CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

FOR THE CONSTRUCTION OF

ELKMONT REGIONAL PUMP STATION AND GRAVITY SEWER

ELKMONT, ALABAMA
MARCH 2023
MORELL PROJECT NUMBER: 23-0047

Prepared for:

Limestone County Water and Sewer Authority
17218 US-72
Athens, AL 35612

ELKMONT REGIONAL PUMP STATION AND GRAVITY SEWER

TABLE OF CONTENTS

ADVERTISEMENT FOR BIDS

Sealed proposals will be received by Limestone County Water and Sewer Authority, until 12:00 p.m., local time on **Wednesday, April 12, 2023** for the construction of the

Elkmont Regional Pump Station and Gravity Sewer

at which time and place they will be publicly opened and read.

A summary of the work items is included below:

Construction of a 180 GPM sanitary sewerage lift station, installation of approximately 1,427 linear feet of 8-inch PVC gravity sewer, 1,713 linear feet of 6-inch diameter PVC force main.

The work of constructing the project will be let under one Contract if an award should be made; and the Owner reserves the right to select the Bid considered by the Owner to be in the best interest of the Owner.

A cashier's check or bid bond payable to Limestone County Water and Sewer Authority, in an amount not less than five (5) percent of the amount of the bid, but in no event more than $10,000, must accompany the bidder's proposal. Performance and Payment Bonds and evidence of insurance required in the bid documents will be required at the signing of the Contract.

Bid Documents may be obtained from the office of the Engineer, Morell Engineering, Inc., at 711 East Hobbs St., Athens, AL 35611, 256-867-4957 for a non-refundable fee in the amount of $50.00.

Bids must be submitted on proposal forms furnished by the Engineer. All bidders bidding in amounts exceeding that established by the state licensing board for general contractors must be licensed under the appropriate/applicable provisions of state law, and must show evidence of license before bidding or bid will not be received or considered by the Engineer; the bidder shall show such evidence by clearly displaying his or her current license number on the outside of the sealed envelope in which the proposal is delivered. The Owner reserves the right to reject any or all proposals and to waive technical errors if, in the Owner's judgment, the best interest of the Owner will thereby be promoted.

OWNER
Limestone County Water and Sewer Authority
17218 Highway 72
Athens, AL 35612
Office: 256-233-6444

ENGINEER
Morell Engineering, Inc.
711 East Hobbs St.
Athens, AL 35611
256-867-4957

INSTRUCTIONS TO BIDDERS

RECEIPT OF BIDS

Sealed Proposals will be received by Limestone County Water and Sewer Authority, at 17218 Highway 72 Athens, AL 35612 where bids will be received, until **Wednesday, April 12, 2023 at 12:00 p.m.** local time, for furnishing all labor, tools, materials and equipment, and for doing the work of construction, according to the Contract Documents, as described in the Advertisement for Bids and in the Specifications, Drawings, and other Contract Documents. No bids will be received after the time set forth hereinabove; and the Proposals will be publicly opened and read aloud. A non-mandatory Pre-Bid meeting will be held at the Limestone County Water and Sewer Authority office on **Wednesday, March 29, 2023 at 9:00 am.** All questions from the Contractors shall be sent to the Engineer no later **than Wednesday, April 5, 2023 at 5:00 pm**. No questions will be answered submitted after this date.

CONTRACT DOCUMENTS

Contract Documents are open to public inspection at the office of Morell Engineering, Inc., 711 East Hobbs St., Athens, AL, 35611.

Copies (hard copies) of the Contract Documents can be obtained from the office of the Engineer, Morell Engineering, Inc., 711 East Hobbs St., Athens, AL, 35611. (256) 867-4957.

DEFINITIONS

The following terms as used in these Contract Documents, are respectively defined as follows:

(a) "Contractor" or "Contractors":	The person, firm or corporation signing the Contract with the Owner.
(b) "Subcontractor":	One who contracts with the Contractor to perform all or any part of the Contract to be performed by the Contractor under the attached Documents.
(c) "Work at Site of Project":	Work to be performed, including work normally done at the location of the project. See Article II of the Contract Agreement and Section 1.1 of the General Conditions.
(d) "Purchaser, Owner, Authority":	Limestone County Water and Sewer Authority
(e) Engineer:	Morell Engineering, Inc. or their duly authorized representative.
(f) "Days":	Calendar days, unless otherwise specified.
(g) "Proposal":	Wherever "Proposal" is used, it shall mean "Bid" and must be on the required Proposal Form.

PROPOSAL FORM

The Engineer will furnish Bidders with a Proposal Form. No bid will be considered unless submitted on such form. The Bidders shall complete the Proposal Form in manner prescribed, using ink for writing figures, or figures may be typed. The Bidder must sign the Bid correctly and legibly; and shall state his interest, title, or office in the company submitting the Bid. If the Bid should be made by an individual, his full name and address shall be shown; if made by a firm or partnership, the full name and address of each member of the firm or each partner shall be shown; and if made by a corporation, the full names and addresses of the president, secretary and treasurer shall be shown. Should the Proposal Form not be fully completed in ink by the Contractor, the Bid will be deemed to be informal and may be rejected.

The Proposal Form shall be fully completed in accordance with the Instruction to Bidders, in accordance with any instructions to bidders given in the Specifications (including the General Conditions), and without any excisions, alterations, special conditions or alterations made by the Bidder. The Bidder shall be fully responsive to all instructions relating to the Proposal.

BIDS

Bids shall be enclosed in a sealed envelope, endorsed Elkmont Regional Pump Station and Gravity Sewer, Morell Project No. 23-0047.

The Bidder shall show, on the outside of the envelope and on the last page of the Proposal Form, firm's Contractor's License Number for the State in which the project is located, and shall also show, on the outside of the envelope, firm's name and address.

No Bid will be received after the time specified in the Advertisement for Bids.

Any Bidder may withdraw firm's bid, either personally, by email, or written request, at any time prior to the scheduled closing time for the receipt of bids.

No Bidder may withdraw firm's bid for a period of sixty (60) days after the scheduled closing time for receipt of bids, as set forth in the Advertisement for Bids.

The Owner reserves the right to reject any or all bids, to waive any informalities in any bid, to select or reject Alternate Bid Items identified on the Proposal Form, and to accept any bid considered advantageous to the Owner.

