC ④	2, 3	N.I.T.	200,000	—	—	—	10,000	—
EHD	1	N.I.T.	—	14,000	—	—	10,000	—
	2, 3	N.I.T.	18,000	—	14,000	—	—	10,000
FDB	2, 3, 4	N.I.T.	18,000	—	14,000	14,000	—	10,000
FD	1	N.I.T.	—	35,000	—	—	10,000	—
FD	2, 3, 4	N.I.T.	65,000	—	35,000	—	—	10,000
FDE ⑤	2, 3, 4	N.I.T.	65,000	—	35,000	18,000	—	—
HFD	1	N.I.T.	—	65,000	—	—	10,000	—
HFD	2, 3, 4	N.I.T.	100,000	—	65,000	—	—	22,000
HFDE ⑤	2, 3, 4	N.I.T.	100,000	—	65,000	25,000	—	—
FDC ④	2, 3, 4	N.I.T.	200,000	—	100,000	35,000	—	22,000
FDCE ⑤	2, 3, 4	N.I.T.	—	—	—	25,000	—	—
HFDDC ⑥	3	N.I.T.	—	—	—	—	—	42,000 ⑦

① N.I.T. is non-interchangeable trip unit.

② Two-pole circuit breaker, or two poles of three-pole circuit breaker.

③ Time constant is 3 milliseconds minimum at 10 kA and 8 milliseconds minimum at 22 kA.

④ Current limiting.

⑤ Electronics available on three-pole only.

⑥ HFDDC is UL only and is not tested to other standards.

⑦ Interrupting rating is 35,000A at 600 Vdc with three poles in series, for ungrounded systems only.

Table 27.4-59. Line and Load Terminals

Maximum Breaker Amperes	Terminal Body Material ⑧	Wire Type	AWG Wire Range	Metric Wire Range (mm ²)	Catalog Number Package of 3 Terminals
-------------------------	--------------------------	-----------	----------------	--------------------------------------	---------------------------------------

Standard Pressure Type Terminals

20 (EHD)	Steel	Cu/Al	(1) #14–#10	2.5–4	3T20FB ⑨
100	Steel	Cu/Al	(1) #14–1/0	2.5–50	3T100FB
150	Aluminum	Cu/Al	(1) #4–4/0	25–95	3TA150FB
225	Aluminum	Cu/Al	(1) #4–4/0	25–95	3TA225FD

Optional Pressure Terminals

50	Aluminum	Cu/Al	(1) #14–#4	2.5–16	3TA50FB ⑨
100	Aluminum	Cu/Al	(1) #14–1/0	2.5–50	3TA100FD
150	Stainless Steel	Cu	(1) #4–4/0	25–95	3T150FB
225	Aluminum	Cu/Al	(1) #6–300 kcmil	16–150	3TA225FDK

⑧ UL listed for use with copper or aluminum conductors as noted.

⑨ Not for use with ED, EDH, EDC breakers.

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Powering Business Worldwide

Motor Circuit Protectors



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Motor Circuit Protectors (MCP)

Product Description

Designated as Eaton’s Types GMCP and HMCP, the instantaneous-only motor circuit protector (MCP) is available in ratings from 3 A to 1200 A for motor starter sizes 0 through 8.

An innovative design of internal components allows higher MCP-starter combination interrupting ratings. The MCP is marked to permit proper electrical application within the assigned equipment ratings.

Standards and Certifications

The MCP is designed to comply with the applicable requirements of Underwriters Laboratories Standard UL 489, Canadian Standards Association Standard C22.2 No. 5.1, and International Electrotechnical Commission Recommendations IEC 157-1.

The MCP is a recognized component (UL File E7819) and complies with the applicable requirements of Underwriters Laboratories Standard UL 489. It is also designed to comply with the applicable requirements of Canadian Standards Association Standard C22.2 No. 5.1, International Electrotechnical Commission Recommendations IEC 157-1, and nameplates bear the CE marking.



Note: Interrupting ratings are dependent on starter it is used with.

2.3

Molded Case Circuit Breakers

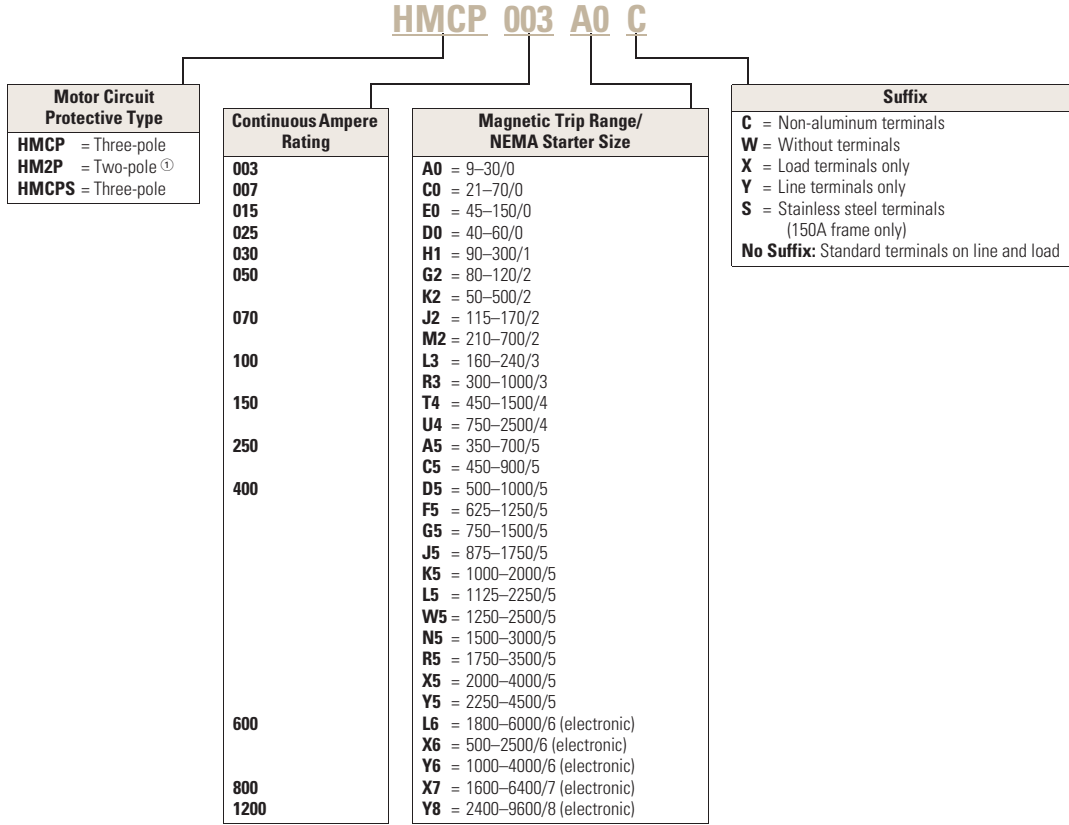
Series C

Catalog Number Selection

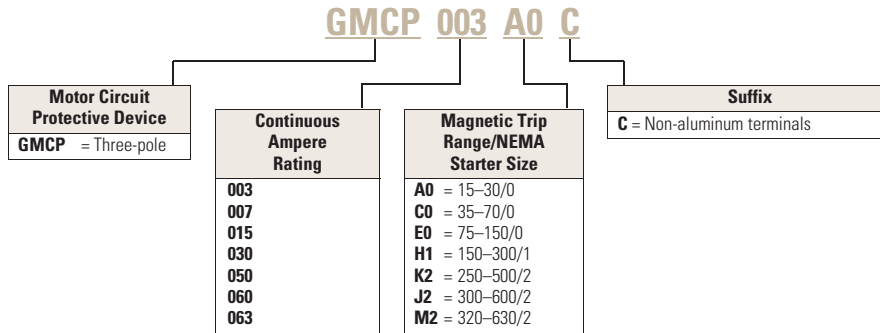
This information is presented only as an aid to understanding catalog numbers. It is not to be used to build catalog numbers for circuit breakers or trip units.

2

Motor Circuit Protector



Motor Circuit Protector



Note

① On J- and K-Frame HMCPs only.

Product Selection

G-Frame

480 Vac Maximum, 600Y/347 Vac

NEMA Starter Size	Continuous Amperes	Cam Setting	Motor Full Load Current Amperes (FLA) ^①	MCP Trip Setting	MCP Catalog Number
0	3	A	1.1–1.2	15	GMCP003A0C
		B	1.3–1.5	18	
		C	1.6–1.7	21	
		D	1.8–1.9	24	
		E	2.0–2.2	27	
		F	2.3–2.5	30	
0	7	A	2.6–3.1	35	GMCP007C0C
		B	3.2–3.6	42	
		C	3.7–3.9	49	
		D	4.3–4.7	56	
		E	4.8–5.2	63	
		F	5.3–5.7	70	
0	15	A	5.7–6.8	75	GMCP015E0C
		B	6.9–7.9	90	
		C	8.0–9.1	105	
		D	9.2–10.3	120	
		E	10.4–11.4	135	
		F	11.5–12.6	150	
1	30	A	11.5–13.7	150	GMCP030H1C
		B	13.8–16.0	180	
		C	16.1–18.3	210	
		D	18.4–20.6	240	
		E	20.7–22.9	270	
		F	23.0–25.2	300	
2	50	A	19.3–22.9	250	GMCP050K2C
		B	23.0–26.8	300	
		C	26.9–30.6	350	
		D	30.7–34.5	400	
		E	34.6–38.3	450	
		F	38.4–42.1	500	
3	60	A	23.1–27.5	300	GMCP060J2C
		B	27.7–32.2	360	
		C	32.3–36.7	420	
		D	36.9–41.4	480	
		E	41.5–46.0	540	
		F	46.2–50.5	600	
3	63	A	24.2–32.1	320	GMCP063M2C
		B	29.1–34.8	380	
		D	38.8–46.4	500	
		E	43.6–48.9	570	
		F	48.5–53.7	630	

Notes

^① Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate Cam settings and/or MCP ratings should be used.

All GMCP 3–63A come with line and load steel body terminals for Cu only wire. Refer to **Page V4-T2-122** under Optional Terminal Types.

UL recognized and CSA approved.

Accessories

Modifications for GMCP

Internal accessories must be factory installed.

Internal Accessories ①

Type Accessory	Electrical Ratings			Contact Arrangement	Factory Suffix	Style Number
	Volts	Frequency	Amperes			
Shunt trip ②	120	50/60 Hz	1.1	—	S5	1373D62G18
Shunt trip ②	240	50/60 Hz	2.1	—	S6	1373D62G19
Auxiliary switch ③	240	50/60 Hz	6.0	1A/1B	A3	1288C74G03
Auxiliary switch ③	240	50/60 Hz	6.0	2A/2B	A6	1288C73G03
Alarm switch ③	240	50/60 Hz	6.0	Make/Break	B3	1288C75G03
Auxiliary switch/alarm switch combination ③	240	50/60 Hz	6.0	1A/1B Make/Break	B13	1288C76G09



External Mounted Accessories

Description	Number Units in Package	Style Number
Lock dog (non-padlockable)	1	1294C01H01
Mounting hardware	1	624B375G23
DIN rail adapter ④	10	1225C79G02

Modifications for HMCP

See Internal Accessories starting on **Page V4-T2-272**.

Handle Mechanisms for Series C Frames**Kits Only (Kit Includes Shaft, Mechanism and Handle)—GMCP-Frame**

Description	Rating Type		GMCP-Frame Catalog Number
	NEMA	IP	
 S01 blue handle, 12-inch shaft	1/3R/12	54	GMHMVD12B / 68C6039G05
	4/4X	65	GMHMVD12BX / 68C6039G07
 S01 red handle, 12-inch shaft	1/3R/12	54	GMHMVD12R / 68C6039G06
	4/4X	65	GMHMVD12RX / 68C6039G08

Direct (Close-Coupled) Handle Mechanisms**G Direct** ⑤

Frame	Black Handle		Yellow Handle	
	With Shroud Catalog Number	Without Shroud Catalog Number	With Shroud Catalog Number	Without Shroud Catalog Number
GMCP	HRGMC1S	HRGMC10	HRGMC3S	HRGMC30

Notes

- ① Only one accessory may be installed in GMCP.
- ② LH only.
- ③ RH only.
- ④ For use with standard 35 mm DIN rail such as, 35 x 7.5 or 15 mm per DIN EN50022.
- ⑤ Suitable for use on two- or three-pole G-Frame.

No UVR available on GMCP.

F-Frame

600 Vac Maximum, 250 Vdc Maximum

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number
0	3	A	0.69–0.91	9	HMCP003A0C
		B	0.92–1.0	12	
		C	1.1–1.2	15	
		D	1.3–1.5	18	
		E	1.6–1.7	21	
		F	1.8–1.9	24	
		G	2.0–2.2	27	
		H	2.3–2.5	30	
0	7	A	1.5–2.0	21	HMCP007C0C
		B	2.1–2.5	28	
		C	2.6–3.1	35	
		D	3.2–3.6	42	
		E	3.7–3.9	49	
		F	4.3–4.7	56	
		G	4.8–5.2	63	
		H	5.3–5.7	70	
0	15	A	3.4–4.5	45	HMCP015E0C
		B	4.6–5.6	60	
		C	5.7–6.8	75	
		D	6.9–7.9	90	
		E	8.0–9.1	105	
		F	9.2–10.3	120	
		G	10.4–11.4	135	
		H	11.5–12.6	150	
1	30	A	6.9–9.1	90	HMCP030H1C
		B	9.2–11.4	120	
		C	11.5–13.7	150	
		D	13.8–16.0	180	
		E	16.1–18.3	210	
		F	18.4–20.6	240	
		G	20.7–22.9	270	
		H	23.0–25.2	300	
2	50	A	11.5–15.2	150	HMCP050K2C
		B	15.3–19.1	200	
		C	19.2–22.9	250	
		D	23.0–26.8	300	
		E	26.9–30.6	350	
		F	30.7–4.5	400	
		G	34.6–38.3	450	
		H	38.4–42.1	500	

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number
2	70	A	16.1–21.4	210	HMCP070M2C
		B	21.5–26.8	280	
		C	26.9–32.2	350	
		D	32.3–37.5	420	
		E	37.6–42.9	490	
		F	43.0–48.3	560	
		G	48.4–53.7	630	
		H	53.8–59.1	700	
3	100	A	23.0–30.6	300	HMCP100R3C
		B	30.7–38.3	400	
		C	38.4–46.0	500	
		D	46.1–53.7	600	
		E	53.8–61.4	700	
		F	61.5–69.1	800	
		G	69.2–76.8	900	
		H	76.9–84.5	1000	
4	150	A	34.6–46.0	450	HMCP150T4C
		B	46.1–57.5	600	
		C	57.6–69.1	750	
		D	69.2–80.6	900	
		E	69.2–80.6	900	
		F	80.7–92.2	1050	
		G	92.3–103.7	1200	
		H	103.8–115.2	1350	
4	150	A	57.0–75.0	750	HMCP150U4C
		B	76.0–95.0	1000	
		C	96.0–114.0	1250	
		D	115.0–130.7	1500	
		E	③	1750	
		F	③	2000	
		G	③	2250	
		H	③	2500	

Notes

- ① Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate Cam settings and/or MCP ratings should be used.
- ② For DC applications, actual trip levels are approximately 40% higher than values shown.
- ③ Settings above 130 amperes are for special applications. NEC Article 430.110(a) requires the ampere rating of the disconnecting means to be not less than 115% of the motor full load ampere rating.

HMCP 3–100 A come with line and load steel body terminals, 3T100FB. HMCP 150A come with line and load steel body terminals, 3T150FB.

Special Low Magnetic Protection Application MCP**600 Vac Maximum, 250 Vdc Maximum**

Cont. Amps	Cam Setting	MCP Trip Setting ^①	MCP Catalog Number
25	A	40	HMCP025D0C
	B	43	
	D	49	
	E	52	
	F	55	
	G	58	
	H	60	
	50	A	
B		87	
C		93	
D		98	
E		103	
F		109	
G		115	
H		120	
70	A	115	HMCP070J2C
	B	122	
	C	130	
	D	139	
	E	145	
	F	153	
	G	160	
	H	170	
100	A	160	HMCP100L3C
	B	174	
	C	185	
	D	196	
	E	207	
	F	218	
	G	229	
	H	240	

Notes

^① For DC applications, actual trip levels are approximately 40% higher than values shown.

HMCP 25–100 A come with line and load steel body terminals, 3T100FB.

MCPs for Application with Motor Starters Equipped with Electronic Overload Relays**600 Vac Maximum, 250 Vdc Maximum**

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number
0	3	A	0.69–0.91	9	HMCP5003A0C
		B	0.92–1.0	12	
		C	1.1–1.2	15	
		D	1.3–1.5	18	
		E	1.6–1.7	21	
		F	1.8–1.9	24	
		G	2.0–2.2	27	
		H	2.3–2.5	30	
0	7	A	1.5–2.0	21	HMCP5007C0C
		B	2.1–2.5	28	
		C	2.6–3.1	35	
		D	3.2–3.6	42	
		E	3.7–3.9	49	
		F	4.3–4.7	56	
		G	4.8–5.2	63	
		H	5.3–5.7	70	
0	15	A	3.4–4.5	45	HMCP5015E0C
		B	4.6–5.6	60	
		C	5.7–6.8	75	
		D	6.9–7.9	90	
		E	8.0–9.1	105	
		F	9.2–10.3	120	
		G	10.4–11.4	135	
		H	11.5–12.6	150	
1	30	A	6.9–9.1	90	HMCP5030H1C
		B	9.2–11.4	120	
		C	11.5–13.7	150	
		D	13.8–16.0	180	
		E	16.1–18.3	210	
		F	18.4–20.6	240	
		G	20.7–22.9	270	
		H	23.0–25.2	300	
2	50	A	11.5–15.2	150	HMCP5050K2C
		B	15.3–19.1	200	
		C	19.2–22.9	250	
		D	23.0–26.8	300	
		E	26.9–30.6	350	
		F	30.7–34.5	400	
		G	34.6–38.3	450	
		H	38.4–42.1	500	

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number
3	100	A	23.0–30.6	300	HMCP5100R3C
		B	30.7–38.3	400	
		C	38.4–46.0	500	
		D	46.1–53.7	600	
		E	53.8–61.4	700	
		F	61.5–69.1	800	
		G	69.2–76.8	900	
		H	76.9–84.5	1000	
4	150	A	34.6–46.0	450	HMCP5150T4C
		B	46.1–57.5	600	
		C	57.6–69.1	750	
		D	69.2–80.6	900	
		E	80.7–92.2	1050	
		F	92.3–103.7	1200	
		G	103.8–115.2	1350	
		H	115.3–126.7	1500	
4	150	A	57.0–75.0	750	HMCP5150U4C
		B	76.0–95.0	1000	
		C	96.0–114.0	1250	
		D	115.0–130.7	1500	
		E	③	1750	
		F	③	2000	
		G	③	2250	
		H	③	2500	

Notes

- ① Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.
- ② For DC applications, actual trip levels are approximately 40% higher than values shown.
- ③ Settings above 130A are for special applications. NEC Article 430.110(a) requires the ampere rating of the disconnecting means to be not less than 115% of the motor full load ampere rating.

HMCP 25–100 A come with line and load steel body terminals, 3T100FB.

HMCP5 3–100 A come with line and load steel body terminals, 3T100FB. HMCP5 150A come with line and load steel body terminals, 3T150FB.

2.3

Molded Case Circuit Breakers

Series C

J-Frame

600 Vac Maximum, 250 Vdc Maximum

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③
4	250	A	27.0–30.7	350	HMCP250A5C
		B	30.8–33.8	400	
		C	33.9–36.9	440	
5	250	D	37.0–40.3	480	
		E	40.4–43.8	525	
		F	43.9–46.9	570	
		G	47.0–50.7	610	
		H	47.0–50.7	660	
		I	47.0–50.7	700	
		5	250	A	
B	38.9–43.4			505	
C	43.5–47.6			565	
D	47.7–52.2			620	
E	52.3–56.5			680	
F	56.6–60.7			735	
G	60.8–64.9			790	
H	65.0–69.2			845	
I	69.3–73.5			900	
5	250	A	38.5–43.4	500	HMCP250D5C
		B	43.5–48.0	565	
		C	48.1–53.0	625	
		D	53.1–57.6	690	
		E	57.7–62.3	750	
		F	62.4–67.3	810	
		G	67.4–71.9	875	
		H	72.0–76.9	935	
		I	77.0–81.6	1000	
5	250	A	48.1–53.8	625	HMCP250F5C
		B	53.9–59.9	700	
		C	60.0–66.1	780	
		D	66.2–72.3	860	
		E	72.4–78.4	940	
		F	78.5–83.8	1020	
		G	83.9–89.9	1090	
		H	90.0–96.1	1170	
		I	96.2–102.0	1250	
5	250	A	57.7–64.6	750	HMCP250G5C
		B	64.7–71.9	840	
		C	72.0–79.2	935	
		D	79.3–86.5	1030	
		E	86.6–93.8	1125	
		F	93.9–101.1	1220	
		G	101.2–108.4	1315	
		H	108.5–115.3	1410	
		I	115.4–122.4	1500	

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③
5	250	A	67.4–75.3	875	HMCP250J5C
		B	75.4–83.8	980	
		C	83.9–92.3	1090	
		D	92.4–100.7	1200	
		E	100.8–109.2	1310	
		F	109.3–117.6	1420	
		G	117.7–126.1	1530	
		H	126.2–134.6	1640	
		I	134.7–142.8	1750	
5	250	A	77.0–86.6	1000	HMCP250K5C
		B	86.6–96.1	1125	
		C	96.2–105.7	1250	
		D	105.8–115.3	1375	
		E	115.4–124.9	1500	
		F	125.0–134.6	1625	
		G	134.7–144.2	1750	
		H	144.3–153.8	1875	
		I	153.9–163.3	2000	
5	250	A	86.6–97.3	1125	HMCP250L5C
		B	97.4–108.4	1265	
		C	108.5–118.8	1410	
		D	118.9–129.9	1545	
		E	130.0–140.7	1690	
		F	140.8–151.5	1830	
		G	151.6–162.3	1970	
		H	162.4–173.0	2110	
		I	173.1–183.6	2250	
5	250	A	96.2–108.0	1250	HMCP250W5C
		B	108.1–119.9	1405	
		C	120.0–132.3	1560	
		D	132.4–144.2	1720	
		E	144.3–156.1	1875	
		F	156.2–168.0	2030	
		G	168.1–179.9	2185	
		H	180.0–192.3	2340	
		I	192.4–204.0	2500	

Notes

- ① Motor FLA ranges are typical. The corresponding trip setting is at 13 times the minimum FLA value shown. Where a 13 times setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.
- ② For DC applications, actual trip levels are approximately 40% higher than values shown.
- ③ Three-pole catalog numbers shown. Two-pole catalog numbers begin with **HM2P** in place of **HMCP**.

All HMCP and HM2P 250A come with line and load steel body terminals, T250KB. (With suffix "C," without "C" comes with TA250KB.)

K-Frame

600 Vac Maximum, 250 Vdc Maximum

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③
4	400	A	27.0–30.7	350	HMCP400A5C
		B	30.8–33.8	400	
		C	33.9–36.9	440	
5	400	D	37.0–40.3	480	HMCP400A5C
		E	40.4–43.8	525	
		F	43.9–46.9	570	
		G	47.0–50.7	610	
		H	50.8–53.8	660	
		I	53.9–57.2	700	
5	400	A	38.5–43.4	500	HMCP400D5C
		B	43.5–48.0	565	
		C	48.1–53.0	626	
		D	53.1–57.6	690	
		E	57.7–62.3	750	
		F	62.4–67.3	810	
		G	67.4–71.9	875	
		H	72.0–76.9	935	
		I	77.0–81.6	1000	
5	400	A	48.1–53.8	625	HMCP400F5C
		B	53.9–59.9	700	
		C	60.0–66.1	780	
		D	66.2–72.3	860	
		E	72.4–78.4	940	
		F	78.5–83.8	1020	
		G	83.9–89.9	1090	
		H	90.0–96.1	1170	
		I	96.2–102.0	1250	
5	400	A	57.7–64.6	750	HMCP400G5C
		B	64.7–71.9	840	
		C	72.0–79.2	935	
		D	79.3–86.5	1030	
		E	86.6–93.8	1125	
		F	93.9–101.1	1220	
		G	101.2–108.4	1315	
		H	108.5–115.3	1410	
		I	115.4–122.4	1500	
5	400	A	67.4–75.3	875	HMCP400J5C
		B	75.4–83.8	980	
		C	83.9–92.3	1090	
		D	92.4–100.7	1200	
		E	100.8–109.2	1310	
		F	109.3–117.6	1420	
		G	117.7–126.1	1530	
		H	126.2–134.6	1640	
		I	134.7–142.8	1750	

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③
5	400	A	77.0–86.5	1000	HMCP400K5C
		B	86.6–96.1	1125	
		C	96.2–105.7	1250	
		D	105.8–115.3	1375	
		E	115.4–124.9	1500	
		F	125.0–134.6	1625	
		G	134.7–144.2	1750	
		H	144.3–153.8	1875	
		I	153.9–163.3	2000	
5	400	A	86.6–97.3	1125	HMCP400L5C
		B	97.4–108.4	1265	
		C	108.5–118.8	1410	
		D	118.9–129.9	1545	
		E	130.0–140.7	1690	
		F	140.8–151.5	1830	
		G	151.6–162.3	1970	
		H	162.4–173.0	2110	
		I	173.1–183.6	2250	
5	400	A	96.2–108.0	1250	HMCP400W5C
		B	108.1–119.9	1405	
		C	120.0–132.3	1560	
		D	132.4–144.2	1720	
		E	144.3–156.1	1875	
		F	156.2–168.0	2030	
		G	168.1–179.9	2185	
		H	180.0–192.3	2340	
		I	192.4–204.0	2500	
5	400	A	115.4–129.9	1500	HMCP400N5C
		B	130.0–144.2	1690	
		C	144.3–158.4	1875	
		D	158.5–173.0	2060	
		E	173.1–187.6	2250	
		F	187.7–201.9	2440	
		G	202.0–216.1	2625	
		H	216.2–230.7	2810	
		I	230.8–244.9	3000	

Notes

- ① Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.
- ② For DC applications, actual trip levels are approximately 40% higher than values shown.
- ③ Three-pole catalog numbers shown. Two-pole catalog numbers begin with **HM2P** in place of **HMCP**.

All HMCP and HM2P 400 A come with aluminum body terminals, 3TA400K. Catalog numbers with suffix "C" as shown above come with copper body terminals 3T400K.

2.3

Molded Case Circuit Breakers

Series C

2

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③
5	400	A	134.7–151.5	1750	HMCP400R5C
		B	151.6–168.4	1970	
		C	168.5–185.3	2190	
		D	185.4–201.9	2410	
		E	202.0–218.8	2625	
		F	218.9–235.7	2845	
		G	235.8–252.6	3065	
		H	252.7–269.2	3285	
		I	269.3–285.7	3500	
5	400	A	153.9–173.0	2000	HMCP400X5C
		B	173.1–192.3	2250	
		C	192.4–211.5	2500	
		D	211.6–230.7	2750	
		E	230.8–249.9	3000	
		F	250.0–269.2	3250	
		G	269.3–288.4	3500	
		H	288.5–307.6	3750	
		I	307.7–326.9	4000	
5	400	A	173.1–194.5	2250	HMCP400Y5C
		B	194.6–216.1	2530	
		C	216.2–237.6	2810	
		D	237.7–259.5	3090	
		E	259.6–281.1	3375	
		F	281.2–302.6	3655	
		G	302.7–324.1	3935	
		H	324.2–346.1	4215	
		I	346.2–368.1	4500	

L-Frame

600 Vac Maximum ④

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting	MCP Catalog Number
6	600	A	138.5–184.5	1800	HMCP600L6W
		B	184.6–230.7	2400	
		C	230.8–276.8	3000	
		D	276.9–323.0	3600	
		E	323.1–369.1	4200	
		F	369.2–415.3	4800	
		G	415.4–461.4	5400	
		H	461.5–507.7	6000	
		6	600	A	
B	46.2–61.4			600	
C	61.5–76.8			800	
D	76.9–96.1			1000	
E	96.2–115.3			1250	
F	115.4–153.7			1500	
G	153.8–192.2			2000	
H	192.3–230.7			2500	
6	600			A	76.9–96.1
		B	96.2–115.3	1250	
		C	115.4–153.7	1500	
		D	153.8–192.2	2000	
		E	192.3–230.7	2500	
		F	230.8–269.1	3000	
		G	269.2–307.6	3500	
		H	307.7–346.1	4000	

Notes

- ① Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.
- ② For DC applications, actual trip levels are approximately 40% higher than values shown.
- ③ Three-pole catalog numbers shown. Two-pole catalog numbers begin with **HM2P** in place of **HMCP**.
- ④ Equipped with electronic trip device.

All HMCP and HM2P 400 A come with aluminum body terminals, 3TA400K. Catalog numbers with suffix "C" as shown above come with copper body terminals 3T400K.

All HMCP 600 A come without terminals. For terminals, see **Page V4-T2-216**.

N-Frame**600 Vac Maximum** ^①

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ^②	MCP Trip Setting	MCP Catalog Number
7	800	A	123.1–184.5	1600	HMCP800X7W
		B	184.6–246.1	2400	
		C	246.2–307.6	3200	
		D	307.7–369.1	4000	
		E	369.2–430.7	4800	
		F	430.8–492.2	5600	
		G	492.3–553.7	6400	
8	1200	A	184.6–276.8	2400	HMCP12Y8W
		B	276.9–369.1	3600	
		C	369.2–461.4	4800	
		D	461.5–553.7	6000	
		E	553.8–646.1	7200	
		F	646.2–738.4	8400	
		G	738.5–830.7	9600	

Notes

- ① Equipped with electronic trip device.
- ② Motor FLA ranges are typical. The corresponding trip setting is at 13X the minimum FLA value shown. Where a 13X setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.

The Eaton logo consists of the word "EATON" in a bold, blue, sans-serif font. The letter "O" is stylized as a white circle with a blue dot in the center, creating a visual effect of a power symbol or a stylized letter.

Powering Business Worldwide

Eaton's SPD Series for integration into electrical distribution equipment



Contents

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Powering Business Worldwide

Introduction

Eaton's SPD Series surge protective devices

Eaton's SPD Series surge protective devices are the latest and most advanced UL® 1449 3rd Edition certified surge protectors. Units are available integrated within Eaton electrical assemblies, including panelboards, switchboards, motor control centers, switchgear, and bus plugs. Side-mount versions of the SPD Series are also available for installation external to an electrical assembly. Application of SPD Series units throughout a facility will ensure that equipment is protected with the safest and most reliable surge protective devices available.

SPD Series units are available in all common voltages and configurations and also in a variety of surge current capacity ratings from 50 through 400 kA. Three feature package options are also available to choose from. The breadth of the SPD Series' features, options, and configurations ensures that the correct unit is available for all electrical applications, including service entrances, distribution switchboards, panelboards, and point-of-use applications.

Applications

The SPD Series is available as an integrated device within the following Eaton electrical assemblies:

- Panelboards
- Switchboards
- Motor control centers
- Switchgear
- Automatic transfer switches
- Bus plugs

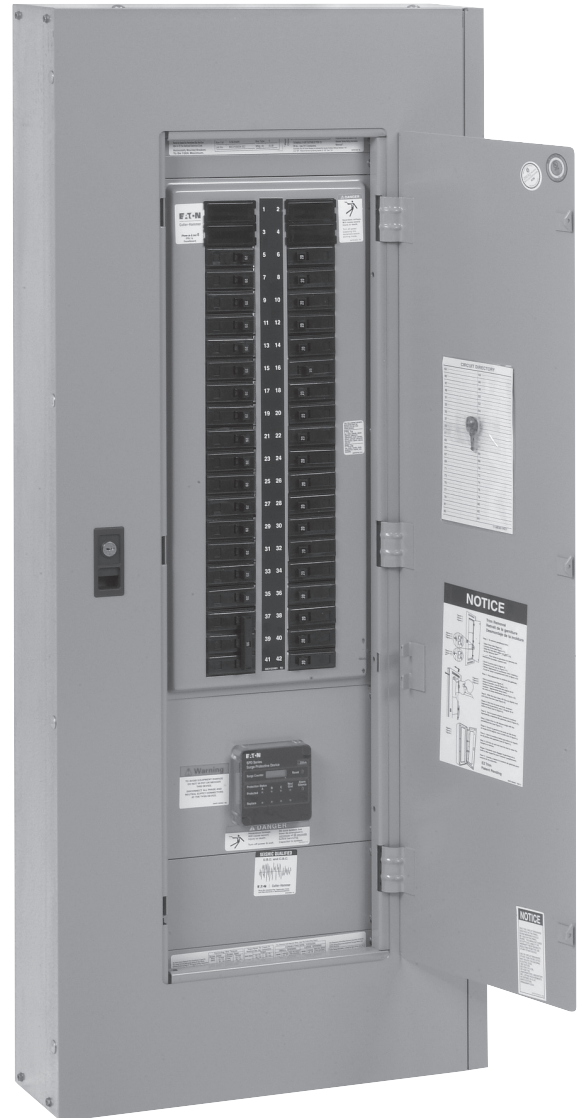
Features

- Uses thermally protected metal oxide varistor (MOV) technology
- 20 kA nominal discharge current (I_n) rating (maximum rating assigned by UL)
- 50 through 400 kA surge current capacity ratings
- Three feature package options
- 200 kA short circuit current rating (SCCR)
- 10-year warranty

Standards and certifications



- UL 1449 3rd Edition recognized component for the United States and Canada, covered by Underwriters Laboratories certification and follow-up service



SPD Series Unit Integrated Within an Eaton Panelboard

Feature package options

The SPD Series provides users with the option of selecting between three feature packages. These feature packages are the basic, standard, and standard with surge counter. The proper feature package can be selected based on the requirements of the application or specification.

Table 1. Feature Package Comparison

Feature	Basic	Standard	Standard with Surge Counter
Surge protection using thermally protected MOV technology	✓	✓	✓
Dual-colored protection status indicators for each phase	✓	✓	✓
Dual-colored protection status indicators for the neutral-ground protection mode	✓	✓	✓
Audible alarm with silence button		✓	✓
Form C relay contact		✓	✓
EMI/RFI filtering, providing up to 50 dB of noise attenuation from 10 kHz to 100 MHz		✓	✓
Surge counter with reset button			✓

Remote display mounting option

The SPD Series offers the option of mounting its display remotely from the device. This is useful for applications where OEMs or other integrators would like to embed the unit within a piece of equipment and still be able to view its display.

SPD Series unit catalog numbers ending with 'B' (refer to catalog number configuration on **Page 7**) should be ordered for applications where the display is to be mounted remotely. These units include the SPD Series unit and the remote display panel.

In addition to the unit itself, a remote display cable will have to be purchased. Remote display cables are available in 4, 8, and 12 foot lengths.

Table 2. Remote Display Cables

Description	Catalog Number
4 ft remote display cable	SPDRDCAB04
8 ft remote display cable	SPDRDCAB08
12 ft remote display cable	SPDRDCAB12

Note: Integrated units factory-installed with Eaton switchgear assemblies do not require the purchase of a remote display cable. The cable is provided and all required mounting is performed at the factory.

Existing SPD Series units previously installed without a remote display also have the capability of mounting their displays remotely from the device. Complete remote display kits are available that contain all items required to mount the display remotely, including the remote display cable. Remote display kits are available in 4, 8, and 12 foot cable length options.

Table 3. Remote Display Kits

Description	Catalog Number
Remote display kit with 4 ft remote display cable	SPDRDKIT04
Remote display kit with 8 ft remote display cable	SPDRDKIT08
Remote display kit with 12 ft remote display cable	SPDRDKIT12

For the dimensions of the cutout required to accommodate the remote display panel, see **Figure 1** below.

Dimensions

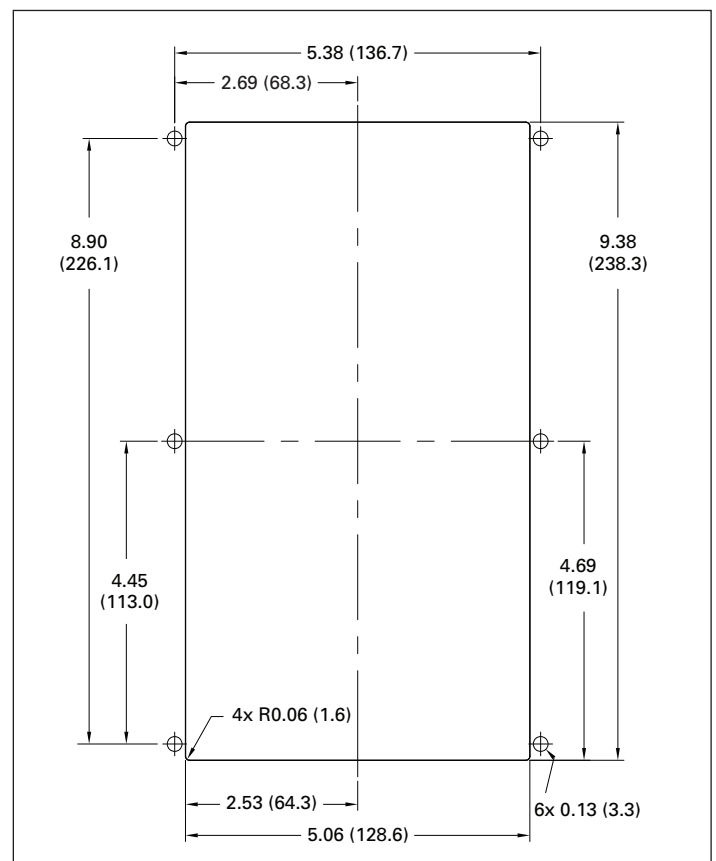


Figure 1. Dimensions of the Cutout Required to Accommodate the Optional Remote Display Panel

Dimensions (continued)

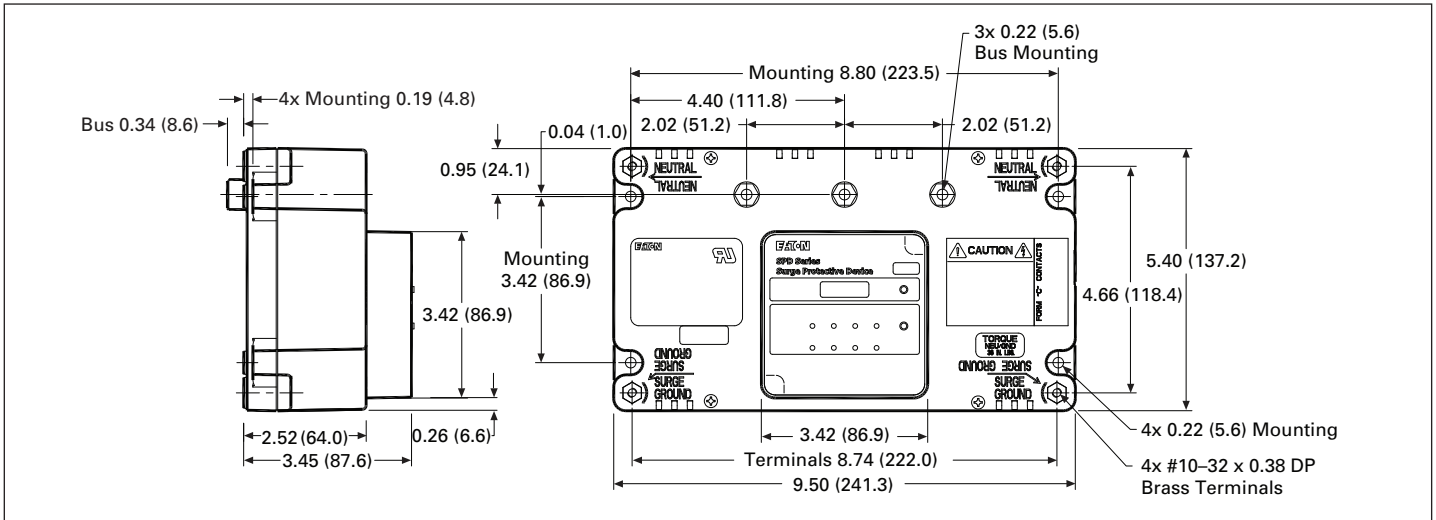


Figure 2. Dimensions of 50 through 200 kA Integrated Units

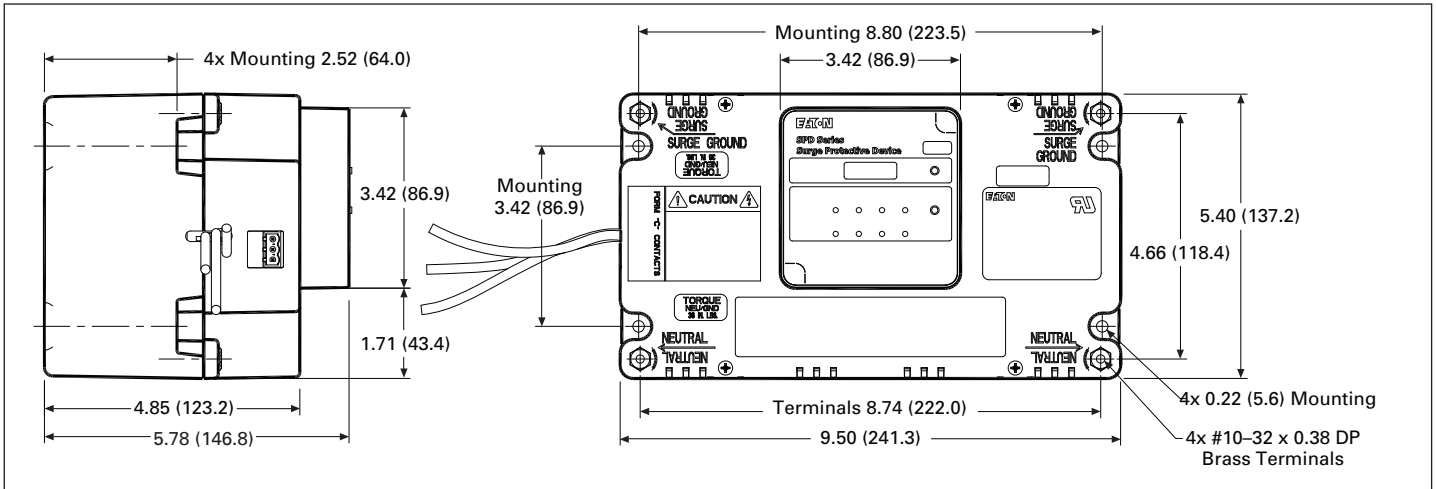


Figure 3. Dimensions of 250 through 400 kA Integrated Units

Performance data

ANSI/UL 1449 3rd Edition voltage protection ratings

Voltage protection rating (VPR) data is included for both direct bus mounted units (catalog number ending with 'A') and units interfaced to the electrical assembly via a circuit breaker (catalog number ending with 'B,' 'C,' or 'J'). Direct bus mounted units are available for installation within Eaton PRL1a, 2a, 3a, and 3E panelboards only.

Table 4. 50 kA Direct Bus Mounted Integrated Unit VPR

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
240S	500	1000	500	1000
208Y and 220Y 400Y and 480Y 600Y	500 1000 1200	1000 2000 2500	500 1000 1200	1000 2000 2500
240D 480D 600D	N/A N/A N/A	1000 2000 2500	N/A N/A N/A	900 2000 2500
240H	500	1000	500	1000

Table 5. 80–100 kA Direct Bus Mounted Integrated Unit VPR

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
240S	500	600	500	900
208Y and 220Y 400Y and 480Y 600Y	500 1000 1200	600 1200 1500	500 1000 1200	900 1800 2500
240D 480D 600D	N/A N/A N/A	1000 1800 2500	N/A N/A N/A	900 1800 2500
240H	500	600	500	900

Table 6. 120–200 kA Direct Bus Mounted Integrated Unit VPR

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
240S	500	600	500	800
208Y and 220Y 400Y and 480Y 600Y	500 900 1200	600 1000 1200	500 900 1200	800 1800 2500
240D 480D 600D	N/A N/A N/A	900 1800 2500	N/A N/A N/A	900 1800 2500
240H	500	600	500	800

Table 7. 250–300 kA Circuit Breaker Interfaced Integrated Unit VPR

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
240S	600 ^①	700	600	1000
208Y and 220Y 400Y and 480Y 600Y	600 ^① 1000 1500	700 1200 1500	600 900 1200	1000 1800 2500
240D 480D 600D	N/A N/A N/A	1000 1800 2500	N/A N/A N/A	1000 1800 2500
240H	600 ^①	700	600	1000

^① L-N VPR for 250–300 kA units containing the standard and standard with surge counter feature packages is 600V. L-N VPR for units containing the basic feature package is 700V. All other VPR numbers reported in all tables represent the VPR for all feature packages.