A bid which has been sealed in its delivery envelope may be revised by writing a change in price on the outside of the envelope over the signature of the bidder or the bidder's "authorized representative". In revising the bid in this manner, the bidder must only write the amount of the change in price on the envelope and must not reveal the bid price, and must specify which item numbers on the Proposal Form are changed. An envelope change to a unit price proposal shall be specifically written in such a way as to alter one or more unit prices.

AWARD OF CONTRACT

The Contract, if awarded, will be awarded to the low, responsive, responsible bidder as soon as practicable, provided a satisfactory bid has been received. In order to be considered for the award of the Contract, the Bidder shall demonstrate to the Owner that he possesses all of the above named qualifications.

BID GUARANTY

Each Bidder must enclose with his Proposal a Bid Bond or a Cashier's Check drawn on a bank that is located in the same state as the project site, in the amount of not less than five percent (5%) of the total bid, but not more than $10,000.00. The payee of such bond or cashier's check shall be Limestone County Water and Sewer Authority. The Bid Bond or Cashier's Check shall bear the same date as that set for the receipt of bids.

Bid Bonds shall be returned to all bidders, other than the low and two next low bidders, when the low bids have been determined. Those of the three low bidders will be returned after execution of the Contract.

If a bidder to whom a contract is awarded shall refuse or neglect to execute the Contract and furnish security in the amount required within ten (10) days after the notice has been given him of such award, his bid bond shall be forfeited to the Owner as liquidated damages for such refusal or neglect.

The successful bidder will be required to furnish, through an authorized agent in the state in which the project is located, a Performance Bond, Labor and Material Payment Bond, Employer's Liability and Workmen Compensation Insurance, Comprehensive Liability Insurance, Property Insurance, Comprehensive Automobile Liability, Special Hazards or Perils and shall furnish proof of carriage of all of the above insurance all as set out in detail under "General Conditions" of the Specifications. The Performance Bond and the Labor and Material Payment Bond must be countersigned by an agent whose office is located in the state in which the project is located and who is authorized to do business in that state; and a valid Power-of-Attorney shall be attached to each Bond.

INTERPRETATIONS

If any person contemplating submitting a bid for the proposed contract is in doubt as to the true meaning of any part of the Contract Documents, he must submit a written request to the Engineer for interpretations thereof. The persons submitting the request will be responsible for its prompt delivery. Any interpretation of the proposed documents will be made by addendum duly issued, and copy of such addendum will be mailed by certified mail (with return receipt requested) or delivered to each person receiving a set of such documents. The Owner will not be responsible for any other explanation or interpretation of the Contract Documents.

COMMENCEMENT AND COMPLETION OF WORK

Following the execution of the Contract by the Owner and the Contractor, the Contractor will be authorized to commence work by written Notice to Proceed from the Owner. The Contractor shall

then commence work on the project within the time stated in the Contract, unless such time stated is extended by signed written agreement between the Owner and the Contractor, and shall fully complete all work under the Contract within the number of consecutive calendar days specified in the Contract.

FAMILIARITY WITH LAWS

The Bidder is assumed to have familiarized himself with all state laws and with all local ordinances and regulations which, in any manner, may affect the conduct of the work or those engaged or employed on the work, and no pleas of misunderstanding will be considered.
The attention of bidders is called to the provisions of state law governing general contractors, and bidders shall be governed by the provisions of said law insofar as it is applicable. The above mentioned provisions of the code make it illegal for the Owner to consider a bid from anyone who is not properly licensed under such code provisions. The Owner, therefore, will not consider any bid unless the bidder produces evidence that he is so licensed. Neither will the Owner enter into a Contract with a foreign corporation which is not qualified under state law to do business in the state in which the project is located.

ASSIGNMENT OF CONTRACT

The Contractor shall not assign his Contract, nor any part thereof, nor any monies due, or to become due thereunder, without prior written consent of the Owner. In case the Contractor, with the consent of the Owner assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in or to any monies due or to become due to the Contractor shall be subject to all claims, rights and remedies of the Owner, and all prior valid claims of all persons, firms, and corporation for services rendered or materials supplied for the performance of work under the Contract.

SUBCONTRACTING

No part of the Contract shall be sublet without the prior written consent of the Owner. The Contractor shall, following execution of the Contract, immediately submit to the Owner the names of subcontractors whom he/she proposes to employ on the project.

EXECUTION OF CONTRACT

The Contract Agreement/Documents shall be executed in triplicate, each counterpart of which shall be considered as an original without accounting for the absence of any of the other counterparts or copies.

QUALIFICATIONS OF BIDDERS

Bidders must meet the qualifications described in the Statement of Bidder Qualifications at the end of this section. Bidders must submit/include the Statement of Bidder Qualifications with their bid(s). Questions or clarifications regarding the Statement of Bidder Qualifications should be submitted in writing during the bid period.

The Contract award, if made, will be made to the low, responsive, responsible Bidder.

A responsive bid shall be evidenced by: (1), a Proposal Form completed in accordance with the Instructions to Bidders and with instructions and/or requests or directions contained in any other sections of the Contract Documents (including the Specifications and General Conditions); (2), a Proposal Form not evidencing any apparent unbalanced pricing for performance of the items of work; (3), a Proposal Form without excisions, alterations, special conditions or qualifications made by the Bidder; and, (4), a Proposal Form containing no alternative bids or offerings (by inclusion, attachment, or otherwise) for any items unless such alternative bids or offers are specifically requested in the Proposal Form and/or Contract Documents.

That a Bidder is responsible may be evidenced by the following facts: (1), that he maintains a permanent place of business; (2), that he has adequate financial capability for meeting the obligations contingent to the work; (3), that he has adequate forces to properly perform the work within the time limit specified; and (4), that he has a competent and experienced organization. In order to be considered for the award the Bidder shall present to the Owner satisfactory evidence that: (1), he has the necessary capital and financial resources to undertake and complete the project; (2), he has equipment, in good working order, adequate for performance of work within the time specified; (3), he has within his organization, at the time of construction, management and supervisory personnel available for assignment to the project; (4), the construction management and supervisory personnel are skilled and experienced in the particular type of work to be undertaken on the project; and (5), meets the requirements listed above.

STATEMENT OF BIDDER'S QUALIFICATIONS

The Bidder shall be one whose principal business and experience is similar to the work included in this project. The Bidder shall have successfully completed, under his/her present firm name, not less than three (3) projects of similar size and scope. Similarly, the Project Manager and Superintendent to be assigned to this project must meet the following minimum requirements:

1. Minimum of 5 years of experience (in their current/respective role) with projects of similar size and scope.
2. Minimum of 1 year of experience with Bidder’s firm and must be (currently and for past 12 months) full time, regular employees of Bidder’s firm.

Bidder must provide a Statement of Bidder Qualifications which includes clear and comprehensive responses to each item below. Statement must be signed by legal representative of the Bidder and signature must be notarized. The statement should be attached to this page. Failure to include a response to ALL items may result in bid being considered non-responsive. Bidder may submit information in addition to the items below.

1. Name/address of firm/Bidder, and date and location of organization/incorporation, and general description of work performed by your company.
2. List all projects within the past 5 years where the following occurred:
    a. Bidder failed to complete any work awarded to you.
    b. Bidder defaulted on a contract.
    c. Bidder was assessed Liquidated Damages.

d. Bidder failed to complete the project by the Final Completion Date but negotiated to avoid Liquidated Damages (include brief description, explanation, and project owner contact info.).

3. List and provide brief description of last 3 projects of similar size and scope and include date and contact information for project owner.
4. Provide name and brief description of experience of the Bidder's proposed Superintendent, including date and project owner contact information for current project on which he/she is assigned and for past 3 projects of similar size and scope.
5. Provide name and brief description of experience of the Bidder's proposed Project Manager, including date and project owner contact information for current project on which he/she is assigned and for past 3 projects of similar size and scope.

END OF SECTION

PROPOSAL FORM

MADE BY _____

ADDRESS _____

TO: Limestone County Water and Sewer Authority

The undersigned, as Bidder, proposes and agrees, if this Bid is accepted, to enter into a Contract with Limestone County Water and Sewer Authority Limestone County, Alabama, in the form of Contract specified and shown in the attached Contract Documents, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation, and labor necessary to complete the construction of a Elkmont Regional Pump Station and Gravity Sewer, 23-0047 as described in the Advertisement for Bids, and in the Contract Documents, which are hereby referred to and made a part of the same extent as if fully set out herein, and in full and complete accordance with the shown, noted, described and reasonably intended requirements of the Contract Documents, to the full and entire satisfaction of the Owner, with a definite understanding that no money will be allowed for extra work except as set forth in the attached Instructions to Bidders, General Conditions, and other Contract Documents, based on the following pricing:

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Mobilization/Demobilization	1	LS		$
2	Sanitary Sewer Lift Station, As Described in the Contract Documents, Furnished and Installed	1	LS		$
3	8" PVC Pipe, SDR 26, Push-On Joint, (4’ - 8’ cut) Furnished and Installed	453	LF		$
4	6" PVC Pipe, SDR-21, Furnished and Installed	1713	LF		$
5	6" PVC Pipe, SDR-21, Creek Crossing, Furnished and Installed	40	LF		$
6	4’ Diameter Precast Manhole Base Section, Furnished and Installed	2	EA		$
7	4’ Diameter Precast Manhole, Riser Section, Furnished and Installed	20	LF		$
8	Standard Manhole Ring and Cover, Furnished and Installed	2	EA		$

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
9	Air Release Valve Assembly, Furnished and Installed	1	EA		$
10	1" Sch. 80 PVC Water Service, Furnished and Installed	900	LF		$
11	Connection to Existing System	2	EA		$
12	Record Survey	1	LS		$
13	Clearing and Grubbing	2	ACRE		$
14	Lift Station Access Road, Furnished and Installed	1250	SY		$
15	Erosion Control Measures, Furnished and Installed	1	LS		$
16	Excavation of Unsuitable Materials and Disposing Off-Site	500	CY		$
17	Backfilling of Unsuitable Materials with Suitable Soils	500	CY		$

TOTAL BASE BID $ _____

BASE BID: For construction complete as shown and specified in table above, the sum of

_____

_____

Dollars

($_____).

ITEM	DESCRIPTION	QTY	UNIT	UNIT PRICE	AMOUNT
1	Mobilization/Demobilization	1	LS		$
2	8" PVC Pipe, SDR 26, Push-On Joint, (8’ - 12’ cut) Furnished and Installed	496	LF		$
3	8" PVC Pipe, SDR 26, Push-On Joint, (4’ - 8’ cut) Furnished and Installed	478	LF		$
4	4’ Diameter Precast Manhole Base Section, Furnished and Installed	5	EA		$
5	4’ Diameter Precast Manhole, Riser Section, Furnished and Installed	42	LF		$
6	Standard Manhole Ring and Cover, Furnished and Installed	5	EA		$
7	Connection to Existing System	1	EA		$
8	Demolish Existing Lift Station, Valves, Piping and Electrical	1	LS		$
9	Record Survey	1	LS		$

TOTAL ADD ALTERNATE No.1 $ _____

ADD ALTERNATE No. 1: For construction complete as shown and specified in table above, the sum of _____

_____

Dollars

($_____).

ADDENDA: The Bidder acknowledges receipt of Addenda Nos. _____ , _____ , _____ ,

The award of the Contract will be based on the total/sum of the base bid price and the alternates (if any) selected by the Owner. The Owner will receive bids and all pricing will be read aloud, but the project will not be awarded until the bids are evaluated and a determination is made on which alternates are selected. Once the Alternates have been selected, the final bid amount will be calculated (base bid price plus adjustments for any alternate selected) for each bid submitted, and if an award is made, the project will be awarded to the responsive bidder with the lowest final bid amount.

The Bidder declares that he/she has examined the site of the work, and has familiarized himself/herself with the existing and proposed/new facilities (including the location, nature, sizes/dimensions, current and intended future use, etc.). The Bidder declares that he/she has fully informed himself/herself of conditions that would affect the proposed work, that, prior to the tender of his/her bid, he/she has examined the Contract Documents for the work and has read

all special instructions and provisions contained in the Documents, and that he/she has satisfied himself/herself with respect to the quality and extent of work to be performed. The Bidder declares that the firm, the project manager and the superintendent are qualified and meet or exceed the experience requirements as outlined in the Instructions to Bidders and/or elsewhere in the Contract Documents.