Table 8. 50 kA Circuit Breaker Interfaced Integrated Unit VPR

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
240S	700	1200	700	1200
208Y and 220Y 400Y and 480Y 600Y	700 1200 1500	1200 2000 2500	700 1200 1500	1200 2000 2500
240D 480D 600D	N/A N/A N/A	1200 2000 2500	N/A N/A N/A	1200 2000 2500
240H	700	1200	700	1200

Table 9. 80–100 kA Circuit Breaker Interfaced Integrated Unit VPR

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
240S	700	700	700	1000
208Y and 220Y 400Y and 480Y 600Y	700 1200 1500	700 1200 1500	700 1200 1500	1000 1800 2500
240D 480D 600D	N/A N/A N/A	1200 2000 2500	N/A N/A N/A	1200 2000 2500
240H	700	700	700	1000

Table 10. 120–200 kA Circuit Breaker Interfaced Integrated Unit VPR

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
240S	700	700	600	1000
208Y and 220Y 400Y and 480Y 600Y	700 1000 1500	700 1200 1500	600 1000 1200	1000 1800 2500
240D 480D 600D	N/A N/A N/A	1000 2000 2500	N/A N/A N/A	1000 1800 2500
240H	700	700	600	1000

Table 11. 400 kA Circuit Breaker Interfaced Integrated Unit VPR

Voltage Code	Protection Mode			
	L-N	L-G	N-G	L-L
240S	700	700	600	1000
208Y and 220Y 400Y and 480Y 600Y	700 1000 1500	700 1200 1500	600 900 1200	1000 1800 2500
240D 480D 600D	N/A N/A N/A	1000 1800 2500	N/A N/A N/A	1000 1800 2500
240H	700	700	600	1000

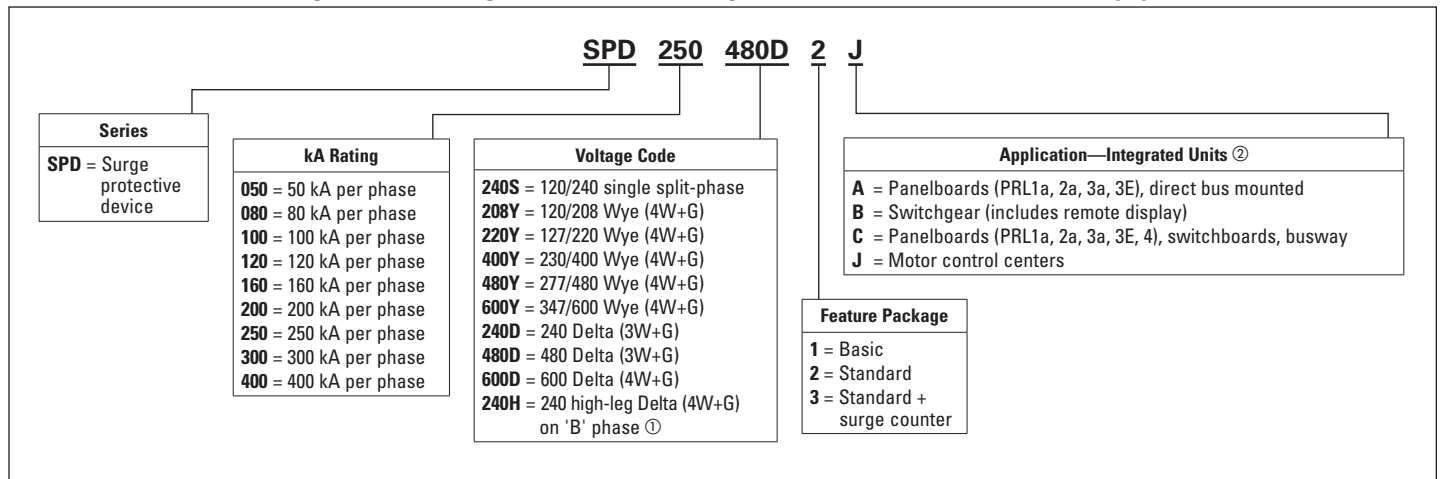
Specifications

Table 12. SPD Series Specifications

Description	Specification
Surge capacity ratings available	50, 80, 100, 120, 160, 200, 250, 300, 400 kA per phase
Nominal discharge current (I _n)	20 kA
Short circuit current rating (SCCR)	200 kA
SPD type	Basic feature package = Type 1 (can also be used in Type 2 applications) Standard and Standard with Surge Counter feature packages = Type 2
Single split phase voltages available	120/240
Three-phase Wye system voltages available	120/208, 127/220, 230/400, 277/480, 347/600
Three-phase Delta system voltages available	240, 480, 600
Input power frequency	50/60 Hz
Power consumption (basic units): 208Y, 220Y, 240S, 240D, and 240H voltage codes 400Y, 480Y, and 480D voltage codes 600Y and 600D voltage codes	0.5W 1.1W 1.3W
Power consumption (standard and standard with surge counter units): 208Y, 220Y, 240S, 240D, and 240H voltage codes 400Y, 480Y, and 480D basic voltage codes 600Y and 600D voltage codes	0.6W 1.7W 2.1W
Protection modes	Single split phase L-N, L-G, N-G, L-L Three-phase Wye L-N, L-G, N-G, L-L Three-phase Delta L-G, L-L Three-phase high-leg Delta . . . L-N, L-G, N-G, L-L
Maximum continuous operating voltage (MCOV): 240S, 208Y, 220Y, and 240H MCOV 400Y and 480Y MCOV 600Y MCOV 240D MCOV 480D MCOV 600D MCOV	150 L-N, 150 L-G, 150 N-G, 300 L-L 320 L-N, 320 L-G, 320 N-G, 640 L-L 420 L-N, 420 L-G, 420 N-G, 840 L-L 320 L-G, 320 L-L 640 L-G, 640 L-L 840 L-G, 840 L-L
Ports	1
Operating temperature	-4°F through 122°F (-20°C through 50°C)
Operating humidity	5% through 95%, noncondensing
Operating altitude	Up to 16,000 ft (5000m)
Seismic withstand capability	Meets or exceeds the requirements specified in IBC® 2006, CBC 2007, and UBC® Zone 4
Weight	50–200 kA units approximately 3.5 lbs (1.6 kg) 250–400 kA units approximately 7.0 lbs (3.2 kg)
Form C relay contact ratings	150 Vdc or 125 Vac, 1A maximum
Form C relay contact logic	Power ON, normal state—NO contact = open, NC contact = closed Power OFF or fault state—NO contact = closed, NC contact = open
EMI/RFI filtering attenuation	Up to 50 dB from 10 kHz to 100 MHz
Agency certifications and approvals	UL 1449 3rd Edition recognized component for the U.S. and Canada UL 1283 (Type 2 SPDs only)
Warranty	10 years

Catalog number selection

Table 13. SPD Series Catalog Number Configuration for Units Integrated into Electrical Distribution Equipment



Example: SPD250480D2J = SPD Series, 250 kA per phase, 480D voltage, standard feature package, motor control center application

- ① Please consult the factory for 240 high-leg Delta (4W+G) applications with high leg on 'C' phase.
- ② Units used in PRL1a, 2a, 3a, and 3E panelboard applications are available in 50–200 kA ratings only. Use the 'C' option for PRL1a, 2a, 3a, and 3E panelboard applications when unit is connected through a circuit breaker.

Technical support information

If you have any questions or need additional information, please contact the Eaton Technical Resource Center at 800-809-2772, option 4, option 2. You may also submit inquiries via e-mail: surgeprotection@eaton.com.

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Powering Business Worldwide



TRAYMOUNT[®] BRAND CAPACITOR SERIES

EATON/CUTLER-HAMMER MOTOR CONTROL CENTER (MCC) DESIGN

APPLICATIONS

- At the load

STANDARD FEATURES

- UL recognized component
- 2-year warranty
- 3-line fusing
- Discharge resistors exceeding NEC requirements
- Assembled in the USA

STANDARD RATINGS

- 240, 480, 600 Volts
- 3-phase
- 60 Hertz

OTHER AVAILABLE RATINGS

- 208 – 575 Volts
- 480 & 600 Volt/Harmonic Duty
- Single phase
- 50 Hertz

CAPACITOR CELLS

- 20-year rated life
- Self-contained, 3-phase, delta-connected
- Industrial grade dry-type construction
- Losses of less than 1/2 watt per KVAR
- Self-healing metallized polypropylene dielectric film
- 3-phase pressure-actuated interrupter
- Hermetically sealed steel case
- Threaded insulated terminals

FUSES

- Fast-acting, current-limiting, with 200,000 ampere interrupting capacity

FIELD WIRING TERMINATION

- Mechanical connections are provided for all field wiring termination points





TRAYMOUNT® BRAND CAPACITOR SERIES

EATON/CUTLER-HAMMER MOTOR CONTROL CENTER (MCC) DESIGN

TRAYMOUNT® SELECTION CHART												
TWPM SERIES: FUSES ONLY – NO INDICATION LIGHTS**												
240V, 3-PHASE, 60 HERTZ				480V, 3-PHASE, 60 HERTZ				600V, 3-PHASE, 60 HERTZ				
KVAR	TRAY	PART NUMBER	AMPS*	KVAR	TRAY	PART NUMBER	AMPS*	KVAR	TRAY	PART NUMBER	AMPS*	
1	1 TRAY	TWPM23001-3	2.4	1	1 TRAY	TWPM43001-3	1.2		1 TRAY			
1.5		TWPM23001x-3	3.6	1.5		TWPM43001X-3	1.8					
2		TWPM23002-3	4.8	2		TWPM43002-3	2.4	2			TWPM63002-3	1.9
2.5		TWPM23002X-3	6.0	2.5		TWPM43002X-3	3.0	2.5			TWPM63002X-3	2.4
3		TWPM23003-3	7.2	3		TWPM43003-3	3.6	3			TWPM63003-3	2.9
4		TWPM23004-3	9.6	4		TWPM43004-3	4.8	4			TWPM63004-3	3.8
5		TWPM23005-3	12	5		TWPM43005-3	6.0	5			TWPM63005-3	4.8
6		TWPM23006-3	14	6		TWPM43006-3	7.2	6			TWPM63006-3	5.8
7		TWPM23007-3	17	7		TWPM43007-3	8.4	7			TWPM63007-3	6.7
7.5		TWPM23007X-3	18	7.5		TWPM43007X-3	9.0	7.5			TWPM63007X-3	7.2
8		TWPM23008-3	19	8		TWPM43008-3	9.6	8			TWPM63008-3	7.7
9		TWPM23009-3	22	9		TWPM43009-3	11	9			TWPM63009-3	8.6
10		TWPM23010-3	24	10		TWPM43010-3	12	10			TWPM63010-3	9.6
11		TWPM23011-3	26	11		TWPM43011-3	13	11			TWPM63011-3	11
12		TWPM23012-3	29	12		TWPM43012-3	14	12			TWPM63012-3	12
12.5		TWPM23012X-3	30	12.5		TWPM43012X-3	15	12.5			TWPM63012X-3	12
14		TWPM23014-3	34	14		TWPM43014-3	17	14			TWPM63014-3	13
15		TWPM23015-3	36	15		TWPM43015-3	18	15			TWPM63015-3	14
16		TWPM23016-3	38	16		TWPM43016-3	19	16			TWPM63016-3	15
17.5		TWPM23017X-3	42	17.5		TWPM43017X-3	21	17.5			TWPM63017X-3	16
18	TWPM23018-3	43	18	TWPM43018-3	22	18		TWPM63018-3	17			
20	TWPM23020-3	48	20	TWPM43020-3	24	20		TWPM63020-3	19			
22.5	TWPM23022X-3	54	22.5	TWPM43022X-3	27	22.5		TWPM63022X-3	22			
25	2 TRAYS	TWPM23025-3	60	25	2 TRAYS	TWPM43025-3	30	25	2 TRAYS	TWPM63025-3	24	
27.5		TWPM23027X-3	66	27.5		TWPM43027X-3	33	27.5		TWPM63027X-3	26	
30		TWPM23030-3	72	30		TWPM43030-3	36	30		TWPM63030-3	29	
32.5		TWPM23032X-3	78	32.5		TWPM43032X-3	39	32.5		TWPM63032X-3	31	
35		TWPM23035-3	84	35		TWPM43035-3	42	35		TWPM63035-3	34	
37.5		TWPM23037X-3	90	37.5		TWPM43037X-3	45	37.5		TWPM63037X-3	36	
40		TWPM23040-3	96	40		TWPM43040-3	48	40		TWPM63040-3	38	
42.5		TWPM23042X-3	102	42.5		TWPM43042X-3	51	42.5		TWPM63042X-3	41	
45		TWPM23045-3	108	45		TWPM43045-3	54	45		TWPM63045-3	43	
50		3 TRAYS	TWPM23050-3	120		50	2 TRAYS	TWPM43050-3		60	50	2 TRAYS
Approximate Dimensions (Inches) H: 9.00 W: 13.75 D: 7.25				60	TWPM43060-3	72		60	TWPM63060-3	58		
				65	TWPM43065-3	78		65	TWPM63065-3	62		
				70	TWPM43070-3	84		70	TWPM63070-3	67		
				75	TWPM43075-3	90		75	TWPM63075-3	72		
				80	TWPM43080-3	96		80	TWPM63080-3	77		
				90	TWPM43090-3	108		90	TWPM63090-3	86		
100	3 TRAYS	TWPM43100-3	120	100	3 TRAYS	TWPM63100-3	96					

*The ampacity of capacitor circuit conductors shall not be less than 135% of the rated circuit of the capacitor (Per NEC).
 **For BLOWN FUSE INDICATION LIGHTS - Change PART NUMBER prefix from TWPM to TWNM.
 Consult factory for OTHER AVAILABLE VOLTAGES, PHASES, OR HERTZ not shown in this chart.

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Powering Business Worldwide

D7 Series Relay



D7PR/D7PF Series

Product Description

The D7 Series is a cost-effective control relay with high dielectric strength and high current-carrying capacity.

Features


D7PR

- Arc barrier equipped relay with high dielectric strength
- Panel and DIN rail mounting

D7PF

- Flag indicator shows relay status in manual or powered condition
- Bipolar LED status lamp allows for reverse polarity applications
 - Shows coil ON or OFF status
 - Ideal in low light conditions
- Color-coded pushbutton identifies AC coils with red or DC coils with blue pushbuttons
 - Allows for manual operation of relay without the need for coil power
 - Ideal for field service personnel to test control circuits
- Lock-down door, when activated, holds pushbutton and contacts in the operate position
 - Excellent for analyzing circuit problems
- Finger-grip cover allows operator to remove relays from sockets more easily than conventional relays
- White plastic ID tag/write label used for identification of relays in multi-relay circuits

Standards and Certifications

 File # E37317, E65657

 File # LR217017, LR217069



 RoHS COMPLIANT

3.4

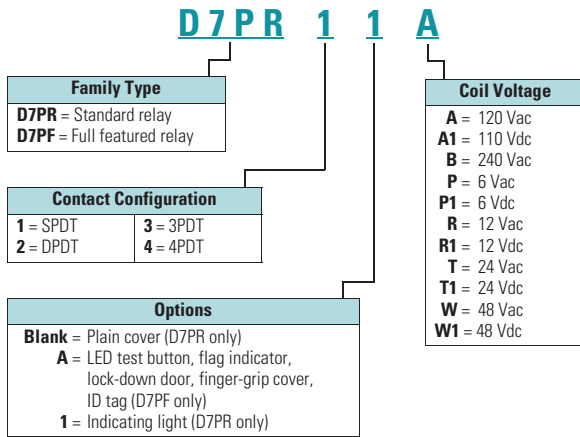
Control Relays and Timers

General Purpose Plug-In Relays

Catalog Number Selection

D7 Series

3



Product Selection

D7 Relay/Socket Quick Reference

Relay Type	Socket/Adapter	Clip	Module Type	ID Tag	Jumper
D7PR1, D7PR2, D7PF1, D7PF2	D7PAA	PQC-1342	B	—	—
		PQC-1349	B	—	—
	D7PA9	PQC-1342	None	—	—
		PFC-D2D72	—	None	—
D7PR3, D7PF3	D7PAB	PQC-1783	A	—	—
		PMC-1783	A	—	—
	PFC-D73	—	None	—	—
D7PR4, D7PF4	D7PAD	PQC-1784	A	—	—
		PMC-1784	A	—	—
	PFC-D74	—	None	—	—

Technical Data and Specifications

D7PR Relay

Description	D7PR (SPDT)	D7PR (DPDT)	D7PR (3PDT)	D7PR (4PDT)
Contact Characteristics				
Contact rating	20A	15A	15A	15A
Terminal style	Plug-in	Plug-in	Plug-in	Plug-in
Contact materials	Silver alloy	Silver alloy	Silver alloy	Silver alloy
Maximum switching voltage	300V	300V	300V	300V
Switching current at voltage—resistive	20A at 277 Vac 50/60 Hz	15A at 120 Vac 50/60 Hz	15A at 120 Vac 50/60 Hz	15A at 120 Vac 50/60 Hz
	20A at 120 Vac 50/60 Hz	12A at 277 Vac 50/60 Hz	12A at 277 Vac 50/60 Hz	12A at 277 Vac 50/60 Hz
	—	10A at 277 Vac 50/60 Hz	—	—
Switching current at voltage	20A at 28 Vdc	12A at 28 Vdc	12A at 28 Vdc	12A at 28 Vdc
	1/2 hp at 120 Vac	1/2 hp at 120 Vac	1/2 hp at 120 Vac	1/2 hp at 120 Vac
	1 hp at 250 Vac	1 hp at 250 Vac	3/4 hp at 250 Vac	3/4 hp at 250 Vac
Pilot duty	B300	B300	B300	B300
Minimum switching requirement	100 mA at 5 Vdc (0.5W)	100 mA at 5 Vdc (0.5W)	100 mA at 5 Vdc (0.5W)	100 mA at 5 Vdc (0.5W)
Coil Characteristics				
Operating range				
% of nominal (AC)	85 to 110%	85 to 110%	85 to 110%	85 to 110%
% of nominal (DC)	80 to 110%	80 to 110%	80 to 110%	80 to 110%
Average consumption	1.2 VA	1.2 VA	1.5 VA	1.5 VA
	0.9W	0.9W	1.4W	1.5W
Dropout voltage threshold	15% (AC)	15% (AC)	15% (AC)	15% (AC)
	10% (DC)	10% (DC)	10% (DC)	10% (DC)
Performance				
Electrical life (UL 508) operations at rated current	100,000 operations	100,000 operations	200,000 operations	200,000 operations
Mechanical life operations unpowered	10,000,000 operations	10,000,000 operations	10,000,000 operations	10,000,000 operations
Response time	20 ms	20 ms	20 ms	20 ms
Dielectric strength				
Between coil and contact Vac (rms)	2500V (rms)	2500V (rms)	2500V (rms)	2500V (rms)
Between poles Vac (rms)	1500V (rms)	1500V (rms)	2500V (rms)	2500V (rms)
Environment				
Ambient air temperature around the device				
Operation	−40° to 131°F (−40° to 55°C)	−40° to 131°F (−40° to 55°C)	−40° to 131°F (−40° to 55°C)	−40° to 131°F (−40° to 55°C)
Storage	−40° to 185°F (−40° to 85°C)	−40° to 185°F (−40° to 85°C)	−40° to 185°F (−40° to 85°C)	−40° to 185°F (−40° to 85°C)
Vibration resistance—operational	3 g-n at 10–55 Hz	3 g-n at 10–55 Hz	3 g-n at 10–55 Hz	3 g-n at 10–55 Hz
Shock resistance	10 g-n	10 g-n	10 g-n	10 g-n
Degree of protection	IP40	IP40	IP40	IP40
Features				
Cover options	Plain cover	Plain cover	Plain cover	Plain cover
Features	Mechanical flag indicator (optional LED)	Mechanical flag indicator (optional LED)	Mechanical flag indicator (optional LED)	Mechanical flag indicator (optional LED)
Product certifications	RoHS/UL/CE/CSA	RoHS/UL/CE/CSA	RoHS/UL/CE/CSA	RoHS/UL/CE/CSA

D7PF Relay

Description	D7PF (SPDT)	D7PF (DPDT)	D7PF (3PDT)	D7PF (4PDT)
Contact Characteristics				
Contact rating	20A	15A	15A	15A
Terminal style	Plug-in	Plug-in	Plug-in	Plug-in
Contact materials	Silver alloy	Silver alloy	Silver alloy	Silver alloy
Maximum switching voltage	300V	300V	300V	300V
Switching current at voltage—resistive	20A at 277 Vac 50/60 Hz	15A at 120 Vac 50/60 Hz	15A at 120 Vac 50/60 Hz	15A at 120 Vac 50/60 Hz
	20A at 277 Vac 50/60 Hz	12A at 277 Vac 50/60 Hz	12A at 277 Vac 50/60 Hz	12A at 277 Vac 50/60 Hz
	—	10A at 277 Vac 50/60 Hz	—	—
	20A at 28 Vdc	12A at 28 VDC	12A at 28 Vdc	12A at 28 Vdc
Switching current at voltage	1/2 hp at 120 Vac	1/2 hp at 120 Vac	3/4 hp at 250 Vac	1/2 hp at 120 Vac
	1 hp at 250 Vac	1 hp at 250 Vac	1/2 hp at 120 Vac	3/4 hp at 250 Vac
Pilot duty	B300	B300	B300	B300
Minimum switching requirement	100 mA at 5 Vdc (0.5W)	100 mA at 5 Vdc (0.5W)	100 mA at 5 Vdc (0.5W)	100 mA at 5 Vdc (0.5W)
Coil Characteristics				
Operating range				
% of nominal (AC)	85 to 110%	85 to 110%	85 to 110%	85 to 110%
% of nominal (DC)	80 to 110%	80 to 110%	80 to 110%	80 to 110%
Average consumption	1.2 VA	1.2 VA	1.5 VA	1.5 VA
	0.9W	0.9W	1.4W	1.5W
Dropout voltage threshold	15% (AC)	15% (AC)	15% (AC)	15% (AC)
	10% (DC)	10% (DC)	10% (DC)	10% (DC)
Performance				
Electrical life (UL 508) operations at rated current	100,000 operations	100,000 operations	200,000 operations	200,000 operations
Mechanical life operations unpowered	10,000,000 operations	10,000,000 operations	10,000,000 operations	10,000,000 operations
Response time	20 ms	20 ms	20 ms	20 ms
Dielectric strength				
Between coil and contact Vac (rms)	2500V (rms)	2500V (rms)	2500V (rms)	2500V (rms)
Between poles Vac (rms)	1500V (rms)	1500V (rms)	2500V (rms)	2500V (rms)
Environment				
Ambient air temperature around the device				
Operation	−40° to 131°F (−40° to 55°C)	−40° to 131°F (−40° to 55°C)	−40° to 131°F (−40° to 55°C)	−40° to 131°F (−40° to 55°C)
Storage	−40° to 185°F (−40° to 85°C)	−40° to 185°F (−40° to 85°C)	−40° to 185°F (−40° to 85°C)	−40° to 185°F (−40° to 85°C)
Vibration resistance—operational	3 g-n at 10–55 Hz	3 g-n at 10–55 Hz	3 g-n at 10–55 Hz	3 g-n at 10–55 Hz
Shock resistance	10 g-n	10 g-n	10 g-n	10 g-n
Degree of protection	IP40	IP40	IP40	IP40
Features				
Cover options	Full featured	Full featured	Full featured	Full featured
Features	Locking pushbutton/ Bipolar LED/ Removable ID tag/ Mechanical flag indicator	Locking pushbutton/ Bipolar LED/ Removable ID tag/ Mechanical flag indicator	Locking pushbutton/ Bipolar LED/ Removable ID tag/ Mechanical flag indicator	Locking pushbutton/ Bipolar LED/ Removable ID tag/ Mechanical flag indicator
Product certifications	RoHS/UL/CE/CSA	RoHS/UL/CE/CSA	RoHS/UL/CE/CSA	RoHS/UL/CE/CSA

The Eaton logo consists of the word "EATON" in a bold, blue, sans-serif font. The letter "O" is stylized as a white circle with a blue dot in the center, creating a visual effect of a power symbol or a stylized letter.

Powering Business Worldwide

1/16th DIN Hour Meters — Eaton



Cat. No. 7-T-65-4848PM-406

Features

- High shock resistance
- Without reset
- Small dimension
- Magnified figures
- Protection IP65
- Data retention if power is lost
- Long service life
- Optional mounting position

Applications

- General elapsed time
- Service interval for measurement systems —
 - Respiratory ventilators
 - Oxygen machines
 - Dialysis machines
- Small appliances
- UV lamps
- Display panels in cars

Standards and Certifications

- UL Recognized

Technical Data and Specifications

- Electrical Connection: Clamp terminal for cable diameter up to 14 AWG (2.5 mm²), tightening torque max. 0.59 lb-ft (0.8 Nm)
- Power Consumption —
 - 10 – 30V DC: Approx. 500 mW
 - 100 – 130V DC: Approx. 750 mW
- Rated Voltages
 - 100 – 130V AC, 50 or 60 Hz
 - 10 – 30V DC
- On Time: 100%
- Display —
 - 7 at AC: 99999.99
 - 8 at DC: 999999.99
- Accuracy —
 - AC: Supply frequency + 30 mS
 - DC: <0.003% (24 h)
- Count Mode: Adding
- Height of Figures: 0.16 Inch (4 mm)

- Color of Figures: White and Red-on-Black
- Ambient Temperature: 5 to 122°F (-15 to 50°C)
- Mounting Position: Any
- Protection: IP65
- Housing: Plastic
- Weight: 1.7 oz (48 g)
- Operating Indicator of the Running Time Meter —
 - AC: Fast rotating wheel with red dashes
 - DC: 1/100 h display turns continuously by 1-digit in 36 sec.
- Test voltage: 2000V AC, 50 Hz for AC counters
- Options: Further voltages on request
- Color of Housing: Gray

Product Selection

Table 54-66. Product Selection — 1/16th DIN Hour Meters

Description	Catalog Number	Price U.S. \$
Electromechanical Hour Meters		
10 – 30V DC, 1.89 x 1.89 Inch (48 x 48 mm)	8-T-65-4848PM-402	
10 – 30V DC, 1.89 x 1.89 Inch (48 x 48 mm), 50 pc. package	8-T-65-4848PM-40284	
100 – 130V AC, 1.89 x 1.89 Inch (48 x 48 mm)	7-T-65-4848PM-406	
100 – 130V AC, 1.89 x 1.89 Inch (48 x 48 mm), 50 pc. package	7-T-65-4848PM-40684	

Accessory



Cat. No. T4848DINADAPT

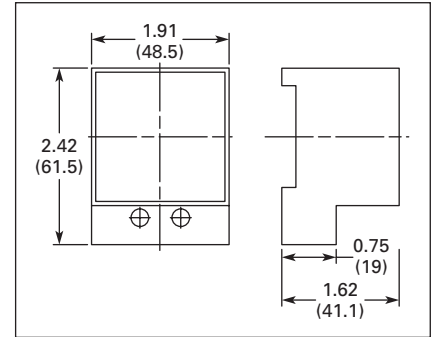


Figure 54-58. DIN Rail Adapter — Approximate Dimensions in Inches (mm)

Table 54-67. Product Selection — DIN Rail Adapter

Description	Catalog Number	Price U.S. \$
DIN Rail Adapter for DIN Electromechanical Hour Meter	T4848DINADAPT	

Dimensions

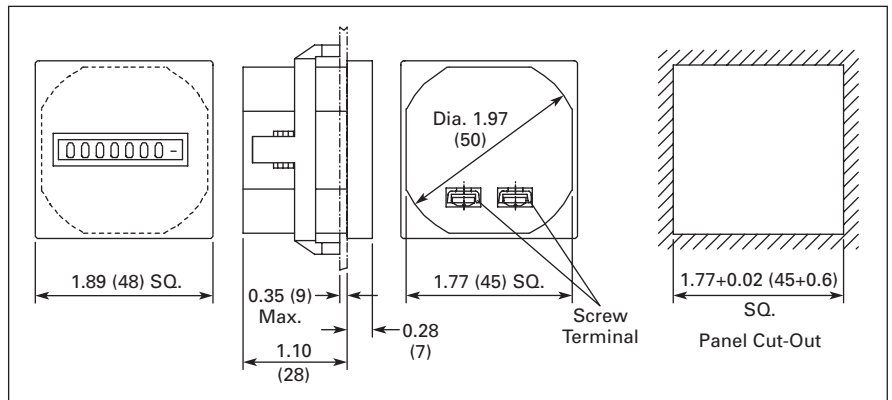
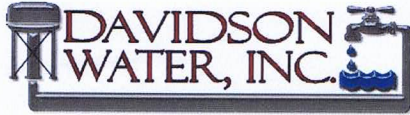


Figure 54-59. 1/16th DIN Hour Meters — Approximate Dimensions in Inches (mm)

APPENDIX C

OWNER-FURNISHED MAIN SWITCHGEAR INFORMATION



DAVIDSON WATER, INC HYATTOWN PUMPING STATION

MAIN SWITCHGEAR, MSWGR
PROCUREMENT

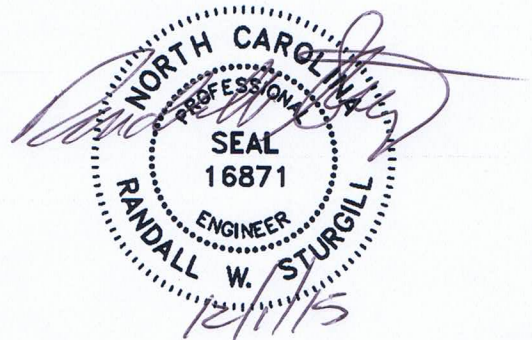
CONTRACT DOCUMENTS & TECHNICAL SPECIFICATIONS

Supplier: _____

Equipment Manufacturer: _____

STURGILL
ENGINEERING
P.A.

One South Main Street
Lexington, NC 27292
Phone: (336) 238-1249
Fax: (336) 236-6393



Hazen

December 1, 2015

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Davidson Water, Inc.
BID REQUEST
Water Treatment Plant Main Switchgear Upgrade
December 1, 2015

Davidson Water, Inc. request a quote/bid for the Main Switchgear, MSWGR to be installed in the Hyatttown Pumping Station under a separate contract.

Informal bids will be received by DAVIDSON WATER, INC., until Friday, December 18, 2015 at 4:30 PM. Bids may be hand-delivered to 7040 Old U.S. Highway 52, Lexington, North Carolina, **faxed** to (336-731-3195), emailed to rwalters@davidsonwater.com or mailed to attention **Robert Walters** 7040 Old U.S. Highway 52, Lexington, North Carolina 27295. Results will be faxed, emailed or mailed after the bids are tabulated. Randall Sturgill – rsturgill@sturgilleng.com, or John Kivett – jkivett@sturgilleng.com (336-238-1249), will answer technical questions.

All equipment shall comply with current NEMA, ANSI, NEC, state and local codes and Davidson Water, Inc. Contract Specifications.

Immediately after receipt of notice to award, the Engineer and the Supplier will establish a mutually agreeable date on which the shop drawings will be reviewed.

MSWGR shall be delivered no later than July 22, 2016.

Each bid should be submitted upon the bid form provided in the Specifications. The method of award will be to the lowest responsible bid.

Davidson Water, Inc. reserves the right to reject any or all proposals.

Robert Walters
Vice-President

Mailing Address
Davidson Water Inc.
P.O. Box 969
Welcome, NC 27374
Lexington (336) 731-2341
Winston-Salem (336) 764-2534
Thomasville (336) 475-8229



Shipping Address
Davidson Water Inc.
7040 Old Highway 52
Lexington, NC 27295
Water Plant (336) 787-5800
Office Fax (336) 731-3195
www.davidsonwater.com
email info@davidsonwater.com

BID SHEET
Hyattown Pumping Station Main Switchgear, MSWGR Procurement

BID DATE: December 18, 2015

MSWGR Cost _____

Supplier/Company Name _____

Contact Name _____

Address _____

Contact Phone # _____

Signed by _____

Title _____

Anticipated Job Award Date: January 4, 2016

MSWGR Delivery Date: July 22, 2016

AGREEMENT FOR SERVICES

Between

DAVIDSON WATER, INC.

And

For

Hyattown Pumping Station Main Switchgear, MSWGR Procurement

THIS AGREEMENT by and between DAVIDSON WATER, INC., 7040 Old U.S. Highway 52, Welcome, North Carolina (hereinafter "Owner") and

_____ . ' .
(hereinafter "Supplier"),

WHEREAS, Owner desires to **purchase a Main Switchgear, MSWGR for the Hyattown Pumping Station** as described in Section 1100 Scope of Work; and,

WHEREAS, Owner desires to engage Supplier to perform the services in order to complete the project as described herein;

NOW, THEREFORE, Owner and Supplier do mutually agree as follows:

ARTICLE I

Description of Project

Owner desires to **purchase a Main Switchgear, MSWGR for the Hyattown Pumping Station.**

ARTICLE II

Items to be provided by Supplier

Supplier shall furnish new **MSWGR** and specified field services after installation by others.

ARTICLE III

Schedule of Performance by Supplier

The equipment to be provided under each this Agreement shall commence as directed by Owner. In the absence of further direction, MSWGR shall be delivered to:

**Davidson Water, Inc.
7040 Old US Highway 52
Lexington, NC 27295**

On or Before:

July 22, 2016

ARTICLE IV
Compensation

For the services rendered under Article II and the project described under Article I, the Supplier shall be compensated as indicated on: **Bid Sheet**

ARTICLE V
Payment for Services

Partial payments shall be made to Supplier as follows:

- After approval of shop drawings 30 percent
- After delivery 60 percent
- After installation by others and start-up 10 percent

Supplier shall submit written statements requesting payment, supplemented or accompanied by such data as may be required by Owner or its engineers or consultants. Owner shall submit such written requests for payment to its Board of Directors for payment approval or disapproval within thirty (30) calendar days after receipt. Upon Board approval of such payment requested by Supplier, payment shall be made by Owner to Supplier within Fifteen (15) calendar days.

If a dispute arises as to payment, the dispute will be reviewed by both parties, and if a resolution cannot be reached, Owner and Supplier agree to submit such dispute to mediation (utilizing a mutually agreed upon mediator certified by and through the Superior Courts of North Carolina) in an attempt to settle the matter prior to the institution of legal action in a court of competent jurisdiction.

ARTICLE VI
Supplier's Personnel and Facilities

The Supplier now has or will secure at its expense, including sub-consultants, all personnel and facilities required to perform the services to be rendered under this Agreement. Such personnel are not employees, nor do they have any contractual relationship with the Owner.

ARTICLE VII
Responsibilities of Owner

It is understood that certain services will be performed and/or furnished by Others. These services include the following:

1. **Owner will take delivery and unload and store MSWGR.**
2. **Installation of MSWGR including wire terminations will be performed by Others under a separate contract. (MSWGR checkout and start-up provided by Supplier)**

ARTICLE VIII
Assignment of Agreement

Neither the Owner nor the Supplier will assign, sublet, or transfer their interest, duties, or obligations under this Agreement without the prior written consent of the other party. Nothing herein shall be construed as creating any personal liability on the part of any officer, director, or agent of any party hereto, nor shall it create any rights or benefits to parties other than the Owner and the Supplier, except such other rights as may be specifically called for herein.

ARTICLE IX
Equal Employment Opportunity

During the performance of this contract, Supplier agrees as follows:

1. The Supplier will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age, handicap, or veteran status. The Supplier will take affirmative action to insure that applicants are employed that employees are treated during employment without regard to race, color, religion, sex, national origin, age, handicap, or veteran status. The Supplier agrees to post in conspicuous places, available to employees and applicants for employment, notices setting for the provisions for this non-discrimination clause.

2. The Supplier will, in solicitations or advertisement for employees placed by or on behalf of the Supplier, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, age, handicap, or veteran status.

3. In the event of Supplier's non-compliance with the non-discrimination clauses of this Agreement or with any such rules, regulations, or order, this Agreement may be cancelled, terminated, or suspended in whole or in part, and the Supplier may be declared ineligible for further owner contracts.

ARTICLE X
Termination of Contract

This Agreement may be terminated by either party upon thirty (30) days' written notice in the event of substantial failure to perform in accordance with the terms hereof by the other party through no fault of the terminating party. If this Agreement is so terminated, the Supplier will be paid for services rendered through the date of such termination, as mutually agreed upon between the parties hereto, provided that all such services to date have been rendered in substantial compliance with the terms of this Agreement.

ARTICLE XI
Standard of Care

Supplier shall perform for or furnish to Owner work and related services in all phases of the project to which this Agreement applies as hereinafter provided. The standard of care for all work and related services performed or furnished by Supplier under this Agreement will be the care and skill ordinarily used by Suppliers working or rendering services under similar conditions at the same time and in the same locality. All work or services performed shall be done in a good and workmanlike manner in accordance with such standard of care. Supplier shall further

have the responsibility of controlling the job site, particularly with respect to implementing procedures for the safety of Supplier's employees, invited guests, as well as establishing safety precautions applicable to the perimeter of the job site for members of the public.

ARTICLE XII
Indemnification

To the fullest extent permitted by law, Supplier shall defend, indemnify and hold harmless Owner, its engineers, agents, employees, officers and board members from and against all claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or relating from the performance of the work described herein provided that any such claims, damage, loss or expense is caused in whole or in part by any negligent act or omission of the Supplier, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by the Owner. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist to any party or person described in this paragraph.

Supplier's indemnification and defense obligations hereunder shall extend to Claims occurring after this Agreement is terminated as well as while it is in force, and shall continue until it is finally adjudicated that any and all actions against the Indemnified Parties for such matters which are indemnified hereunder are fully and finally barred by applicable laws.

ARTICLE XIII
Applicable Law

This Agreement, including but not limited to the interpretation thereof and the rights and remedies of the parties hereunder, shall be governed by the laws of the State of North Carolina. Except as this Agreement otherwise provides, all claims, counterclaims, disputes, and other matters in question between the Owner and Supplier arising out of, or relating to this Agreement or the breach of it, will be decided by resort to a court of competent jurisdiction within the State of North Carolina unless alternate means of dispute resolution are mutually agreed upon by the parties hereto.

ARTICLE XIV
Entire Agreement

This document states the entire agreement between the Owner and Supplier and shall not be modified except in writing and signed by authorized representatives of both parties.

OWNER:
DAVIDSON WATER, INC.

Robert Walters, Vice President (Seal)

SUPPLIER:

Owner (Seal)

NORTH CAROLINA
COUNTY OF DAVIDSON

I, _____, Notary Public, certify that _____ first came before me this day and acknowledged that he is Vice President of Davidson Water, Inc., a corporation, and that he as Vice President being authorized to do so, executed the foregoing on behalf of the corporation.

Witness my hand and notarial seal, this the ____ day of _____, 20__.

My commission expires: _____
Notary Public

NORTH CAROLINA
COUNTY OF _____

I, _____, Notary Public, certify that _____ first came before me this day and acknowledged that he is President of _____, a corporation, and that he as President being authorized to do so, executed the foregoing on behalf of the corporation.

Witness my hand and notarial seal, this the ____ day of _____, 20__.

My commission expires: _____
Notary Public

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 Work Covered By Contract Documents

The work includes furnishing the Main Switchgear, (MSWGR) for the Hyattown Pumping Station. This includes field checkout, testing, and start-up of MSWGR after installation by Others.

1.2 Checkout Testing and Startup

After all equipment installation by Others has been completed to the satisfaction of the Engineer and Owner all equipment has been inspected and certified to be operational by the Supplier, prior to equipment being placed in service.

This startup procedure shall be accomplished in the presence of the Engineer, operating personnel employed by the Owner and, where required or necessary, representatives of the major equipment manufacturers. This period shall be used as the specified instruction period for operating personnel in the proper operation and maintenance of the respective equipment.

The Supplier shall furnish the Owner with keys for all key operated locks, switches, etc. for the project.

All required Operation and Maintenance Manuals shall be submitted to the Engineer prior to startup and operation.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 Related Documents

Drawings and general provisions of the Contract, including Division 1 Specification Sections, apply to this Section.

1.2 Submittal Procedures

1.2.1 Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

- A. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
- B. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
- C. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, Supplier shall submit electronic copies to Engineer with 48 hours' notice. Engineer will return submittals with 48 hours. No extension of Contract Time will be authorized because of failure to transmit submittals to the Engineer sufficiently in advance of the Work to permit processing.

1.2.2 Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

- A. Provide a space approximately 4 by 5 inches on the label or beside the title block on Shop Drawings to record the Supplier's review and approval markings and the action taken.
- B. Include the following information on the label for processing and recording action taken.
 - Project name.
 - Date.
 - Name and address of the Engineer.
 - Name and address of the Supplier.
 - Name of the manufacturer.
 - Number and title of appropriate Specification Section.
 - Drawing number and detail references, as appropriate.

1.2.3 Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Supplier to the Engineer using a transmittal form.

- A. The Engineer will not accept submittals received from sources other than the Supplier.
- B. On the transmittal, note relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including variations and limitations. Include Supplier's certification that information complies with Contract Document requirements.

1.2.4 Supplier's Approval: All submittals shall be thoroughly checked by the Supplier for accuracy and conformance with the Contract Documents before submittal to the Engineer. The submittals must bear the Supplier stamp of approval. Submittals received without the Supplier's stamp of approval will not be reviewed by the Engineer and will be returned to the Supplier.

1.3 Supplier's Schedule

1.3.1 Schedule: Prepare a developed Supplier's schedule. Submit within 15 days after the date established for "Contract Award." Schedule shall include submittal schedule.

1.3.2 Revisions: When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

1.3.3 Schedule Updates: Revise the schedule after each meeting, event, or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.4 Shop Drawings

Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:

- Dimensions.
- Identification of products and materials included by sheet and detail number.
- Compliance with specified standards.
- Notation of coordination requirements.
- Notation of dimensions established by field measurement.
- Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 36 by 48 inches.
- Do not use Shop Drawings without an appropriate final stamp indicating action taken.

1.5 Product Data

Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

- A. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
 - Manufacturer's printed recommendations.
 - Compliance with trade association standards.
 - Compliance with recognized testing agency standards.
 - Application of testing agency labels and seals.
 - Notation of dimensions verified by field measurement.
 - Notation of coordination requirements.
- B. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
- C. Submittals: Submit 4 copies of each required submittal. The Engineer will retain one and will return the other marked with action taken and corrections or modifications required. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
- D. Distribution: Furnish copies of final submittal to installers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
 - Do not proceed with installation until a copy of Product Data is in the Installer's possession.
 - Do not permit use of unmarked copies of Product Data in connection with construction.

1.6 Quality Assurance Submittals

Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements. Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 16.

1.7 Operation and Maintenance Data and Manuals

Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention.

Operation and maintenance manuals are specially prepared for this project.

Operation and maintenance instructions and parts list include standard printed information on manufactured products.

The equipment supplier shall prepare an operation and maintenance manual for each type of equipment indicated in each specification section. Parts lists and operating and maintenance instructions shall be

furnished for other equipment which does not require full manuals.

Operation and Maintenance Manuals shall include the following:

- Equipment function, normal operating characteristics and limiting conditions.
- Assembly, installation, alignment, adjustment and checking instructions.
- Operating instructions for startup, routine and normal operation, regulation and control, shutdown and emergency conditions.
- Lubrication and maintenance instructions.
- Guide to "troubleshooting".
- Parts lists and predicted life of parts subject to wear.
- Outline, cross section and assembly drawings, engineering data and wiring diagrams.
- Test data and performance curves, where applicable.
- Computer disks of tables, drawings, etc. included in manual, if available.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Supplier.

Manuals and other data shall be printed on heavy, first quality paper, 8-1/2 by 11 inch size with standard 3-hole punching. Drawings and diagrams shall be reduced to 8-1/2 by 11 inches or 11 by 17 inches. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes which are bound into the manuals. Each envelope shall bear suitable identification on the outside.

One (1) preliminary manual shall be submitted no less than 30 days prior to equipment start-up for review. Four (4) final hard copies of each operation maintenance manual shall be submitted to Engineer not less than 2 weeks prior to the date of start-up of the equipment. Manuals, and all other parts lists and information, shall be bound in heavy binder notebooks bearing suitable identification. A table of contents and index tabs shall be furnished for all volumes containing data for three or more items of equipment. Two (2) electronic copies shall be provided on CD or DVD.

Three (3) copies of standard operation and maintenance instructions and parts lists shall be submitted for equipment not listed, where applicable or where required by the Engineer. These manuals shall be supplied prior to the date of shipment of the equipment.

All material shall be marked with Project identification, and inapplicable information shall be marked out or deleted.

Shipment of equipment will not be considered complete until all required manuals and data have been received. Engineer may withhold payment for equipment until manuals are received.