The Bidder declares that he/she understands that, when quantities of work for which unit price bids are requested in the Proposal, such quantities are approximate only and are subject to either increase or decrease, that, should the quantities of any of the work items be increased, the Bidder proposes to perform the additional work at the unit prices bid by him, that, should the quantities of any of the work items be decreased, payment will be made only for the actual quantities of work performed and such payment will be based upon the unit prices bid by him/her, and that he/she shall make no claim for profits anticipated on the decrease in quantities of work. Actual quantities will be paid for as the work progresses, in accordance with the provisions of the Contract Agreement, and such quantities shall be subject to final measurements and determinations made upon completion of the work.

The Bidder understands that the Owner reserves the right, in the Owner's discretion, to reject any or all bids, to waive any informality in any bid, and to accept any bid considered to be advantageous to the Owner.

The Bidder agrees that his/her bid shall be valid for a period of sixty (60) calendar days after the date set for receipt of bids, and shall not be withdrawn for a period of sixty (60) calendar days after the date set for receipt of bids.

The Bidder has attached hereto a Bid Bond executed by a Surety Company authorized to do business in the state in which the project is located (with valid Power-of-Attorney attached), or a cashier's check drawn on a bank in the state in which the project is located, in favor of (made payable to) Limestone County Water and Sewer Authority, the amount of 5% of the bid amount (total), but in no event
more than $10,000.

The Bidder agrees that, should he/she be notified that his/her Bid on the work has been accepted, he/she will, within ten (10) days from receipt of such notice, execute the formal Contract Agreement bound herein, and will furnish with the Contract evidence of Insurance Coverage of his/her construction operations and all of his/her operations associated with the project, all in accordance with the requirements of the General Conditions.

The Bidder further agrees that, in case of failure on his/her part to execute said Contract Agreement, and to furnish all Bonds required by the Contract Documents, within ten (10) consecutive calendar days after receipt of notice of award of Contract to him, the monies payable to the Obligee of his/her Bid Bond, in accordance with the terms and conditions of the Bond, shall be paid to the Owner as liquidated damages for the delay and additional expense to the Owner caused by such failure on the part of the Bidder.

The Bidder hereby agrees that, should the work under the Contract be awarded to him/her, he/she will commence work under this Contract on or before a date to be specified in written "Notice to Proceed" given by the Owner, and that he/she will achieve Substantial Completion of

the Contract within 240 consecutive calendar days following the Notice to Proceed, and will achieve Final Completion of the Contract within 270 consecutive calendar days following the Notice to Proceed. The Bidder agrees to pay, as liquidated damages, the sum of $1,000.00 for each consecutive calendar day after the date set for Substantial Completion of the work until such time as Substantial Completion has been achieved. Once Substantial Completion has been achieved, the Bidder will not be assessed additional liquidated damages unless and until he/she fails to meet the Final Completion Date. If the Bidder fails to meet the Final Completion date, then he/she agrees to pay, as liquidated damages, the sum of $500.00 for each consecutive calendar day after the date set for Final Completion of the work, all as provided in the General Conditions. At no time shall the Bidder pay more than $1,000.00 per calendar day for liquidated damages. The Bidder agrees that, once the Substantial and/or Final Completion dates have passed, the Owner/Engineer will begin deducting liquidated damages from the monthly progress payments. The Bidder further agrees that he/she will not make any claim for extra compensation should completion of work under the Contract be effected in advance of the time specified hereinabove.

The undersigned Bidder states that he/she fully understands the meaning of "low, responsive, responsible Bidder", as defined in these Documents, and that these criteria will be applied in the evaluation of this Bid.

The undersigned, as Bidder, hereby declares that the name (or names) of the only person (or persons) interested in this Proposal, as principal (or principals), is (or are) as herein below set out and that no person other than that (or those) herein below stated has any interest in this Proposal, or in the Contract to be entered into; that this Proposal is made without connection with any other person, firm or corporation making a proposal; and that it is in all respect fair and in good faith, without collusion or fraud.

Following are the names and addresses of all persons, firms, and corporation interested in the foregoing bid:

_____

_____

_____
(Type or Print Name and Address of Firm)

_____
(Type or Print Contractor License No.)

_____
(Type or Print Name and Title of Officer/Legal Representative of Firm Submitting Bid)

_____
(Signature of Officer/Legal Representative of Firm Submitting Bid)

_____
(Type or Print Date)

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,

_____

_____

as Principal _____ and

as Surety, are hereby held and firmly bound unto _____

_____

as owner in the penal sum of _____

_____

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.

Signed this_____ day of_____ , 20___

The condition of the above obligation is such that whereas the Principal submitted to_____ a certain Bid, attached hereto and hereby made a part hereof to enter into a contract in writing, for the _____

_____

_____

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.

_____ (L.S.)
Principal

_____
Surety

By _____

SEAL

CONTRACT AGREEMENT

THIS AGREEMENT is made and entered into as of the_____ day of _____ in the year of 2023, by and between Limestone County Water and Sewer Authority (the "Owner"), and _____ (the "Contractor").

WITNESSETH: That the Owner and the Contractor, in consideration of the mutual covenants hereinafter set forth, agree as follows:

Article I. CONTRACT DOCUMENTS. The Contract Documents shall consist of: this Agreement; the Contractor's Proposal on the required form; the General Conditions; the Performance Bond on the required form; the Labor and Material Payment Bond on the required form; all Addenda issued prior to the submittal of the Proposal; all Modifications issued, agreed upon, and signed by the Owner after the execution of this Agreement; and the Drawings (Plans) and Specifications as prepared by Morell Engineering, Inc. (the "Engineer"), and as on file in the office of the Engineer. The documents enumerated above form the Contract and all are as fully a part of the Contract as if attached to this Agreement and fully set forth herein. The Contract Documents are sometimes collectively referenced as the "Contract," and any reference to the "Contract" in this Agreement and elsewhere in the Contract Documents includes all of the Contract Documents.

Article II. SCOPE OF WORK. The work to be done under this Contract by the Contractor, at his/her own cost, shall consist of furnishing all labor, materials, supplies, tools, documentation, facilities, transportation, services, testing, and equipment, and of performing all work, necessary to construct and fully complete the project entitled **Elkmont Regional Pump Station and Gravity Sewer**, **23-0047** all in accordance with the Drawings and Specifications and with the requirements and provisions of the Contract Documents. The Contractor's scope of work under this Contract is not limited merely to physical construction and related services, material, or equipment, but also includes the totality of all of the Contractor's obligations (e.g., including insurance, indemnity, and warranty obligations) under or arising from any of the Contract Documents

Article III. TIME OF COMPLETION. The work to be performed under this Contract shall be commenced within 10 calendar days after the date on which the Notice to Proceed is issued. The work shall be Substantially Complete within 240 calendar days after the date on which the Notice to Proceed is issued, and Final Completion of the work shall be achieved within 270 days after the date on which the Notice to Proceed is issued, subject, only to such extensions of time as may be expressly authorized by provisions of the Contract Documents.

Should the work under Contract not be fully completed within the times/dates specified, it is understood and agreed that the Contractor shall be liable to the Owner for liquidated damages, (to be deducted from the monthly/periodic and final estimates of work performed by the Contractor) computed at the rate of $1,000.00 per day for each additional day required to achieve Substantial Completion of the work. Once Substantial Completion has been achieved, the Contractor will not be assessed additional liquidated damages unless and until he/she fails to meet the Final Completion Date. If the Contractor fails to meet the Final Completion date, then he/she agrees to pay, as liquidated damages, the sum of $500.00 for each consecutive calendar day after the date set for Final Completion of the work. At no time shall the Contractor pay more than $1,000.00 per calendar day for liquidated damages.

It is understood and agreed that these liquidated damages are not a penalty, but are to reimburse and compensate the Owner for the damages caused by the delay in the completion of the work, and that these liquidated damages may be deducted from the amounts otherwise payable to the Contractor or alternately may be recovered directly from the Contractor or its performance bond surety. It is also understood and agreed that, in the event that the work should be completed in advance of the completion date specified, the Contractor will make no claim for extra payment therefor.

Article IV. CONTRACT PRICE. The Owner shall pay the Contractor in full for performance of work under this Contract, in accordance with the price or prices set forth in the Proposal submitted by the Contractor, which Proposal made a part hereof to the same extent as if fully set out herein, but subject to such additions and deductions as expressly provided for in the Contract Documents, the sum of XXXX ($XXXX.XX) (the "Contract Price" or "Contract Amount").

The Contract Price may be adjusted only as expressly provided in the Contract Documents.

Article V. CHANGES IN WORK AND EXTRA WORK. The Owner shall have the right to increase or decrease quantities of work, to make changes in the work, and to require the Contractor to perform extra work necessary for the satisfactory completion of the project.

Where new and/or additional items of work are found to be necessary for the satisfactory completion of the project, and where the character of the work is such that a reasonable price for the performance of the work cannot be established by use of contract prices or combinations thereof, such new and/or additional items of work shall be classed as Extra Work.

The procedure to be followed in such cases shall be in accordance with the provisions of the Articles of the General Conditions relating to CHANGES IN WORK, and PAYMENT FOR EXTRA WORK.

Article VI. PROGRESS PAYMENTS. The Owner shall make progress payments to the Contractor in amounts equal to values of work performed on the project through the closing dates of the preceding estimate periods, but less five percent (5%) of the combined values and less previous payments made. The five percent (5%) retained percentage may be held by the Owner until the value of work completed in accordance with the Contract Documents (as determined by the Engineer) at the end of any estimate period equals or exceeds fifty percent (50%) of the total amount of the Contract, after which time, if the Owner and the Engineer deem that satisfactory progress is being made, no further retainage will be withheld. The retainage as set forth above shall be held until final completion and acceptance of the work. When the work has reached substantial completion, as determined by the Engineer in accordance with the provisions of the Contract Documents, the retainage may be reduced to such an amount as would reasonably cover 150% of the cost of correction of minor items of work heretofore found to be faulty and the cost of work remaining to be done in order to effect the completion of all of the work in full accordance with the provisions of the Contract Documents. Progress payments will be made in accordance with the provisions of the General Conditions.

Article VII. FINAL PAYMENT. Final payment, constituting the entire balance of the Contract Price, shall be paid by the Owner to the Contractor within thirty days after the full

completion and acceptance of the work and satisfaction of all conditions and requirements for final payment provided in the Contract Documents. The work will not be accepted until the Contractor has certified that he/she has completed all of the work in full accordance with the provisions of the Contract Documents, the Owner and the Engineer have completed the final review of the work and found that it appears to have been fully completed in accordance with the provisions of the Contract Documents, the Contractor has advertised completion of the work in accordance with the General Conditions, and the Contractor has presented to the Owner satisfactory evidence that all indebtedness connected with the work has been fully paid and satisfied, all as set forth in the General Conditions.

Article VIII. MISCELLANEOUS PROVISIONS. Terms used in this Agreement which are defined in the General Conditions shall have the same meanings as designated in those component parts of the Contract Documents.

The Contract Documents, which constitute the entire agreement between the Owner and the Contractor are listed in Article I of this Agreement and, except for Modifications issued after the execution of this Agreement, are enumerated below. The signatures which appear hereunder shall have the same force and effect as if appearing on all of the Contract Documents enumerated as follows:

1. Contract Agreement
2. Proposal
3. General Conditions
4. Supplementary Conditions
5. Performance Bond
6. Labor and Material Payment Bond
7. Specifications
8. Drawings
9. Addenda (include date of addenda):

IN WITNESS HEREOF, the said Contractor has hereunder executed this Agreement by his/her signature shown hereon, and said Owner has hereunder executed this Agreement by affixing hereto his/her corporate seal and by signature of his/her corporate officer(s) as shown, on the date first written above, in 3 counterparts, each of which shall, without proof or accounting for the other counterparts, be deemed an original.

By signing this Agreement, the contracting parties affirm, for the duration of the Contract, that they will not violate federal immigration law or knowingly employ, hire for employment, or continue to employ an unauthorized alien within the state of Alabama. Furthermore, a contracting party found to be in violation of this provision shall be deemed in breach of the Contract and shall be responsible for all damages resulting therefrom.