1.8 Record Drawings

Supplier shall keep one Record Set of all specifications, drawings, addenda, modifications and shop drawings at the site in good order and annotated to show all changes made during the construction process. The set shall be kept current, and the Engineer may inspect the Record Set at progress or pay request meetings. These shall be available to the Engineer and shall be delivered to the Engineer upon completion of the project.

Complete record drawings shall be submitted to the Engineer and then approved by the Engineer before final payment is approved. Annotations on the drawings shall include installed lengths, sizes and types of materials, locations, etc. Pipelines shall be measured from the edge of pavement at regular intervals. Underground manholes, vaults, valves, etc. shall be dimensioned from at least two permanent features (power poles, intersections, paved roads, corners, fences, etc.) For plant and electrical work, annotations on the drawings shall include any approved deviation from the contract drawings.

1.9 Engineer's Action

Except for submittals for the record or information, where action and return is required, the Engineer will review each submittal, mark to indicate action taken, and return promptly. Compliance with specified characteristics is the Supplier's responsibility.

Action Stamp:

The Engineer will stamp each submittal with a uniform action stamp. The Engineer will mark the stamp appropriately to indicate the action taken, as follows:

- A. Final Unrestricted Release: When marked "NO EXCEPTIONS," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
- B. Final-But-Restricted Release: When marked "EXCEPTIONS NOTED" the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
- C. Returned for Resubmittals: When marked "REVISE AND RESUBMIT" do not proceed with work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark. Do not use, or allow others to use, submittals marked "Revise and Resubmit".
- D. Rejected and not allowed: When marked "NOT APPROVED" do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Prepare a new submittal according to the notations and in compliance with the Contract Documents; resubmit without delay. Do not use, or allow others to use, any submittals marked "Not Approved" in any fashion.

Unsolicited Submittals:

The Engineer will return unsolicited submittals to the sender without action.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01700
CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 Related Documents

Drawings and general provisions of the Contract and Division 1 Specification Sections, apply to this Section.

1.2 Summary

This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:

- Startup
- Project record document submittal.
- Submittal of warranties.

1.3 Substantial Completion

1.3.1 Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

- A. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
 - Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
- B. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents. Warranty period shall be 30 months from delivery of equipment. Date of startup is estimated to be in March, 2017.
- C. Submit record drawings, maintenance manuals, and similar final record information.
- D. Deliver tools, spare parts, extra stock, and similar items.
- E. Make final changeover of permanent locks and transmit keys to the Owner.
- F. Complete startup testing of systems and instruction of the Owner's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with construction tools, and similar elements.
- G. Complete all electrical and control panel labeling, place schematics inside MSWGR as required.

1.3.2 On receipt of a request for inspection, the Engineer will either proceed with inspection or advise the

Supplier of unfilled requirements. The Engineer will prepare the Certificate of Substantial Completion following inspection or advise the Supplier of construction that must be completed or corrected before the certificate will be issued.

- A. The Engineer will repeat inspection when requested and assured that the Work is substantially complete.
- B. Results of the completed inspection will form the basis of requirements for final acceptance.

1.4 Final Acceptance

1.4.1 Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

- A. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
- B. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
- C. Submit a certified copy of the Engineer's final inspection list of items to be completed or corrected, endorsed and dated by the Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by the Engineer.
- D. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

1.4.2 The Engineer will re-inspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the Engineer.

- A. Upon completion of re-inspection, the Engineer will prepare a certificate of final acceptance. If the Work is incomplete, the Engineer will advise the Supplier of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
- B. If necessary, re-inspection will be repeated.

1.5 Record Document Submittal

1.5.1 Supplier shall modify shop drawings as marked by installing Contractor.

1.5.2 Record document shall be included in O & M.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 16492

480V MAIN SWITCHGEAR, MSWGR

PART 1 GENERAL

1.1 Scope

The following specifications cover the requirements for providing a complete lineup of freestanding assemblies containing circuit breakers, instrumentation, and control devices for plant power distribution and emergency generator control as indicated on the drawings. Components shall be provided for a complete and operable system.

Main switchgear shall be 480/277 Vac, 3 phase, 4 wire.

The switchgear assembly shall be arranged for fully automatic or manual operation at the discretion of the operator. Each section shall be complete and include the necessary AC instrumentation, relaying, voltage regulator equipment, generator control equipment, engine governor controls, pilot lights, selector switches, relay setup and coordination, etc., and accessories, as indicated on the contract drawings and as specified hereinafter.

All control voltage for auxiliary relays, circuit breakers, synchronizing and other automatic equipment shall be obtained from the emergency generators, existing engine starting batteries, and the new station battery.

The switchgear is to be assembled using ANSI and 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.

1.2 Applicable Standards

The generator control and distribution switchgear covered by these specifications shall be designed, tested and assembled in strict accordance with all applicable standards of NEC, ANSI, UL, IEEE and NEMA.

To provide for unit responsibility each individual section of the switchgear lineup, including modifications to the engine generator control sections, master synchronizing control sections, and distribution breaker sections, with all internal components mounted, shall be 1listed and labeled under the control manufacturer's name at the time of the proposal opening. Manufacturers not listed and labeled by UL under circuit breakers at the time of proposal opening, shall not be acceptable.

1.3 Shop Drawings

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.

Shop drawings for each switchgear assembly shall include but not be limited to:

- A. Equipment specifications and product data sheets identifying all electrical ratings and all materials used.
- B. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.
- C. Weights of all component parts, assembled weight of unit, and approximate total shipping weight.
- D. Example equipment nameplate data sheet.
- E. Plan, front and side view drawings, including overall dimensions of each switchgear assembly. Identify shipping splits and show conduit entry/exit area locations on the drawings.
- F. Internal wiring diagram of each switchgear section and each generator control section. Each wiring diagram shall include wire identification and terminal numbers. Internal wiring diagrams of each low voltage metering compartment including wiring identification and terminal numbers.
- G. Internal section-to-section interconnection wiring diagrams including wiring identification and terminal numbers.
- H. Complete one-line diagram of the switchgear line-up and complete three line diagrams for each switchgear section. These drawings shall indicate devices comprising the switchgear assembly

including, but not limited to, circuit breakers, control power and instrument transformers, meters, protective relays, and control devices. Clearly indicate the electrical ratings of all devices.

- I. Bill of material list for each switchgear assembly including each switchgear cell.
- J. Nameplate schedule for each cell.
- K. Manufacturer's installation instructions.
- L. Manufacturer's standard warranty.
- M. Cable terminal sizes
- N. DC battery system sizing calculations.

1.4 Operations and Maintenance Manuals

The Contractor shall submit three (3) operation and maintenance manuals. The manual shall include:

- A. Instruction books, descriptive bulletins, technical bulletins, application data booklets, operational sequence descriptions, troubleshooting aids, and other applicable instructional information.
- B. Recommended spare parts list.
- C. Final as-built construction drawings for MSWGR included in the shop drawings incorporating all changes made in the manufacturing process.

1.5 Tools, Supplies, And Spare Parts

The switchgear shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment and all spare parts as recommended by the equipment manufacturer.

The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designing the contents and the pieces of equipment for which they are intended.

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.

Spare parts lists, included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished.

Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. A separate number shall properly identify each part. Those parts that are identical for more than one size shall have the same part number.

1.6 Identification

Each new switchgear assembly shall be identified. A nameplate shall be securely affixed in a conspicuous place on each section. Individual components shall be identified for maintenance and operation.

1.7 Training

The Supplier shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained representative(s) who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section. A minimum of 1 day shall be provided in addition to startup services.

PART 2 PRODUCTS

2.1 General

Switchgear shall be suitable for use in accordance with Underwriters Laboratories requirements. Each complete assembly including each circuit breaker shall bear a UL label.

The switchgear described in this specification shall be designed for operation on a 480/277 V, three-phase, four wire, solidly grounded 60-hertz system.

2.2 Ratings

Nominal voltage rating shall be 480/277 V. The entire assembly shall be suitable for 600 volts maximum AC service.

Rate complete switchgear assembly to withstand mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault of 65,000 amperes.

The main bus shall be rated 2,500 amperes.

Switchgear assembly shall be suitable and rated for indoor construction.

2.3 Control Wiring And Testing

Wire and factory test switchgear to satisfy the requirements of the operation specified and required.

Switchgear secondary wiring shall be NEC Type SIS, single-conductor, stranded copper, rated 600 volts, 90°C bundled and secured with nylon ties. Provide flexible stranding for swinging doors and panels. Minimum wire size shall be No. 14 AWG for voltage transformer and control circuits. For current transformer circuits, minimum wire size shall be No. 12 AWG. Number 10 AWG or larger wire shall be used to decrease resistance as required.

Route outgoing control wires for outgoing or "cell-to-cell" interconnecting wiring to the master terminal blocks with suitable numbering strips numbered in agreement with the manufacturer's detailed wiring diagrams.

Terminate control wiring in molded terminal blocks acceptable to Engineer. Provide a minimum of 10 percent (10%) spare terminal blocks for each circuit breaker and auxiliary compartment. Compression type terminal blocks are not acceptable. Terminal blocks shall be States Company sliding link Type NT or as accepted by Engineer.

Number wiring with shrink-type tag devices at both ends consistent with the manufacturer's detailed wiring diagrams. Duplication of wire numbers and terminal block numbers is not acceptable.

One control circuit cut-out device shall be furnished in current breaker housings.

2.4 Instruments, Meters, Protective Relays And Control Devices

The switchgear manufacturer shall furnish and install the switchgear instruments, meters, protective relays, and control devices complete with devices and associated circuitry necessary to perform the required functions specified herein and indicated on the drawings. Manufacturers of relays and controls are listed to describe system operating requirements. Other manufacturers will be considered where equivalent protective relay operating characteristics can be provided as accepted by the Engineer and Owner. Any material not specifically listed or indicated but necessary to perform required functions shall be furnished.

Mount instruments and relays on the hinged doors secured to the stationary structure. Devices shall have enclosing cases, dull black finish, and mounted semi-flush.

Panel mounted protective relays shall be switchgear type and provided with testing facilities.

Instrument and control switches shall be rotary operated type with means for maintaining contact position. Contacts shall be silver-to-silver, enclosed in easily removable protective covers. Provide indicating lights for circuit breakers with low voltage indicating lamps. Lamps shall be easily removable from front of panel and shall be LED type. Indicating lights shall be NEMA rated 30 mm with chrome bezel. Switches shall be as manufactured by Electro-Switch, Inc., General Electric Company, or equal.

Furnish wiring, potential bus, necessary fuses, and terminal blocks within each cell.

Requirements for items mounted on hinged doors or panels are as follows:

Semi-flush mounting unless otherwise noted.

Items specified as draw-out case type shall be removable-chassis construction providing for removal of the relay from the case without disconnecting the leads or removing the case from the panel. The associated current-transformer secondary shall automatically short-circuit at the case when the relay is removed from its case. Furnish built-in test facilities and visible self-aligning contacts.

Terminal blocks, wireways, wiring, device mounting brackets, and other miscellaneous items shall be provided as required.

2.5 Nameplates

Provide engraved plastic nameplates to identify switchgear units, door mounted devices, and internal components.

Nameplates shall be specified in Section 16000. Nameplates shall be engraved with the circuit number and the circuit name as indicated on the drawings.

Label the switchgear per the requirements of NEC and ANSI C37.20.2.

Provide a master nameplate giving switchgear designations, voltage-ampere rating, short circuit rating, manufacturer's name, general order number and item number to be mounted on front of switchgear.

Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.6 Bus

Buses and main connections shall consist of flat copper bars.

The main bus shall be dipped to be fully insulated for its entire length for, except provide removable, insulation boots at bus joints.

The bus shall be braced to withstand fault currents equal to the close and latch (momentary) rating of circuit breakers.

Bus supports between units shall be flame-retardant, track-resistant glass polyester. Bus joints shall be silver-plated and bolted bus joints shall use constant pressure washers for positive contact.

An uninsulated ground bus of adequate capacity shall be furnished and installed throughout the switchgear structure. Each stationary unit shall be effectively connected to this ground bus. A substantial ground contact shall be provided between each breaker and removable element and the ground bus, which shall automatically be made before the primary contacts touch. Contact engagement to the ground bus shall be maintained in the CONNECTED and TEST positions. The ground bus shall be tin-plated copper bar. Ground housing directly to this bus.

Ground relay panels with a No. 6 AWG (minimum) insulated copper wire to the ground bus. All main and ground busses shall be extended through the entire length of the switchgear assembly. All busses shall have provisions for future extension.

2.7 Miscellaneous Equipment

Door-mounted circuit breaker pistol grip control switch with red (closed) and green (open) indicating lights to indicate breaker contact position.

Top and/or bottom entries for power cable entry as required and as indicated on the Drawings.

Ground bus extending the full length of the switchgear. Provide lugs at each end of the bus for ground cable terminations.

Auxiliary contacts, auxiliary relays, and interposing contactors as required to provide remote interlocking and indicating functions specified herein and indicated on the Drawings. Provide spare normally open and 2 spare normally closed contacts per auxiliary relay, contactor, and similar equipment.

Switchgear shall be furnished complete with fused, thermostatically controlled space heaters. One space heater shall be installed in each vertical structure. Utilize tubular type operated at half voltage for long life; 250 volt rated heaters at 120 volt. Provide power supplies to the space heaters shall be as specified herein and indicated on the Drawings. The Contractor shall wire heaters to provide temporary heating during storage.

Each lineup shall contain a graphic one line on the main control section indicating circuit breaker status.

Each lineup section shall have internal LED lighting for visibility throughout fed from same source as the heaters.

2.8 Warning Signs

Provide a minimum of two (2) warning signs on the front of the switchgear lineup and two (2) on the back.

Red laminated plastic engraved with white letters approximately ½ inch high.

Signs shall read "DANGER HIGH VOLTAGE"

2.9 Transient Voltage Surge Suppression

TVSS at the main power entrance for each SWBD shall be suitable for use on a 480Y/277V 3-phase 4-wire grounded wye system. Maximum Suppressed Voltage Rating (SVR) per UL1449 2nd Edition shall not exceed 800 volts for L-N, N-G, & L-G and 1500 volts for L-L. The TVSS shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage. The total surge current based on an 8 x 20 microsecond waveform that the device is capable of surviving shall not be less than 250kA per mode.

2.9.1 General Requirements:

- A. Minimum life shall be 2000 current surges of 5,000 amperes on a 10 x 20 microsecond wave shape, and the subsequent power-follow current, per mode.
- B. TVSS shall be integral to the SWBD, listed for installation in the SWBD, and connected through a disconnecting means to the bus. Overcurrent protection shall be as recommended by the manufacturer.
- C. TVSS shall have visual and audible status indication plus form "C" relay contacts that change state when the TVSS has been damaged or is no longer providing protection.
- D. TVSS shall be UL1449 Second Edition listed.
- E. Transient Voltage Surge Suppression shall be GE Tranquell, Sq-D Surgelologic, Siemens TPS, Cutler-Hammer Visor Series, or equal.

2.10 Accessories

Switchgear accessories shall be provided by the switchgear manufacturer for test, inspection, maintenance, and operation as follows:

- One (1) maintenance tool for manual charging the breaker closing spring and manually opening the shutter
- One (1) levering crank for moving the breaker between the TEST and CONNECTED positions
- One (1) test jumper for electrically operating the breaker while out of its cell
- One (1) breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails
- One (1) set of rail extensions and rail clamps
- One (1) portable lifting device for lifting the breaker on or off the rails
- One (1) transport dolly for moving breaker about outside its compartment
- One (1) ramp for rolling breaker directly onto the floor.
- One (1) test cabinet for testing electrically operated breakers outside the cell
- Secondary couplers for operating a power circuit breaker in the DISCONNECTED position.
- Test plugs for draw-out relays and meters.
- Shorting type terminal blocks for all CT connections accessible from the front (test blocks).

2.11 Finish

The switchgear finish shall consist of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray. Prior to shipment, the complete assemblies, indoor as well as outdoor, shall be given 1.5 to 2.0 mil thick exterior finish spray coat of air drying high-gloss gray enamel.

2.12 Instruments, Sensors, Miscellaneous Equipment

2.12.1 Operator Interface Terminal (OIT):

The operator interface shall display system status, alarms, alarm history, and allow operator input as indicated on the drawings as specified herein. Display shall meet the following requirements:

- A. Touch screen display, 200 touch cells (minimum).
- B. VGA 640 X 480 pixel resolution (minimum).
- C. 15" diagonal active matrix (minimum), color display.
- D. Automatic screen saver function with configurable delay.
- E. Communication protocol compatible with PLC selected.

Operator Interface Touch Screen shall be Allen Bradley PanelView 1000 or equivalent.

2.12.2 Control Switches: Heavy-duty, rotary switchgear type, rated 30 ampere at 600VAC.

2.12.3 Current Transformers: Ring type current transformers shall be furnished as specific herein and indicated on the Drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Current ratio shall be as indicated on the Drawings. Multi-tap primary transformers shall be provided as indicated on the Drawings. Transformers shall be rated in accordance with ANSI Standard C57.13 with accuracy of the current transformers suitable for B.5 metering accuracy at rated burden. The current transformers shall be capable of carrying rated burden. The current transformers shall be sized for the necessary burden for the required devices, minimum. Identify the current transformers for polarity with standard marking or symbols. The transformers shall be capable of carrying rated primary current continuously without damage. Secondary wiring from current transformers shall be routed in suitable wiring trough or conduit to proper short-circuiting type terminal blocks for connection to protective relays, instruments, and other devices. Locate the current transformers on the bus side and line side of the current breaker units to be front accessible to permit adding or changing of transformers. 5.0 ampere secondary, wound type, with single secondary winding and primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

2.12.4 Potential Transformers: Voltage transformers shall be indoor dry type, single-phase, 60 hertz. Voltage transformers shall have an accuracy classification determined according to ANSI Standards. The voltage transformers shall be suitable for metering accuracy, the burden to be served for the required devices plus 20 percent, and shall meet the following minimum requirements:

- A. Primary Voltage: 480 V or 288 V (per drawings)
- B. Secondary Voltage: 120 volts
- C. Metering Accuracy Class: 0.3 at rated burden

Identify polarity with standard markings or symbols. Connect secondary to voltage buses as required. Protect voltage transformers with primary and secondary fuses. Protect the primary side with current-limiting fuses.

2.12.5 Control Power Transformers: Provide control power transformers (CPT) as specified herein, indicated on the Drawings, and as required. Furnish control power transformers that have adequate capacity for the load to be served plus 25%.

Control power transformers shall be protected with current limiting fuses on primary and molded case circuit breaker on secondary. Control power transformers for space heaters, lighting, receptacles and other ancillary loads shall be separate from those used for control circuits.

Control power transformers shall be mounted inside of lineup easily accessible from front doors to permit easy inspection, testing, and fuse replacement.

2.13 Main & Generator Circuit Breakers (52-U, 52-G1, & 52-G2)

Shall be molded case breakers covered under UL 489.

Shall include zone selective interlocking system

Each draw-out circuit breaker shall be capable of being withdrawn on rails and shall be enclosed in a separate metal compartment. The breakers shall be operated by a motor-charged stored spring mechanism, charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts shall be silver-plated copper. When circuit breaker is closed, it will always have ability to trip.

Circuit breakers shall have the following minimum ratings and features:

- A. Nominal voltage: 480 V
- B. Maximum voltage: 600 V
- C. Continuous current: As indicated
- D. Short circuit current 65,000 amperes

Circuit breakers of equal rating shall be completely interchangeable.

Equip each circuit breaker with silver-plated secondary disconnecting contacts to automatically engage in the CONNECTED position and manually engaged in the TEST position to complete circuits as required.

Provide a means for racking the circuit breaker in and out of the cell and between positions. Provide a means for holding the circuit breaker in the cell in all positions. Include a provision for padlocking open to prevent manual or electric closure of the circuit breaker.

Provide interlocking to prevent a closed circuit breaker from racking to or from any position. Provide an additional interlock to assure automatic discharging of the closing springs upon insertion or removal of the breaker into or out of the cell.

A TEST position for each circuit breaker shall be provided and so interlocked to insure proper sequence and safe operation.

Each circuit breaker shall be provided with "a" and "b" auxiliary contacts which will open or close when the breaker is open or closed. Each breaker shall also be provided with an alarm switch or contact to indicate that the breaker has tripped. All of these contacts shall be wired to terminals in each cell for use in indicating breaker status. Each circuit breaker shall be furnished with enough auxiliary contacts to indicate breaker position as required for this Contract.

The circuit breakers shall be electrically operated by 120Vac charge/close and 24 volt DC trip. The control voltage shall be derived from the DC control voltage system specified herein and indicated on the Drawings.

Circuit breakers shall provide arc flash reduction.

Circuit breakers shall be as manufactured by General Electric, Eaton/Cutler-Hammer, Square D or approved equal.

2.14 MCC1 and MCC2 Feeder Circuit Breakers

Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall be Eaton, General Electric, Square D or approved equal.

Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

Circuit breakers shall have a minimum symmetrical interrupting capacity of 65 KAIC at 480Vac.

Circuit breakers shall have microprocessor-based rms sensing trip units.

Each molded case circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use Microprocessor-based technology to provide the adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing

the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.

Interchangeable ratings plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed or adjustable as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

- A. Adjustable long-time setting (set by adjusting the trip setting dial or rating plug)
- B. Adjustable short-time setting and delay with selective curve shaping
- C. Adjustable instantaneous setting
- D. Adjustable ground fault setting and delay

The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override.

Where internal ground fault protection is specified, adjustable settings shall not exceed 1200 amperes. Provide neutral ground fault sensor for four-wire loads.

Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.

2.15 Automatic Synchronizer

All circuitry shall be housed in a rugged semi-dust-tight enclosure, suitable for switchboard mounting. The synchronizer shall contain all control adjustments and input output terminals legibly marked. The inputs shall consist of 120 volt, AC, nominal, 60 Hertz signals from the selected power sources. A separate terminal shall be provided to ground the enclosure.

2.16 Multifunction Relay

Drawout circuit breaker cells shall be furnished with a door mounted draw-out, multi-function microprocessor based protective relay. The device shall be true RMS sensing of each phase and ground. The unit shall be operational from a 24 volt DC control power source. The relay shall provide the following minimum protection and metering functions:

Device ID	Function
27	Bus/Line Overvoltage
32	Reverse Power (52-U & 52-G1 & 52-G2 Circuit Breakers)
47	Negative Sequence Voltage
50	Phase/Neutral/Ground Instantaneous Overcurrent
51	Phase/Neutral/Ground Time Overcurrent
59	Bus Overvoltage
67	Phase/Ground Directional Control
81	Bus Underfrequency
25	Synchrocheck
81	Overfrequency

The relay shall be provided with complete monitoring and metering functions that include, but are not limited to the following:

- A. Actual V, A, Hz, W, KWh, KVar, KVA, and Pf
- B. Line (Synchro) Voltage: RMS voltage, frequency and differentials
- C. Analog Input
- D. Real-time and peak demand for A, KW, Kvar, and KVA

Relays shall provide timed directional overcurrent in two directions.

The device shall also be furnished with a minimum of one RS-232 port and one (1) RS-485 port and (1) Ethernet port. Relay shall communicate with selected PLC.

The device shall be as manufactured by General Electric, Schweitzer, Basler, Beckwith, Eaton or equal.

The switchgear manufacturer shall interconnect the protective relays via their respective serial communications ports. Data shall be communicated to master PLC.

2.17 Nameplates

Nameplates shall be laminated plastic, and attached with bolts. Characters shall be white engraved on a black background.

2.18 Main Switchgear Programmable Controllers

(1) GE Fanuc, Modicon, or Allen-Bradley programmable controller with complete back-up power supply, chassis, and input and output cards for system control. In addition, PLC shall communicate via an Ethernet TCP/IP connection to the Water Plant SCADA system.

The entire system will be controlled by a new PLC. PLC programming for system operation shall be the responsibility of the switchgear manufacturer. The PLC will monitor loss of utility via inputs from the utility feeder relay.

A password protected Operator Interface Terminal (OIT) shall be provided on the master control cubicle door for each PLC. This Operator Interface Terminal shall allow the operator access to the PLC control without having to implement software changes. The Operator Interface Terminal can be used to initiate and/or change all timer settings, load demand and load control set points, and load demand engine sequence positions for two (2) generators. If an engine is locked out, a lockout alarm indicator will flash for the respective generator. Hand held PLC programmers and/or laptop computers to make timer settings, are not acceptable. (Only one generator will be installed initially).

2.19 Existing Engine Generator Assembly Data

- A. Caterpillar 3512 engine, 1800 RPM, 51.8L, electronic timing. Conforms to 2006 U.S.EPA regulations
- B. MFG 2006, 1875 kVA, 1500 kW 0.8 PF, 60 hz, STANDBY rating
- C. 3-phase, 480volts 2255 amps 6 wire wye
- D. Excitation 29 volts, 7.6 amps
- E. 697 Frame
- F. Maximum temperature rise 130 degrees C by resistance, 40 degrees C ambient, 1000 meters altitude.
- G. Class H insulation
- H. MODEL NUMBER 3512C, Product identification number CAT3512CASBG00187
- I. GENERATOR MODEL SR4B-GD, SERIAL NUMBER G6J00180
- J. Arrangement number 262-8100

PART 3 SYSTEM OPERATION

3.1 Operational Overview

All system operation and control functions shall be coordinated and integrated such that during automatic and/or manual operation, no unsafe condition shall occur, no malfunction of intended operation shall occur, and the highest possible reliability of operation shall be maintained. The following descriptions indicate general control requirements. Supplier shall coordinate exact requirements with the Owner and Engineer prior to installation. Minor modifications to strategies shall be provided as directed by Owner and Engineer.

System operations shall be initiated locally at the main switchgear or remotely through the Plant SCADA system and/or Duke Energy load shed system. Automatic and manual synchronization shall be provided for each generator feed. Necessary interlocks shall be provided as required to provide a safe and reliable system.

Supplier shall coordinate and integrate the functions and circuitry of all selector switches to ensure that the various settings available do not cause a malfunction of the intended system operation. Unless otherwise noted, switches shall be a part operator interface touch screen.

The MSWGR operator interface terminal (OIT) shall be provided with the following software switches (minimum):

- A. Transfer Mode Switch: Switch shall allow selection of closed or open transition return on utility failure.
- B. Generator Mode Switch: Switch shall allow selection of Generator 1, Generator 2 or Auto for unit to operate. "Generator 1" selection will allow only Generator 1 to operate, "Generator 2" will allow only Generator 2 to operate, and "Auto" allow PLC to select unit to operate. PLC selection will be based on unit closed to the latest system power demand.
- C. 480Vac Service No.1/ 480Vac Service No. 2 Switch: Switch to select transformer feeding the 480VAC switchgear.
- D. Engine Generator Selector Switch: Each generator shall be provided a software four-position engine selector switch labeled, "Lockout/Reset-Off-Auto-Run". When in the "Lockout/Reset" position, the generating systems shall be locked out. Whenever the switch is placed in the "lockout/reset" position while the engine generator is operating, it will immediately shut down and its circuit breaker will trip.

An "Off" position shall be provided to allow a normal shutdown, with a time delay to allow the engine to cool after operating under load. Whenever the engine switch is placed in the "Off" position while the engine is operating, the generator circuit breaker will trip, but the engine will continue to operate until the expiration of time delay setting of the idle relay.

When the switch is placed in the "Auto" position, the engine generator shall be on standby and shall start whenever an engine start signal is received from the automatic transfer system. When the utility power returns, and the transfer system signals the engine generator to shut down, the circuit breaker will be tripped, and the engine will continue to operate for the idle time delay period before shutting down in readiness for the next power failure.

When the engine selector switch is in the "Run" position, the engine will start and come up to speed. It will continue to run until the switch is returned to "off" or "lockout/reset" position. This position is to be used for testing or for manual operation.

- A. Normal-No Load Test Switch: Provide a two-position test switch labeled "Load Test-Normal" in the generator master control section to permit operation and testing as follows:
- B. When the switch is placed in the "Test" position, automatic start of the generators shall occur and all automatic synchronizing and transfer functions shall operate as described in the following sections.
- C. Returning the switch to the "Normal" position shall open the generator circuit breakers and initiate the cool down cycle of the engine generators, and restore all equipment to normal operation.
- D. Master "Manual-Auto" Control Switch (Two-Position): Whenever the master "Manual-Auto" switch is placed in the "Manual" position, the engine generator power circuit breakers and synchronizing shall be operated manually.

- E. Open-Close-Auto switch for the MSWGR breakers. In Auto, circuit breakers are controlled by system logic as described in the following paragraphs.

Normal system operation shall be the following:

- A. Utility Feed circuit breaker 52-U is closed.
- B. MSWGR Breaker 52-MCC1 is closed.
- C. Generator 52-G1 circuit breaker is open.
- D. Generator 52-G2 circuit breaker is open.

Loss of Utility Sequence (Closed Transition Return): Provide interconnecting control circuits and programming to produce the following operating function when the utility power is lost and the "Transfer Mode Selector Switch" is in the "Closed Transition" mode:

- A. Initiate an adjustable time delay of 0-5 minutes.
- B. Upon expiration of the time delay, open the utility breaker 52-U. Open MSWGR feeder breaker 52-MCC1.
- C. When 52-MCC1 feeder breaker is confirmed open, initiate an automatic start sequence (see below).
- D. After the required engine generator(s) are connected to the MSWGR bus plus a 0 – 3 mins adjustable time delay, close 52-MCC1 breaker.
- E. Monitor plant demand and start additional generator and synchronize if necessary
- F. Upon restoration of utility supply voltage, and after an adjustable period of time (0-60 minutes), the engine generator system shall synchronize with the utility power source, close the utility breaker 52-U, transfer the load gradually to the utility source, and open the generator breaker 52-G1 or 52-G2), providing a no-break (closed transition), soft load transfer, to the utility source.
- G. After the load has been transferred to the utility source, the engine generator(s) shall continue to run at no load for an adjustable cool down period of time from 0-50 minutes before complete shutdown.

Loss of Utility Sequence (Open Transition Return): Provide interconnecting control circuits to produce the following normal operating function when the utility power is lost and the "Transfer Mode Selector Switch" is in the "Open Transition" mode:

- A. Initiate an adjustable time delay of 0-5 minutes.
- B. Upon expiration of the time delay, open the utility breaker 52-U. Open feeder breaker 52-MCC1.
- C. When feeder breaker 52-MCC1 is confirmed open, initiate an automatic start sequence (see below).
- D. After the required engine generator(s) (52-G1 and/or 52-G2) are connected to the MSWGR bus plus a 0 – 3 mins adjustable time delay, close feeder breaker 52-MCC1.
- E. Upon restoration of utility supply voltage, and after an adjustable period of time (0-60 minutes), the generator breaker(s) (52-G1 and/or 52-G2) shall open and, after an adjustable time delay of 0-3 mins, the utility main breaker 52-U shall close, providing a break-before-make (open transition), transfer to the utility source.
- F. After the load has been transferred to the utility source, the engine generator(s) shall continue to run at no load for an adjustable cool down period of time from 0-50 minutes before complete shutdown.

Load Test Sequence (Actual Plant Loads) - Closed Transition Load Assumption and Return: Provide interconnecting control circuits to produce the following normal operation functions when the "Test/Normal" switch is selected to the "Load Test" position, and the "Transfer Mode Selector Switch" is in the "Closed Transition" mode.

- A. Initiate an automatic start sequence.
- B. The generator shall be brought into synchronism with the utility and the generator breaker (52-G1 or 52-G2) shall close (closed transition) and parallel the utility and generator sources.
- C. The engine generators shall be gradually loaded until they have assumed the entire power requirements of the system load under test. The utility main breaker shall remain closed. This process shall occur in approximately 10-15 seconds. The generator control system shall regulate the output power of the engine generators so they never exceed the actual plant loads (to prevent a reverse power situation where generator power is fed into the utility system).
- D. If power failures occur while in this condition, the emergency system will continue to operate the system loads on generators.
- E. When the "Test/Normal" switch is returned to the "Normal position after a power failure has occurred and the generators are supplying the load, the system will revert to the automatic loss of utility sequence described above.
- F. When the "Test Normal" switch is returned to the "Normal" position, and a power failure has not occurred, the engine generator shall remained synchronized with the utility power source and gradually transfer the load back to the utility source, and open the main generator breaker (52-G1 or 52-G2) (closed transition).
- G. The engine generators shall continue to run at no load for an adjustable cool down period of time from 0-50 minutes before complete shutdown.

Load Test Sequence (Actual Plant Load) - Open Transition Load Assumption and Return: Provide interconnecting control circuits to produce the following normal operating function when the "Test/Normal" switch is selected to the "Load Test" position, and when the "Transfer Mode Selector Switch" is in the "Open Transition" mode.

- A. Initiate an automatic start sequence.
- B. After a pre-determined number of engine generators are closed to the bus, the standby system shall be capable of assuming bus load.
- C. With the engine generators able to assume the entire power requirements of the load bus under test, the main utility breaker 52-U and MSWGR feeder breaker 52-MCC1 shall open and, after an adjustable time delay of 0 to 30 seconds, the generator breaker(s) (52-G1 and/r 52-G2) shall close (open transition).
- D. After a 0 – 3 mins adjustable time delay, close feeder breaker 52-MCC1.
- E. If a power failure occurs while in this condition, the emergency system will continue to operate the system load on generators.
- F. When the "Test/Normal" switch is returned to the "Normal" position after a power failure has occurred and the generators are supplying the load, the system shall revert to the automatic loss of utility sequence as described above.
- G. When the "Test/Normal" switch is returned to the "Normal" position, and a power failure has not occurred, the main generator breaker(s) (52-G1 and/or 52-G2) shall open and, after an adjustable time delay of 0 to 3 mins, the main utility breaker 52-U shall close, providing a break-before-make (open transition) transfer to the utility source.
- H. After the load has been transferred back to the utility, the individual engine generator breakers shall open the engine generators shall continue to run no load for an adjustable cool down period of time from 0-50 minutes before complete shutdown.

Automatic Start/Stop Sequence: Provide interconnecting control circuits and programming to produce the following normal operating function when a system start command is given to the engine generator standby system.

- A. Upon receipt of a start signal, system shall start Generator 1, Generator 2 or both depending on "Generator Selector Switch" position. In "Auto", the system shall start generator with capacity

closet to last recorded demand. If latest demand was greater than capacity of one generator, both generators shall start.

- B. Close the generator output circuit breaker for the first generator to reach operating voltage and frequency.
- C. If two (2) generators are required and the second generator reaches operating voltage and frequency, it shall synchronize to unit on-line and close into the bus.
- D. Provide positive lockout such that both engine generators cannot be connected to a dead bus simultaneously.
- E. Upon receipt of a stop signal, all individual generator circuit breakers shall open and the engine generators shall continue to run at no load for an adjustable cool down period of time (0-30 minutes) before complete shutdown.

Peak shaving - Closed Transition Load Assumption and Return: Upon manual or remote initiation from Plant SCADA system or Duke Energy contact closure, the system generator(s) shall assume all plant load. The prior sequence "Load Test Sequence (Actual Plant Loads) - Closed Transition Load Assumption and Return" shall be followed. If a power failure occurs on the utility system, the utility feed breaker will open and plant will be served from generator while a closed transition to remaining service is initiated.

Storm or Island Mode – Closed Transition: Upon manual or remote initiation from Plant SCADA system or Duke Energy contact closure, the system generator(s) shall assume all plant load.

- A. Initiate an automatic start sequence.
- B. The generator shall be brought into synchronism with the utility and the generator breaker (52-G1 or 52-G2) shall close (closed transition) and parallel the utility and generator sources.
- C. The engine generators shall be gradually loaded until they have assumed the entire power requirements of the system load. The utility main breaker 52-U shall then open. This process shall occur in approximately 10-15 seconds.
- D. If power failures occur while in this condition, the Storm or Island Mode system will continue to operate the system loads on generators.
- E. When the "Test/Normal" switch is returned to the "Normal position after a power failure has occurred and the generators are supplying the load, the system will revert to the automatic loss of utility sequence described above.
- F. Upon manual or remote termination from Plant SCADA system or Duke Energy contact open, and a power failure has not occurred, the engine generator shall synchronize with the utility power source, close the utility breaker 52-U, and gradually transfer the load back to the utility source, and open the main generator breaker(s) (52-G1 and/or 52-G2) (closed transition).
- G. The engine generators shall continue to run at no load for an adjustable cool down period of time from 0-50 minutes before complete shutdown.

3.2 Load Control Circuits

The System shall provide control circuits, interlocks, and relays to protect against overloading. System shall provide five priority control contacts to plant SCADA system as later described in this specification.

The programmable controller shall be provided for the system to allow only predetermined loads to be closed to the system bus, until additional engine generators are connected in parallel to the main switchboard bus. If the programmable controller fails, the back-up programmable logic controller shall automatically control the system, control and sound an alarm.

The load shedding controls shall be back up, with a bus frequency monitor that shall shed all non-essential loads during a bus under frequency condition.

A load shed bypass selector switch shall be provided on the master control cubicle door, to permit manual disabling of the load shedding logic (except in an under frequency condition).

3.3 Fail To Synchronize Time Delays

System shall include a fail to synchronize time delay for each generator. Alarm shall terminate the operation of the synchronizer and sound a warning horn, in the event the generator is unable to be synchronized within an adjustable period of time, approximately 0-5 minutes. After failing to synchronize automatically, the operator, at his discretion, shall be able to connect either one or all the generators to the MSWGR bus by operating the manual synchroscope system and the circuit breaker control switches.

3.4 Operation Of The Fail Light, Lockout, And Alarm System

Each engine generator power circuit breaker and control section shall be provided with separate alarm relays and alarm lights, to shut down the engine generator, disconnect it from the main bus, and illuminate a light to indicate the nature of the failure.

If the generating plant is running automatically with the master selector switch in the "AUTO" position, a failure at the engine shall cause the respective fail light to light and the engine will be shut down and locked out of the automatic mode of operation.

To reset an engine generator after a failure while in automatic operation, the engine selector switch shall be rotated to the "lockout/reset" position.

After the failure has been corrected, the engine generator shall then be returnable to a standby condition by returning the selector switch to the "AUTO" position.

3.5 Selector Switch Coordination

Coordinate the functions and circuitry of the various selector switches, to insure that the various settings available do not cause malfunction in the intended system operation.

3.6 Over And Under Voltage\Frequency Monitoring

Over and under voltage\frequency monitoring shall be supplied to monitor the bus voltage and provide alarms and initiate load shedding, if required, for abnormal conditions. OIT alarms lights, auxiliary contacts, and an alarm in the engine generator master control section will be energized to indicate an abnormal voltage or frequency condition.

3.7 Reverse Power Monitoring

Reverse power monitoring shall be furnished to detect excessive reverse power flow, caused by the motorizing of a failing generator plant. Upon detection of a true reverse power flow, the monitor shall signal the alarm circuits to immediately disconnect the generator, and to actuate the load shedding circuits. The reverse power monitor shall automatically reset upon generator power disconnect and shall include the following features:

- A. Time Delay: An adjustable time dial shall be provided with inverse time characteristic.
- B. Sensitivity: Adjustable taps from 13 to 150 watts.
- C. Reverse power protection shall utilize a utility grade relay, with inverse time characteristics.

3.8 Ground Fault Protection

Adjustable ground fault sensitivity from 0 to 5 amperes, time delay four (4) (adjustable from 0 to 15) seconds. Indicate ground fault on main switchgear.

3.9 Load Demand/Engine Start/Stop Sequence

In a normal power failure operation, load demand sensing will, after a (0 to 60 minute adjustable) time delay, be placed into operation. The programmable controller shall monitor the load on the bus and will initiate signals to

subtract and add generators as required. An indicating lamp on the master control cubicle will be flashing during the 0 to 60 minute time delay and will be on constant, when the system is operating in load demand mode. System shall be coordinated with Plant Control system interface addressed later in this specification.

The engine starting and stopping sequence can be changed through the OIT.

If the sequence is changed during an automatic operation, any engine on line will remain on line. If the engine selected as the base engine is not on line, it will be immediately started up and placed on line. The engine generators that are selected as sequence position #2 through #6 will be added in sequence to the bus and subtracted in reverse sequence. Should an engine be locked out of the system it will be skipped over and the next engine in sequence will be started as required.

Back-lit engraved indicating windows shall be provided on the master control cubicle to light when the loading of the generating system reaches preset "Decreasing Load", "Increasing Load" and "Overload" set points. These lights are flashing when timing and are on constant when timed out.

The set points shall be field adjustable through the Operator Interface Touch-Screen. The "Overload" set point is adjustable from 90 to 125% of each engines' rated loading. The "Increase" is adjustable from 60 to 100% (or "Overload" minus 10%, whichever is smallest) of the on line capability of the system. The "Decrease" is adjustable from 40 to 80% (or "Increase" minus 10%, whichever is smallest) of the on line capability of the system after the decrease.

The overload and increase time delays shall "inverse time characteristics" - the higher the loading - the shorter the time delay. The settings shall be programmable through the OIT. The ranges are 0 to 10.0 seconds for the overload set point, and 0 to 9.9 for the increase time delay. The decrease time delay shall be adjustable from 0 to 99.0 seconds.

PART 4 EQUIPMENT

4.1 Main Switchgear

The main switchgear shall be furnished with the following basic components, and any additional equipment necessary to provide for a complete and dependable system.

- A. Three (3) 480 volt, circuit breaker, 3 phase, 2500 amperes, stored energy, draw out type, arranged for tripping on 24 vDC control power, charge and close on 120VAC power, with 65,000 ampere interrupting rating. The circuit breaker shall be provided with short circuit protection, along with additional auxiliary contacts, as necessary.
- B. Potential and current transformers as required.
- C. One (1) Main Switchgear multifunction protection relay for the 52-U breaker such as Basler BE1-11i or equivalent.
- D. One (1) set of 3 phase, 2500 amperes, insulated copper bus and ground bus.
- E. One (1) power quality meter
- F. Annunciator for the following circuit breaker status indications for each circuit breaker:
 - Circuit breaker opened
 - Circuit breaker closed
 - Circuit breaker drawn out
- G. One (1) set of control wiring, fuses, fuse blocks, terminals, nameplates, etc. All wiring to be labeled at both ends. Wiring labels shall match manufacturer's drawings.
- H. Set of compression type lugs for connections to each circuit breaker

A main switchgear transfer control cubicle shall be furnished with the following basic components and any additional equipment necessary to provide for a complete and dependable system:

- A. Master PLC system for system control and communications with existing generator PLC and Plant SCADA system.
- B. One (1) operator interface terminal for PLC
- C. Battery backup for 90 minutes of operation for the master PLCs and OITs
- D. Separate reverse power relay, equivalent to the Basler 32R. Unit shall be coordinated with Duke Energy prior to installation and setup.
- E. Screens, logic and circuitry for display of the following on OIT or with individual devices.
 - System layout with status of all drawout circuit breakers.
 - Load management requested from Duke Energy
 - Protective Relay Trip
 - Fail to Transfer
 - Normal Power On
 - Bus under voltage
 - Bus over frequency, MSWGR
 - Bus under frequency, MSWGR
 - Critical control voltage failure, MSWGR
 - AC control voltage failure, MSWGR
 - System Overload
 - PLC failure: solid PLC failure: flashing PLC battery low
 - Generator No. 1 online
 - Spare
 - Utility Feed available
 - Generator Feed 1 breaker lockout
 - Spare
 - Generator Feed 1 breaker open
 - Spare
 - Generator Feed 1 breaker closed
 - Spare
 - Generator alarms
 - System Voltage, all phases
 - System Current, all phase
 - Power factor
 - KVA
 - KW
 - KVAR
 - Frequency
 - Load shed and re-add controls with a manual load shed bypass
 - One (1) bus voltage/frequency failure relay, with fail indication and reset
 - One (1) fail to synchronize time delay
 - One (1) station alarm horn, with silencer switch and light
 - One (1) master "auto-man" switch, with indication
 - One (1) master "Load Test-Normal" switch
 - One (1) load shed bypass switch
 - One (1) increase load push-button
 - One (1) shed non-essential load
 - Re-add non-essential load push-button
 - One (1) load demand selector switch
- F. One set of control wiring, fuses, fuse blocks, terminals, nameplates, etc. All wiring to be labeled at both ends. Wiring labels shall match manufacturer's drawings.
- G. Necessary controls, wiring, and devices for a completely functioning and safe system.
- H. Automatic Synchronizer.
- I. Over/Under voltage and Frequency monitoring

- J. Fail to synchronize alarms
- K. Ground Fault Protection

PART 5 COORDINATION WITH SCADA SYSTEM

- 5.1 The SCADA system will be provided under separate contact. Communications with SCADA system shall Ethernet TCP/IP. Communication shall be through master PLC in main switchgear.
- 5.2 Owner shall be able to monitor and control circuit breakers 52-U, 52-G1, and 52-G2.
- 5.3 Points to be monitored are indicated at end of this section. System shall be designed through the main switchgear PLC. Points indicated are minimums.
- 5.4 All points in existing PLC shall be available to the master PLCs. The master PLCs shall communicate with the Plant SCADA system. Additional points shall be provided as recommended by the manufacturer for a complete and functional system. System shall provide the following points for plant monitoring as a minimum:
 - A. Generator No. 1 Running
 - B. Generator No. 2 Running
 - C. System Not in Auto
 - D. Generator No. 1 Common Alarm
 - E. Utility Feed available
 - F. Generator Feed available
 - G. Generator Feed "52-G1" breaker status
 - H. Generator Feed "52-G2" breaker status
 - I. Utility Feed "52-U" breaker status
 - J. KW, KWhr, KVA, pf, Kvar for each breaker in the MSWGR
- 5.5 System shall monitor generator loads and if generator capacity is available, allow loads to be added based on these priorities through the plant SCADA system.
- 5.6 System manufacturer shall coordinate with SCADA supplier and Owner on communicating with plant control system.

PART 6 EXECUTIONS

6.1 Factory Quality Control And Test

Completely assemble, wire, and test the switchgear at the factory. A factory operational test shall be simulated to check out the entire system before delivery. Detailed inspections before and after assembly shall assure correctness of design and workmanship. Provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips. Provide factory test report prior to shipment.

After assembly, provide the switchgear with lifting channels having eyebolts for attachment of crane slings to facilitate lifting and handling each shipping-assembly unit. These lifting channels shall be removable after equipment is placed on permanent foundations

6.2 Field Service

The main switchgear shall be delivered to Davidson Water where it will be unloaded and stored by Davidson Water, Inc. Supplier shall provide written storage instructions for use by Owner.

The main switchgear will be installed under a separate contract. Supplier shall provide written installation instructions, including stub-up drawings for use by the installing Contractor.

After installation by the Contractor, the switchboard manufacturer shall provide the service of a competent factory based service Engineer to instruct the Electrical Contractor and Owner. Service representative shall certify equipment is properly installed prior to energizing. The field service Engineer shall assist in placing the equipment into operation and provide instruction, as required, to the person or persons who are delegated by the Owner to operate the equipment.

This service shall include four (4) separate visits (as a minimum) by the factory service Engineer as follows:

- A. Pre-installation coordination meeting with the Electrical Contractor, Consulting Engineer, and Owner to coordinate the installation and interconnection of the switchgear.
- B. The Service Representative shall make a visit for initial checkout of the installation of this equipment to allow energization of the equipment.
- C. The Service Representative shall make a visit to modify the existing switchgear, provide checkout and start-up of new gear, and trouble shoot switchgear. This visit shall be a minimum of 3 days.
- D. Post installation start-up and testing assistance, prior to system turnover, and initial instruction and training period for operating personnel. This trip shall include all service required to check out the system and demonstrate the complete operation, for final acceptance by the Owner.
- E. Approximately six (6) months after the complete system turnover, a visit shall be made to provide instruction for operating personnel on complete operation and maintenance program.

The switchgear manufacturer shall maintain a competent field service organization that is available on a 24-hour call basis.

The manufacturer's representative shall sign in and out in a pre-arranged manner on each day he is at the project.

6.3 Operation Instructions And Maintenance Manual

After completion of work and start-up of the equipment at the job site, deliver to the owner and engineer, copies of operating instructions, maintenance manuals and drawings presenting full details for care and maintenance of each item of equipment furnished and/or installed under this Contract.

Each manual shall contain the operating and maintenance information and parts lists furnished by the manufacturer, for all equipment provided in the Contract. When necessary, provide supplemental drawing to show system operation and servicing and maintenance points. For all electrical components, furnish wiring and connection diagrams. Manuals shall include instructions required to accomplish specified operation and functions. Data shall be neat, clean, legible copies. Drawings shall be accordion folded. Non-applicable information shall not be included. Four (4) sets of manuals shall be furnished to the Owner.

Switchgear drawings and wiring diagrams shall be furnished complete and up to date at the completion of start-up and system acceptance by the Owner. Drawings and wiring diagrams shall include any field modifications or changes to reflect actual as built conditions.

6.4 Installation

Supplier shall coordinate installation with selected Contractor and provide complete start-up services. Supplier shall provide checkout of installed system prior to performing start-up. One (1) copy of installation instructions shall be included with the equipment prior to shipment. The equipment shall be suitable protected with space heaters connected until accepted by the Owner.

The equipment shall be checked in accordance with the manufacturer's recommendations. This shall include, but not be limited to:

- A. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
- B. Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
- C. Secure assemblies to foundation to floor channels.
- D. Inspect and install all circuit breakers in their proper compartments.

6.5 Testing

The new switchgear specified in this Section shall witness shop tested and inspected in accordance with the equipment manufacturer's standard procedures. The testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified and shall be approved the Engineer. At least 10 days' notice shall be give the Engineer prior to such tests and inspection dates.

Submit description of proposed testing methods, procedures, and apparatus.

As a minimum, the entire switchgear assembly shall go through a quality inspection before shipment. This inspection shall include, but is not limited to, the following:

- A. Physical inspection of the structure and the electrical conductors including bussing, general wiring, and cells.
- B. General electrical tests including power circuit phasing, control circuit wiring, instrument transformers, meters, protective relaying, and device electrical operation.
- C. AC dielectric tests of the power circuits and control circuits.
- D. Markings/labels, including instructional type, Underwriters Laboratory (UL), and inspector's stamps.

The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI standards.

- A. Alignment tests with master cell to verify all interfaces and interchangeability.
- B. Circuit breakers operated over the range of minimum to maximum control voltage.
- C. Factory setting of control gap.
- D. One-minute dielectric test per ANSI standards.
- E. Final inspections and quality checks.

The following production test shall be performed on each breaker housing.

- A. Alignment test with master breaker to verify interfaces.
- B. One-minute dielectric test per ANSI standards on primary and secondary circuits.
- C. Operation of wiring, protective relays, and other devices verified by an operational sequence test.
- D. Final inspection and quality check.

The manufacturer shall use integral quality control checks throughout the manufacturing process to maintain the correctness of the switchgear.

Submit certified copies of all factory test reports.

6.6 Painting

Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly; all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

6.7 Field Adjustments

The protective relays shall be set in the field by a qualified representative of the supplier, in accordance with the settings designated in the Coordination Study provided under separate contract.

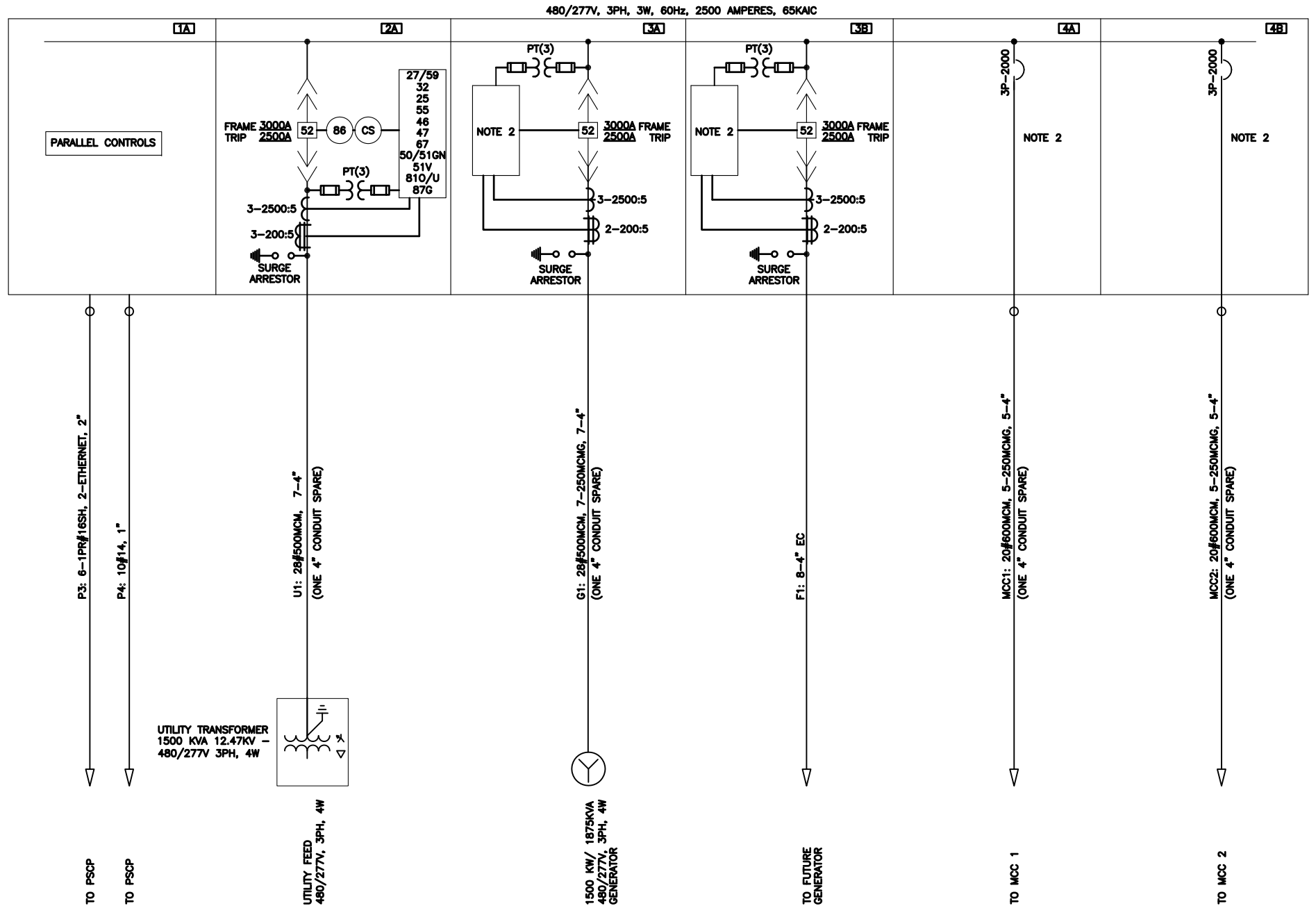
6.8 Manufacturer's Certification

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.

6.9 Warranty

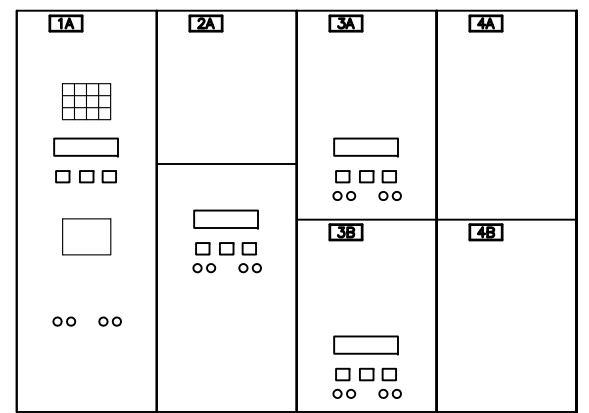
Supplier shall warranty the switchgear under this specification for a 30 month period from delivery of equipment.

END OF SECTION



MAIN SWITCHGEAR, MSWGR ONE-LINE DIAGRAM
NOT TO SCALE

- NOTES:**
1. SYSTEM WILL INCLUDE AN INTEGRATED FEEDER CONTROL PACKAGES.
 2. MCC1 AND MCC2 FEEDERS SHALL BE MOLDED CASE WITH LSIG ADJUSTMENTS.



MSWGR FRONT ELEVATION
NOT TO SCALE

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 PLOT DATE: 2015/12/01 1:55:20 PM
 BY: RHINGS

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
DRAWN BY:	J. W. COOK
CHECKED BY:	-
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	

PROCUREMENT DRAWING FOR PRICING ONLY

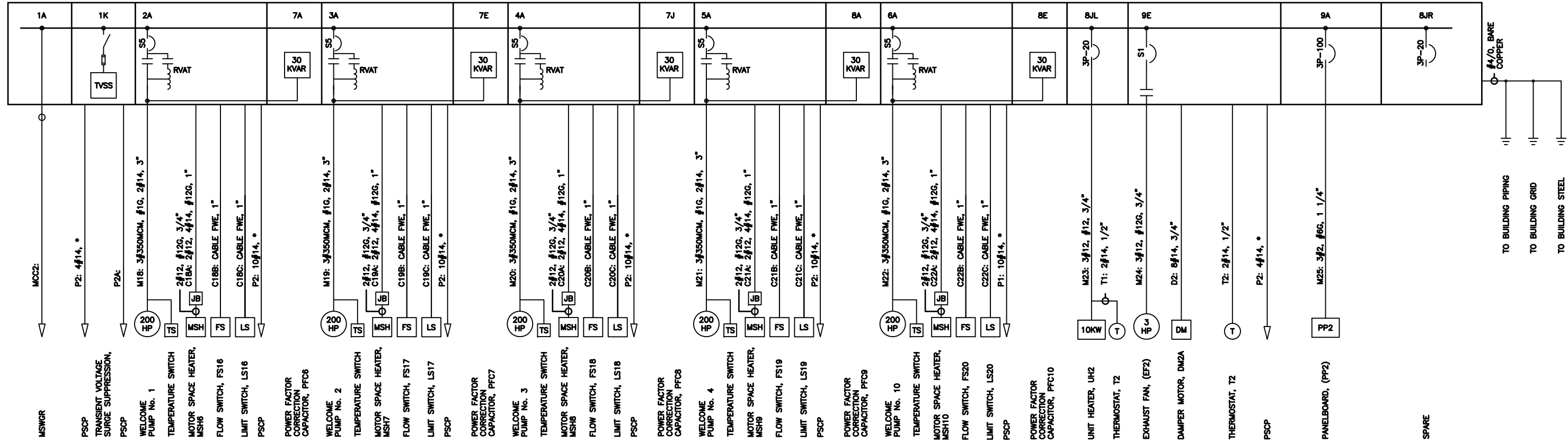
STURGILL ENGINEERING PA
 ONE SOUTH MAIN ST.
 LEXINGTON, NC 27292
 (336) 238-1249 PH.
 (336) 236-6393 FAX

DAVIDSON COUNTY
 NORTH CAROLINA

 DAVIDSON WATER INC.
 HYATTOWN PUMP STATION IMPROVEMENTS

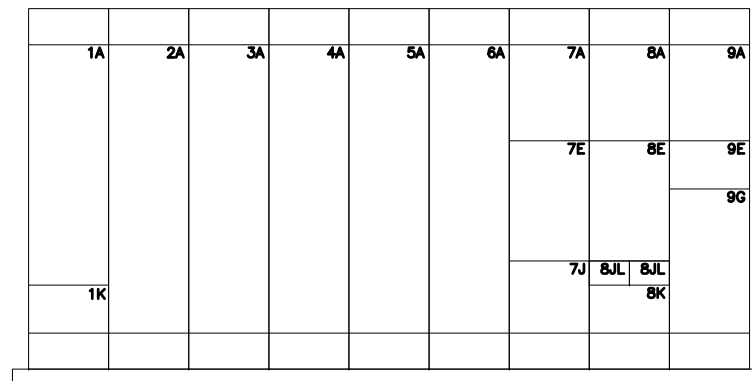
SYSTEM ONE-LINE DIAGRAM

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E101



MCC2 ONE-LINE DIAGRAM

NOT TO SCALE



MCC2 FRONT ELEVATION

NOT TO SCALE

NOTES:

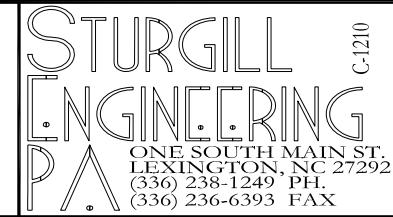
1. CONTRACTOR RESPONSIBLE FOR ROUTING ALL CONDUITS.
2. CONTRACTOR SHALL VERIFY EQUIPMENT STUB-UP PRIOR TO INSTALLATION.

FILE: \\SERVER\ENGINEERING\VAZEA & SAWYER\HATTOWN PS IMPROVEMENTS\ELECTRICAL\DWGS\E103_Sched By RHINDS_Saw Date: 2015/12/01 1:52 PM
 PLOT DATE: 2015/12/01 1:57:55 PM BY: RHINDS

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
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CHECKED BY:	-
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	

PROCUREMENT DRAWING FOR PRICING ONLY

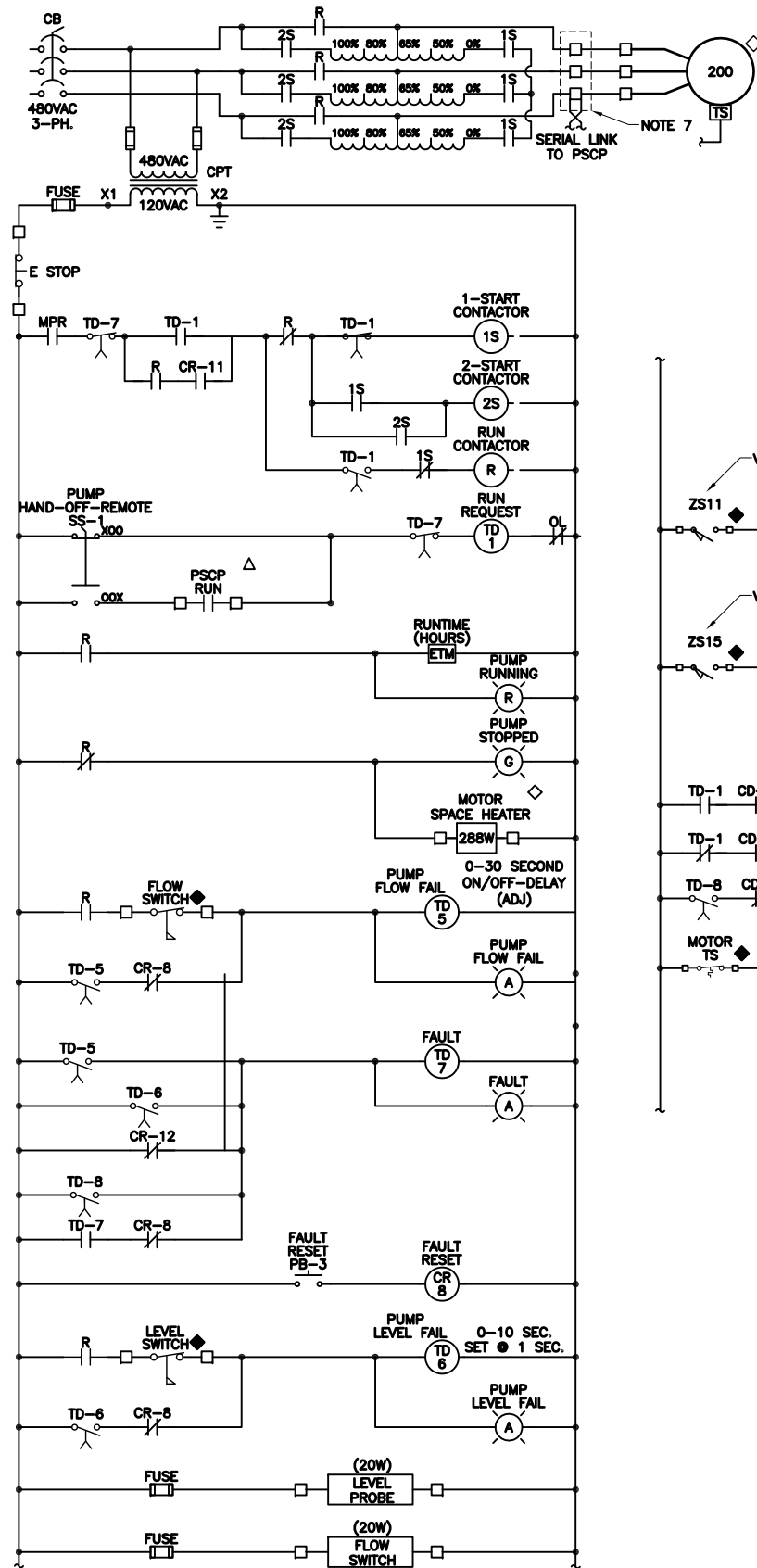


DAVIDSON COUNTY
NORTH CAROLINA

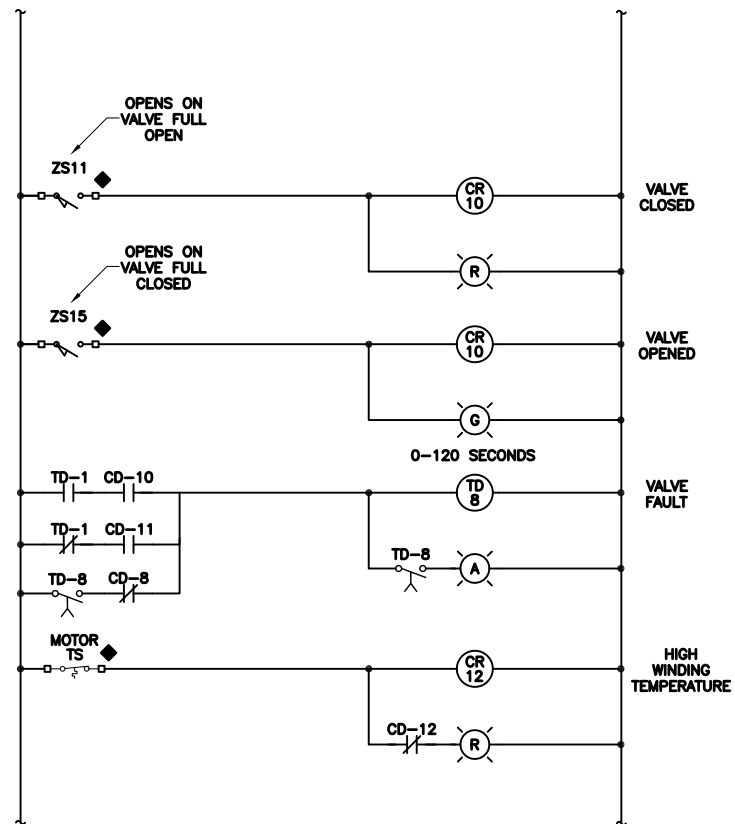
DAVIDSON WATER INC.
HYATTOWN PUMP STATION IMPROVEMENTS

MCC2
FRONT ELEVATION

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E103

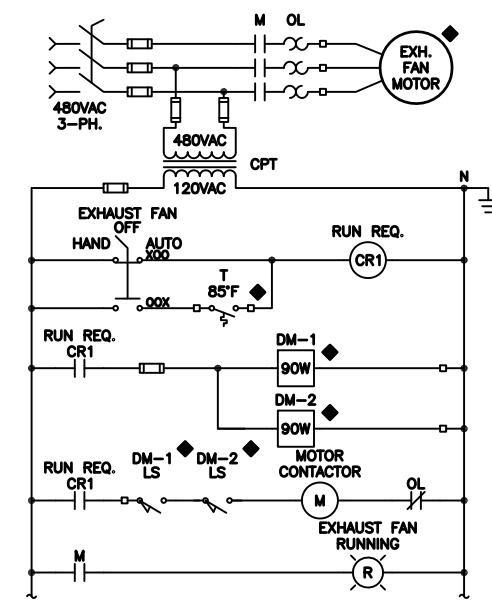


PUMP CONTROL SCHEMATIC (TYP. OF 10)
NOT TO SCALE TYPICAL FOR ALL WATER PUMPS



CONTACTS SHALL BE PROVIDED FOR CONNECTION TO PUMP STATION CP (PSCP)

◇	PUMP HAND-OFF-REMOTE SS-1
◇	PUMP RUNNING
◇	PUMP FLOW FAIL TD-5
◇	PUMP LEVEL FAIL
◇	PUMP FAULT CR-7
◇	FAULT RESET CR-8
◇	VALVE FAULT TD-8
◇	CR-12



EF AND DAMPER CONTROL
NO SCALE

SYM	LOCATION LEGEND
◇	LOCATED AT DRIVEN EQUIPMENT
◆	REMOTE FROM STARTER AND DRIVEN EQUIPMENT
△	LOCATED IN REMOTE PUMP STATION CONTROL PANEL(PSCP)

- NOTES:
- SEE SHEET E001 FOR ELECTRICAL LEGEND AND ABBREVIATIONS.
 - UNLESS OTHERWISE NOTED, DEVICES INDICATED ON THIS DRAWING SHALL BE SUPPLIED AS AN INTEGRAL PART OF THE PUMP DRIVE (VFD, RVAT, CONTACTORS, CONTROLS, ETC.) DEVICES LOCATED REMOTELY SHALL BE IDENTIFIED BY A LOCATION SYMBOL AS DEFINED IN THE DEVICE LOCATION LEGEND.
 - RELAY AND TIMER DESIGNATIONS APPLY TO THE INDIVIDUAL SCHEMATIC ONLY.
 - CONTROL SETTINGS, ALARM LIMITS, TIMER SETTINGS AND ADJUSTABLE PARAMETERS ARE INTENDED TO BE FOR THE INITIAL START-UP. ADJUSTABLE SETTINGS SHALL BE TESTED AND CHANGED BY THE CONTRACTOR, IF REQUIRED FOR PROPER OPERATION.
 - MOTOR STARTER SCHEMATICS INDICATE GENERAL CONTROLS AND SEQUENCING. EQUIPMENT SUPPLIER SHALL ADAPT THE SPECIFIC PACKAGE TO PROVIDE A FULLY FUNCTIONAL SYSTEM.
 - CONTROL SCHEMATICS ARE A DIAGRAMMATIC REPRESENTATION TO INDICATE THE MINIMUM ACCEPTABLE CONTROL FUNCTIONS. ACTUAL CONTROL LOGIC WILL DEPEND ON DRIVE MANUFACTURER'S CONTROL.
 - MOTOR PROTECTION RELAY, MPM SHALL PROVIDE MOTOR PROTECTION FOR OVERLOAD, LOSS-OF-PHASE AND PHASE REVERSAL. IN ADDITION, SHALL PROVIDE KW, KWHR AMPS TO PSCP VIA MODBUS LINK.

FILE: \\SERVER\ENGINEERING\WATER & SANITARY\WATOWN PS IMPROVEMENTS\ELECTRICAL\DWGS\E021.dwg
 PLOT DATE: 2015/10/01 11:46:54 AM
 BY: RHINDS
 SAVED BY: RHINDS
 DATE: 2015/10/01 11:30 AM

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
DRAWN BY:	J. W. COOK
CHECKED BY:	-

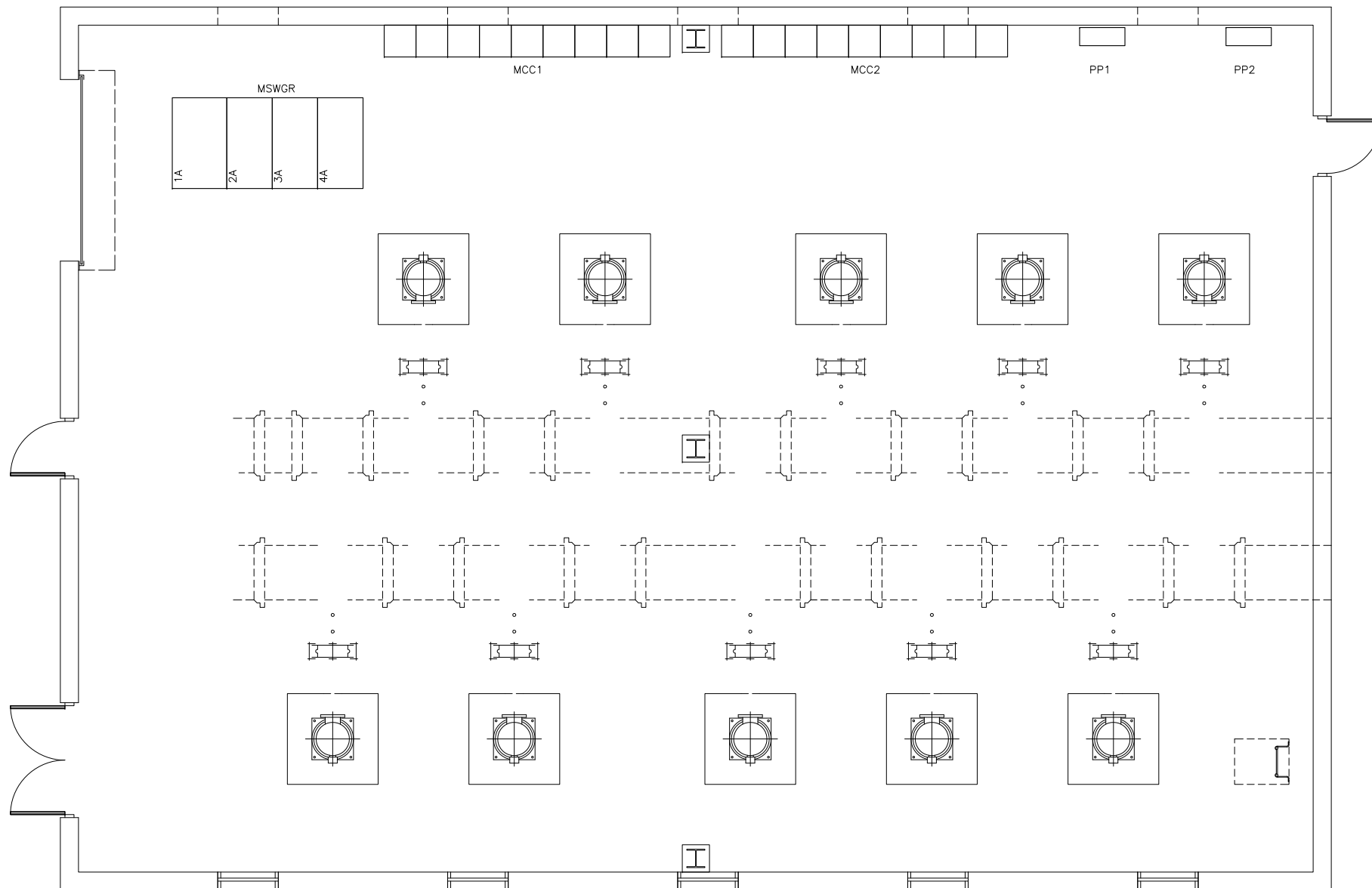
PROCUREMENT DRAWING FOR PRICING ONLY

STURGILL ENGINEERING PA
 ONE SOUTH MAIN ST. LEXINGTON, NC 27292
 (336) 238-1249 PH. (336) 236-6393 FAX

DAVIDSON COUNTY NORTH CAROLINA
 DAVIDSON WATER INC.
 HYATTOWN PUMP STATION IMPROVEMENTS

MISCELLANEOUS CONTROL SCHEMATIC

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E201



BOOSTER PUMP STATION POWER PLAN

SCALE 1/4" = 1'-0"

File: \\SERVER\ENGINEERING\VAZIR & SAWYER\HATTOWN PS IMPROVEMENTS\ELECTRICAL\DWGS\EA01.dwg
 Plot Date: 2015/10/27 11:44:04 AM
 Drawn By: RHWIS
 Date: 2015/10/27 6:42 PM

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER:	R. W. STURGILL
DESIGNED BY:	R. W. STURGILL
DRAWN BY:	J. W. COOK
CHECKED BY:	-
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE	

PROCUREMENT DRAWING FOR PRICING ONLY

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 C-1210
 ONE SOUTH MAIN ST.
 LEXINGTON, NC 27292
 (336) 238-1249 PH.
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DAVIDSON COUNTY
 NORTH CAROLINA

 DAVIDSON WATER INC.
 HYATTOWN PUMP STATION IMPROVEMENTS

BOOSTER PUMP STATION
 POWER PLAN

DATE:	OCTOBER 2015
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	E301



Drawing Submittal DW022516

Hyatttown Plant Main Switchgear Upgrade

Lexington, North Carolina

2/25/2016



Submittal Transmittal

Transmittal Information:

Wednesday, February 25, 2016

Notes:

- 1) The information and data are based on the Bid request for the Water Treatment Plant Main Switchgear Upgrade package dated December 01, 2015.

Attn: Robert Roy

Phone: 856-467-1213 Office 907-250-9149 Cell robertr@tdxcorp.com

Richard Porter

Phone: 856-467-1213 Office 907-229-1370 Cell richardp@tdxcorp.com



DRAWINGS

DAVIDSON WATER

HYATTOWN SWITCHGEAR & CONTROL UPGRADE

FOR OFFICIAL USE ONLY

DRAWING NOTES:

1. GENERATORS - CAT 3500 - DIESEL
2. ALL GENERATORS ARE SYNCHRONIZED ACROSS GENERATOR
3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
4. GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO TDX

REV. NO.	DATE	REV BY	DESCRIPTION
0	2-8-16	EWR	Original Issue

DRAWING TITLE:
COVER SHEET

DRAWING NUMBER: 225961-DWG-O-000
SHEET NO. AUTHOR: EWR **DATE:** 2/8/2016

CLIENT:
DAVIDSON WATER
HYATTOWN PS

PROJECT:
POWER SYSTEM
CONTROL UPGRADES

TDX global llc
615 E. 82nd Avenue, Suite 200
Anchorage, AK 99518

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15	22CK	AUTOMATIC SYNCHRONIZER	27L	CBCL	CIRCUIT BREAKER CLOSE LAMP	IC	INITIATE START	R	RESISTOR
27L	27L	UNDER VOLTAGE CHECK RELAY	CBOR	CBOR	CIRCUIT BREAKER OPEN LAMP	IDS	ISOLATED SWITCH	RR	RESISTOR
32L	32L	REVERSE POWER RELAY	CBRR	CBRR	CIRCUIT BREAKER AUX RELAY	IRS	ISOLATED SWITCH	RR	RESISTOR
40L	40L	LOSS OF EXCITATION RELAY	CBMS	CBMS	CIRCUIT BREAKER MODE SWITCH	JMHR	JACKET WATER HEATER RELAY	RRX	RUN RELAY
46L	46L	CURRENT IMBALANCE LAMP	CDL	CDL	COOL DOWN LAMP	LCS	LOUVER CONTROL SWITCH	SAP	SPEED ADJUST POTENTIOMETER
46L	46L	CURRENT IMBALANCE LAMP	CDL	CDL	COOL DOWN LAMP	LCT	LOUVER CLOSE TIMER	SAR	SUMMARY ALARM RELAY
51L	51L	OVER CURRENT LAMP	CDTR	CDTR	CUSTOMER INTERFACE MODULE	LDR	LOUVER DRIVER RELAY	SDL	SENSORS DISABLED LIGHT
52	52	MAIN CIRCUIT BREAKER	CM	CM	CUSTOMER SHUTDOWN RELAY	LFSS	LOW FUEL LEVEL ALARM SWITCH	SDRX	SHUT DOWN RELAY
52	52	MAIN CIRCUIT BREAKER	CM	CM	CUSTOMER SHUTDOWN RELAY	LFSS	LOW FUEL LEVEL ALARM SWITCH	SL	SYNCHRONIZING LAMP
59L	59L	OVER VOLTAGE LAMP	CT	CT	CRANK TERMINATE RELAY	LOLS	LOW OIL LEVEL SWITCH	SM	STARTER MOTOR
65	65	GOVERNOR	CIR	CIR	CRANK TERMINATE RELAY	LDR	LOUVER POSITION RELAY	SMMS	STARTER MOTOR RELAY
81U	81U	UNDER FREQUENCY RELAY	D	D	DIODE	LTR	LAMP TEST RELAY	SMR	STARTER MOTOR RELAY
81OL	81OL	OVER FREQUENCY RELAY	DCS	DCS	DC POWER SUPPLY	LWS	LOW WATER LEVEL ALARM SWITCH	SPD	SURGE PROTECTIVE DEVICE
81UL	81UL	UNDER FREQUENCY LAMP	DCS	DCS	DC POWER SUPPLY	LWS	LOW WATER LEVEL ALARM SWITCH	SPD	SURGE PROTECTIVE DEVICE
90L	90L	VOLTAGE REGULATOR FAULT LAMP	DT	DT	DISTRIBUTION TRANSFORMER	MFM	MULTI FUNCTION METER	STR	STOP RELAY
A	AMPERE	AMPERE	ECG	ECG	ENGINE CONTROL SWITCH	MIP	MANUAL LOADING POTENTIOMETER	STR	STOP RELAY
ACK	ACKNOWLEDGE	ACKNOWLEDGE	EFGRX	EFGRX	ELECTRICAL FAULT COOL DOWN RELAY	MPS	MANUAL LOADING POWER SUPPLY	THM	THERMOSTAT
AOS	AIR DAMPER SWITCH	AIR DAMPER SWITCH	EGA	EGA	ENGINE GOVERNOR ACTUATOR	MPU	MAGNETIC SPEED PICKUP	TP	TEST SIGNAL
ALT	ALARM MODULE	ALARM MODULE	EMS	EMS	ENGINE MODE SWITCH	NEU	NEUTRAL	UCBR	UTILITY CIRCUIT BREAKER RELAY
ALT	ALARM MODULE	ALARM MODULE	ENR	ENR	ENGINE ALARM RELAY	OHLL	OIL FIBED HEATER ON LAMP	UBCL	UTILITY BREAKER CLOSED LAMP
AN	ANNUNCIATOR MODULE	ANNUNCIATOR MODULE	ENR	ENR	ENGINE ALARM RELAY	ORR	OIL FIBED HEATER SWITCH	VAP	VOLTAGE ADJUST POTENTIOMETER
ASOS	AIR SHUT-OFF SOLENOID	AIR SHUT-OFF SOLENOID	ESR	ESR	ENGINE SHUT DOWN RELAY	ORR	OIL FIBED HEATER SWITCH	VAP	VOLTAGE ADJUST POTENTIOMETER
ASL	AIR SHUT-OFF LAMP	AIR SHUT-OFF LAMP	F	F	FUSE	P	PLUG-IN CONNECTOR	VAP	VOLTAGE ADJUST POTENTIOMETER
ASR	AUTO START RELAY	AUTO START RELAY	FCR	FCR	FUEL CONTROL RELAY	PFM	POWER FACTOR METER	VARTD	VOLT-AMP REACTIVE METER
ASSS	ASSIST	ASSIST	FES	FES	FLOAT EQUILIBRATE SWITCH	PFTD	POWER FACTOR TRANSDUCER	VBT	VOLT-AMP BUILDUP RELAY
AS1R	AUTO START RELAY	AUTO START RELAY	FL	FL	FLASH SIGNAL	PBL	PROGRAMMABLE LOGIC CONTROLLER	VCR	VOLTAGE BUILDUP RELAY
ATB	AUTO TRANSMISSION BLOCK	AUTO TRANSMISSION BLOCK	FM	FM	FLASHER MODULE	PICL	PLC NOT RUNNING LAMP	VDC	VOLTAGE CONTROL RELAY
BC	BATTERY CHARGER	BATTERY CHARGER	FPL	FPL	FAILED PARALLEL LAMP	PICR	PLC RELAY	VDR	VOLTAGE DROOP RHEOSTAT
BCA	BATTERY CHARGER AMMETER	BATTERY CHARGER AMMETER	FPT	FPT	FUELED PARALLEL LAMP	PIR	PRELUBE PUMP	VFG	VARIABLE FREQUENCY DEVICE
BCF	BATTERY CHARGER FAILURE	BATTERY CHARGER FAILURE	FSDS	FSDS	FUEL SHUT-OFF SOLENOID	PPMS	PRELUBE PUMP PRESURE SWITCH	VFR	VOLTAGE REGULATOR
BPT	BUS POTENTIAL TRANSFORMER	BUS POTENTIAL TRANSFORMER	FTD	FTD	FREQUENCY TRANSDUCER	PS	PEAKSHAVE START RELAY	VTR	VOLTAGE REGULATOR ALARM RELAY
CB	COMMON ALARM RELAY	COMMON ALARM RELAY	GHR	GHR	GENSET FAULT RELAY	PT	POTENTIAL TRANSFORMER	VTD	VOLTAGE REGULATOR FAULT RELAY
CB	CIRCUIT BREAKER	CIRCUIT BREAKER	GND	GND	GROUND	PT	POTENTIAL TRANSFORMER	WMT	WATT METER
			GSR	GSR	GENERATOR SET CONTROL	PUR	PRIMARY UNIT RELAY	XVR	CHANGE OVER RELAY
			HRN	HRN	HORN SIGNAL			XVTD	CHANGE OVER TIME DELAY

▲	ENGINE MOUNTED DEVICE			BATTERY		DIODE		TOGGLE SWITCH (NORMALLY OPEN)
~	REFERENCE POINT			FUSE		RESISTOR		THERMOSTAT (NORMALLY CLOSED)
○	SHIELDED WIRE			GROUND		FLOAT (NORMALLY CLOSED)		THERMOSTAT (NORMALLY OPEN)
●	ELECTRICAL CONNECTION POINT			HORN		FLOAT (NORMALLY OPEN)		TIMER (TIMED TO CLOSE)
≪	PLUG IN CONNECTOR			CIRCUIT BREAKER (1 POLE)		LAMP		TIMER (TIMED TO OPEN)
—	INTERIOR CONTROL PANEL WIRING			CIRCUIT BREAKER (2 POLE)		EMERGENCY STOP PUSH BUTTON		CURRENT TRANSFORMER
—	OTHER CONTROL PANEL WIRING			CIRCUIT BREAKER (2 POLE)		RELAY COIL		DISTRIBUTION TRANSFORMER
—	LOWER PANEL INTERCONNECT WIRING			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		POTENTIAL TRANSFORMER
—	UPPER PANEL INTERCONNECT WIRING			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY CLOSED)		120V, 15A OUTLET
—	FIELD INTERCONNECT WIRING			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET
—	SWITCHGEAR TERMINAL POINT			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET
—	UPPER PANEL TERMINAL			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET
—	LOWER PANEL TERMINAL			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET
—	LUG CONNECTION WITH CT			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET
—	LUG CONNECTION WITHOUT CT			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET
—	QUICK DISCONNECT TERMINAL BLOCK			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET
—	TERMINAL BLOCK			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET
—	EXAMPLE SIB IS SECTION 1 ROW B			CIRCUIT BREAKER (3 POLE)		RELAY CONTACT (NORMALLY OPEN)		120V, 15A OUTLET

LOCATION NAME
 F □ □ M
 SIB-TB1-1

- DRAWING NOTES:**
- GENERATORS - CAT 3500 - DIESEL
 - ALL GENERATORS ARE SYNCHRONIZED ACROSS GENERATOR
 - ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
 - ALL CT RATIOS ARE PER DOCUMENTS PROVIDED
 - TO TDX

REV NO.	DATE	REV BY	DESCRIPTION
0	2-8-16	EWR	Original Issue

DRAWING TITLE:
 DRAWING LIST

DRAWING NUMBER: 225961-DWG-L-001

SHEET NO. SHEET NO.