CONTRACTOR

_____
(Print/Type Name of Firm)

_____
(Print/Type Name and Title of Officer/Legally Authorized Individual)

_____
(Signature of Officer/Legally Authorized Individual)

_____
(Print/Type Name of Attesting Witness)

_____
(Signature of Attesting Witness)

OWNER

_____ _____
(Print/Type Name of Owner)

_____
(Print/Type Name and Title of Owner Representative)

_____
(Signature of Owner Representative)

_____
(Print/Type Name of Attesting Witness)

_____
(Signature of Attesting Witness)

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that we (Contractor) hereinafter called the Principal, and _____, hereinafter called the Surety, do acknowledge ourselves to be held and firmly bound unto Limestone County Water and Sewer Authority hereinafter called the Owner, in the penal sum of XXXX ($XXXX.XX) for payment of which sum well and truly to be made in lawful money of the United States, we bind ourselves, our successors, heirs, executors, administrators, assigns and personal representatives, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION OR BOND IS THIS:

Whereas, the Principal has entered into a certain written contract with the Owner, bearing the date of _____ , 2023 for the performance of the Elkmont Regional Pump Station (the "Contract"), which is fully incorporated herein by reference, and made a part hereof to the same extent as if set out herein in full, and the Principal and Surety are and shall remain bound under this Bond for the full and faithful performance and satisfaction of all of the Principal's duties, undertakings, work, and obligations under the Contract,

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform and satisfy all of his duties, undertakings, work, and obligations, all in accordance with the covenants, terms, conditions, agreements and provisions of the Contract, and if the Principal shall satisfy all claims and demands made or incurred under the Contract, shall fully correct all faulty work or defective work and make good any work that does not comply with the Principal's warranty and guaranty, shall fully indemnify and save harmless the Owner from all costs and damages whatsoever which the Owner may suffer by reason of any failure on the part of the Principal to do so, and shall fully reimburse and repay the Owner for any and all outlay, damage, and expense (including all additional engineering costs, all legal costs and attorney's fees) which the Owner may incur in making good any default or by reason of any failure by the Principal to fully perform and satisfy all of the Principal's duties, undertakings, work, and obligations under the Contract, then this obligation shall be void; otherwise, it shall remain in full force and effect.

Be it also understood that should the Principal be in default on or non-compliance with any of its obligations under the Contract, the Owner having performed the Owner's obligations thereunder, then upon written notice by the Owner to the Surety of such default or non-compliance, the Surety shall promptly:

(1) Remedy the default or non-compliance of the Principal, or

(2) Perform and satisfy all of the Principal's remaining work and obligations under the Contract in full accordance with the terms and conditions of the Contract, using for performance of such work a contractor chosen by the Surety and approved by the Owner, or

"Promptly", as used herein, shall be defined as within thirty (30) days from the date on which the Owner has notified the Surety in writing of the Principal's default on or non-compliance with the Contract.

Whichever method may be used by the Surety to remedy the Principal's default on or non-compliance with the Contract or to complete the work under the Contract and satisfy the Principal's

obligations, the Surety shall also pay to the Owner all additional costs and damages incurred by the Owner by reason of the Principal's default on or non-compliance with the Contract and the subsequent completion of the work under the Contract by the Surety.

PROVIDED FURTHER, that the said Surety, for value received, hereby stipulates and agrees that no change, modification, extension of time, alteration, or addition to or of the terms of the Contract or to the work to be performed thereunder shall in any wise affect the obligation of the Surety under this Bond and the Surety does hereby waive notice of any such change, modification, extension of time, alteration, or addition to or of the terms of the Contract or to the work to be performed thereunder.

PROVIDED FURTHER, that final payment by the Owner to the Principal shall not abridge the rights of the Owner hereunder.

[Signature Page Follows]

IN WITNESS WHEREOF, this instrument is executed in _3_ counterparts, each one of which shall, without proof of or accounting for the other counterparts, be deemed an original, on this day the _____ day of _____, 20 ____.

ATTEST:

By _____
(Principal Secretary)

_____
Principal

By _____

Title _____

_____
Witness as to Principal

_____
Address

_____

_____
Address

_____
Surety

ATTEST:

By _____
(Surety Secretary)

By _____
Attorney-in-Fact

_____

_____
Address

_____
Witness to Surety

_____

_____
Address

Countersigned _____
Resident Agent of Surety

_____

_____
Resident Agent Address

_____
Phone No.

LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that we (Contractor), hereinafter called the Principal, and _____, hereinafter called the Surety, do acknowledge ourselves to be held and firmly bound unto _____ hereinafter called the Owner, in the penal sum of ($XXXX.XX) for payment of which sum well and truly to be made in lawful money of the United States, we bind ourselves, our successors, heirs, executors, administrators, assigns and personal representatives, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION OR BOND IS THIS:

Whereas, the Principal has entered into a certain written contract with the Owner, bearing the date of _____ , 20___ for the construction of the Elkmont Regional Pump Station and Gravity Sewer, a copy of which contract is attached hereto, incorporated herein by reference, and made a part of to the same extent as if set out herein in full, and the Principal and Surety are bound under this Bond which shall remain in full force and effect until all claims and demands with respect to labor and materials connected with the work under the contract have been satisfied, subject however to statutory limitations and to such other conditions as hereinafter stated.

NOW, THEREFORE, if the Principal and all Subcontractors to whom any portion of the work provided for in the contract is sublet, and all assignees of said Principal and said sub-contractors, shall promptly make payment to all persons, firms, subcontractors and corporations for furnishing said Principal and said Subcontractors with labor, materials, equipment, machinery, parts, fuel, foodstuffs, supplies, or repairs on machinery or equipment used in or incorporated in the work, for performing any work in connection with the prosecution of the work under the Contract, and under any modifications or extensions thereof, for all insurance premiums in connection with the work, for all labor performed in connection with the work whether by subcontractor or otherwise, or for reasonable attorney's fees incurred by any claimant or claimants in suits under this Bond, then this obligation shall be void; otherwise it shall remain in full force and effect.

PROVIDED FURTHER, that the said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or to the Specifications accompanying the same, shall in any wise affect the obligation of the Surety under this Bond, and the Surety does hereby waive notice of any such change, extension of time, or alteration or addition to the terms of the Contract or to the Specifications.

PROVIDED FURTHER, that this Bond is subject to the following limitations and conditions:

(a) Any person, firm or corporation who has furnished labor, materials, equipment, machinery, fuel, parts, foodstuffs, supplies, or repairs for machinery or equipment used or incorporated in the prosecution of the work under the Contract, or amendment or extension thereof, and who has not received due payment for furnishing such items, shall have a direct right of action in his or their name or names against the Principal and Surety on this Bond, which right of action shall be asserted in a proceeding instituted in a Court of competent jurisdiction in the area in which the work under the contract has been performed. Such right of action shall be asserted in a proceeding brought in the name of the claimant for his or their use and benefit against said Principal or Surety, or either of them not later than one year after the final settlement

of the contract, in which action such claim or claims shall be adjudicated and judgement thereon.