AUTHOR: EWR **DATE:** 2/8/2016

CLIENT:
 DAVIDSON WATER
 HYATTOWN PS

PROJECT:
 POWER SYSTEM
 CONTROL UPGRADES

TDX global llc
 615 E. 82nd Avenue, Suite 200
 Anchorage, AK 99518

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52M1 UTILITY AVAILABLE	STANDBY MODE	BUS AVAILABLE	GEN 1 AVAILABLE	GEN 2 AVAILABLE	TRANSFER LOAD MODE	SPARE
52M1 MAIN CLOSED	SYSTEM NOT IN AUTO	GEN 1 ALARM	GEN 1 CLOSED	GEN 2 CLOSED	GEN 2 ALARM	SPARE
52M1 MAIN OPEN	MAIN BREAKER NOT IN AUTO	GEN 1 NOT IN AUTO	GEN 1 OPEN	GEN 2 OPEN	GEN 2 NOT IN AUTO	SPARE
52M1 MAIN 86 LOCKOUT	GEN BREAKERS NOT IN AUTO	SPARE	GEN 1 86 LOCKOUT	GEN 2 86 LOCKOUT	SPARE	SPARE
52M1 FAIL TO SYNCH	PLC A FAILURE	GEN 1 FAULT	GEN 1 FAIL TO SYNCH	GEN 2 FAIL TO SYNCH	GEN 2 FAULT	SPARE

DRAWING NOTES:

1. GENERATORS – CAT 3500 – DIESEL
CAT 1875KVA / 480VAC
2. ALL GENERATORS ARE SYNCHRONIZED ACROSS GENERATOR
DEV. 52 VIA TDSLC MODULE AND SEL 250X FUNCTION
3. ALL RELAYS WILL BE UTILITY GRADE SS/DO TYPE
4. GE RX3 PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED
TO TDx

REV. NO. DATE REV BY DESCRIPTION

REV. NO.	DATE	REV BY	DESCRIPTION
0	1-19-16	RWP	Original Issue

DRAWING TITLE:

MASTER CONTROL PANEL
ANNUNCIATOR

CLIENT:

DAVIDSON WATER
HYATTOWN

DRAWING NUMBER:

225961-DWG-A-0102

AUTHOR: RWP DATE: 1-19-16

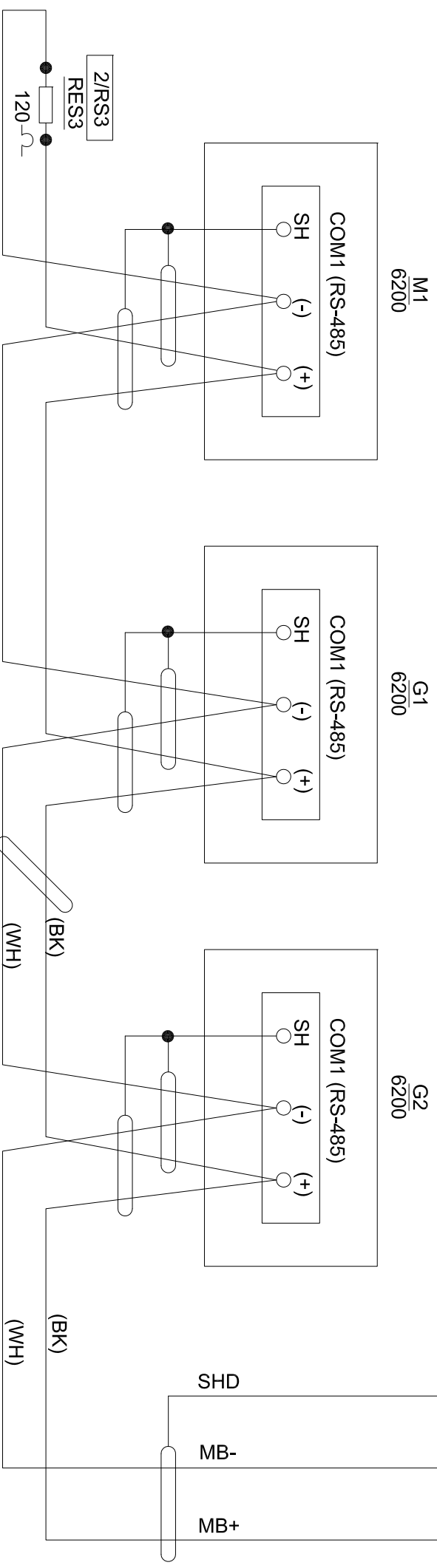
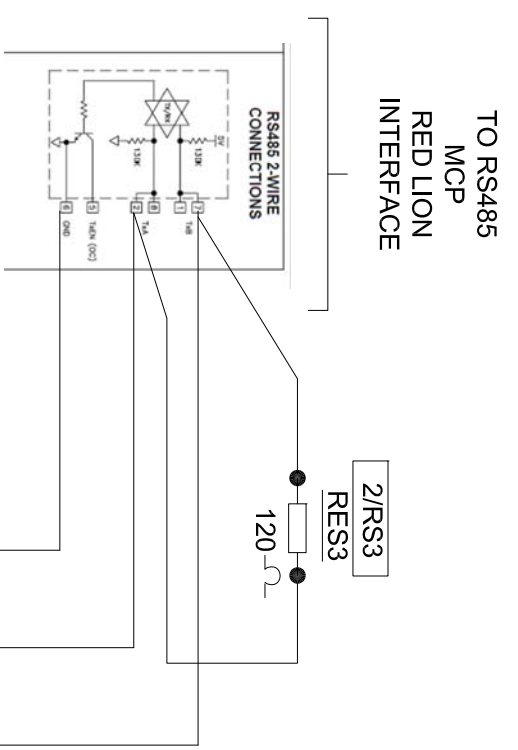
PROJECT:

POWER SYSTEM
CONTROL UPGRADES



615 E. 82nd Avenue, Suite 200
Anchorage, AK 99518

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BELDIN 9841 CABLE

METERING RS485 COMMUNICATION CIRCUIT

DRAWING NOTES:

1. GENERATORS – CAT 3500 – DIESEL
2. CAT 1875KVA / 480VAC
3. ALL GENERATORS ARE SYNCHRONIZED ACROSS GENERATOR
4. DEL. SZ VIA DISC. MODULE AND SEL. ZSCK FUNCTION
5. ALL RELAYS WILL BE ULTILTY GRADE, SS/DO TYPE
6. GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
7. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED
8. TO IDK

REV. NO.	DATE	REV BY	DESCRIPTION
0	2-17-16	RHP	Original Issue

DRAWING TITLE:
COMMUNICATION LOOPS

DRAWING NUMBER: 225961-DWG-E-201

SHEET NO. SHEET NO.

AUTHOR: RHP DATE: 2/17/2016

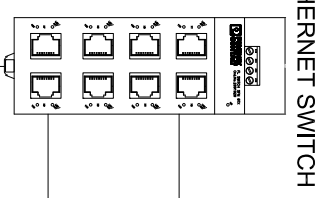
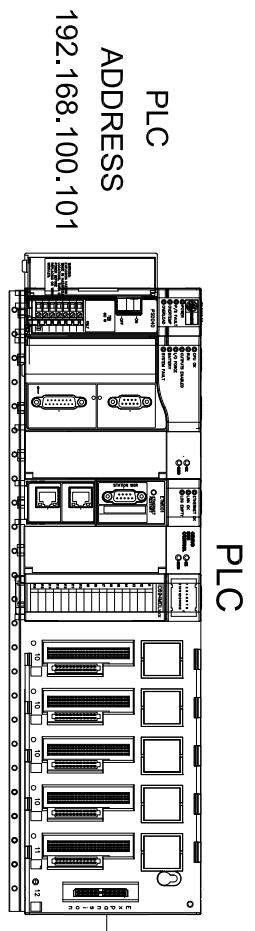
CLIENT:
DAVIDSON WATER
HYATTWON PS

PROJECT:
POWER SYSTEM
CONTROL UPGRADES

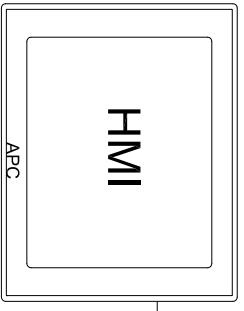
TDX global llc
615 E. 82nd Avenue, Suite 200
Anchorage, AK 99518

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1 2 3 4 5 6 7 8 9 10 11 12



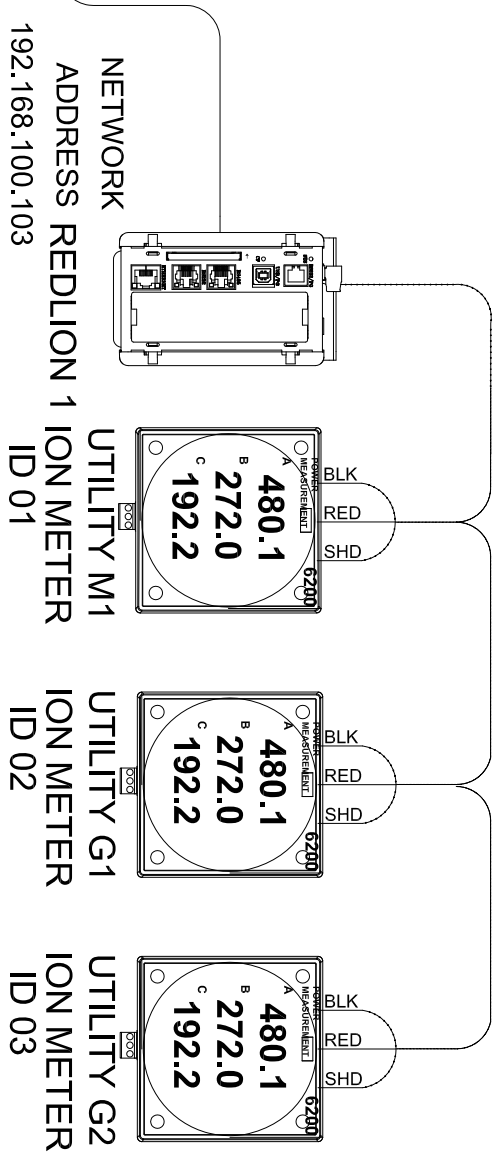
ETHERNET
CABLE



NETWORK
ADDRESS
192.168.100.102

MODBUS LOOP 1

BELDEN CABLE # 9841



DRAWING NOTES:

1. GENERATOR- CAT 3500 - DIESEL #2 CAT 1875KVA / 480VAC
2. GENERATOR IS SYNCHRONIZED ACROSS GENERATOR DEV. 52 VIA SEL 250K FUNCTION
3. ALL RELAYS WILL BE UTILITY GRADE. SS/DO TYPE
4. GE RxC3 PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO IDX

REV. NO.	DATE	REV BY	DESCRIPTION
0	2-17-16	RWP	Original Issue

DRAWING TITLE:
COMMUNICATION LOOP ID'S

DRAWING NUMBER: 225961-DWG-C-0202
SHEET NO.

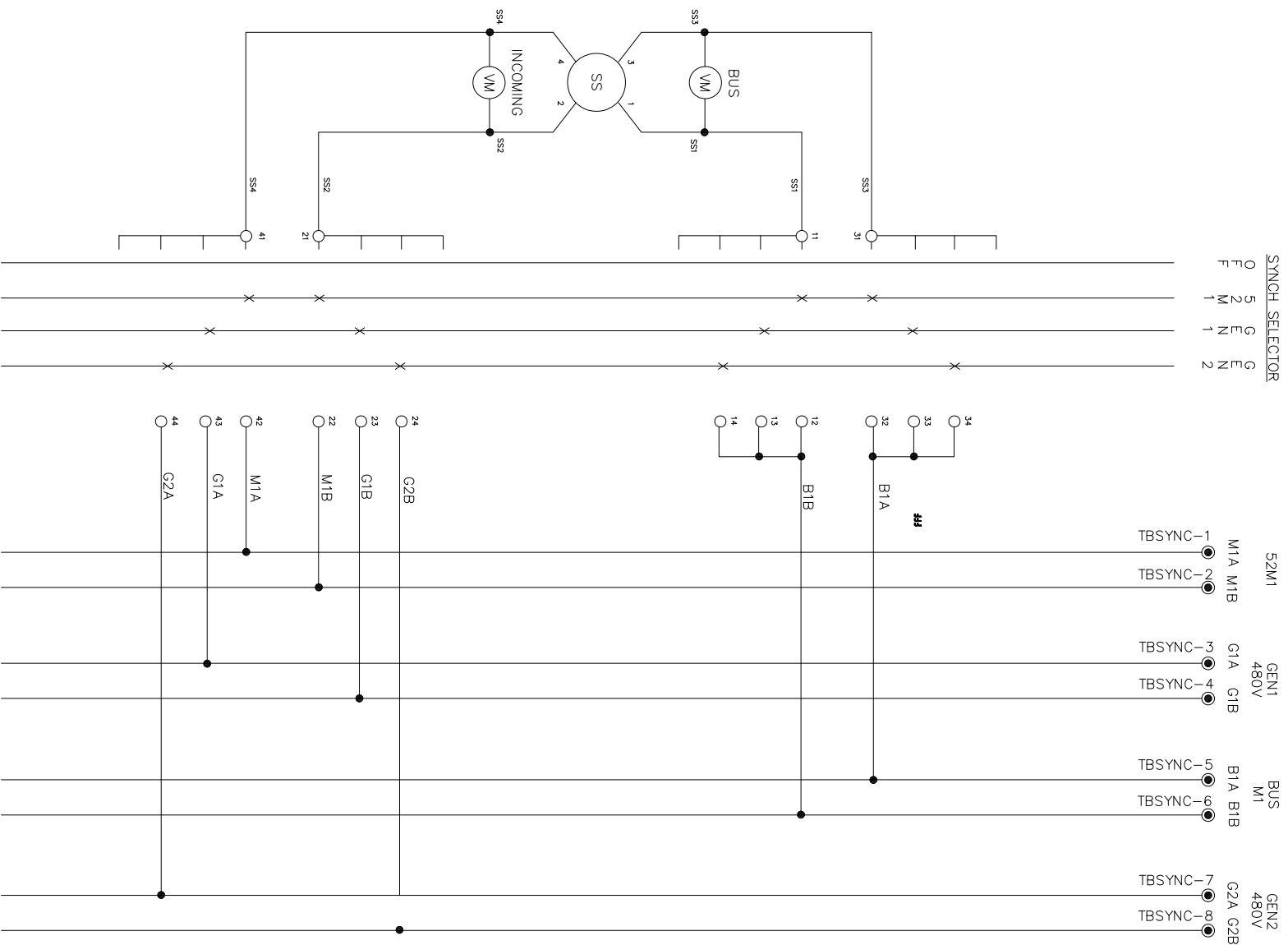
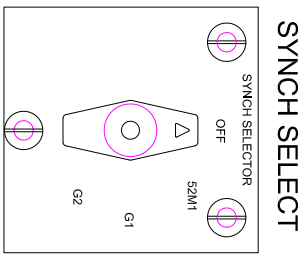
AUTHOR: RWP **DATE:** 2/17/2016

CLIENT:
DAVIDSON WATER
HYATTOWN PS

PROJECT:
POWER SYSTEM
CONTROL UPGRADES

TDX global llc
615 E. 82nd Avenue, Suite 200
Anchorage, AK 99518

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DRAWING NOTES:

1. GENERATOR – CAT 3500 – DIESEL #2 1875KVA / 480VAC
2. GENERATOR ARE SYNCHRONIZED ACROSS GENERATOR DEV. 52 VIA SEL 250K FUNCTION
3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
4. GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO TDx

VM=Volt Meter
SS= Synch Scope

REV. NO. DATE REV BY

0 2-17-16 RHP

DESCRIPTION

Original Issue

DRAWING TITLE:
SYNCHRONIZING CIRCUITRY
AC SCHEMATIC

DRAWING NUMBER: 225961-DWG-E-203

SHEET NO. 1

AUTHOR: RHP **DATE:** 2/17/2016

CLIENT:

DAVIDSON WATER
HYATTOWN PS

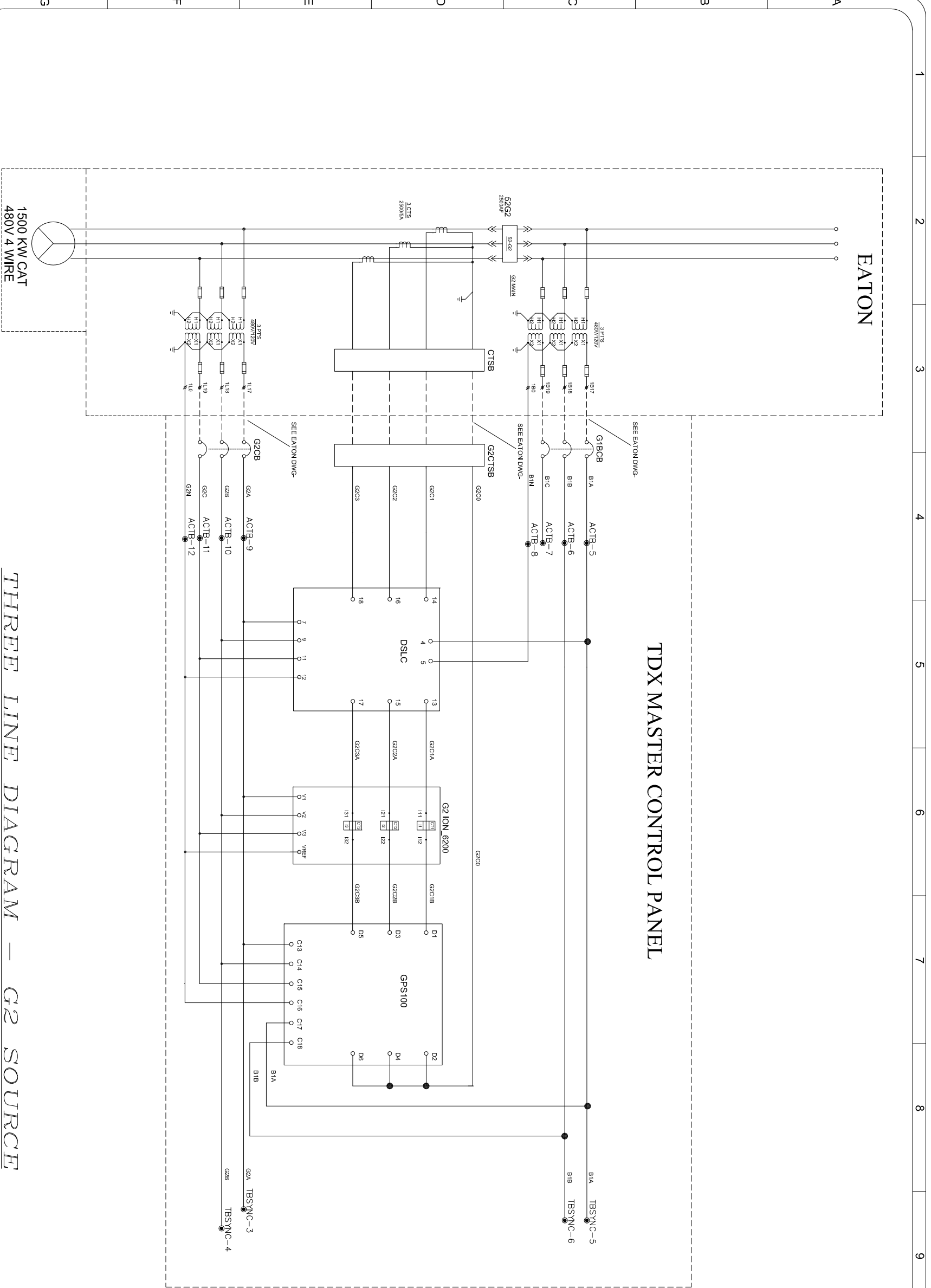
PROJECT:

POWER SYSTEM
CONTROL UPGRADES



615 E. 82nd Avenue, Suite 200
Anchorage, AK 99518

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THREE LINE DIAGRAM - G2 SOURCE

- DRAWING NOTES:**
1. GENERATOR - CAT 3500 - DIESEL #2 1875KVA / 480VAC
 2. GENERATOR IS SYNCHRONIZED ACROSS GENERATOR DEV. 52 VIA DSUC AND BELT 250K FUNCTION
 3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
 4. GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
 5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO TDX

REV. NO.	DATE	REV BY	DESCRIPTION
0	1-25-16	RHP	Original Issue

DRAWING TITLE:
3 LINE 52-G2 SOURCE

DRAWING NUMBER: 225961-DWG-E-304
SHEET NO.:

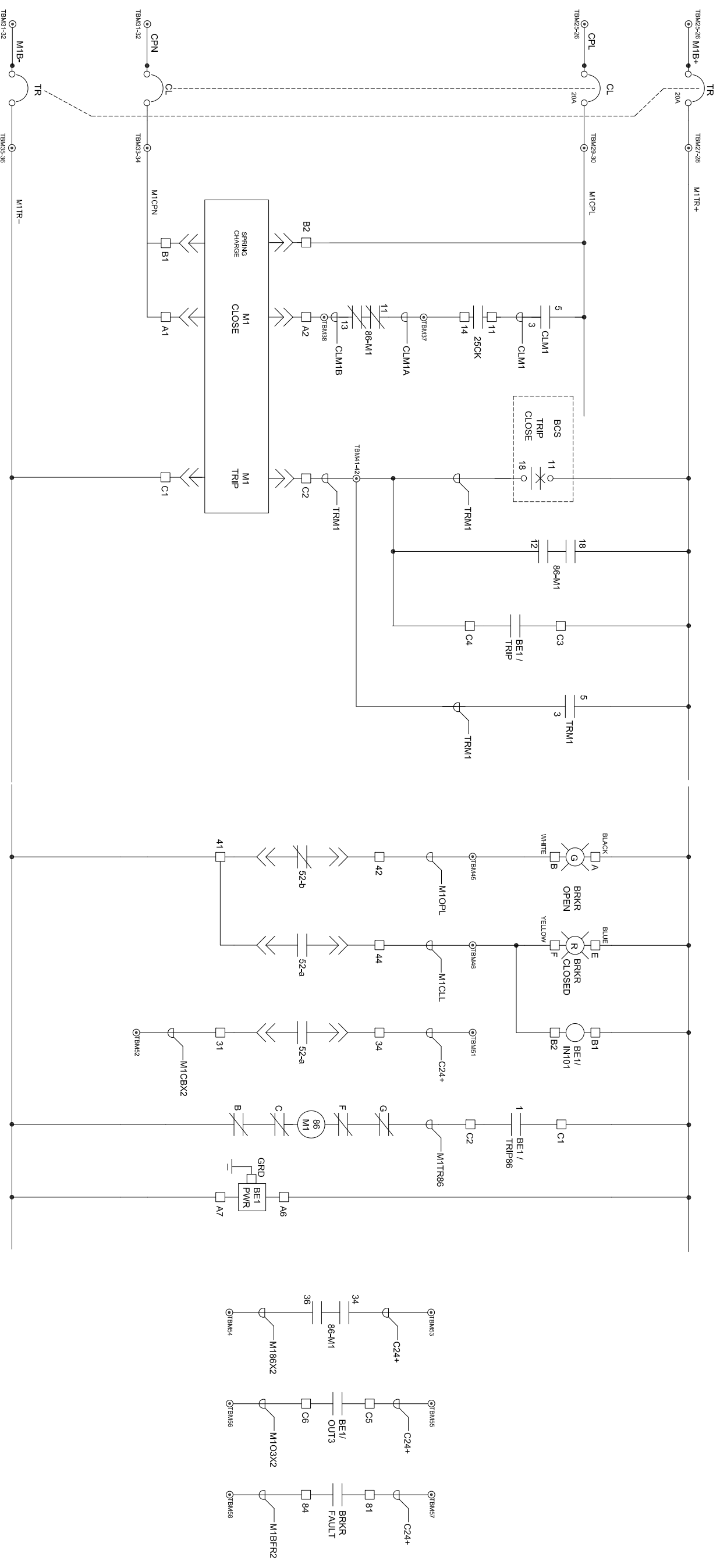
AUTHOR: RHP **DATE:** 1/25/2016

CLIENT:
DAVIDSON WATER
HYATTOWN PS

PROJECT:
POWER SYSTEM
CONTROL UPGRADES

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CONTROL CIRCUIT GENERATOR BREAKER 52-M1

- DRAWING NOTES:**
1. GENERATORS – CAT 3500 – DIESEL
 - 1875KVA / 480VAC
 2. GENERATOR IS SYNCHRONIZED ACROSS GENERATOR
 - DEV. 52 VIA DSIIC AND BE1 250K FUNCTION
 3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
 4. GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
 5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED
 - TO TDx

REV. NO.	DATE	REV BY	DESCRIPTION
0	1-22-16	RWP	ORIG ISSUE

DRAWING TITLE:
CIRCUIT BREAKER 52-M1
CONTROL

CLIENT:
DAVIDSON WATER
HYATTOWN PS

PROJECT:
POWER SYSTEM
CONTROL UPGRADES

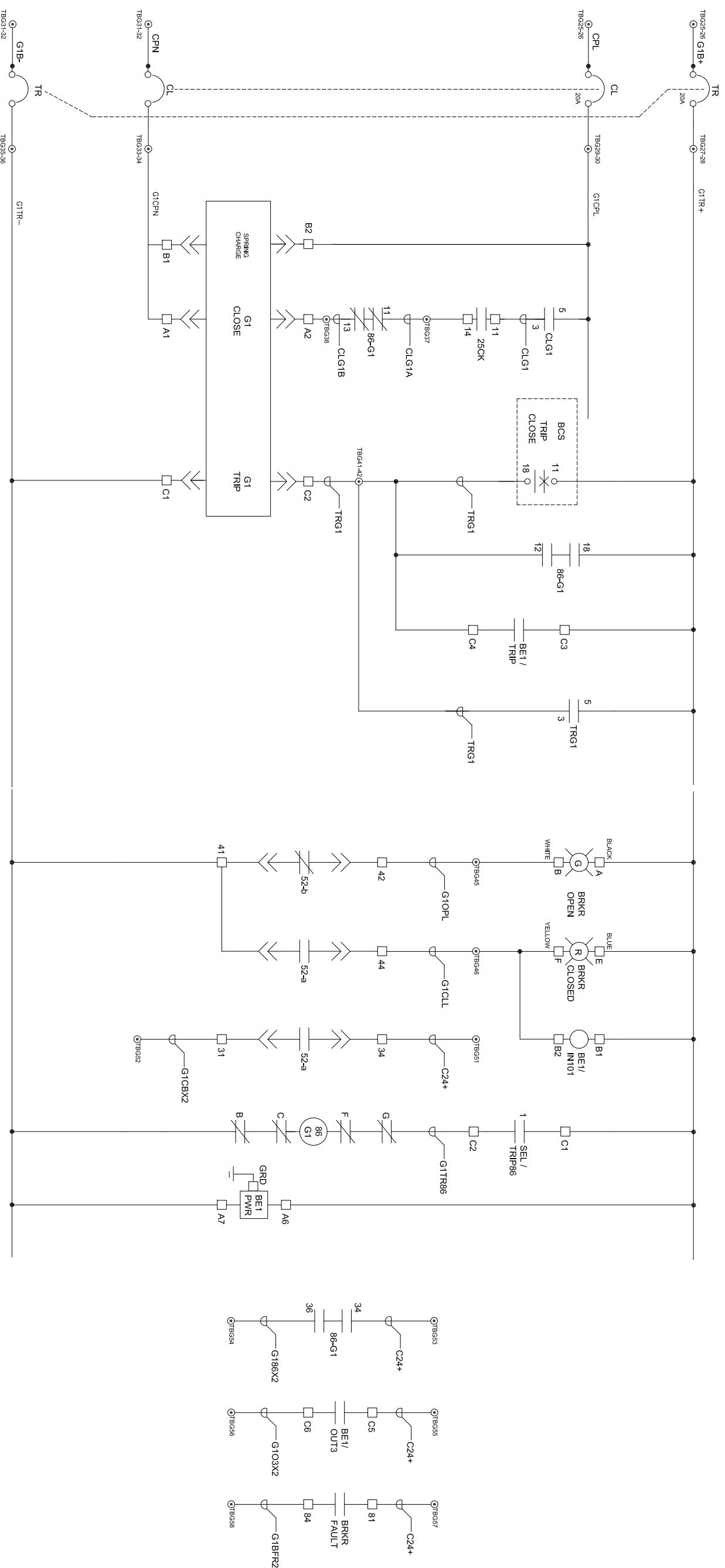
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TDx global llc
Engineering & Construction

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DRAWING NUMBER: SHEET NO.
225961-DWG-E-305

AUTHOR: RWP **DATE:** 01/22/2016



CONTROL CIRCUIT GENERATOR BREAKER 52-G1

- DRAWING NOTES:**
1. GENERATORS – CAT 3500 – DIESEL
1875KVA / 480VAC
 2. GENERATOR IS SYNCHRONIZED ACROSS GENERATOR
DEV. 52 VIA DSLC AND BE1 25CK FUNCTION
 3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
 4. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED
TO TDx

REV. NO.	DATE	REV BY	DESCRIPTION
0	1-22-16	RWP	ORIG ISSUE

DRAWING TITLE:
CIRCUIT BREAKER 52-G1
CONTROL

DRAWING NUMBER: SHEET NO.
225961-DWG-E-306

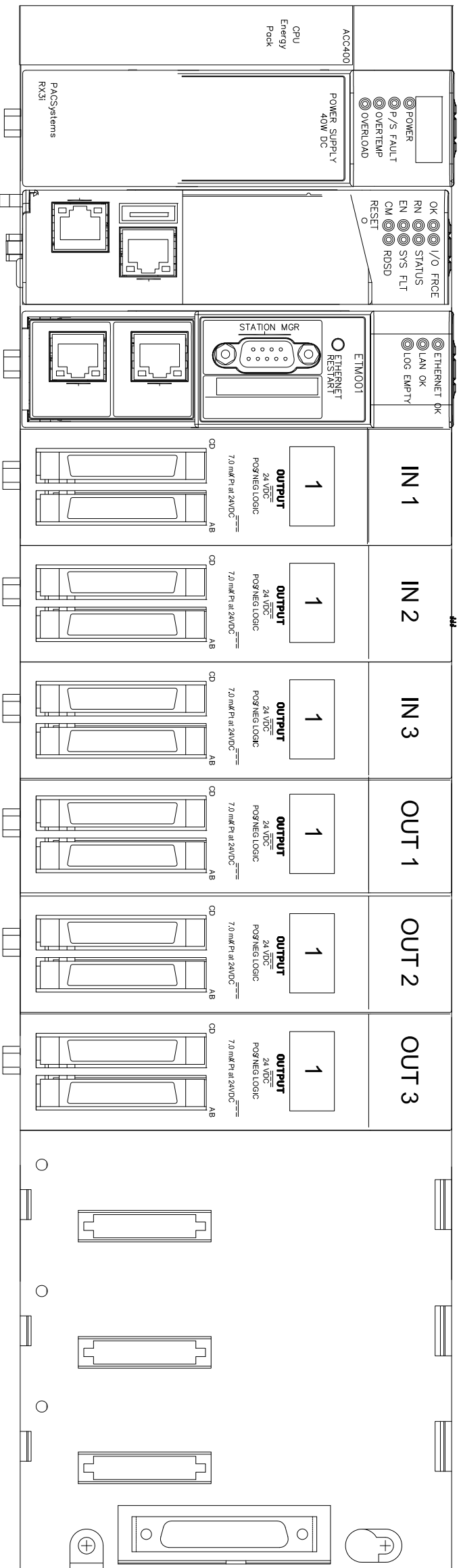
AUTHOR: RWP DATE: 01/22/2016

CLIENT:
DAVIDSON WATER
HYATTOWN PS

PROJECT:
POWER SYSTEM
CONTROL UPGRADES

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DRAWING NOTES:

1. GENERATOR- CAT 3500 - DIESEL #2 CAT 1875KVA / 4160VAC
2. GENERATOR IS SYNCHRONIZED ACROSS GENERATOR DEV. 52 VIA D5LC AND BET 250K FUNCTION
3. ALL RELAYS WILL BE UTILITY GRADE. SS/DO TYPE
4. GE RX3i PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO ID#

REV. NO. DATE REV BY DESCRIPTION

REV. NO.	DATE	REV BY	DESCRIPTION
0	2-7-16	RHP	Original Issue

DRAWING TITLE:

PLC RACK LAYOUT

CLIENT:

DAVIDSON WATER
HYATTOWN PS

PROJECT:

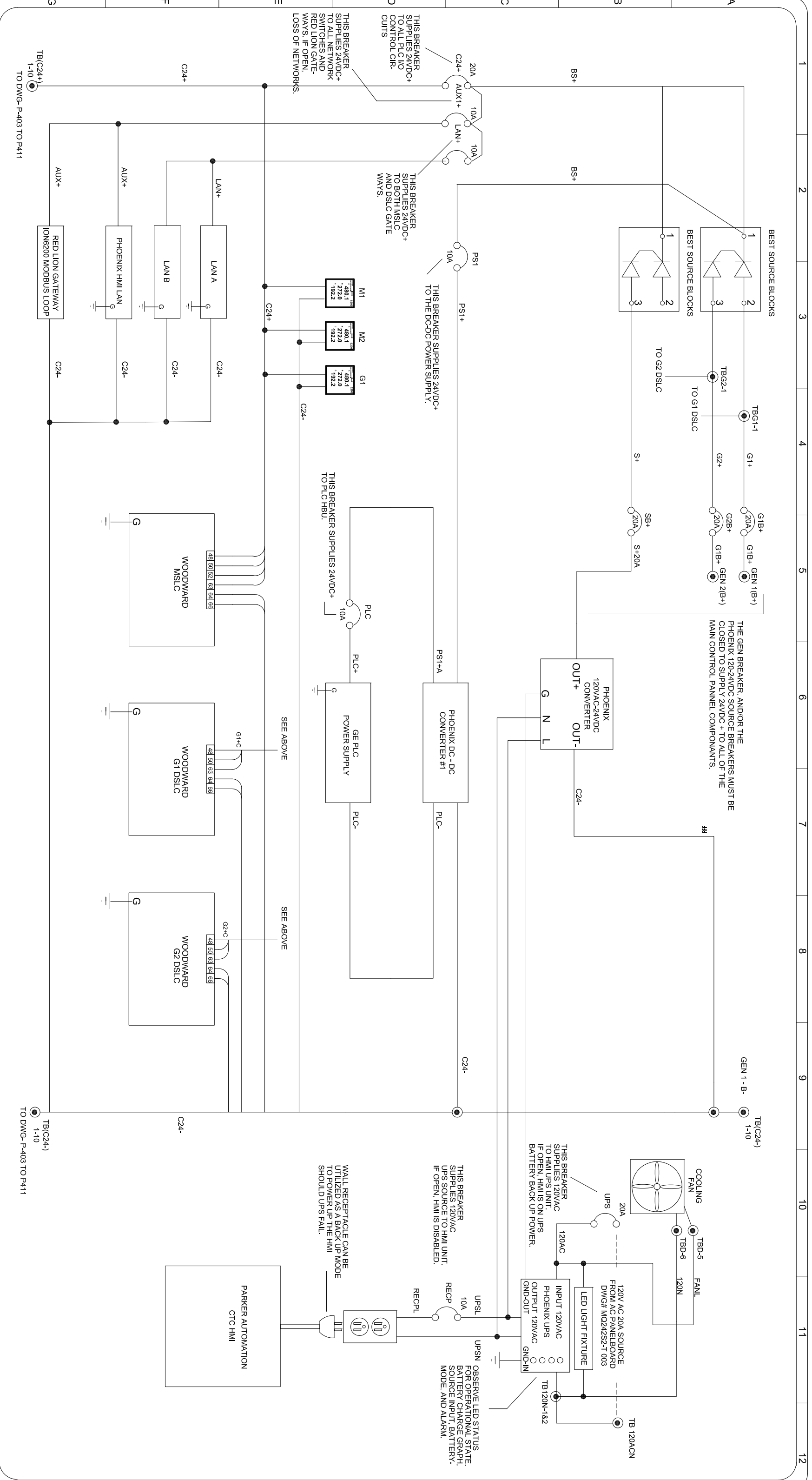
POWER SYSTEM
CONTROL UPGRADES



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DRAWING NUMBER: 225961-DWG-P-401
SHEET NO.
AUTHOR: RHP DATE: 2/07/2016



- DRAWING NOTES:**
1. GENERATOR- CAT 3500 - DIESEL #2 CAT 1875KVA / 480VAC
 2. GENERATOR IS SYNCHRONIZED ACROSS GENERATOR DEV. 52 VIA DSLC AND BET 250K FUNCTION
 3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
 4. GE RX3 PLC SUPERVISORY CONTROL OF SYSTEM
 5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO TX

REV. NO.	DATE	REV BY	DESCRIPTION
0	2-07-16	RWP	Original Issue

DRAWING TITLE:
**PLC AND COMMUNICATION
 DEVICE POWER CIRCUITS**

DRAWING NUMBER: 225961-DWG-P-402
SHEET NO.

AUTHOR: RWP **DATE:** 2/07/2016

CLIENT:
**DAVIDSON WATER
 HYATTOWN PS**

PROJECT:
**POWER SYSTEM
 CONTROL UPGRADES**

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 Anchorage, AK 99518

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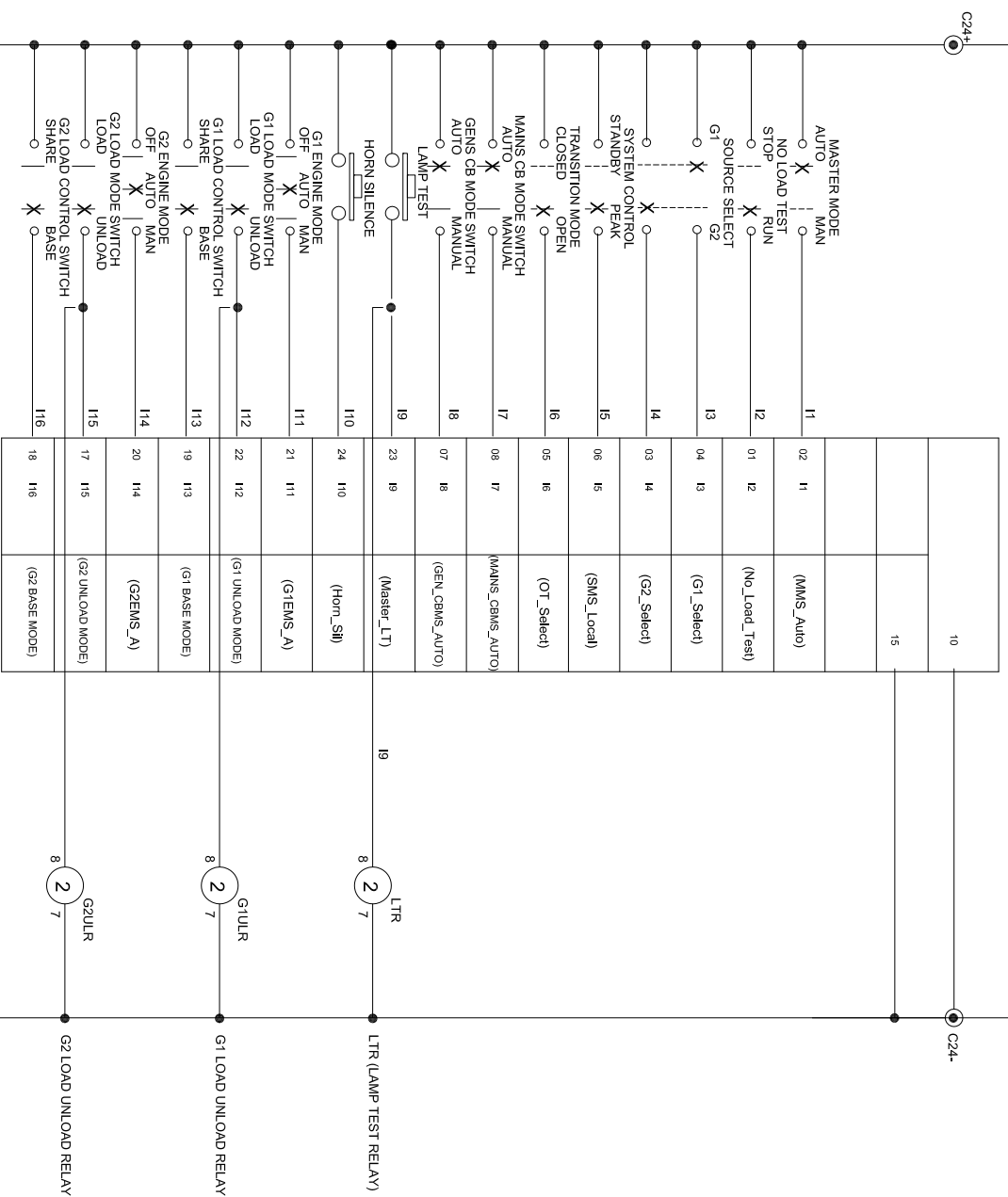
FROM SHEET 403

FROM SHEET 403

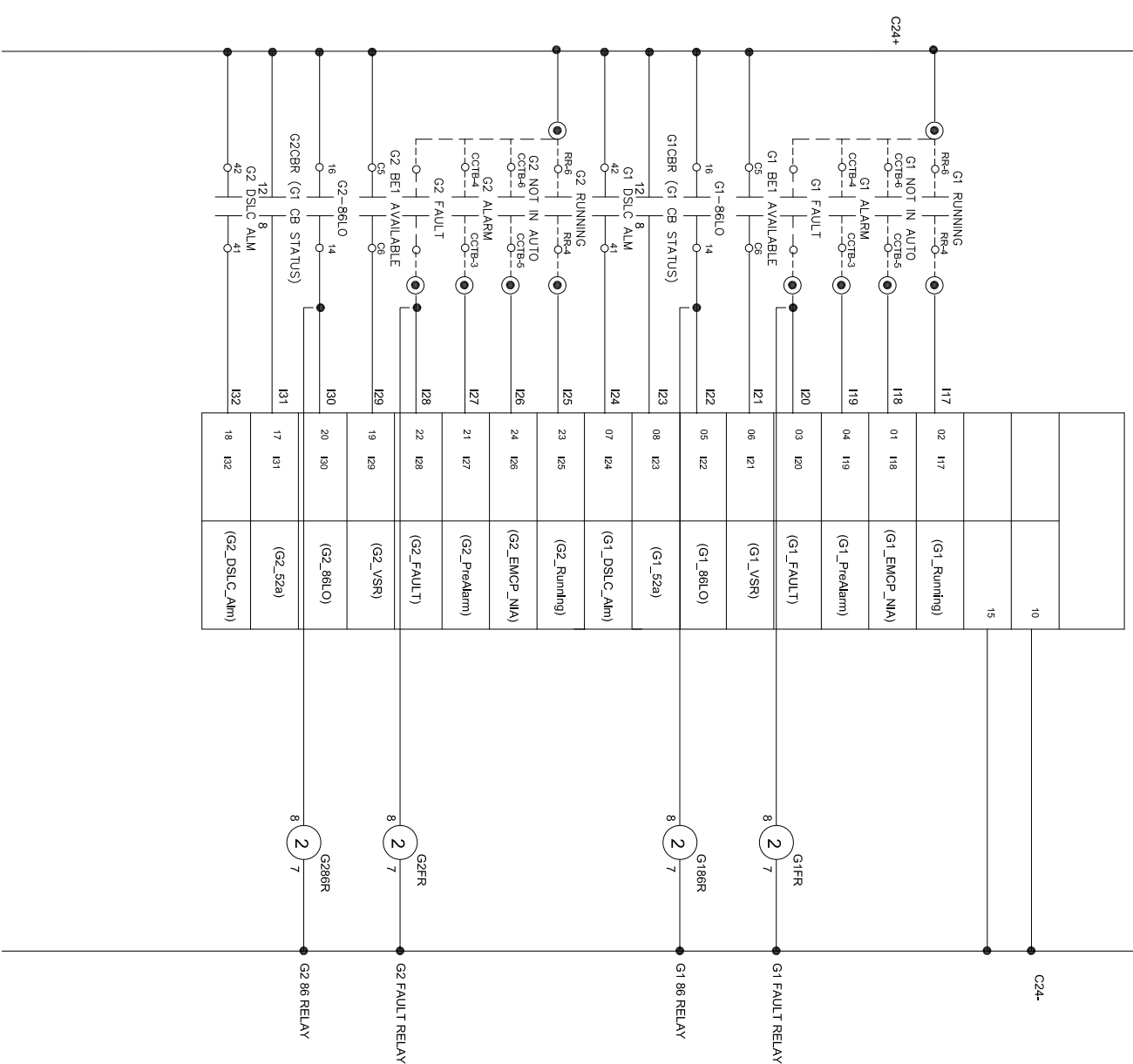
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**GE PLC SERIES RX3I
INPUT CARD 1AB**



**GE PLC SERIES RX3I
INPUT CARD 1CD**



8 2 7 = 2 POLE CONTROL RELAY

DRAWING NOTES:

1. GENERATORS – CAT 3500 – DIESEL #2 1875KVA / 480VAC
2. ALL GENERATORS ARE SYNCHRONIZED ACROSS GENERATOR
3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
4. GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO TDx

REV. NO.	DATE	REV BY	DESCRIPTION
0	2-19-16	RWP	Original Issue

DRAWING TITLE:

PLC INPUT CARD 1AB & 1CD

DRAWING NUMBER: SHEET NO.