(b) In addition to any other legal mode of service, service of summons and other process in suits brought on this Bond may be had on the Principal or Surety by leaving a copy of the summons and complaint, or other pleading or process, with the

_____

and the principal and the Surety agree to be bound by such mode of service above described, and consent that such service shall be the same as personal service on the Principal or Surety.

(c) The Surety shall not be liable hereunder for any damage or compensation recoverable under any workmen's compensation or employer's liability statute.

(d) In no event shall the Surety be liable for a greater sum than the penalty of this bond, or subject to any suit, action or proceeding thereon that is instituted later than one year after final settlement of the said Contract.

(e) No final settlement between the Owner and the Principal shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

[Signature Page Follows]

IN WITNESS WHEREOF, this instrument is executed in _3_ counterparts, each one of which shall, without proof of or accounting for the other counterparts, be deemed an original, on this day the _____ day of _____, 20 ____.

ATTEST:

By _____
(Principal Secretary)

_____
Principal

By _____

Title _____

_____
Witness as to Principal

_____
Address

_____

_____
Address

_____
Surety

ATTEST:

By _____
(Surety Secretary)

By _____
Attorney-in-Fact

_____

_____
Address

_____
Witness to Surety

_____

_____
Address

Countersigned _____
Resident Agent of Surety

_____

_____
Resident Agent Address

_____
Phone No.

GENERAL CONDITIONS

1. WORK TO BE PERFORMED

1.1 The work to be performed under this Contract includes, without limitation, the furnishing of all materials, labor, tools, appliances, equipment, supplies, transportation, testing, inspections, documentation, facilities, and services necessary for the satisfactory completion, functioning as intended, and acceptance of all repairs, remediation, replacements, installations, improvements, and modifications described or required by any of the Contract Documents. The term "work" as used in these General Conditions and elsewhere in the Contract Documents, whether capitalized or not, is not limited merely to physical construction and related services, materials, or equipment, but also includes the totality of all of the Contractor's obligations (e.g., including insurance, indemnity, and warranty obligations) under or arising from any of the Contract Documents.

1.2 The Contractor shall pay all sales, consumer, use and similar taxes for the work to be performed by the Contractor which are legally enacted when bids are received or negotiations concluded. The Contractor shall be solely responsible for determining whether the Owner is exempt from payment of sales and compensating use taxes (state and city/county) thereof on materials to be incorporated into the Work. If exempt, then the Owner will furnish the required certificates of tax exemption to the Contractor for use in the purchase of materials and equipment to be incorporated into the work. The Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by the Contractor, or to materials and equipment not incorporated into the work. Except for materials covered by the Owner's tax exemption, the Contractor shall pay all sales, consumer, use, and similar taxes for the work.

2. CONTRACT DOCUMENTS

2.1 The Contract Documents form the Contract between the Owner and the Contractor. These documents supersede prior negotiations or agreements, either written or oral, and shall not be interpreted to create a contractual relationship between the Engineer and the Contractor, or between any persons or entities other than the Owner and the Contractor.

The Contract Documents are the following:

A. The Contractor's Proposal submitted on the required Proposal Form.

B. The signed Contract Agreement between the Owner and the Contractor, and all documents it incorporates by reference. Execution of the Contract Agreement by the Contractor represents that the Contractor has visited and thoroughly investigated the site to become familiar with all conditions affecting the Contractor's performance of the work.

C. These General Conditions, which outline certain responsibilities and liabilities of the Owner and the Contractor and also the authority and responsibilities of the Engineer.

D. The Drawings (Plans) and Specifications, which show and describe the work to be performed. It is the intent of the Drawings and Specifications that the Contractor shall furnish all materials, labor, tools, appliances, equipment, supplies, transportation, testing, inspections, documentation, facilities, and services necessary for the proper execution of

the work so shown or described so that it will satisfactorily fulfill all of its intended purposes and functions. The Contractor shall execute all work so described in full conformance with the Drawings, Specifications, and all other Contract Documents; shall perform all incidental work necessary to complete the project in an acceptable manner; and shall fully, timely, and satisfactorily perform all obligations provided in any of the Contract Documents.

The Engineer shall be deemed the author of the Drawings and Specifications, including those in electronic format, and shall retain all reserved rights, including the copyright. The Contract Documents are for use solely with respect to this project, and shall not be used by the Contractor for any other purpose.

The Contract Documents shall be considered to be inseparable documents, and the Contractor shall use them in performing the work in accordance with their combined intent. Before submitting its Proposal, the Contractor shall thoroughly examine and compare all of the Contract Documents, and shall specifically notify the Engineer in writing of any perceived or suspected ambiguities, deficiencies, conflicts, or omissions within the Contract Documents. The Contractor waives any right or claim to any additional compensation or any time extension on account of any such ambiguity, conflict, deficiency, inconsistency, or omission if the Contractor fails to notify the Engineer of the same specifically and in writing before submitting the Contractor's Proposal.

The Drawings and Specifications are intended to be complementary, and where work is called for in one but not in the other, it shall be performed as though it were specified or shown in both. Any seeming conflict between the Drawings, Specifications, and other Contract Documents, shall be submitted in writing to the Engineer as provided in the Contract Documents, and the Engineer's decision shall be final.

All actual or suspected discrepancies found between the Contract Documents and site conditions, and all actual or suspected inconsistencies or ambiguities within the Contract Documents, shall be immediately (and no later than three days after the discrepancy, inconsistency, or ambiguity is first discovered or suspected) reported in writing by the Contractor to the Engineer, who shall promptly respond in writing. After such discrepancies, inconsistencies, ambiguities are first discovered or suspected by the Contractor, any work done by the Contractor on any part of the project affected by such discrepancies, inconsistencies or ambiguities before receipt of written directions from the Engineer shall be at the Contractor's risk.

The figured dimensions and/or elevations shown on the Drawings shall be used by the Contractor for the layout of the work. Where the work of the Contractor is affected by finish dimensions, such dimensions shall be determined by the Contractor at the site of the work, and he shall assume the responsibility therefor.

The Owner reserves the right to amend or revise the Drawings or Specifications, and to furnish such other detail drawings as, in the opinion of the Engineer, may be necessary for the proper prosecution of the work. All such additional drawings or specifications shall have equal force and effect as the original Drawings and Specifications.