225961-DWG-P-0403

AUTHOR: RWP DATE: 02/19/2016

CLIENT:

DAVIDSON WATER
HYATTOWN PS

PROJECT:

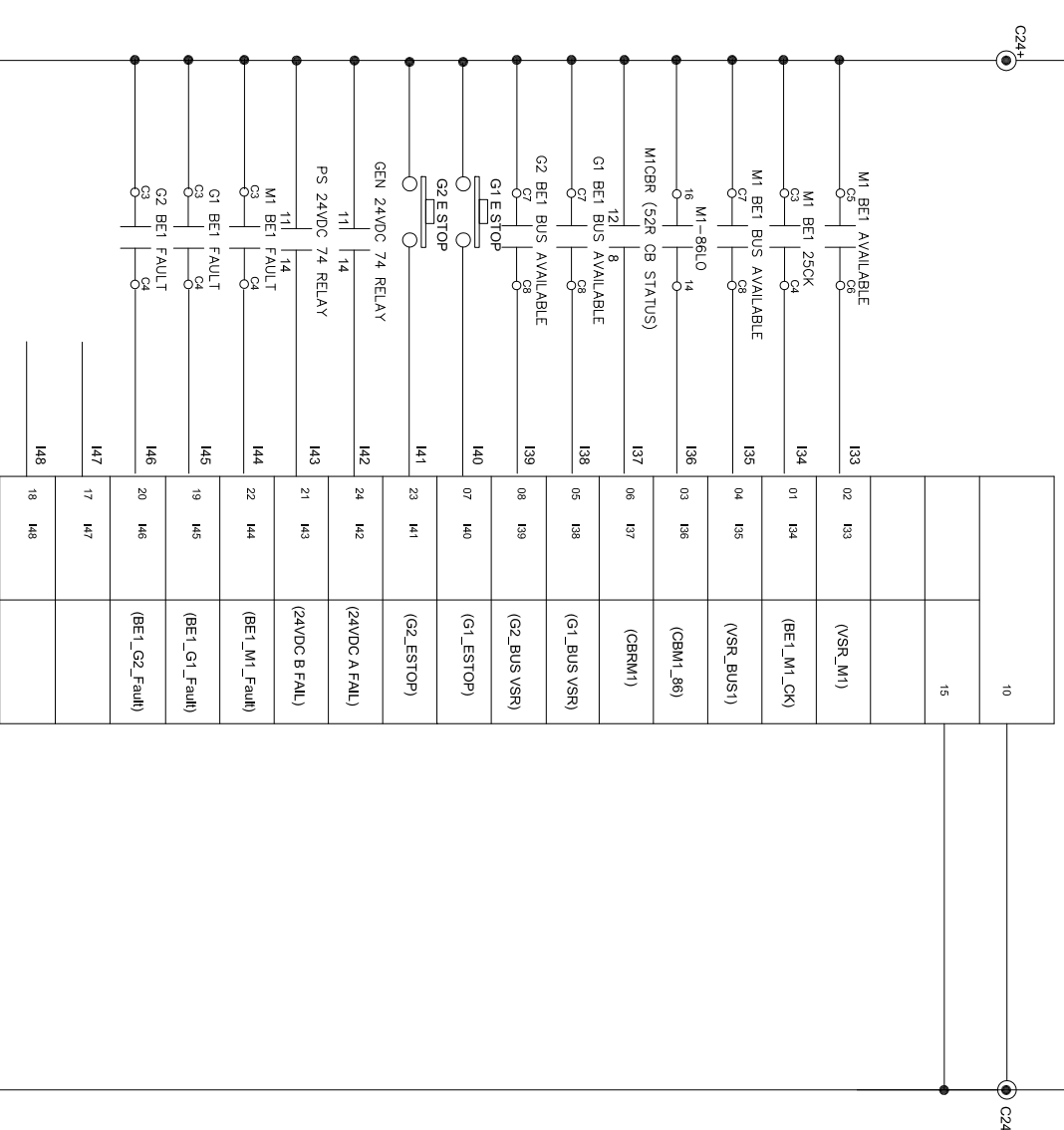
POWER SYSTEM
CONTROL UPGRADES



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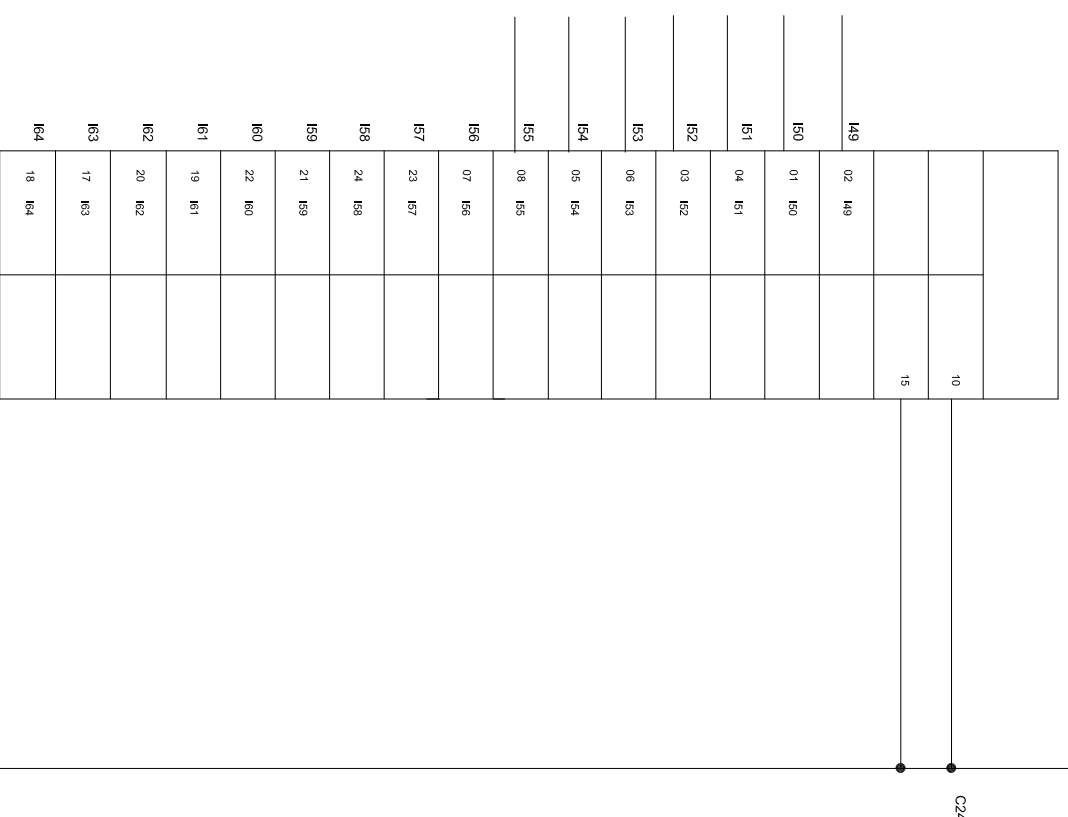
FROM SHEET 403
**GE PLC SERIES RX3I
 INPUT CARD 2 AB**



CONT TO RIGHT

FROM SHEET 403

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**GE PLC SERIES RX3I
 INPUT CARD 2CD**



CONT TO RIGHT

CONT'D FROM LEFT

DRAWING NOTES:

1. GENERATORS - CAT 3500 - DIESEL #2 1875KVA / 480VAC
2. ALL GENERATORS ARE SYNCHRONIZED ACROSS GENERATOR DEV. 52 VIA DISC AND BE1 250K FUNCTION
3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
4. GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO TDx

REV. NO. DATE REV BY DESCRIPTION

REV. NO.	DATE	REV BY	DESCRIPTION
0	1-19-16	RWP	Original Issue

DRAWING TITLE:

PLC INPUT CARD 2AB & 2CD

CLIENT:

DAVIDSON WATER
 HYATTOWN PS

PROJECT:

POWER SYSTEM
 CONTROL UPGRADES

DRAWING NUMBER: SHEET NO.

225961-DWG-P-0404

AUTHOR: RWP DATE: 01/19/2016



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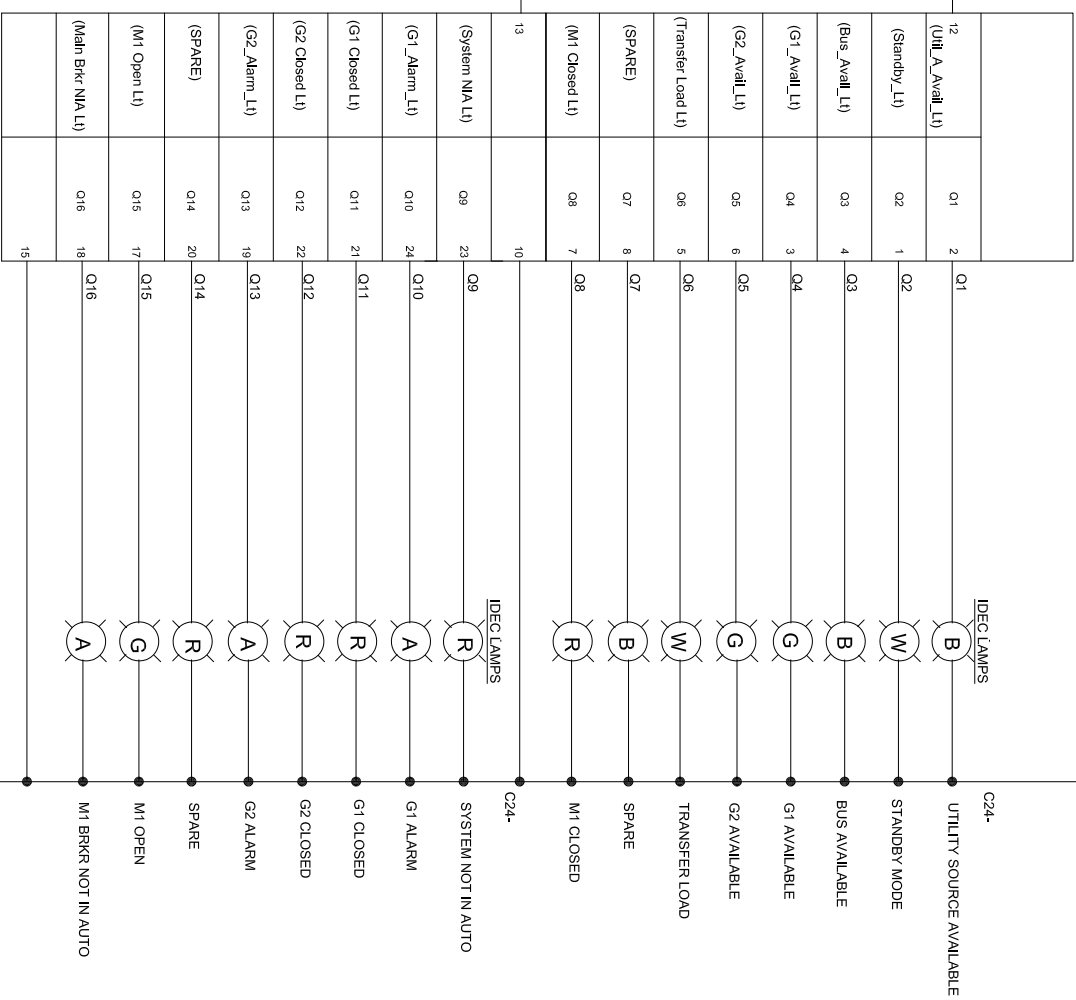
FROM SHEET 403

FROM SHEET 403

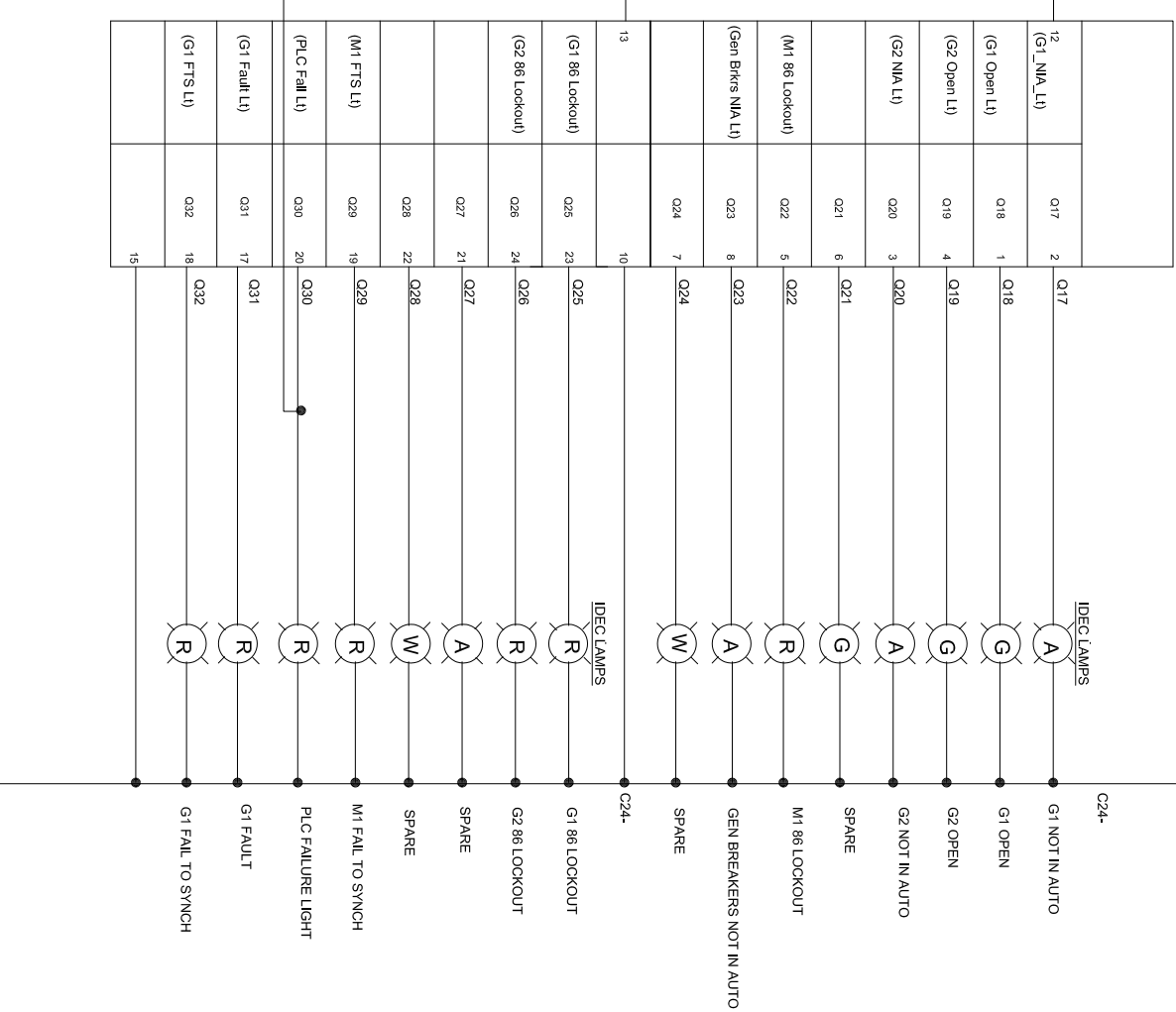
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CONT'D FROM LEFT

**GE PLC SERIES RX3I
OUTPUT CARD 1AB**



**GE PLC SERIES RX3I
OUTPUT CARD 1CD**



DRAWING NOTES:

1. GENERATORS – CAT 3500 – DIESEL #2 1875KVA / 480VAC
2. ALL GENERATORS ARE SYNCHRONIZED ACROSS GENERATOR DEV. 52 VIA DISC AND BE1 25CK FUNCTION
3. ALL RELAYS WILL BE UTILITY GRADE, SS/DO TYPE
4. GE RX3I PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO TDx

REV. NO. DATE REV BY DESCRIPTION

REV. NO.	DATE	REV BY	DESCRIPTION
0	1-21-16	RWP	Original Issue

DRAWING TITLE:

PLC OUTPUT CARD 1AB & 1CD

DRAWING NUMBER:

225961-DWG-P-0405

AUTHOR: RWP DATE: 01/21/2016

CLIENT:

DAVIDSON WATER
HYATTOWN PS

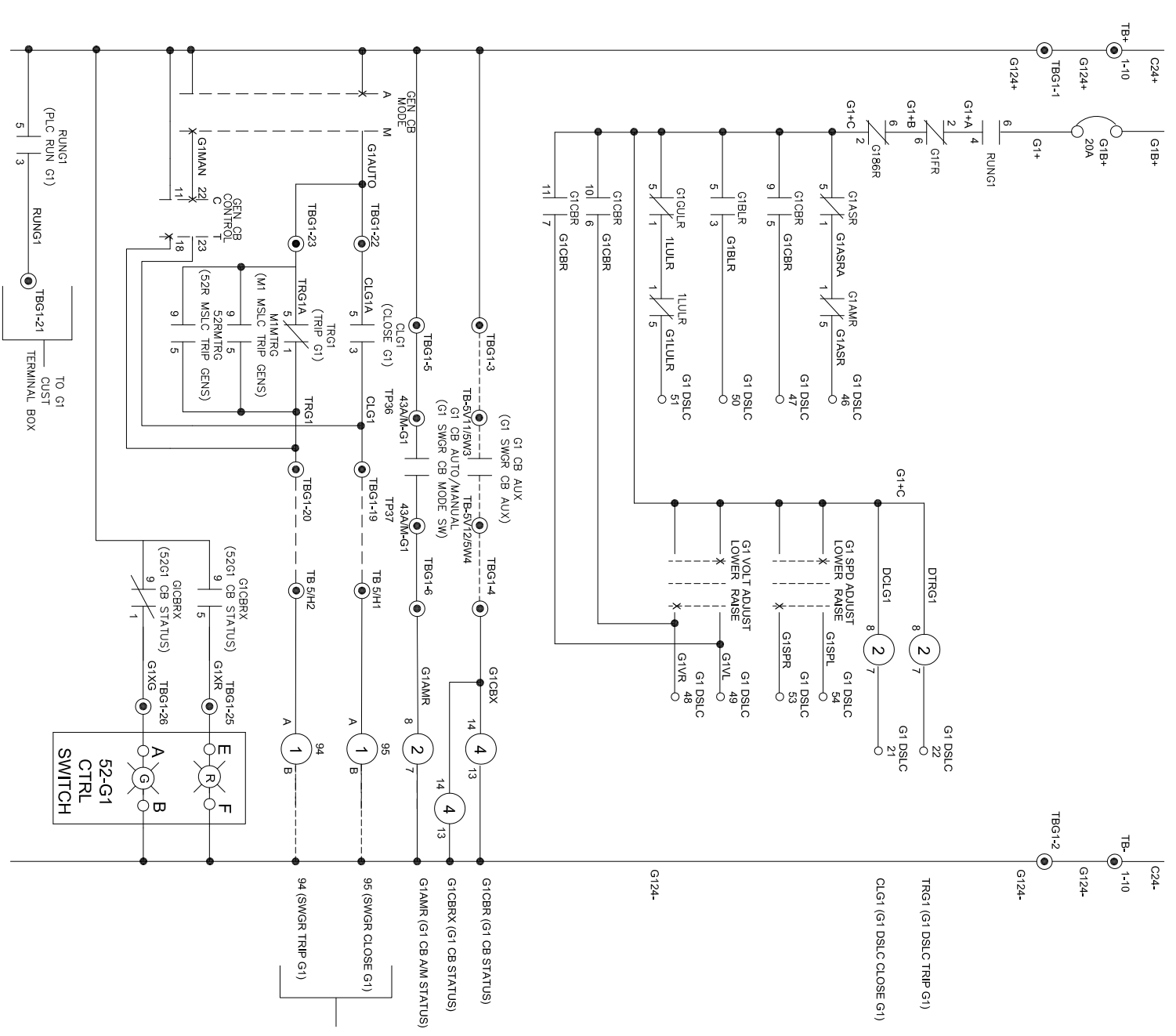
PROJECT:

POWER SYSTEM
CONTROL UPGRADES



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DRAWING NOTES:

1. GENERATORS – CAT 3500 – DIESEL #2 1875KVA / 480VAC
2. ALL GENERATORS ARE SYNCHRONIZED ACROSS GENERATOR DEV. 52 VIA DS/LC AND BE1 25CK FUNCTION
3. ALL RELAYS WILL BE UTILITY GRADE SS/DO TYPE
4. GE RX3 PLC SUPERVISORY CONTROL OF SYSTEM
5. ALL CT RATIOS ARE PER DOCUMENTS PROVIDED TO TX

- 2 = 2 POLE CONTROL RELAY
- 4 = 4 POLE CONTROL RELAY

REV. NO. DATE REV BY DESCRIPTION

REV. NO.	DATE	REV BY	DESCRIPTION
0	2-25-16	RWP	Original Issue

DRAWING TITLE:

PLC DC CONTROL G1

CLIENT:

DAVIDSON WATER
HYATTOWN PS

PROJECT:

POWER SYSTEM
CONTROL UPGRADES



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Anchorage, AK 99518

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DRAWING NUMBER: SHEET NO.
225961-DWG-P-0408

AUTHOR: RWP **DATE:** 02/25/2016

APPENDIX D

OWNER-FURNISHED BUTTERFLY VALVE INFORMATION



**DAVIDSON WATER, INC
HYATTOWN PUMPING STATION**

**BUTTERFLY VALVES
PROCUREMENT**

***PROCUREMENT DOCUMENTS & TECHNICAL
SPECIFICATIONS***

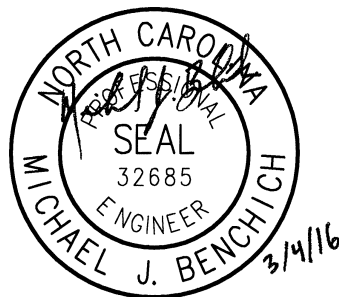


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01300 Submittals.....	01300-1 - 01300-3

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15100 Valve Operators	15100-1 – 15100-2
15101 Butterfly Valves	15101-1 – 15101-4

Drawings (Reduced Size)

Civil Yard Piping Plan	C13
------------------------------	-----

Davidson Water, Inc.

INVITATION TO BID

Hyatttown Pumping Station Butterfly Valves Procurement

March 4, 2016

Davidson Water, Inc. requests a quote/bid for the buried butterfly valves as indicated herein to be installed for the Hyatttown Pumping Station project under a separate contract.

Informal bids will be received by DAVIDSON WATER, INC., until Monday, March 15, 2016 at 4:30 PM. Bids may be **hand-delivered** to 7040 Old U.S. 52, Lexington, North Carolina, **faxed** to (336-731-3195), **emailed** to rwalters@davidsonwater.com or **mailed** to attention **Robert Walters** 7040 Old U.S. 52, Lexington, North Carolina 27295. Results will be faxed, emailed, or mailed after the bids are tabulated. Michael Benchich – mbenchich@hazenandsawyer.com, (704-941-6058), will answer technical questions.

All equipment shall comply with the specifications contained herein.

Immediately after receipt of notice to award, the Engineer and the Supplier will establish a mutually agreeable date on which the shop drawings will be reviewed.

All equipment shall be delivered no later than July 29, 2016.

Submit bid with the bid form provided. Bids shall not be conditional, limited, or restricted in any way.

Davidson Water, Inc. reserves the right to reject any or all proposals.

Robert Walters
Vice-President

Mailing Address
Davidson Water Inc.
P.O. Box 969
Welcome, NC 27374
Lexington (336) 731-2341
Winston-Salem (336) 764-2534
Thomasville (336) 475-8229



Shipping Address
Davidson Water Inc.
7040 Old Highway 52
Lexington, NC 27295
Water Plant (336) 787-5800
Office Fax (336) 731-3195
www.davidsonwater.com
email info@davidsonwater.com

BID SHEET
Hyattown Pumping Station Butterfly Valves Procurement

BID DATE: March 15, 2016

Total Bid Amount _____

Supplier/Company Name _____

Contact Name _____

Address _____

Contact Phone # _____

Signed by _____

Title _____

Anticipated Job Award Date: March 29, 2016

Equipment Delivery Date: July 29, 2016

AGREEMENT FOR SERVICES

Between

DAVIDSON WATER, INC.

And

For

Hyattown Pumping Station Butterfly Valves Procurement

THIS AGREEMENT by and between DAVIDSON WATER, INC., 7040 Old U.S. 52, Welcome, North Carolina (hereinafter "Owner") and

_____ ,
(hereinafter "Supplier"),

WHEREAS, Owner desires to purchase butterfly valves for the Hyattown Pumping Station as described in Section 01010 Summary of Work; and,

WHEREAS, Owner desires to engage Supplier to perform the services in order to complete the project as described herein;

NOW, THEREFORE, Owner and Supplier do mutually agree as follows:

ARTICLE I

Description of Project

Owner desires to purchase butterfly valves for the Hyattown Pumping Station.

ARTICLE II

Items to be provided by Supplier

Supplier shall furnish new butterfly valves, appurtenances, and specified field services after installation by Others.

ARTICLE III

Schedule of Performance by Supplier

The equipment to be provided under each this Agreement shall commence as directed by Owner. In the absence of further direction, valves shall be delivered to:

**Davidson Water, Inc.
7040 Old U.S. 52
Lexington, NC 27295**

On or Before:

July 29, 2016

ARTICLE IV
Compensation

For the services rendered under Article II and the project described under Article I, the Supplier shall be compensated as indicated on the **Bid Sheet**.

ARTICLE V
Payment for Services

Partial payments shall be made to Supplier as follows:

- After approval of shop drawings 30 percent
- After delivery 60 percent
- After installation by others and successful testing 10 percent

Supplier shall submit written statements requesting payment, supplemented or accompanied by such data as may be required by Owner or its engineers or consultants. Owner shall submit such written requests for payment to its Board of Directors for payment approval or disapproval within thirty (30) calendar days after receipt. Upon Board approval of such payment requested by Supplier, payment shall be made by Owner to Supplier within Fifteen (15) calendar days.

If a dispute arises as to payment, the dispute will be reviewed by both parties, and if a resolution cannot be reached, Owner and Supplier agree to submit such dispute to mediation (utilizing a mutually agreed upon mediator certified by and through the Superior Courts of North Carolina) in an attempt to settle the matter prior to the institution of legal action in a court of competent jurisdiction.

ARTICLE VI
Supplier's Personnel and Facilities

The Supplier now has or will secure at its expense, including sub-consultants, all personnel and facilities required to perform the services to be rendered under this Agreement. Such personnel are not employees of, nor do they have any contractual relationship with the Owner.

ARTICLE VII
Responsibilities of Owner

It is understood that certain services will be performed and/or furnished by Others. These services include the following:

- 1. Owner will take delivery and unload and store the equipment.**
- 2. Installation of the equipment will be performed by Others under a separate contract.**

ARTICLE VIII
Assignment of Agreement

Neither the Owner nor the Supplier will assign, sublet, or transfer their interest, duties, or obligations under this Agreement without the prior written consent of the other party. Nothing

herein shall be construed as creating any personal liability on the part of any officer, director, or agent of any party hereto, nor shall it create any rights or benefits to parties other than the Owner and the Supplier, except such other rights as may be specifically called for herein.

ARTICLE IX
Equal Employment Opportunity

During the performance of this contract, Supplier agrees as follows:

1. The Supplier will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age, handicap, or veteran status. The Supplier will take affirmative action to insure that applicants are employed that employees are treated during employment without regard to race, color, religion, sex, national origin, age, handicap, or veteran status. The Supplier agrees to post in conspicuous places, available to employees and applicants for employment, notices setting for the provisions for this non-discrimination clause.

2. The Supplier will, in solicitations or advertisement for employees placed by or on behalf of the Supplier, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, national origin, age, handicap, or veteran status.

3. In the event of Supplier's non-compliance with the non-discrimination clauses of this Agreement or with any such rules, regulations, or order, this Agreement may be cancelled, terminated, or suspended in whole or in part, and the Supplier may be declared ineligible for further Owner contracts.

ARTICLE X
Termination of Contract

This Agreement may be terminated by either party upon thirty (30) days' written notice in the event of substantial failure to perform in accordance with the terms hereof by the other party through no fault of the terminating party. If this Agreement is so terminated, the Supplier will be paid for services rendered through the date of such termination, as mutually agreed upon between the parties hereto, provided that all such services to date have been rendered in substantial compliance with the terms of this Agreement.

ARTICLE XI
Standard of Care

Supplier shall perform for or furnish to Owner work and related services in all phases of the project to which this Agreement applies as hereinafter provided. The standard of care for all work and related services performed or furnished by Supplier under this Agreement will be the care and skill ordinarily used by Suppliers working or rendering services under similar conditions at the same time and in the same locality. All work or services performed shall be done in a good and workmanlike manner in accordance with such standard of care.

ARTICLE XII
Indemnification

To the fullest extent permitted by law, Supplier shall defend, indemnify and hold harmless Owner, its engineers, agents, employees, officers and board members from and against all claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or relating from the performance of the work described herein provided that any such claims, damage, loss or expense is caused in whole or in part by any negligent act or omission of the Supplier, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by the Owner. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist to any party or person described in this paragraph.

Supplier's indemnification and defense obligations hereunder shall extend to Claims occurring after this Agreement is terminated as well as while it is in force, and shall continue until it is finally adjudicated that any and all actions against the Indemnified Parties for such matters which are indemnified hereunder are fully and finally barred by applicable laws.

ARTICLE XIII
Applicable Law

This Agreement, including but not limited to the interpretation thereof and the rights and remedies of the parties hereunder, shall be governed by the laws of the State of North Carolina. Except as this Agreement otherwise provides, all claims, counterclaims, disputes, and other matters in question between the Owner and Supplier arising out of, or relating to this Agreement or the breach of it, will be decided by resort to a court of competent jurisdiction within the State of North Carolina unless alternate means of dispute resolution are mutually agreed upon by the parties hereto.

ARTICLE XIV
Entire Agreement

The Agreement entered into by the Owner and Supplier consists entirely of the following documents attached hereto and shall not be modified except in writing and signed by authorized representatives of both parties.

- Agreement
- Invitation to Bid
- Bid Sheet
- Specification Section 01010 – Summary of Work
- Specification Section 01300 – Submittals
- Specification Section 15095 – Valves, General
- Specification Section 15100 – Valve Operators
- Specification Section 15101 – Butterfly Valves

IN WITNESS WHEREOF, the parties hereto have made and executed this Agreement the day and year indicated herein:

OWNER:
DAVIDSON WATER, INC.

Robert Walters, Vice President (Seal)

SUPPLIER:

Owner (Seal)

NORTH CAROLINA
COUNTY OF DAVIDSON

I, _____, Notary Public, certify that _____ first came before me this day and acknowledged that he is Vice President of Davidson Water, Inc., a corporation, and that he as Vice President being authorized to do so, executed the foregoing on behalf of the corporation.

Witness my hand and notarial seal, this the ____ day of _____, 20__.

My commission expires: _____
Notary Public

NORTH CAROLINA
COUNTY OF _____

I, _____, Notary Public, certify that _____ first came before me this day and acknowledged that he is President of _____, a corporation, and that he as President being authorized to do so, executed the foregoing on behalf of the corporation.

Witness my hand and notarial seal, this the ____ day of _____, 20__.

My commission expires: _____
Notary Public

SECTION 01010
SUMMARY OF WORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The work includes furnishing twelve (12) 24" and six (6) 36" butterfly valves for the Hyattown Pumping Station, including extension stems, operating nuts, valve boxes, joint restraining devices, and all other appurtenances required for complete and operable installation.
- B. The Supplier shall provide submittals, shop testing, and field services in coordination with installation activities by others. Refer to the technical specifications in Division 15 for detailed scope of services to be provided and equipment specifications.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

- END OF SECTION -

SECTION 01300

SUBMITTALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Shop Drawings

1. Supplier shall submit for review by the Owner Shop Drawings for all manufactured items.
2. 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.
3. Supplier Responsibilities
 - a. Supplier shall thoroughly check all Drawings for accuracy and conformance to the intent of the Procurement Documents. Drawings found to be inaccurate or otherwise in error shall be returned to the Supplier for correction before submitting them to the Owner.
 - b. All submittals shall be bound, dated, properly labeled and consecutively numbered. Information on the label shall indicate Specification Section, Drawing number, 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.
 - e. ALL SUBMITTALS SHALL BE THOROUGHLY CHECKED BY THE SUPPLIER FOR ACCURACY AND CONFORMANCE TO THE INTENT OF THE PROCUREMENT DOCUMENTS BEFORE BEING SUBMITTED TO THE OWNER AND SHALL BEAR THE SUPPLIER'S STAMP OF APPROVAL CERTIFYING THAT THEY HAVE BEEN SO CHECKED. SUBMITTALS WITHOUT THE SUPPLIER'S STAMP OF APPROVAL WILL NOT BE REVIEWED BY THE OWNER AND WILL BE RETURNED TO THE SUPPLIER.
 - f. If the submittals contain any departures from the Procurement Documents, specific mention thereof shall be made in the Supplier'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 Owner returns to the Supplier 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 Owner 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 Owner's prior review of the submittals does not relieve the Supplier 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 Owner at least five (5) working days for review and processing.
 - b. Supplier shall transmit five (5) 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 Owner in one of the following ways:
 - "Furnish as Submitted" (FAS) - no exceptions are taken
 - "Furnish as Corrected" (FAC) - minor corrections are noted and shall be made.
 - "Furnish as Corrected – Confirm" (FACC) - some corrections are noted and a partial resubmittal or additional information are required as specifically requested.
 - "Revise and Resubmit" (R&R) - major corrections are noted and a full resubmittal is required.
 - "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 Owner in full or in part, the Owner 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 Supplier. If reproducible transparencies are submitted, the Owner will retain the copies and return the reproducible transparencies to the Supplier. 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 Owner will annotate the submittal "Revise and Resubmit" and transmit three (3) copies to the Supplier for appropriate action. If reproducible transparencies are submitted, the Owner will retain the copies and return the reproducible transparencies to the Supplier.
- g. Supplier 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 Owner until submittals are acceptable to the Owner.
- h. Acceptance of a Working Drawing by the Owner 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. Owner's Review

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

B. Operation and Maintenance Manuals

- 1. Refer to Section 15095.

E. Certified Shop Test Reports

- 1. Refer to Section 15095.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 15095
VALVES, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Supplier shall furnish, complete with all assemblies and accessories, all valves listed in the valve schedule contained herein and as specified herein.
- 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. All valves 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. For the purposes of this Section, "Supplier" shall mean the designer, manufacturer, supplier and tester of the furnished valves. The Supplier shall be have sole-source unit responsibility for the design, coordination, installation, testing, and satisfactory performance of all the components.
- E. For the purposes of this Section, "Installation Contractor" shall mean the construction contractor retained by the Owner to construct the Hyattown Pumping Station who will incorporate and install the equipment furnished by the Supplier.

1.02 SUBMITTALS

- A. Each submittal shall be transmitted with five (5) copies, and be submitted as a single complete package for the pumping equipment, including all ancillary components, by the Supplier.
- B. Submit Performance Affidavit for pumping equipment being furnished.
 - 1. By these affidavits, the Supplier must certify to the Owner that he has examined the specifications accompanying the Owner's purchase order and that the valves he offers to furnish will meet in every way the performance requirements set forth or implied in the specifications.
 - 2. Transmit three (3) original copies of the affidavit along with the initial shop drawings.
 - 3. The Performance Affidavit shall be signed by an officer of the Supplier and witnessed by a notary public.
 - 4. The Performance Affidavit shall have the following format:

Addressed to: Davidson Water, Incorporated

Reference: Hyattown Pumping Station

Text: (Supplier's Name) has examined the specifications accompanying Purchase Order No. _____ from Davidson Water, Incorporated, and hereby states that the valves and appurtenances meet in every way the performance requirements set forth or implied therein.

Signature: Corporate Officers shall be Vice President or higher, unless statement authorizing signature is attached.

- C. Shop Drawings are required for all valves. Submittals shall include all layout dimensions, size and materials of construction for all components, weights, protection coating, actuator description/weight, actuator torque calculations, information on support and anchoring where necessary, hydraulic characteristics, recommended spare parts, and complete descriptive information to demonstrate full compliance with the Documents.
- D. Submit results of shop tests.
- E. Submit ANSI/NSF 61 certifications for all valve components and coatings which will be in contact with potable water.
- F. Submit 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 Owner prior to the delivery of the respective equipment.
 - 2. The preliminary manuals shall be reviewed by the Owner prior to the Supplier submitting final copies. Following review of the preliminary copies of the Operation and Maintenance Manuals, one (1) copy will be returned to the Supplier with required revisions noted, or the acceptance of the Owner 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 Supplier contact information.
 - 5. 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 Owner's review of the preliminary manuals, the Supplier shall submit five (5) paper copies and one (1) electronic copy of the final Operation and Maintenance Manuals to the Owner. The manuals shall reflect the required revisions

noted during the Owner's review of the preliminary documents. Failure of the final manuals to reflect the required revisions noted by the Owner during a review of the Preliminary documents will result in the manuals being returned to the Supplier. Acceptable final Operation and Maintenance Manuals shall be provided not less than two weeks prior to equipment start-up.

1.03 EQUIPMENT WARRANTY

- A. The valves and appurtenances furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of two (2) years 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 Supplier'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 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.

1.04 VALVE SCHEDULE

Quantity	Type	Service	Size	AWWA C504 Classification	Maximum Differential Pressure (psi)	Maximum Flow (gpm)	Installation Description
6	Butterfly	Potable Water	36"	250B	250	10,000	Buried with extension stem and valve box
12	Butterfly	Potable Water	24"	250B	250	10,000	Buried with extension stem and valve box

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All valves will be used for potable water service. All valve products, components, accessories, and coatings shall be ANSI/NSF 61 approved.
- B. Valves shall have the name of the maker, nominal size, working pressure for which they are designed, and standard to which they are manufactured cast in raised letter on some appropriate part of the body.
- C. Unless noted otherwise on the Drawings, valves shall be of the same nominal diameter and be subjected to the same test pressure as the pipe for fittings to which they are connected.

- D. Special tools and the Supplier's standard stock of spare parts, if required for normal operation and maintenance of the valve, shall be supplied with each distinct type or size of valve.
- E. Refer to Section 15100 for specifications for valve operators.

2.02 VALVE BOXES

- A. The Supplier shall furnish a valve box as specified herein for each valve supplied for buried service.
- B. 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.

2.03 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Spare parts for valves and appurtenances shall be furnished where indicated in Section 15101.
- 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.
- F. The Supplier shall furnish all special tools necessary to operate, disassemble, service, repair, and adjust the equipment in accordance with the Supplier's operation and maintenance manual.
- G. The Supplier shall furnish a one year supply of all recommended lubricating oils and greases. The Supplier shall submit a list of at least four standard lubricants which may be used interchangeably for each type of lubricant required.

2.04 JOINT RESTRAINING DEVICES

- A. The Supplier shall furnish two (2) joint restraining devices for each valve furnished.
- B. The joint restraining devices shall be Series 1100 MegaLug® by EBAA Iron, Inc. or equal product from Sigma Corporation or Star Pipe Products.
- C. Each joint restraining device shall match in size the valve for which it is furnished and shall include all materials and components required for installation including the follower gland, bolts, and gaskets.

PART 3 -- EXECUTION

3.01 SHOP TESTING

A. Shop 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 Supplier shall submit certified copies of the reports covering the test for acceptance by the Owner.
2. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
3. Refer to Section 15101 for specific shop tests required.

3.02 SUPPLIER'S FIELD SERVICES

A. The Supplier's Technical Representative shall provide the following services in coordination with Installation Contractor's work.

1. Installation: The Technical Representative shall supervise installation and inspect the installed equipment to verify that installation is in accordance with the Supplier's requirements. A minimum of two (2) non-consecutive 8-hour days shall be provided on-site.
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 Installation Contractors contract and is ready for startup and that nothing in the installation will render the Supplier'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 Installation Contractor. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment is installed properly and is ready for permanent operation and that nothing in the installation will render the Supplier'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 Supplier 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.

- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Supplier.
- C. A written report covering the representative's findings and installation approval shall be mailed directly to the Owner 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 Supplier of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

- END OF SECTION -

SECTION 15100
VALVE OPERATORS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Equipment shall be provided in accordance with the requirements of Section 15095.
- B. Valve operators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.
- C. For the purposes of this Section, "Supplier" shall mean the designer, manufacturer, supplier, and tester of the valves for which the operators specified herein will be used.
- D. For the purposes of this Section, "Installation Contractor" shall mean the construction contractor retained by the Owner to construct the Hyattown Pumping Station which will incorporate the valve operators specified herein.
- E. The valve operators shall be the full and undivided responsibility of the Supplier in order to ensure complete coordination of the components and to provide single unit responsibility.

1.02 SUBMITTALS

- A. Submit information on valve operators with valve shop drawings per the requirements of Section 15095.

PART 2 -- PRODUCTS

2.01 MANUAL OPERATORS

- A. All valves shall be equipped with geared nut operators, conservatively sized extended stems, and valve boxes. Where the depth of the operating nut is more than 4 feet below finish grade, a valve operator extension shall be provided to bring the operating nut to within 18-24 inches of the surface.
- B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.
- C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.
- D. Design pressures for sizing of valve operators shall be the same as the design pressure for the valves as specified in Section 15101.
- E. Nut operators shall have standard 2-inch square AWWA operating nuts designed in accordance with AWWA C504-94.

- F. Operators shall be of the worm gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.
- G. Operators on below grade valves shall be permanently lubricated and watertight under an external water pressure of 10 psi.
- H. Valve actuators shall be factory coated in accordance with the Supplier's standard paint system.

PART 3 -- EXECUTION

3.01 SUPPLIER'S FIELD SERVICES

- A. See Section 15095.

- END OF SECTION -

SECTION 15101
BUTTERFLY VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all butterfly valves shown indicated in the valve schedule in Section 15095 in accordance with the specifications herein.

1.02 SUBMITTALS

- A. Submit Shop Drawings and Performance Affidavit in accordance with the submittal requirements specified in Section 15095.
- B. Shop Drawings shall include end clearance dimensions when the disc is in the full open position.

PART 2 -- PRODUCTS

2.01 BUTTERFLY VALVES

- A. Acceptable manufacturers shall be DeZurik, Golden Anderson, Mueller, Pratt, and Val-Matic.
- B. Butterfly valves shall be of the rubber-seated, tight-closing type conforming to the latest revision of AWWA C504 and ANSI/NSF 61. Valves shall be bubble tight at rated pressures and flow velocities in either direction, be satisfactory for applications involving shutoff, throttling and modulating service, and capable of being actuated after a period of inactivity of 12 months.
- C. Butterfly valves shall be AWWA C504 Class 250B and of the short body design with AWWA C110 and AWWA C111 mechanical joints.
- D. Valves shall be suitable for potable water service, containing free and/or combined chlorine (chloramines).
- E. Valves shall be designed for a flow range of 0 – 10,000 gpm.
- F. Operators shall be sized for flow velocity direction as indicated on Drawings.
- G. Valve bodies shall be epoxy coated cast iron conforming to ASTM A-126, Grade B; ASTM A-48, Class 40; or Ductile Iron ASTM A536, Grade 65-45-12. Where required to meet design operating conditions, valve bodies shall be manufactured of higher strength materials. Valve bodies shall have integral hubs for housing shaft bearings and seals. Valves shall have the name of the manufacturer, nominal size, working pressure for which they are designed and standard to which they are manufactured cast in raised letters on the valve body.

- H. Valve discs shall be constructed of epoxy coated ductile iron meeting the materials requirements of the valve bodies. Discs shall provide a full 360 degree seating surface with no external ribs transverse to flow, and shall comply with the latest revision of AWWA C504 Specifications. The disc shall not have any hollow chambers that can entrap water. All surfaces shall be visually inspected and measurable to assure all structural members are at full disc strength.
- I. The resilient seat shall be synthetic rubber and be suitable for bi-directional shut-off at the rated pressures. The seats shall be factory tested as per AWWA C504 at a test pressure of 250 psig and post adjusted for differential pressures specified herein.
- J. The resilient seat shall be mechanically attached to the valve disc or valve body. Any required seat attachment hardware shall be stainless steel. The resilient seat shall be capable of being adjusted or replaced in the field without moving the valve disc along the shaft axis, or removing the valve from the line. The mating seat surface shall be stainless steel or monel.
- K. Valve shafts shall be turned, ground, and polished, one-piece or two-piece units of ASTM A-276 type 304 or 316 stainless steel; ASTM A564 type 630 or XM25, and shall be of a diameter not less than those listed in AWWA C504-06, Class 250B. Shafts shall be suitably sized with a factor of safety to transmit the torque required to operate the valve. The use of shafts having a hexagonal cross section will not be acceptable. Shafts shall be securely attached to valve disc by means of conservatively sized type 316 stainless steel taper pins, threaded at one end and secured with lockwashers and nuts (i.e. mechanically attached). Provide O-ring seal on taper pin if required to prevent leakage. Shafts shall be keyed for actuator connection. Keys shall be corrosion-resistant material. The use of set screws or other devices instead of the pins specified herein shall not be allowed.
- L. Shaft bearings shall be contained in the integral hubs of the valve body and shall be the permanently self-lubricated, corrosion resistant, sleeve type of teflon or heavy-duty bronze. Bearing load shall not exceed 1/5 of the compressible strength of the bearing or shaft material. The valve assembly shall be furnished with a factory set two-way thrust bearing designed to center the valve disc in the valve seat at all times. End cover bolts shall be type 316 stainless steel.
- M. Shaft seals shall be stuffing box pulldown or removable bronze cartridge type.
 - 1. The shaft seal shall be of the type utilizing a stuffing box and pulldown packing gland. Packing shall be GARLOCK, Chevron Style 432, or equal. It shall be self-adjusting, self-compensating type. Butterfly valves with pull down packings shall be designed with an extension bonnet so that repacking can be done without removal of the actuator or disturbing any part of the valve or operator assembly, except the packing gland follower. For buried valves with pull down packing the packing gland cover assembly shall be heavy duty, soil and water resistant. Stuffing boxes for pull down packing shall have a depth sufficient to accept at least four rings of self-compensating type packing specifically selected for the operating pressures to be encountered. Stuffing box bolts, studs and nuts shall be type 316 stainless steel.

2. The shaft seal shall be contained in a removable bronze cartridge. The bronze cartridge shall be manufactured from ASTM B505 copper alloy UNS #C93200 and shall meet the requirements of AWWA C504 for bronze, Grade E. The "O" ring material shall be nitrile, BUNA-N rubber, as intended for use with potable water or wastewater and per ASTM D-2000 with a hardness of 70 Shore A Durometer.
- N. Material Quality: Minimum quality standards for valve components shall comply with MSS SP-55. Materials of construction shall be clean and free from defects that would weaken the structural integrity of the valve or affect the ability of the valve to withstand hydraulic pressure over the life of the valve. Surface defects greater than 1/8 inch in any direction and 1/8th of wall thickness will not be acceptable. Indication of shrinkage, cracks, hot tears, sand inclusions (on machined surfaces), or porosity caused during the casting process will not be acceptable. Valves determined to be defective in accordance with the above shall be replaced. Repair of defects will not be permitted. Previously repaired valves or discs will be rejected prior to testing.
 - O. Casting Structure: Operator mounting surface must be primarily structurally cast to the outer perimeter of the flange ring as well as cast to the pressure boundary of the body to securely contain the shaft seal.
 - P. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be painted with two coats of the manufacturer's NSF approved premium epoxy polyamide for potable water applications.

PART 3 – EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The valve manufacturer shall provide a qualified technical representative in accordance with Section 15095.

3.02 FACTORY TESTING

- A. Each butterfly valve supplied shall be subject to performance testing consisting of an actuator operability test, leakage test, and hydrostatic test. The tests shall be performed as described in AWWA C504. Any valve in whole or in part which fails any or all of the performance tests shall be made satisfactory or replaced at the discretion of the Owner and/or Engineer.
- B. The actuator operability test shall be performed to demonstrate proper operation of the valve assembly consisting of the valve, valve actuator, and valve operator, including extended shafts. The actuator operability test will consist of the completed assembly from the fully closed to the fully open position a total of three (3) times. This test will immediately precede the leakage test and hydrostatic test.
- C. Leakage Test
 1. The leakage test shall be performed with the valve disc in a fully closed position. One side of the valve disc shall be fully visible during the test. Water shall be applied to one side of the valve disc at the rated pressure of the valve. Pressure

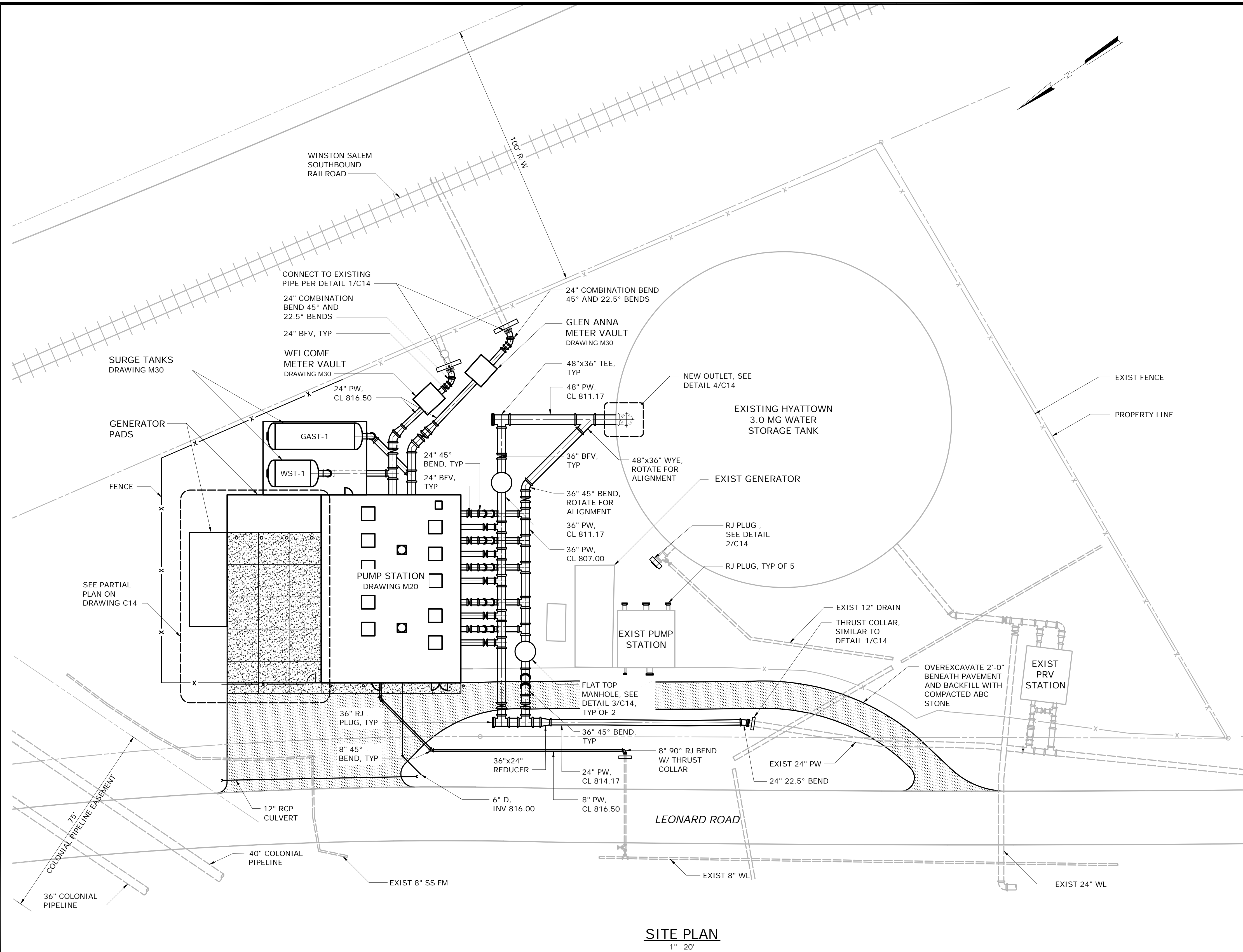
will be applied for a duration of 10 minutes. Any indication of water passing around the disc will deem the test a failure. The leakage test will be performed in two steps with pressure being applied to the valve disc both in the direction of flow and against the direction of flow. No alternative to this procedure will be accepted.

2. Valve disc deflection will be measured during the performance of the leakage test. Deflection will be measure by using dial indicators to measure disc position at the shaft ends and 90 degrees from the shaft ends prior to the application of pressure and while pressure is being applied. Once pressure is released, all dial indicators shall return to within 0.01 inches of their original readings. Any readings greater will indicate a failure of the test.
- D. The hydrostatic test will consist of applying an internal pressure equal to two (2) times the rated pressure to the valve for a period of ten (10) minutes. Any indication of leakage through the valve body will be considered a failed test.

- END OF SECTION -

NOTES:

1. FIELD VERIFY LOCATION OF EXISTING PIPING PRIOR TO ORDERING MATERIALS. PERFORM LOCATING SERVICES AND/OR CONSTRUCT TEST PITS DURING FIRST 60 DAYS OF CONTRACT. SCHEDULE EXCAVATIONS ACTIVITIES WITH OWNER IN ADVANCE.
2. ALL PIPING SHALL BE RESTRAINED JOINT.
3. DESIGN PRESSURE FOR ALL PIPING, VALVES, AND APPURTENANCES IS 250 PSI.
4. ALL 36" AND 24" BUTTERFLY VALVES SHOWN BURIED IN THE YARD SHALL BE FURNISHED BY THE OWNER. SEE SPECIFICATION SECTION 15095 AND APPENDIX D OF THE PROJECT MANUAL FOR DETAILS.



SITE PLAN
1"=20'

File: D:\30961-010-CHV\DRAWINGS\CIVIL\C13_Sheet by MESSERE.dwg Date: 2/16/2016 4:11 PM
 Plot Date: 2/16/2016 11:08:15 AM BY: M.KARMANOCKY

PROJECT ENGINEER:	M. J. BENCHICH		
DESIGNED BY:	M. J. BENCHICH		
DRAWN BY:	M.P. KARMANOCKY		
CHECKED BY:	M.J. MESSERE		
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE			
REV	ISSUED FOR	DATE	BY
2	BUILDING PERMIT REVIEW	2-26-16	JCJ
1	REGULATORY REVIEW	1-20-16	JCJ

ISSUED FOR BUILDING PERMIT REVIEW

Hazen

HAZEN AND SAWYER
4944 PARKWAY PLAZA BLVD, SUITE 375
CHARLOTTE, NORTH CAROLINA 28217
LICENSE NO. : C-0381

DAVIDSON COUNTY
NORTH CAROLINA

DAVIDSON WATER INC.
HYATTOWN PUMP STATION IMPROVEMENTS

CIVIL
YARD PIPING PLAN

DATE:	FEBRUARY 2016
HAZEN NO.:	30961-010
CONTRACT NO.:	1
DRAWING NUMBER:	C13

APPENDIX E
GEOTECHNICAL REPORT

**Report of Subsurface Exploration
Hyattown Pump Station Improvements
Lexington, North Carolina
S&ME Project No. 1358-15-068**



Prepared for:
Hazen and Sawyer
4944 Parkway Plaza Blvd, Suite 375
Charlotte, North Carolina 28217

Prepared by:
S&ME, Inc.
8646 W Market St, Suite 105
Greensboro, North Carolina 27409

October 23, 2015



October 23, 2015

Hazen and Sawyer
4944 Parkway Plaza Blvd, Suite 375
Charlotte, North Carolina 28217

Attention: Mr. Michael Benchich, P.E.

Reference: **Report of Subsurface Exploration
Hyatttown Pump Station Improvements**
Lexington, North Carolina
S&ME Project No. 1358-15-068
NC PE Firm License No. F-0176

Dear Mr. Benchich:

S&ME, Inc. (S&ME) has completed subsurface exploration services for the proposed Hyatttown Pump Station improvements in Lexington, North Carolina. The exploration was performed in general accordance with S&ME Proposal No. 13-1500509 dated September 16, 2015 and authorized through a Subcontract Agreement for Professional Services dated September 29, 2015. The purpose of our work was to explore subsurface conditions within the proposed pump station and evaluate those conditions with regard to foundation design and construction. This report presents our findings together with our conclusions and recommendations.

S&ME appreciates the opportunity to be of service to you. If you have questions regarding the subsurface exploration, or if we may be of further assistance, please contact us.

Sincerely,

S&ME, Inc.


Stephen Lacz, P.E.
Project Engineer
Registration No. 030037



Matt Moler, P.E.
Senior Engineer/Project Manager
Registration No. 030944



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1.0 Project Information

Project information has been obtained from the following sources:

- ◆ An e-mail from Michael Benchich with Hazen and Sawyer to Matt Moler with S&ME on September 14, 2015. The e-mail included a preliminary Mechanical Site Plan (Sheet M20 dated March 2015), and selected pages of S&ME Proposal No. 33-1400526 Rev 1 with edits.
- ◆ An e-mail from Michael Benchich to Stephen Lacz with S&ME on September 14, 2015 with additional project information and an attached preliminary Mechanical Plan and Section (Sheet M21 dated March 2015).
- ◆ A site visit by Finley Lloyd with S&ME on September 15, 2015.
- ◆ Review of aerial and street view photos on Google Maps and Bing Maps.

The subject property is located at the existing Hyattown Pump Station near 1276 Leonard Road in Lexington, North Carolina as shown on the Site Vicinity Plan (Figure I-1 located in the Appendix). The project consists of the construction of a new one-story above grade pump station with approximate dimension of 55 x 75 feet. Two grade supported surge tanks with capacities of 9,300 and 18,500 gallons are planned along with a meter vault, generator pad, and associated below grade 18 and 24-inch piping. Structural loads for the structures were not available at the time of this report. Based on our experience with similar projects, we anticipate maximum wall loads on the order of 3 kips per foot. Mat and slab-on-grade contact pressures of less than 800 psf are anticipated.

The existing water storage tank, pump station, and generator are within a secured fenced area. Based on the Davidson County GIS data, the site generally slopes down from the south to the north with elevations ranging from 821 to 823 feet near the existing storage tank down to 819 feet outside the fenced area. A large soil stockpile is present to the north of the fence line.

Based on the provided drawings, the pump station finished floor elevation is planned at 823.0 feet. Planned site grades are anticipated to be at or near existing grades requiring maximum mass grading cuts and fills of less than 2 feet. Pumps located within the pump station are planned to extend to a bottom of can elevation of 804.97 feet, which would require excavations of up to 18 feet below the planned finished floor elevation.

S&ME was requested to perform a subsurface exploration that consisted of soil test borings and laboratory testing for the planned pump station site.

2.0 Exploration

S&ME explored the general subsurface conditions at the pump station by performing twelve soil test borings at the approximate locations indicated on Figure I-2 in the Appendix. Three borings were performed at piping junctions (B-1, B-2, and B-3), five borings were performed at the pump station building (B-4, B-5, B-7, B-8, and B-9), one boring at the meter vault (B-6), one boring at the generator pad (B-11), and two borings at each of the surge tanks (B-10 and B-12). Boring locations were selected by Hazen and Sawyer and established in the field by S&ME using site features as reference. As drilled boring



locations were located using Global Positioning Satellite (GPS) equipment. The boring surface elevations were not available at the time of this report.

The borings were conducted using an ATV-mounted CME-550X drill rig equipped with an autohammer. Hollow stem, continuous flight augers were used to advance the borings to planned termination depths of 10 to 49.4 feet below existing grade. Standard Penetration Tests (SPT) were performed in the drill-rig advanced borings at 2.5-foot intervals in the top 10 feet, then at 5-foot intervals thereafter, in general accordance with ASTM D 1586 to provide an index for estimating strength parameters and relative consistency of subsurface soils.

Groundwater measurements were attempted after drilling was completed in each boring. Groundwater level measurements were also attempted approximately 24 hours after drilling in select borings to estimate the stabilized water level. For safety, the boreholes were backfilled with auger cuttings and a hole closure device before demobilizing the drill rig from the site.

Once the samples were received in our laboratory, the samples were visually examined to estimate the distribution of grain sizes, plasticity, organic content, moisture condition, color, presence of lenses and seams, and apparent geological origin. The results of the classifications as well as the field test results are presented on the individual Boring Logs included in the Appendix. Similar soils were grouped into strata on the logs. The strata contact lines represent approximate boundaries between the soil types; the actual transition between the soil types in the field may be gradual in both the horizontal and vertical directions.

Representative soil samples obtained during the field exploration were tested in S&ME's laboratory to confirm visual classifications of the soils and to evaluate engineering index properties. Laboratory testing included:

- ◆ Atterberg Limits (ASTM D 4318),
- ◆ Grain Size 200 Wash (ASTM D 422), and
- ◆ Natural Moisture Contents (ASTM D 2216).

A Summary of Laboratory Test Data and individual laboratory tests are presented in the Appendix.

3.0 Regional Geology

The Geologic Map of North Carolina (1985) indicates that the proposed pump station facility is in the Piedmont Physiographic Province. The soils in this region have formed as a mantle of soil that has weathered in-place from the parent bedrock. These soils have variable thicknesses and are referred to as residuum or residual soils. The residuum is typically fine grained and has a higher clay content near the surface because of advanced weathering. The soils generally become less clayey and more sandy with depth because of less advanced weathering.

The boundary between soil and rock is not sharply defined. This transitional zone termed "partially weathered rock" is normally found overlying the parent bedrock. Partially weathered rock is defined for engineering purposes as residual material that can be penetrated by the drilling rig augers and has standard penetration test blow counts in excess of 50 blows for six inches or less of sampler penetration. Weathering is facilitated by fractures, joints, and by the presence of less resistant rock types. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even

over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and zones of partially weathered rock within the soil mantle, well above the general bedrock level.

4.0 Findings

Conditions encountered in the soil test borings are summarized on the attached Generalized Subsurface Profile (Figure I-3) and the individual boring logs included with this report. More detailed information is provided on the Boring Logs in the Appendix. A summary of the conditions encountered in the borings is provided below.

4.1 Surface Materials

Two of the borings (B-4 and B-8) encountered 2 inches of ABC stone at the ground surface. A 1.5 inch thick layer of topsoil was encountered in three of the borings (B-1, B-5, and B-6).

4.2 Fill

Man-placed fill soils were encountered in each of the borings underlying the surficial materials or the ground surface to depths ranging from 1 to 4 feet. The fill soils generally consisted of low plasticity silts and clays (Unified Soil Classification of CL and ML) with highly plastic clayey silts (MH). Standard Penetration Test (SPT) N-values in the fill generally ranged from 6 to 18 blows per foot (bpf) suggesting the majority of the fill was placed in a controlled manner.

Atterberg limits testing of the existing fill soils in borings B-7 and B-9 indicated liquid limits of 77 percent, plastic limits of 36 and 38, and plasticity indices of 41 and 39 percent, respectively. These soils classified as high plasticity silt (MH). The plastic limit is the soil moisture content at which a soil can be rolled into a 1/8 inch diameter thread. Natural moisture contents of these materials ranged from 28.8 to 32.1 percent.

4.3 Residuum

Residual soils resulting from the in-place weathering of underlying bedrock were encountered underlying the fill soils and extending to the boring termination depths or top of partially weathered rock. Residual soils typically consisted of sandy silts and silty sands (ML and SM). Highly plastic clayey silts and silty clays (MH and CH) were encountered in borings B-2, B-4, and B-8 within the upper 9 feet of the ground surface. Standard Penetration Test values in the residual soils generally ranged from 6 to 33 bpf above the water table and 4 to 12 bpf below the water table. Moisture contents were judged to be within or above compactable levels at the time of this exploration.

Atterberg limits testing of the residual soils in boring B-2, B-4, and B-8 indicated liquid limits of 71 to 81 percent, plastic limits of 35 to 45, and a plasticity indices of 33 to 42 percent. These soils classified as high plasticity silt (MH). The natural moisture contents of residual samples tested ranged from 22.9 to 47.7 percent.



4.4 Partially Weathered Rock

Partially Weathered Rock (PWR) is defined for engineering purposes as residual material that can be penetrated with drill rig augers and has standard penetration resistance values in excess of 50 blows for 6 inches of penetration.

PWR was encountered in boring B-7 at a depth of 49 feet and extended to the boring termination depth at 49.4 feet. PWR was not encountered in the other borings to the depths explored.

4.5 Auger Refusal Material

Auger refusal is defined as material that could not be penetrated by the drill equipment used on the project. Auger refusal materials were not encountered by the borings to the depths explored.

4.6 Groundwater

Groundwater was encountered in eight borings at the time of drilling and approximately 24 hours after drilling completion as shown in the following table.

Table 4-1 – Summary of Water Level Measurements

Boring	Depth to Water at Time of Drilling (ft)	Depth to Water After 24 hours (ft)	Hole Cave Depth (ft)
B-1	NE	NM	5.9
B-2	NE	NM	6.9
B-3	NE	NM	7.2
B-4	26.8	14.7	27.6
B-5	NE	14.2	25.8
B-6	17.0	13.8	17.6
B-7	NM	14.3	NM
B-8	24.5	14.8	25.1
B-9	NE	14.5	23.2
B-10	NE	14.5	16.2
B-11	NE	NM	15.6
B-12	NE	14.6	15.7

NE – Not Encountered

NM – Not Measured

Groundwater was not encountered by the remaining four borings to the depths explored at the time of boring. The groundwater level fluctuates during the year due to seasonal and climatic changes.

5.0 Pump Station Evaluation and Recommendations

5.1 Foundation Support

Some of the near-surface existing fill soils encountered by the borings are highly plastic (MH) are not recommended for direct support of spread foundations or slabs. These materials have the potential to shrink and swell with changes in moisture content over time. If these highly plastic materials are encountered at the planned building subgrade elevation, we recommend highly plastic soils (PI greater than 25) be overexcavated to a depth of 3 feet below final grade within footing excavations and to a depth of 2 feet below final grade in slab and pavement areas. Overexcavations can be backfilled to the planned design foundation bearing depths using compacted low plasticity soils or lean concrete.

Sporadic undercutting for foundation and slab support should be anticipated. Recommendations regarding site preparation measured are provided in Section 6.3 of this report.

5.1.1 *Spread Foundations*

Following remediation of unsuitable site soils, subsurface conditions are suitable for support of the proposed pump station building on spread foundations designed for an allowable foundation contact pressure of up to 2,500 psf. Foundations should bear on evaluated and approved existing site soils and/or new compacted structural fill. Wall and column footings should have minimum dimensions of at least 18 and 24 inches, respectively. Foundations should bear a minimum of 18 inches below finished grade for frost protection and protective embedment.

5.1.2 *Mat Foundations*

For surge tank and generator mat foundations, the net bearing pressure may be increased to up to 3,000 psf for transient loads (wind and seismic). A mat foundation modulus of subgrade reaction of 10 to 20 pounds per cubic inch (pci) may be assumed within the foundation footprint.

The bottom of all footing excavations should be evaluated by the project Geotechnical Engineer or a senior soil technician working under the direction of the Geotechnical Engineer using a dynamic cone penetrometer (DCP) to gauge the consistency of subgrade soils. Soils that 1) appear unstable, 2) exhibit DCP blowcounts less than required to achieve the design bearing pressure, and/or 3) are highly plastic and located within 3 feet of final exterior grades, should be undercut and backfilled with lean concrete or compacted structural fill.

5.2 Hydrostatic Uplift

The meter vault may extend below the groundwater level, resulting in hydrostatic buoyant uplift force. Uplift loads may be resisted by the weight of the structure, engaging the weight of backfill by extending the foundation beyond the wall exterior face, or a combination of these. The most efficient method is highly dependent on the structure geometry and depth below the design water level. The following guidance is offered to assist in design to resist hydrostatic uplift forces.

Table 5-1 – Hydrostatic Uplift Considerations

HYDROSTATIC UPLIFT RESISTANCE	
METHOD	GUIDANCE
Weight of Structure	1. If the weight of the structure is less than the weight of water displaced by the structure, additional uplift resistance is required. 2. The structure weight may be increased by increasing the wall or foundation thickness to increase uplift resistance. Only the buoyant weight of additional concrete weight (87 pcf) should be considered, as the increased concrete volume will displace additional water.
Engagement of Wall Backfill Weight	1. The buoyant weight of soil backfill (50 pcf) above a mat foundation projection beyond the exterior wall face may be used to resist hydrostatic uplift. 2. Only the rectangular prism of backfill above the foundation projection should be used. Any strength contribution due to soil shear should be ignored.

5.3 Floor Slabs

Slab-on-grades for the pump station and generators can be adequately supported on evaluated and approved (proofrolled) existing site soils or new compacted structural fill placed and compacted in accordance with the recommendations in this report. **The subgrade evaluation should address remedial measures for high plasticity soils.** Highly plastic soil (PI>25) should be removed and replaced by low plasticity soil structural fill to a depth of 2-feet below the slab subgrade. We recommend a vapor barrier be included in the design of the slabs if vapor penetration is an unacceptable condition.

We recommend a modulus of subgrade modulus (k) value of 125 pci for slabs-on-grade bearing on a minimum 6-inch thick layer of crushed aggregate base course (CABC).

5.4 Lateral Earth Pressures

The soil lateral pressure on below grade walls is a function of the relative movement between the structure and the surrounding soils. Meter vault walls are rigid and restrained against rotation, and should be designed for the "at-rest" earth pressure condition. The at-rest earth pressure is also dependent on the soil material used as backfill. We have assumed that compacted, non-plastic silts such as those encountered below a depth of 8-feet will be used as wall backfill. Based on this assumption, we recommend an at-rest earth pressure coefficient of 0.50, a unit weight of 110 pcf, and a sliding coefficient of 0.35.

The ground water level encountered in our borings was approximately 14 feet below existing grade. Groundwater levels can fluctuate over time. The design high water table should be considered during design and the walls should be designed to resist the hydrostatic pressure.

5.5 Seismic Considerations

Based on the subsurface conditions encountered and experience with the area geology, we recommend **Site Class D** for use in seismic design at this site in accordance with the 2012 North Carolina Building Code (2009 IBC with North Carolina Amendments). Table 5-2 presents the USGS ground motion parameters for the site.

Table 5-2 – Seismic Design Parameters

IBC	Site Class	S_s	S_1	F_a	F_v	S_{DS}	S_{D1}
2012	D	0.187g	0.088g	1.60	2.40	0.199g	0.140g

Using the spectral accelerations presented in Table 5-2 and an Occupancy Category IV, the Seismic Design Category is D. This information should be confirmed by the Structural Engineer.

5.6 Construction Dewatering

Temporary construction dewatering will be required for the construction excavation. Dewatering may be accomplished using deep, cased sumps, or wellpoints installed as the construction excavation is advanced. Continuous pumping of sumps will be required. The number and spacing of sumps or wellpoints should be sufficient to control the groundwater level a minimum of 3-feet below the final Pump Station soil subgrade elevation, before the excavation is advanced to this level. The bearing surface will be degraded if the excavation extends below the groundwater level, requiring removal and replacement of degraded bearing materials with washed stone. Based on approximate correlations between laboratory grain size distribution and the soil types encountered in the borings, the Pump Station excavation is anticipated to have permeability values on the order of 10^{-5} to 10^{-3} cm/s.

6.0 Site Earthwork Recommendations

The following paragraphs present our recommendations for site preparation and grading. When reviewing these recommendations, please note that deteriorated subgrades due to adverse weather can develop during construction. Such conditions, if encountered, can best be handled by engineering evaluations made in the field during construction.

6.1 Previously Graded Sites

Our experience with previously graded sites indicates unexpected conditions often exist between soil test boring locations. These may include active or abandoned utility lines, areas of low consistency fill, buried debris, and others. Such conditions, if encountered, can be handled by engineering evaluations at the time of construction.

6.2 Grubbing and Stripping

Prior to initiating the earthwork, all roots should be grubbed, and topsoil stripped from the proposed development areas extending a minimum of 10 feet beyond the outside edges of the building/pavement footprints.



6.3 Site Preparation

After stripping of surficial materials has been completed and following excavation to final grade in cut areas, the exposed subgrade should be evaluated by the project Geotechnical Engineer (or his representative) by proofrolling with a loaded dump truck or similar pneumatic tire vehicle (minimum loaded weight of 20 tons) to identify unstable soils requiring remediation.

The proofrolling procedure should consist of two complete passes of the equipment over the subgrade. Areas of the subgrade that rut or deflect excessively in the opinion of the project Geotechnical Engineer, considering the depth below finished grade and proposed construction at the specific location, should be repaired. Repair may consist of undercut and replacement or scarifying, moisture conditioning, and recompacting. **Sporadic repair of unsuitable existing site soils including undercutting and replacement or recompaction should be anticipated.** Highly plastic soils (PI greater than 25) be overexcavated to a depth of 3 feet below final grade within footing excavations and to a depth of 2 feet below final grade in slab and pavement areas

6.4 Excavation

We understand the Pump Station construction excavations will extend up to approximately 18-feet below existing grade. We are not aware of any constraints to performance of a sloped construction excavation. We anticipate the planned piping lines will predominantly be constructed using the open trench method.

Based on the subsurface conditions encountered by the borings and anticipated construction excavation depths, site excavations are anticipated to be performed by conventional earthmoving equipment without ripping, or blasting. It is expected that confined excavations for shallow utility trenches and foundations may be performed by a rubber tired backhoe. In this geology, it is possible to encounter occasional, isolated boulders, pinnacles, or ledges of rock at varied depths that may require enlargement of the excavation, ripping or blasting to remove.

All excavations should be sloped or shored in accordance with OSHA (29 CFR Part 1926) excavation trench safety standards.

Groundwater is anticipated to be encountered during site excavations. Construction dewatering recommendations are presented in Section 5.5 of this report.

6.5 Fill Material

The majority of the deeper existing sandy silt and silty sand soils appear suitable for reuse as structural fill. Structural fill soil used in site grading should consist of the following characteristics:

- ◆ Less than 3 percent organics and no deleterious materials.
- ◆ USCS classification of GW, SW, SM, SC, ML, CL or some combination of these.
- ◆ A standard Proctor maximum dry density of at least 90 pcf.
- ◆ Maximum particle size of 3 inches in any dimension.

Samples of the proposed fill soils should be tested for moisture content and moisture-density relationship (standard Proctor) to establish their compaction properties. Moisture adjustment may be needed to achieve a compactable soil moisture content. The extent of soil moisture adjustments will be affected by the weather conditions prior to and during grading. Drying may be accomplished by spreading and



discing to maximize exposure to sun and wind during favorable weather conditions. Difficulties working with the high plasticity silts and clays (MH and CH) should be anticipated. Favorable weather conditions are typical of the late Spring, Summer, and early Fall.

6.6 Structural Fill Placement and Compaction

New structural fill should be placed beneath and a minimum of 5 feet horizontally beyond the structure footprints. Structural fill should be placed in layers not exceeding 8 inches in thickness, and each layer should be compacted to a minimum of 95 percent of its maximum dry density as determined by a standard Proctor test (ASTM D 698). Field density tests should be performed on the structural fill to evaluate whether the specified compaction is achieved. One-point Proctor tests should also be performed on the fill at a frequency determined by the project Geotechnical Engineer to evaluate whether the laboratory Proctor data is appropriate.

6.7 Potential Subgrade Deterioration and Repair

Potential subgrade soil types are expected to include silty clays, clayey silts, and sandy silts that are moderately to highly susceptible to weather related deterioration. The exposed subgrade soil of both cut and fill areas can deteriorate when exposed to construction activities and environmental changes. Subgrade soil deterioration can occur from exposure to rainwater, rutting from construction traffic, freezing, and erosion. Exposed subgrades in the structure areas that have deteriorated should be properly repaired by scarifying, moisture conditioning, and recompacting, or by undercutting and replacement immediately prior to construction.

7.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report were based on the applicable standards of the engineering profession at the time this report was prepared. No other warranty, express or implied, is made.

The analysis and recommendations submitted in this report are based, in part, upon the data obtained from the subsurface exploration. The nature and extent of variations between the borings may not become evident until construction. If variations appear evident, then it will be necessary to reevaluate the recommendations of this report.

A document prepared by S&ME and titled *Important Information About Your Geotechnical Engineering Report* follows this page. This document discusses how geotechnical recommendations are developed based on professional opinions of site subsurface conditions, limited exploration information, and experience. Variations in subsurface conditions can be a principal cause of construction delays, cost overruns, and claims. This document is provided to assist you in understanding and managing the risk of these variations.



Important Information About Your Geotechnical Engineering Report

Variations in subsurface conditions can be a principal cause of construction delays, cost overruns and claims. The following information is provided to assist you in understanding and managing the risk of these variations.

Geotechnical Findings Are Professional Opinions

Geotechnical engineers cannot specify material properties as other design engineers do. Geotechnical material properties have a far broader range on a given site than any manufactured construction material, and some geotechnical material properties may change over time because of exposure to air and water, or human activity.

Site exploration identifies subsurface conditions at the time of exploration and only at the points where subsurface tests are performed or samples obtained. Geotechnical engineers review field and laboratory data and then apply their judgment to render professional opinions about site subsurface conditions. Their recommendations rely upon these professional opinions. Variations in the vertical and lateral extent of subsurface materials may be encountered during construction that significantly impact construction schedules, methods and material volumes. While higher levels of subsurface exploration can mitigate the risk of encountering unanticipated subsurface conditions, no level of subsurface exploration can eliminate this risk.

Scope of Geotechnical Services

Professional geotechnical engineering judgment is required to develop a geotechnical exploration scope to obtain information necessary to support design and construction. A number of unique project factors are considered in developing the scope of geotechnical services, such as the exploration objective; the location, type, size and weight of the proposed structure; proposed site grades and improvements; the construction schedule and sequence; and the site geology.

Geotechnical engineers apply their experience with construction methods, subsurface conditions and exploration methods to develop the exploration scope. The scope of each exploration is unique based on available project and site information. Incomplete project information or constraints on the scope of exploration increases the risk of variations in subsurface conditions not being identified and addressed in the geotechnical report.

Services Are Performed for Specific Projects

Because the scope of each geotechnical exploration is unique, each geotechnical report is unique. Subsurface conditions are explored and recommendations are made for a specific project. Subsurface information and recommendations may not be adequate for other uses. Changes in a proposed structure location, foundation loads, grades, schedule, etc. may require additional geotechnical exploration, analyses, and consultation. The geotechnical engineer should be consulted to determine if additional services are required in response to changes in proposed construction, location, loads, grades, schedule, etc.

Geo-Environmental Issues

The equipment, techniques, and personnel used to perform a geo-environmental study differ significantly from those used for a geotechnical exploration. Indications of environmental contamination may be encountered incidental to performance of a geotechnical exploration but go unrecognized. Determination of the presence, type or extent of environmental contamination is beyond the scope of a geotechnical exploration.

Geotechnical Recommendations Are Not Final

Recommendations are developed based on the geotechnical engineer's understanding of the proposed construction and professional opinion of site subsurface conditions. Observations and tests must be performed during construction to confirm subsurface conditions exposed by construction excavations are consistent with those assumed in development of recommendations. It is advisable to retain the geotechnical engineer that performed the exploration and developed the geotechnical recommendations to conduct tests and observations during construction. This may reduce the risk that variations in subsurface conditions will not be addressed as recommended in the geotechnical report.

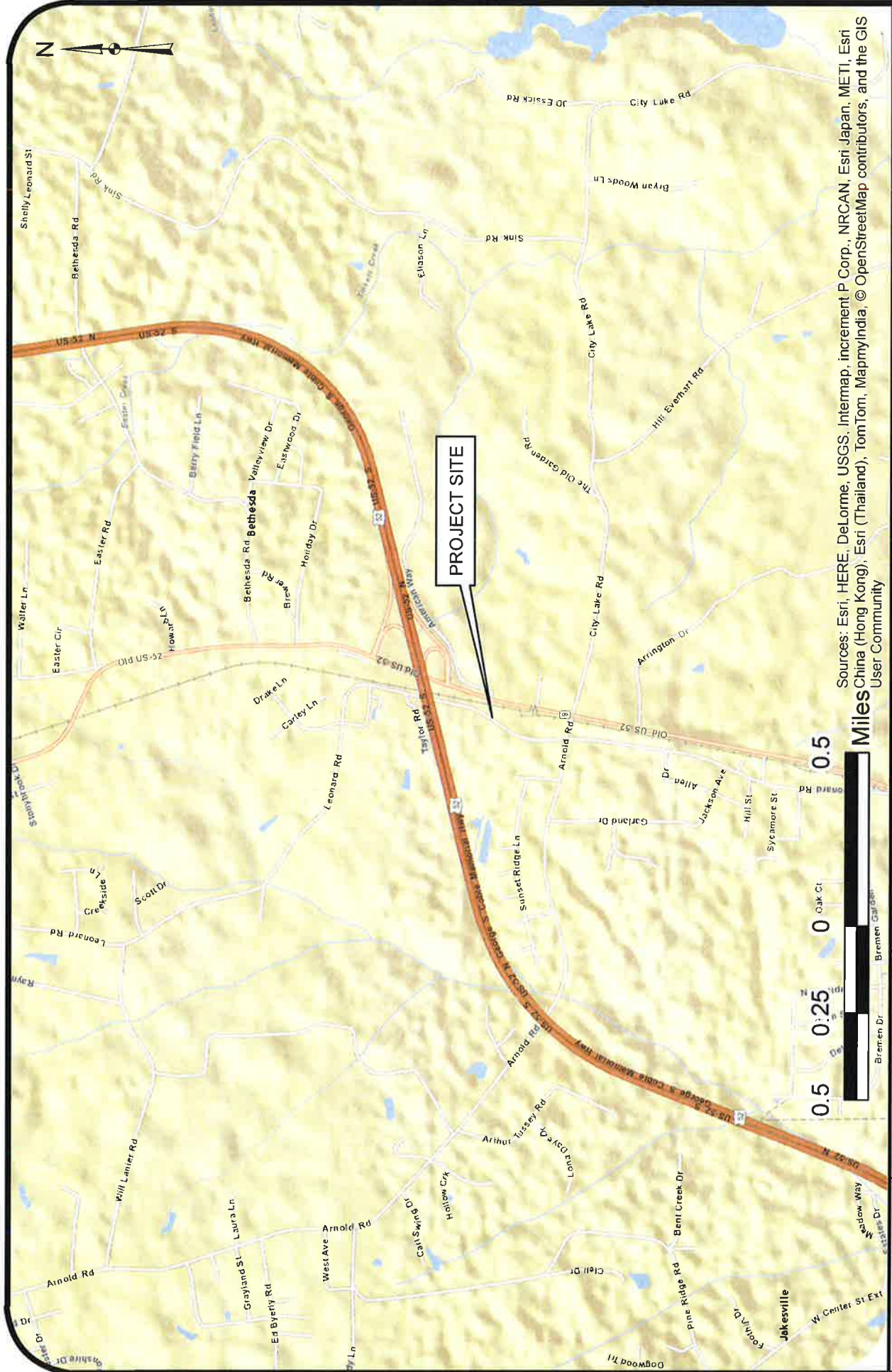
Appendices

Appendix I – Figures

Figure I-1 – Site Vicinity Plan

Figure I-2 – Boring Location Plan

Figure I-3 – Generalized Subsurface Profile



Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

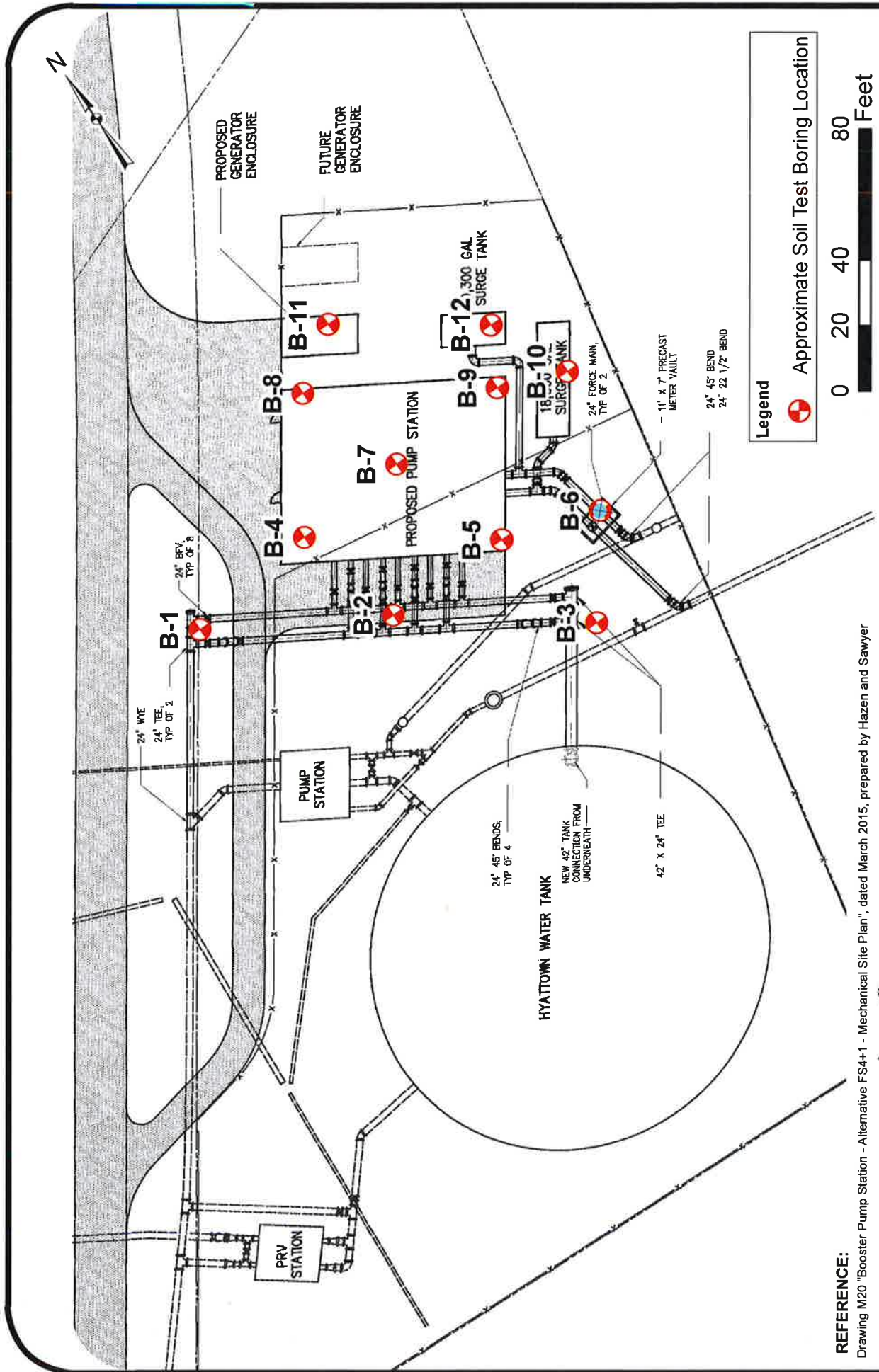
FIGURE NO. **I-1**

SITE VICINITY PLAN
HYATTSTOWN PUMP STATION
LEXINGTON, NORTH CAROLINA



SCALE: **As Shown** DATE: **OCT 2015**

PROJECT NO: **1358-15-068** DRAWN BY: **JFL** CHECKED BY: **SWL**



REFERENCE:

Drawing M20 "Booster Pump Station - Alternative FS4+1 - Mechanical Site Plan", dated March 2015, prepared by Hazen and Sawyer

SCALE: 1"=40'

DATE: OCT. 2015

DRAWN BY: JFL

CHECKED BY: SWL

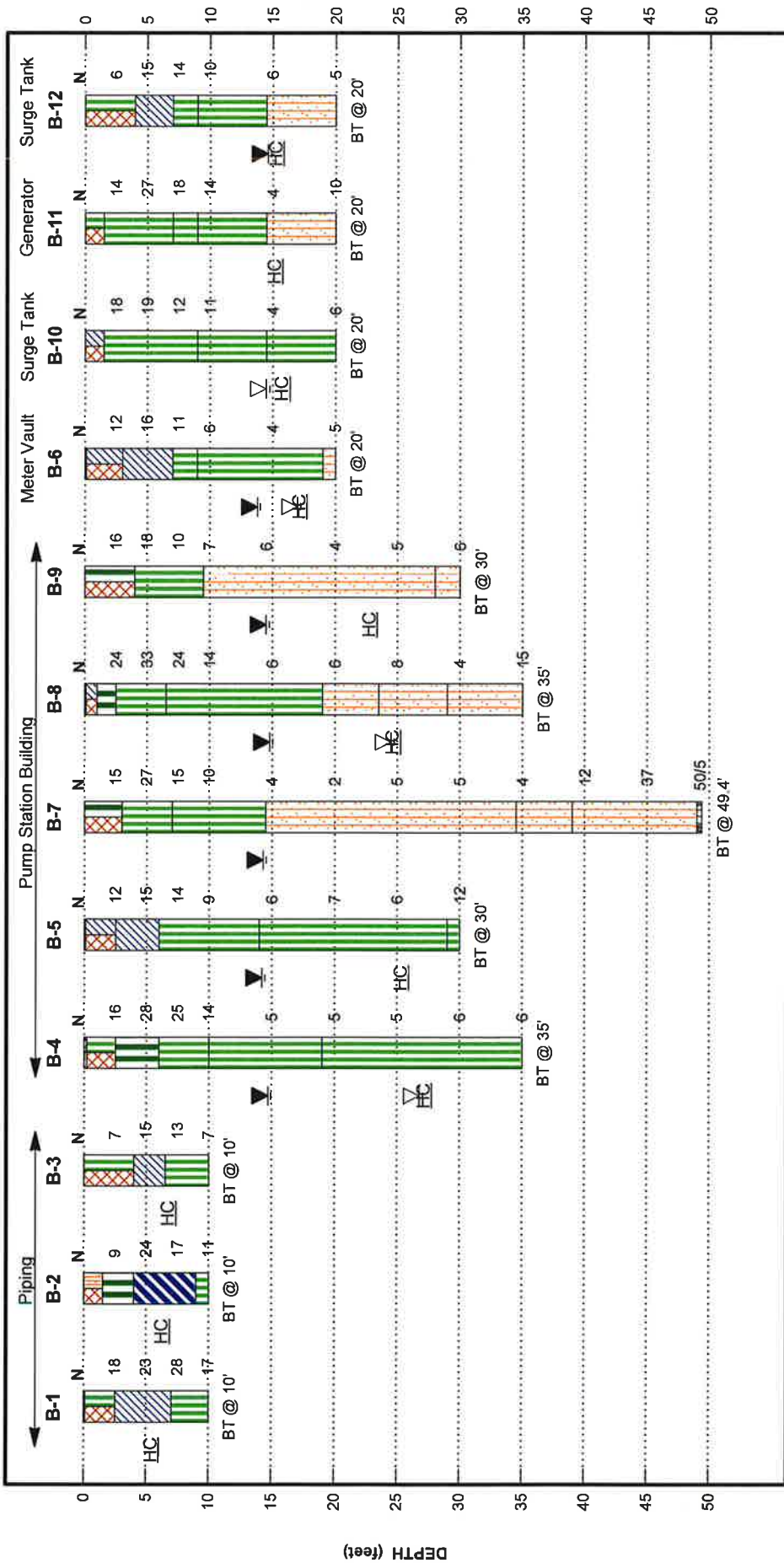
PROJECT NO: 1358-15-068

FIGURE NO

BORING LOCATION PLAN
HYATTOWN PUMP STATION
LEXINGTON, NORTH CAROLINA



I-2



- Topsoil
- MH, High Plasticity Silt
- Fill
- CL, Low Plasticity Clay
- CH, High Plasticity Clay
- ML, Low Plasticity Silt
- Aggregate Base Course
- Water Level at Time of Boring
- Water Level after 24 hours
- SM, Silty Sand
- Partially Weathered Rock
- HC
- Hole Cave
- BT @ 20'
- Boring Termination Depth

N = Standard Penetration Test resistance value (blows per foot). The depicted stratigraphy is shown for illustrative purposes only. The actual subsurface conditions will vary between boring locations. Elevations are approximate.



JOB NO: 1358-15-068
 DATE: 10/19/15

Diagram: Generalized Subsurface Profile
 Project: Hyattown Pump Station
 Location: Lexington, NC

Figure I-3

Appendix II – Additional Information

Legend to Soil Classification and Symbols

Soil Test Borings (B-1 through B-12)





















Summary of Laboratory Test Data (1 page)

Individual Laboratory Test Sheets (7 pages)

LEGEND TO SOIL CLASSIFICATION AND SYMBOLS




SOIL TYPES

(Shown in Graphic Log)

	Fill
	Asphalt
	Concrete
	Topsoil
	Partially Weathered Rock
	Cored Rock
	GW WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	GP POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	GM SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	GC CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SW WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	SP POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	SM SILTY SANDS, SAND - SILT MIXTURES
	SC CLAYEY SANDS, SAND - CLAY MIXTURES
	ML INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
	CL INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	OL ORGANIC SILTS AND ORGANIC CLAYS OF LOW PLASTICITY
	MH INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS, ELASTIC SILTS
	CH INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
	OH ORGANIC SILTS AND ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY

WATER LEVELS

(Shown in Water Level Column)

-  = Water Level At Termination of Boring
-  = Water Level Taken After 24 Hours
-  = Loss of Drilling Water
- HC = Hole Cave

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY

Very Soft
Soft
Firm
Stiff
Very Stiff
Hard
Very Hard

STD. PENETRATION RESISTANCE BLOWS/FOOT

0 to 2
3 to 4
5 to 8
9 to 15
16 to 30
31 to 50
Over 50

RELATIVE DENSITY OF COHESIONLESS SOILS

RELATIVE DENSITY





Very Loose
Loose
Medium Dense
Dense
Very Dense

STD. PENETRATION RESISTANCE BLOWS/FOOT

0 to 4
5 to 10
11 to 30
31 to 50
Over 50

SAMPLER TYPES

(Shown in Samples Column)

-  Shelby Tube
-  Split Spoon
-  Rock Core
-  No Recovery

TERMS

Standard Penetration Resistance - The Number of Blows of 140 lb. Hammer Falling 30 in. Required to Drive 1.4 in. I.D. Split Spoon Sampler 1 Foot. As Specified in ASTM D 1586.

REC - Total Length of Rock Recovered in the Core Barrel Divided by the Total Length of the Core Run Times 100%.

RQD - Total Length of Sound Rock Segments Recovered that are Longer Than or Equal to 4" (mechanical breaks excluded) Divided by the Total Length of the Core Run Times 100%.



PROJECT: Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-1											
DATE DRILLED: 10/7/05		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.											
DRILL RIG: CME 550		BORING DEPTH: 10.0 ft													
DRILLER: J. White		WATER LEVEL: Dry at TOB													
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz													
SAMPLING METHOD: Split spoon				NORTHING:		EASTING:									
DRILLING METHOD: 3 1/4" H.S.A.															
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE	
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	/ REMARKS					
		TOPSOIL 1.5 inches					11	8	10						
		FILL: CLAYEY SILT (ML) very stiff, orange tan, moist, with medium to fine sand					6	9	14						
5		RESIDUAL: SILTY CLAY (CL) very stiff, tan red brown, moist, with fine sand	HC				16	12	16						
		CLAYEY SILT (ML) very stiff, tan red brown, moist, with fine sand					5	8	9						
10		Boring terminated at 10 ft													

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

NOTES:

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- WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.



DATE DRILLED: 10/7/15	ELEVATION:	NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.
DRILL RIG: CME 550	BORING DEPTH: 10.0 ft	
DRILLER: J. White	WATER LEVEL: Dry at TOB	
HAMMER TYPE: 140 lb automatic	LOGGED BY: S. Lacz	

SAMPLING METHOD: Split spoon	NORTHING:	EASTING:
DRILLING METHOD: 3 1/4" H.S.A.		

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RGD	/REMARKS				
							10	20	30	60	80			
0		FILL: SILTY SAND (SM) orange, fine to medium, moist				3	4	5					9	
5		RESIDUAL: CLAYEY SILT (MH) stiff, brown orange, moist, with medium to fine sand				6	9	15					24	
7		SILTY CLAY (CH) very stiff, red tan orange, moist, with fine sand	HC			6	7	10					17	
10		FINE SANDY SILT (ML) stiff, orange tan, moist, with trace clay				3	5	6					11	
		Boring terminated at 10 ft												

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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DATE DRILLED: 10/7/15	ELEVATION:	NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.
DRILL RIG: CME 550	BORING DEPTH: 10.0 ft	
DRILLER: J. White	WATER LEVEL: Dry at TOB	
HAMMER TYPE: 140 lb automatic	LOGGED BY: S. Lacz	

SAMPLING METHOD: Split spoon	NORTHING:	EASTING:
DRILLING METHOD: 3/4" H.S.A.		

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE	
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	/REMARKS					
										10	20	30	60	80	
1		FILL: CLAYEY SILT (ML) firm, red brown, moist, trace fine sand			1	2	2	5							7
5		RESIDUAL: SILTY CLAY (CL) stiff, tan orange, moist, trace fine sand			2	2	6	9							15
10		CLAYEY SILT (ML) firm to stiff, red tan orange, moist to wet, with fine sand	HC		3	5	5	8							13
10		Boring terminated at 10 ft			4	3	3	4							7

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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DATE DRILLED: 10/8/15	ELEVATION:	NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.
DRILL RIG: CME 550	BORING DEPTH: 35.0 ft	
DRILLER: J. White	WATER LEVEL: 14.7 feet after 24 hours	
HAMMER TYPE: 140 lb automatic	LOGGED BY: S. Lacz	

SAMPLING METHOD: Split spoon	NORTHING:	EASTING:
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DRILLING METHOD: 3/4" H.S.A.														
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	/REMARKS				
							10	20	30	60	80			
0		FILL ABC Stone 2 inches			1		4	6	10				16	
5		FILL: FINE TO COARSE SANDY SILT (ML) very stiff, orange tan, moist, with clay			2		8	12	16				28	
		RESIDUAL: CLAYEY SILT (MH) very stiff, tan orange, moist			3		8	12	13				25	
		CLAYEY SILT (ML) stiff to very stiff, tan orange, moist, with fine sand			4		5	6	8				14	
10		FINE SANDY SILT (ML) firm, gray orange tan, moist to wet, with trace clay			5		2	2	3				5	
15		FINE SANDY SILT (ML) firm, brown orange tan, wet	▽		6		3	2	3				5	
20					7		1	2	3				5	
25			▽	HC	8		2	3	3				6	
30					9		2	3	3				6	
35		Boring terminated at 35 ft												

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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PROJECT:		Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-5							
DATE DRILLED: 10/7/15		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.									
DRILL RIG: CME 550		BORING DEPTH: 30.0 ft											
DRILLER: J. White		WATER LEVEL: 14.2 feet after 24 hours											
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz											
SAMPLING METHOD: Split spoon				NORTHING:		EASTING:							
DRILLING METHOD: 3 1/4" H.S.A.													
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA				STANDARD PENETRATION TEST DATA (blows/ft) /REMARKS	N VALUE	
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RGD				
0 - 1.5		TOPSOIL 1.5 inches					3	4	8				
1.5 - 5		FILL: SILTY CLAY (CL) very stiff, red brown, moist, trace fine sand					5	8	7				
5 - 10		RESIDUAL: SILTY CLAY (CL) very stiff, red brown, moist, trace fine to medium sand					5	7	7				
10 - 15		CLAYEY SILT (ML) stiff, gray tan orange, moist, with fine sand					4	4	5				
15 - 20		FINE SANDY SILT (ML) firm, gray brown tan, wet, with manganese	▼				3	2	4				
20 - 25							2	3	4				
25 - 30							2	2	4				
30 - 30		FINE TO MEDIUM SANDY SILT (ML) stiff, brown gray tan, wet Boring terminated at 30 ft	HC				4	5	7				

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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PROJECT: Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-6											
DATE DRILLED: 10/7/15		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.											
DRILL RIG: CME 550		BORING DEPTH: 20.0 ft													
DRILLER: J. White		WATER LEVEL: 13.8 ft. after 24 hours													
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz													
SAMPLING METHOD: Split spoon				NORTHING:		EASTING:									
DRILLING METHOD: 3 3/4" H.S.A.															
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE	
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	/ REMARKS					
										10	20	30	60	80	
0		TOPSOIL 1.5 inches					2	5	7						12
1.5		FILL: SILTY CLAY (CL) stiff, red brown, moist, with fine sand					6	7	9						16
5		RESIDUAL: SILTY CLAY (CL) very stiff, red brown, moist, with fine sand					4	5	6						11
10		FINE SANDY SILT (ML) firm to stiff, red tan orange, moist, with trace clay					3	2	4						6
10		FINE TO MEDIUM SANDY SILT (ML) soft, orange brown tan, wet, with manganese					2	1	3						4
15							2	2	3						5
20		SILTY SAND (SM) loose, orange gray tan, fine to medium, wet, with manganese					2	2	3						
20		Boring terminated at 20 ft													

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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PROJECT:		Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-7								
DATE DRILLED: 10/7/15		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.										
DRILL RIG: CME 550		BORING DEPTH: 49.4 ft												
DRILLER: J. White		WATER LEVEL: 14.3 feet after 24 hours												
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz												
SAMPLING METHOD: Split spoon				NORTHING:		EASTING:								
DRILLING METHOD: 3/4" H.S.A.														
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	/ REMARKS				
							10	20	30	60	80			
0 - 5		FILL: CLAYEY SILT (MH) stiff, yellow tan, moist, with fine to medium sand			1	5	7	8					15	
5 - 10		RESIDUAL: FINE TO MEDIUM SANDY SILT (ML) very stiff, orange tan, moist, with clay			2	11	12	15					27	
10 - 15		FINE SANDY SILT (ML) stiff, red gray orange, moist to wet, trace clay			3	5	7	8					15	
15 - 20		SILTY SAND (SM) very loose to loose, gray orange tan, fine, wet		14.3	4	2	4	6					10	
20 - 25		SILTY SAND (SM) very loose to loose, gray orange tan, fine, wet			5	1	2	2					4	
25 - 30		SILTY SAND (SM) very loose to loose, gray orange tan, fine, wet			6	1	1	1					2	
30 - 35		SILTY SAND (SM) very loose to loose, gray orange tan, fine, wet			7	1	2	3					5	
35 - 40		SILTY SAND (SM) medium dense, brown tan, fine, moist, trace mica			8	1	2	3					5	
40 - 45		SILTY SAND (SM) medium dense, brown tan, fine, moist, trace mica			9	1	2	2					4	
45 - 49.4		SILTY SAND (SM) medium dense, brown tan, fine, moist, trace mica			10	3	5	7					12	

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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PROJECT: Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-7										
DATE DRILLED: 10/7/15		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.										
DRILL RIG: CME 550		BORING DEPTH: 49.4 ft												
DRILLER: J. White		WATER LEVEL: 14.3 feet after 24 hours												
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz												
SAMPLING METHOD: Split spoon				NORTHING:		EASTING:								
DRILLING METHOD: 3 1/2" H.S.A.														
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	/ REMARKS				
45		SILTY SAND (SM) medium dense to dense, white brown tan, fine to medium, wet, trace mica (<i>continued</i>)		11	17	17	17	20	17					37
		PARTIALLY WEATHERED ROCK: SILTY SAND tan brown, fine to medium, wet, trace mica Boring terminated at 49.4 ft		12	25	50/5		50/5						50/5

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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PROJECT: Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-8											
DATE DRILLED: 10/8/15		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.											
DRILL RIG: CME 550		BORING DEPTH: 35.0 ft													
DRILLER: J. White		WATER LEVEL: 14.8 ft. after 24 hours													
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz													
SAMPLING METHOD: Split spoon				NORTHING:											
DRILLING METHOD: 3 1/2" H.S.A.				EASTING:											
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft)				N VALUE	
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	/REMARKS					
										10	20	30	60	80	
		FILL ABC Stone - 2 inches		1		6	9	15							24
5		FILL: SILTY CLAY (CL) tan orange, with fine sand		2		11	15	18							33
		RESIDUAL: CLAYEY SILT (MH) very stiff, red tan, moist, with fine sand and manganese		3		8	12	12							24
10		FINE SANDY SILT (ML) very stiff, gray red tan, moist, with clay		4		5	7	7							14
		FINE SANDY SILT (ML) firm to stiff, gray red tan, moist to wet, trace clay		5		3	2	4							6
20		SILTY SAND (SM) loose, gray yellow tan, fine, wet		6		3	2	4							6
25		SILTY SAND (SM) very loose to loose, brown orange tan, fine, wet	HC	7		3	4	4							8
30		SILTY SAND (SM) medium dense, tan gray, fine to medium, wet		8		2	2	2							4
35		Boring terminated at 35 ft		9		5	6	9							15

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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PROJECT:		Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-9										
DATE DRILLED: 10/8/15		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.												
DRILL RIG: CME 550		BORING DEPTH: 30.0 ft														
DRILLER: J. White		WATER LEVEL: 14.5 feet after 24 hours														
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz														
SAMPLING METHOD: Split spoon				NORTHING:		EASTING:										
DRILLING METHOD: 3/4" H.S.A.																
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft) /REMARKS				N VALUE		
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	10	20	30	60		80	
0 - 5		FILL: CLAYEY SILT (MH) very stiff, brown tan, moist, with fine sand			1		3	6	10							16
5 - 10		RESIDUAL: FINE SANDY SILT (ML) stiff to very stiff, red tan orange, moist, with clay			2		5	8	10							18
10 - 15		SILTY SAND (SM) very loose to loose, gray orange tan, fine, moist to wet, trace mica			3		3	5	5							10
15 - 20		SILTY SAND (SM) very loose to loose, gray orange tan, fine, moist to wet, trace mica			4		2	2	5							7
20 - 25		SILTY SAND (SM) very loose to loose, gray orange tan, fine, moist to wet, trace mica			5		2	2	4							6
25 - 30		SILTY SAND (SM) loose, orange brown tan, fine to medium, wet			6		2	2	2							4
30 - 30		SILTY SAND (SM) loose, orange brown tan, fine to medium, wet			7		1	2	3							5
30 - 30		SILTY SAND (SM) loose, orange brown tan, fine to medium, wet			8		1	2	4							6
		Boring terminated at 30 ft														

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME GDT 10/23/15

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PROJECT: Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-10											
DATE DRILLED: 10/8/15		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.											
DRILL RIG: CME 550		BORING DEPTH: 20.0 ft													
DRILLER: J. White		WATER LEVEL: 14.5 ft at TOB													
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz													
SAMPLING METHOD: Split spoon				NORTHING:		EASTING:									
DRILLING METHOD: 3 1/4" H.S.A.															
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft) /REMARKS				N VALUE	
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	10	20	30	60		80
		FILL: SILTY CLAY (CL) tan orange, moist, with fine sand			1	5	8	10							18
5		RESIDUAL: CLAYEY SILT (ML) stiff to very stiff, tan red brown, moist, with fine sand			2	7	9	10							19
10		FINE SANDY SILT (ML) stiff, gray red tan, moist, trace clay			3	11	6	6							12
15		FINE SANDY SILT (ML) soft to firm, brown tan, moist to wet, with manganese	▽ HC		4	4	5	6							11
20		Boring terminated at 20 ft			5	2	2	2							4
					6	2	2	4							6

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

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PROJECT: Hyattown Pump Station Lexington, North Carolina S&ME Project No. 1358-15-068		BORING LOG		B-11											
DATE DRILLED: 10/7/15		ELEVATION:		NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.											
DRILL RIG: CME 550		BORING DEPTH: 20.0 ft													
DRILLER: J. White		WATER LEVEL: Dry at TOB													
HAMMER TYPE: 140 lb automatic		LOGGED BY: S. Lacz													
SAMPLING METHOD: Split spoon				NORTHING:		EASTING:									
DRILLING METHOD: 3 1/4" H.S.A.															
DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft) /REMARKS				N VALUE	
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	10	20	30	6080		
		FILL: FINE SANDY SILT (ML) tan orange, moist, with rock fragments			1	▲	5	6	8						14
		RESIDUAL: CLAYEY SILT (ML) stiff to very stiff, orange brown tan, moist, with fine sand and manganese			2	▲	8	11	16						27
		FINE SANDY SILT (ML) stiff, orange gray red, moist, with clay			3	▲	5	7	11						18
		FINE SANDY SILT (ML) stiff, brown orange gray, moist, trace clay			4	▲	5	7	7						14
		SILTY SAND (SM) very loose to loose, brown orange tan, fine, moist, with manganese	HC		5	▲	1	2	2						4
		Boring terminated at 20 ft			6	▲	2	5	5						10

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME.GDT 10/23/15

NOTES:

1. THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.
2. BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.
3. STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.
4. WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.



DATE DRILLED: 10/8/15	ELEVATION:	NOTES: Borehole backfilled with auger cuttings and a commercial hole closure device placed near the surface.
DRILL RIG: CME 550	BORING DEPTH: 20.0 ft	
DRILLER: J. White	WATER LEVEL: 14.6 ft. after 24 hours	
HAMMER TYPE: 140 lb automatic	LOGGED BY: S. Lacz	
SAMPLING METHOD: Split spoon		NORTHING:
DRILLING METHOD: 3 1/4" H.S.A.		EASTING:

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	ELEVATION (feet)	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT / CORE DATA			STANDARD PENETRATION TEST DATA (blows/ft) /REMARKS				N VALUE
							1st 6in / RUN #	2nd 6in / REC	3rd 6in / RQD	10	20	30	60 80	
1		FILL: FINE SANDY SILT (ML) firm, gray red brown, moist			1	☒	3	3	3					6
5		RESIDUAL: SILTY CLAY (CL) stiff, gray brown red, moist, with fine sand			2	☒	4	7	8					15
10		CLAYEY SILT (ML) stiff, gray brown red, moist, with fine sand			3	☒	4	6	8					14
10		FINE SANDY SILT (ML) stiff, gray tan, moist to wet			4	☒	3	5	5					10
15		SILTY SAND (SM) loose, gray brown tan, fine, saturated	▼ HC		5	☒	3	3	3					6
20		Boring terminated at 20 ft			6	☒	2	2	3					5

S&ME BORING LOG 1358-15-068 HYATTOWN PUMP STATION.GPJ S&ME GDT 10/23/15

- NOTES:**
1. THIS LOG IS ONLY A PORTION OF A REPORT PREPARED FOR THE NAMED PROJECT AND MUST ONLY BE USED TOGETHER WITH THAT REPORT.
 2. BORING, SAMPLING AND PENETRATION TEST DATA IN GENERAL ACCORDANCE WITH ASTM D-1586.
 3. STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.
 4. WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.





SUMMARY OF LABORATORY TEST DATA
Hyattown Pump Station
Lexington, North Carolina
S&ME Project No. 1358-15-068

Boring	Sample Depth (feet)	Sample Type	USCS Classification	Natural Moisture Content (%)	Grain Size Analysis			Atterberg Limits		
					Gravel (%)	Sand (%)	Silt and Clay (%)	LL	PL	PI
B-2	3.5 - 5.0	SS	MH	31.3	--	--	--	81	39	42
B-4	3.5 - 5.0	SS	MH	33.9	--	--	--	78	45	33
B-5	13.5 - 15.0	SS	ML*	47.7	0	22.8	77.2	--	--	--
B-7	1.0 - 2.5	SS	MH	28.8	--	--	--	77	36	41
B-8	1.0 - 2.5	SS	MH	22.9	--	--	--	71	35	36
B-9	1.0 - 2.5	SS	MH	32.1	--	--	--	77	38	39
	8.5 - 10.0	SS	ML*	39.2	--	--	--	--	--	--

* - Visual/manual classification
 Contains Fill soils
 SS - Split Spoon

LL - Liquid Limit
 PL - Plastic Limit
 PI - Plasticity Index
 NP - Non-plastic

Laboratory Determination of Water Content



ASTM D 2216

AASHTO T 265

Quality Assurance

S&ME, Inc. - Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #:	1358-15-068	Report Date:	10-16-15
Project Name:	Hyattown Pump Station	Test Date(s):	10-13-15
Client Name:	Hazen and Sawyer		
Client Address:	Charlotte NC		
Sample by:	J. White	Sample Date(s):	10/7-10/8/15
Sampling Method:	NA	Drill Rig :	NA

Method: **A (1%)** **B (0.1%)** *Balance ID.* **5544** *Calibration Date:* **2-26-15**

Boring No.	Sample No.	Sample Depth	Tare #	Tare Weight	Tare Wt.+ Wet Wt	Tare Wt. + Dry Wt	Water Weight	Percent Moisture	Note
		ft. or m.		grams	grams	grams	grams	%	
B-2	2	3.5'-5.0'	N	9.47	70.87	56.25	14.62	31.3%	
B-4	2	3.5'-5.0'	8	7.50	77.12	59.48	17.64	33.9%	
B-5	5	13.5'-15.0'	10	119.20	357.79	280.72	77.07	47.7%	
B-7	1	1.0'-2.5'	23	9.40	72.49	58.38	14.11	28.8%	
B-8	1	1.0'-2.5'	B-1	7.78	74.82	62.34	12.48	22.9%	
B-9	1	1.0'-2.5'	42	7.87	76.64	59.93	16.71	32.1%	
B-9	4	8.5'-10.0'	45	8.92	72.11	54.33	17.78	39.2%	

Notes / Deviations / References

ASTM D 2216: Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Jimmy Thomasson
Technician Name

Signature

Nicet #119392
Certification Type / No.

Date

Steve Lacz, PE
Technical Responsibility

Signature

Project Engineer
Position

Date

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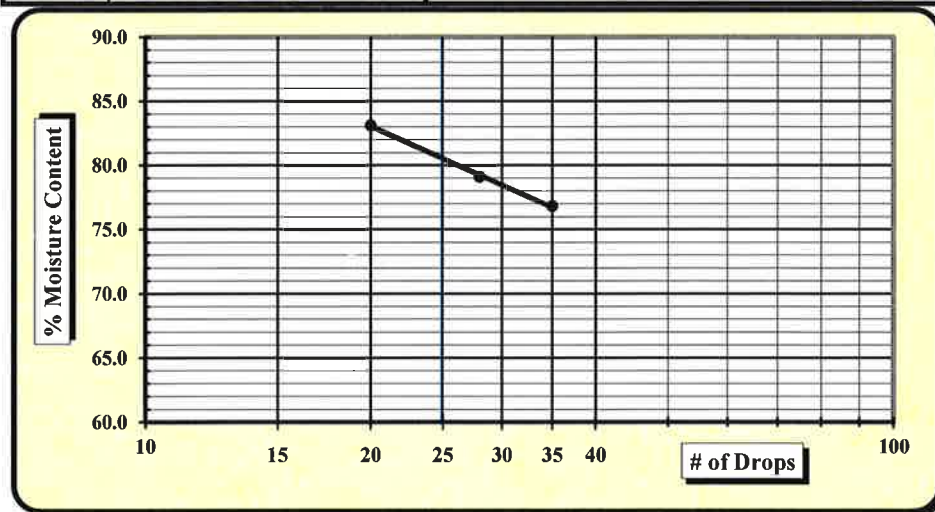
Liquid Limit, Plastic Limit, and Plastic Index

S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #:	1358-15-068	Report Date:	10-16-15
Project Name:	Hyattown Pump Station	Test Date(s)	10-16-15
Client Name:	Hazen and Sawyer		
Client Address:	Charlotte NC		
Boring #:	B-2	Sample #:	2
		Sample Date:	10/7-10/8/15
Location:	NA	Offset:	NA
		Elevation:	3.5'-5.0'

Sample Description: Brown Orange Sandy Clayey SILT					
<i>Type and Specification</i>	<i>S&ME ID #</i>	<i>Cal Date:</i>	<i>Type and Specification</i>	<i>S&ME ID #</i>	<i>Cal Date:</i>
Balance (0.01 g)	5544	2/26/2015	Grooving tool	5788	2/28/2015
LL Apparatus	5571	2/28/2015	Grooving tool		
Oven	5470	4/1/2015	Grooving tool		

Pan #	Tare #:	Liquid Limit					Plastic Limit			
		16	18	24	4	5	6	112	16	9
A	Tare Weight	15.99	16.02	13.96				11.41	11.40	
B	Wet Soil Weight + A	23.61	23.90	23.26				17.92	17.84	
C	Dry Soil Weight + A	20.30	20.42	19.04				16.10	16.03	
D	Water Weight (B-C)	3.31	3.48	4.22				1.82	1.81	
E	Dry Soil Weight (C-A)	4.31	4.40	5.08				4.69	4.63	
F	% Moisture (D/E)*100	76.8%	79.1%	83.1%				38.8%	39.1%	
N	# OF DROPS	35	28	20				Moisture Contents determined by ASTM D 2216		
LL	LL = F * FACTOR									
Ave.	Average							39.0%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic

Liquid Limit **81**

Plastic Limit **39**

Plastic Index **42**

Group Symbol **MH**

Multipoint Method

One-point Method

Wet Preparation Dry Preparation Air Dried

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson
Technician Name

Date

Steve Lacz, PE
Technical Responsibility

Date

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Liquid Limit, Plastic Limit, and Plastic Index

S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #: 1358-15-068 **Report Date:** 10-16-15
Project Name: Hyattown Pump Station **Test Date(s)** 10-16-15
Client Name: Hazen and Sawyer
Client Address: Charlotte NC

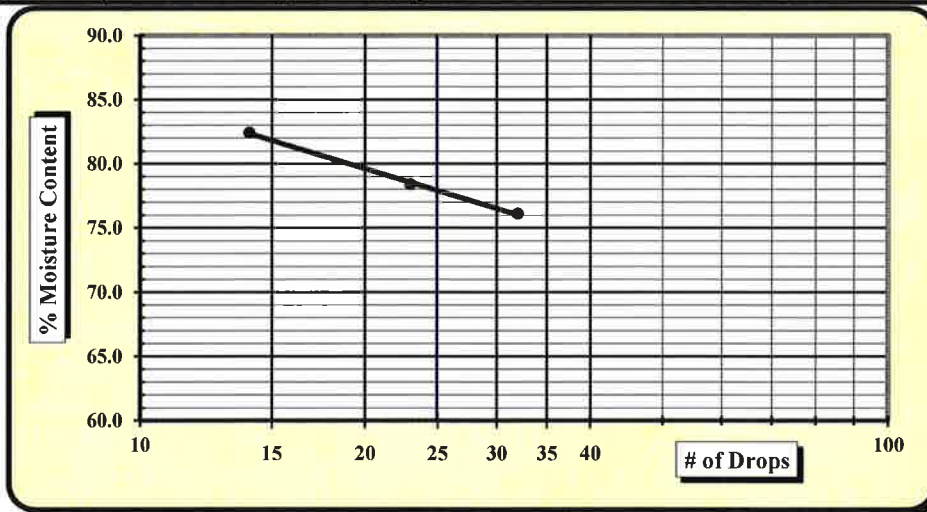
Boring #: B-4 **Sample #:** 2 **Sample Date:** 10/7-10/8/15

Location: NA **Offset:** NA **Elevation:** 3.5'-5.0'

Sample Description: Tan Orange Sandy Clayey SILT

Type and Specification	S&ME ID #	Cal Date:	Type and Specification	S&ME ID #	Cal Date:
Balance (0.01 g)	5544	2/26/2015	Grooving tool	5788	2/28/2015
LL Apparatus	5571	2/28/2015	Grooving tool		
Oven	5470	4/1/2015	Grooving tool		

Pan #	Tare #:	Liquid Limit						Plastic Limit		
		23	25	23	4	5	6	104	123	9
A	Tare Weight	15.84	15.90	14.06				11.38	11.40	
B	Wet Soil Weight + A	23.94	23.57	23.36				17.01	17.34	
C	Dry Soil Weight + A	20.44	20.20	19.16				15.27	15.52	
D	Water Weight (B-C)	3.50	3.37	4.20				1.74	1.82	
E	Dry Soil Weight (C-A)	4.60	4.30	5.10				3.89	4.12	
F	% Moisture (D/E)*100	76.1%	78.4%	82.4%				44.7%	44.2%	
N	# OF DROPS	32	23	14				Moisture Contents determined by ASTM D 2216		
LL	LL = F * FACTOR									
Ave.	Average							44.5%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic
Liquid Limit 78
Plastic Limit 45
Plastic Index 33
Group Symbol MH

Multipoint Method
 One-point Method

Wet Preparation Dry Preparation Air Dried

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson
 Technician Name

_____ Date

Steve Lacz, PE
 Technical Responsibility

_____ Date

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Sieve Analysis of Soils

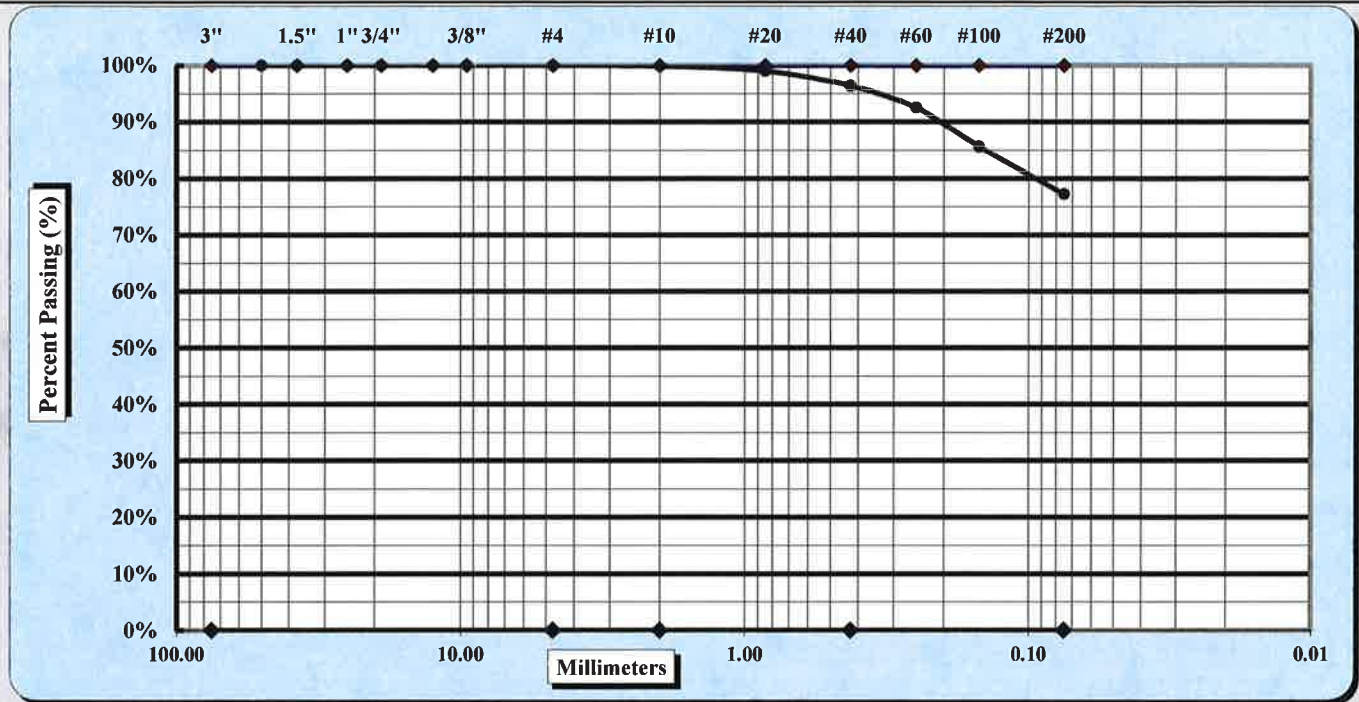


ASTM D 422

Quality Assurance

S&ME, Inc. - Greensboro 8646 west market St. Suite 105 Greensboro NC 27409			
Project #:	1358-15-068	Report Date:	10-16-15
Project Name:	Hyattown Pump Station	Test Date(s):	10-16-15
Client Name:	Hazen and Sawyer		
Client Address:	Charlotte NC		
Sample Id.	B-5	Type:	NA
		Sample Date:	10/7-10/8/15
Location:	NA	Sample:	5
		Elevation:	13.5'-15.0'

Sample Description: Gray Tan Orange Sandy Clayey SILT



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 and > 0.005 mm
Coarse Sand	< 4.75 mm and > 2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	#4	Coarse Sand	0.1%	Fine Sand	19.1%
Gravel	0.0%	Medium Sand	3.5%	Silt & Clay	77.2%
Liquid Limit		Plastic Limit		Plastic Index	
Specific Gravity		Cc = #####	Cu = #####	Moisture Content	
Coarse Sand	0.1%	Medium Sand	3.5%	Fine Sand	19.1%

Description of Sand & Gravel Particles:	Rounded	<input type="checkbox"/>	Angular	<input type="checkbox"/>	
Hard & Durable	<input type="checkbox"/>	Soft	<input type="checkbox"/>	Weathered & Friable	<input type="checkbox"/>

Notes / Deviations / References:

Steve Lacz, PE
Technical Responsibility

Signature

Project Engineer
Position

Date

Liquid Limit, Plastic Limit, and Plastic Index



Another code ASTM D 4318 AASHTO T 89 AASHTO T 90 Quality Assurance

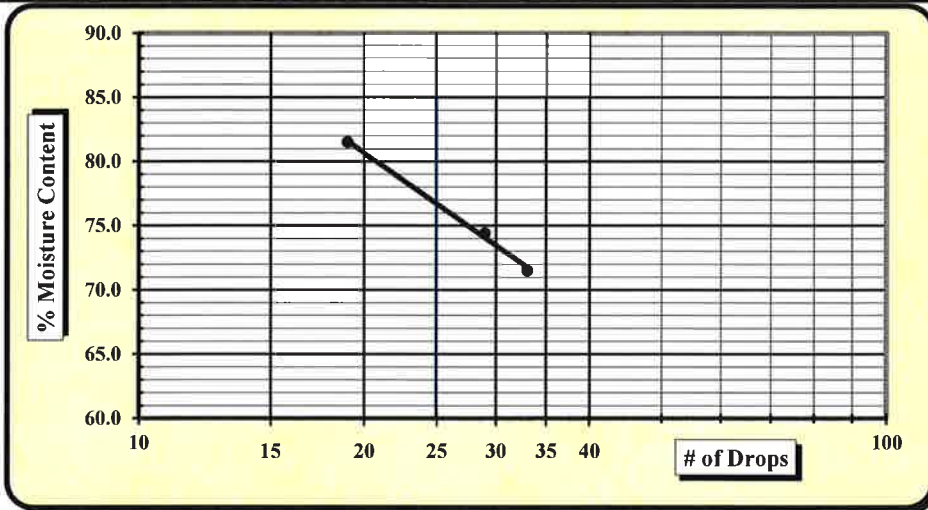
S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #: 1358-15-068 Report Date: 10-16-15
 Project Name: Hyattown Pump Station Test Date(s): 10-16-15
 Client Name: Hazen and Sawyer
 Client Address: Charlotte NC

Boring #: B-7 Sample #: 1 Sample Date: 10/7-10/8/15
 Location: NA Offset: NA Elevation: 1.0'-2.5'

Sample Description:	Yellow Tan Sandy Clayey SILT				
Type and Specification	S&ME ID #	Cal Date:	Type and Specification	S&ME ID #	Cal Date:
Balance (0.01 g)	5544	2/26/2015	Grooving tool	5788	2/28/2015
LL Apparatus	5571	2/28/2015	Grooving tool		
Oven	5470	4/1/2015	Grooving tool		

Pan #	Tare #:	Liquid Limit					Plastic Limit			
		8	36	1	4	5	6	102	105	9
A	Tare Weight	15.77	15.85	15.76				11.04	11.37	
B	Wet Soil Weight + A	23.64	23.54	23.53				17.48	17.39	
C	Dry Soil Weight + A	20.36	20.26	20.04				15.77	15.78	
D	Water Weight (B-C)	3.28	3.28	3.49				1.71	1.61	
E	Dry Soil Weight (C-A)	4.59	4.41	4.28				4.73	4.41	
F	% Moisture (D/E)*100	71.5%	74.4%	81.5%				36.2%	36.5%	
N	# OF DROPS	33	29	19				Moisture Contents determined by ASTM D 2216		
LL	LL = F * FACTOR									
Ave.	Average							36.4%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic
 Liquid Limit 77
 Plastic Limit 36
 Plastic Index 41
 Group Symbol MH

Multipoint Method
 One-point Method

Wet Preparation Dry Preparation Air Dried

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson
 Technician Name

Date

Steve Lacz, PE
 Technical Responsibility

Date

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Liquid Limit, Plastic Limit, and Plastic Index

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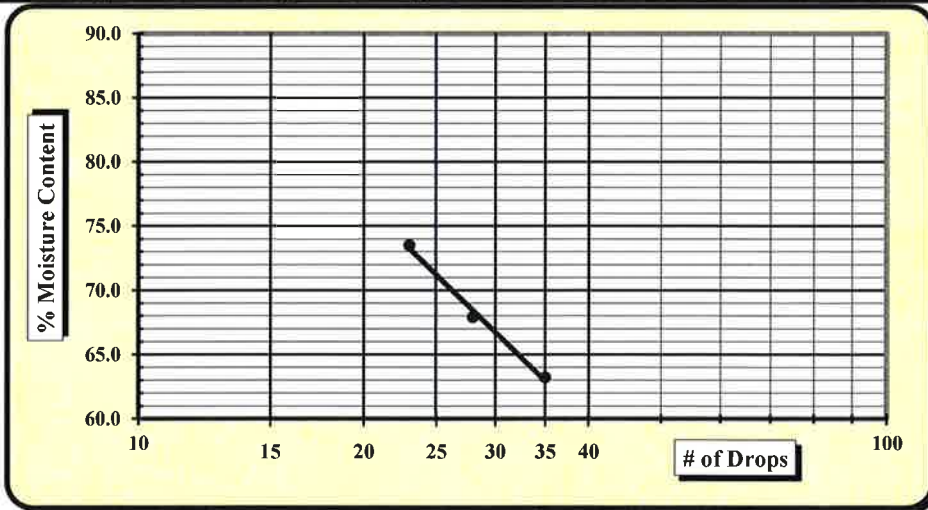
Project #: **1358-15-068** Report Date: 10-16-15
 Project Name: Hyattown Pump Station Test Date(s) 10-16-15
 Client Name: Hazen and Sawyer
 Client Address: Charlotte NC

Boring #: B-8 Sample #: 1 Sample Date: 10/7-10/8/15
 Location: NA Offset: NA Elevation: 1.0'-2.5'

Sample Description: Red Tan Sandy Clayey SILT

Type and Specification	S&ME ID #	Cal Date:	Type and Specification	S&ME ID #	Cal Date:
Balance (0.01 g)	5544	2/26/2015	Grooving tool	5788	2/28/2015
LL Apparatus	5571	2/28/2015	Grooving tool		
Oven	5470	4/1/2015	Grooving tool		

Pan #	Tare #:	Liquid Limit					Plastic Limit			
		22	12	15	4	5	6	111	113	9
A	Tare Weight	16.07	16.11	15.73				11.28	11.15	
B	Wet Soil Weight + A	23.84	23.95	23.64				17.33	17.82	
C	Dry Soil Weight + A	20.83	20.78	20.29				15.75	16.11	
D	Water Weight (B-C)	3.01	3.17	3.35				1.58	1.71	
E	Dry Soil Weight (C-A)	4.76	4.67	4.56				4.47	4.96	
F	% Moisture (D/E)*100	63.2%	67.9%	73.5%				35.3%	34.5%	
N	# OF DROPS	35	28	23				Moisture Contents determined by ASTM D 2216		
LL	LL = F * FACTOR									
Ave.	Average							34.9%		



N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic
 Liquid Limit **71**
 Plastic Limit **35**
 Plastic Index **36**
 Group Symbol **MH**

Multipoint Method
 One-point Method

Wet Preparation Dry Preparation Air Dried

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson
 Technician Name

 Date

Steve Lacz, PE
 Technical Responsibility

 Date

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Liquid Limit, Plastic Limit, and Plastic Index

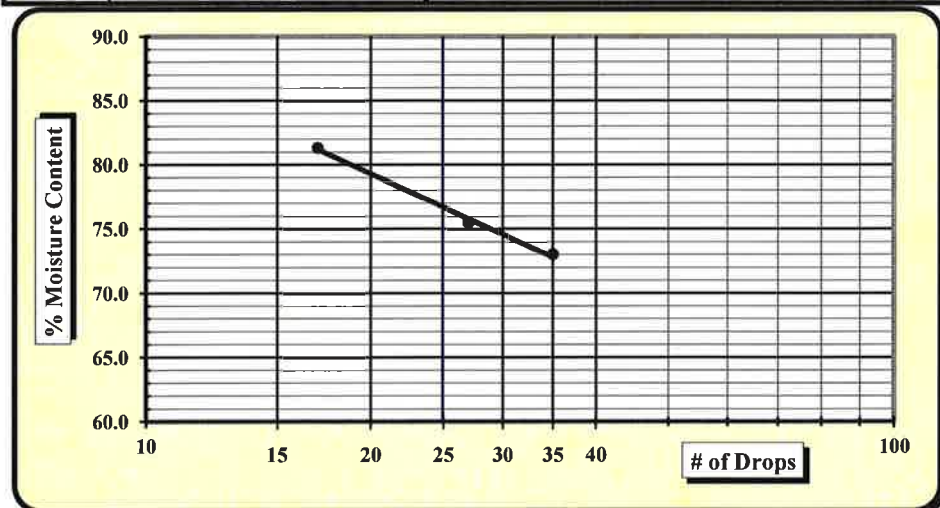
S & ME, Inc.- Greensboro 8646 West Market St. Suite 105, Greensboro NC 27409

Project #: 1358-15-068	Report Date: 10-16-15
Project Name: Hyattown Pump Station	Test Date(s) 10-16-15
Client Name: Hazen and Sawyer	
Client Address: Charlotte NC	

Boring #: B-9	Sample #: 1	Sample Date: 10/7-10/8/15
Location: NA	Offset: NA	Elevation: 1.0'-2.5'

Sample Description: Brown Tan Sandy Clayey SILT					
<i>Type and Specification</i>	<i>S&ME ID #</i>	<i>Cal Date:</i>	<i>Type and Specification</i>	<i>S&ME ID #</i>	<i>Cal Date:</i>
Balance (0.01 g)	5544	2/26/2015	Grooving tool	5788	2/28/2015
LL Apparatus	5571	2/28/2015	Grooving tool		
Oven	5470	4/1/2015	Grooving tool		

Pan #	Tare #:	Liquid Limit					Plastic Limit			
		9	2	24	4	5	6	114	121	9
A	Tare Weight	15.93	15.95	15.75				11.13	11.34	
B	Wet Soil Weight + A	23.61	23.99	23.58				17.40	17.18	
C	Dry Soil Weight + A	20.37	20.53	20.07				15.67	15.59	
D	Water Weight (B-C)	3.24	3.46	3.51				1.73	1.59	
E	Dry Soil Weight (C-A)	4.44	4.58	4.32				4.54	4.25	
F	% Moisture (D/E)*100	73.0%	75.5%	81.3%				38.1%	37.4%	
N	# OF DROPS	35	27	17				Moisture Contents determined by ASTM D 2216		
LL	LL = F * FACTOR									
Ave.	Average							37.8%		



One Point Liquid Limit			
N	Factor	N	Factor
20	0.974	26	1.005
21	0.979	27	1.009
22	0.985	28	1.014
23	0.99	29	1.018
24	0.995	30	1.022
25	1.000		

NP, Non-Plastic

Liquid Limit **77**

Plastic Limit **38**

Plastic Index **39**

Group Symbol **MH**

Multipoint Method

One-point Method

Wet Preparation Dry Preparation Air Dried

Notes / Deviations / References:

ASTM D 4318: Liquid Limit, Plastic Limit, & Plastic Index of Soils

Jimmy Thomasson
Technician Name

Date

Steve Lacz, PE
Technical Responsibility

Date

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