Except as provided for otherwise, or specified to the contrary, all copies of Contract Documents required for and necessary for the execution of the work will be furnished to the Contractor without charge.

E. Addenda to Contract Documents issued during the time of bidding (before receipt of bids) or forming a part of the Contract Documents issued to the Contractor for the preparation of the Proposal, shall be covered in the Proposal, and shall be a part of the Contract Documents. Receipt of each Addendum shall be acknowledged in the Proposal.

F. Performance and Payment Bonds furnished by the Contractor at the time of execution of the Contract Agreement, which shall be in the form prescribed by the Owner, and shall be with a surety authorized to do business in the state in which the project is located and countersigned by a resident agent of the surety in that state. Bonds shall be as follows:

1. Performance Bond in an amount equal to 100% of the Contract Amount as a guaranty of performance and satisfaction of all of the Contractor's obligations in accordance with the terms of the Contract Documents.

2. Labor and Material Payment Bond in an amount equal to 100% of the Contract Amount as a guaranty on the part of the Contractor to make all payments for labor, material, supplies, and equipment in connection with the Contract and the work.

G. Written modifications signed and issued after execution of the Contract Agreement, including, but not limited to, written amendments to the Contract, Change Orders, Construction Change Directives, and minor changes in the work issued by the Engineer.

3. INSURANCE

3.1 The Contractor shall not commence any work on the project until he obtains, at his/her own expense, all required insurance; and the Contractor shall not, at any time, conduct any operations on the project or associated with the project unless such operations are covered by the specified insurance. Such insurance must have the approval of the Owner as to limit, form, and scope of coverage. The Contractor shall not permit any subcontractor to commence work on the project until the same insurance requirements have been complied with by such subcontractor (or sub-subcontractors). The insurance coverage shall be maintained throughout the full period of the Contractor's performance of its obligations, including all times after final payment when the Contractor may be correcting, removing, or replacing faulty or defective work as a warranty or correction obligation, or otherwise, or returning to the site to conduct other tasks arising from the Contract Documents, and in addition, products and competed operations coverage shall be maintained for not less than five years after final payment. At the request of the Owner, the Contractor shall be required to submit insurance certificates after project completion showing that all insurance required to be maintained after project completion remains in place. The Contractor may use only insurers with a minimum A.M. Best rating of A-VII or better. All insurance policies shall include a waiver of subrogation in favor of the Owner and the Engineer.

3.2 As evidence of specified insurance coverage the Owner may, in lieu of receipt of actual policies, and at the Owner's sole option, accept certificates issued by the insurance carrier showing such policies

to be in force for the specified period, but the Owner may thereafter at any time require that the Contractor provide complete copies of the actual policies.

3.3 Nothing contained in these insurance requirements is to be construed as limiting the extent of the Contractor's responsibility for payment of damages resulting from his/her operations or performance under this Contract. The Contractor shall have responsibility to enforce subcontractor compliance with these insurance requirements.

3.4 The types of insurance that the Contractor shall be required to obtain and maintain are listed below:

A. Workmen's Compensation and Employer's Liability Insurance shall be in strict accordance with the requirements of the current and applicable Workmen's Compensation Laws of the state in which the project is located. The insurance shall cover all of the Contractor's employees employed or associated with the project; and where any part of the work is subcontracted, the Contractor shall require the subcontractor to provide similar Workmen's Compensation and Employer's Liability Insurance for all employees of the subcontractor unless such employees are covered by the protection afforded by the Contractor. In case any class of employees engaged in hazardous work under this Contract is not protected under the Workmen's Compensation Statute, the Contractor shall provide, and shall cause such subcontractor to provide, adequate coverage for the protection of all employees on the project not otherwise protected under applicable provisions of the statutes relating to Workmen's Compensation and Employer's Liability Insurance.

B. Comprehensive General Liability Insurance shall cover the Contractor and any subcontractors performing work under this Contract for any claims for bodily injury, for sickness or disease, for death, for personal injury, and for property damages which may arise either directly or indirectly out of, or in connection with, the performance of work under this Contract. The minimum limits of coverage shall be as follows:

Umbrella Liability $5,000,000 each occurrence, $5,000,000 aggregate
Bodily Injury $1,000,000 each occurrence, $2,000,000 aggregate
Property Damage $1,000,000 each occurrence, $2,000,000 aggregate
Personal Injury $250,000 each occurrence, $250,000 aggregate

The naming of minimum limits of coverage shall not be construed as limiting the Contractor's responsibility to provide contractual coverage sufficiently broad to ensure the provisions of the Article of these General Conditions relating to Indemnity, or limiting the responsibilities of the Contractor as outlined under the aforesaid Article.

Without limiting any of the above, the liability insurance coverage of the Contractor and its subcontractors shall include the following coverages and endorsements:

1. Products and completed operations coverage shall be maintained for five years after final payment. The Contractor shall furnish the Owner and each other Additional Insured evidence of continuation of such insurance at final payment and five years thereafter.

2. Blanket contractual liability coverage, to the fullest extent permitted by law, including, but not limited to, coverage of the Contractor's contractual indemnity obligations in Article 4 and elsewhere in the Contract Documents.

3. Broad form property damage coverage.

4. Severability of interest.

5. Underground, explosion, and collapse coverage.

6. Personal injury coverage.

7. Additional Insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.

C. Comprehensive Automobile Liability Insurance shall protect the Contractor and any subcontractor performing work under this Contract from any claims for bodily injury, for death, and for property damages which may arise either directly or indirectly out of, or in connection with, the performance of work under this Contract.
The minimum limits of coverage shall be as follows:

Bodily Injury - $1,000,000 each occurrence, $1,000,000 aggregate
Property Damage - $1,000,000 each occurrence, $1,000,000 aggregate

The naming of minimum limits of coverage shall not be construed as limiting the Contractor's responsibility to provide contractual coverage sufficiently broad to ensure the provisions of the Article of these General Conditions relating to Indemnity, or limiting the responsibilities of the Contractor as outlined under the aforesaid Article.

D. Property Insurance shall afford protection against physical damage to property during performance of any of the Contractor's obligations. Insurable portions of the project shall be covered on a completed value basis; and at any given time the dollar coverage provided shall be actual value of completed work, value of work in progress, and value of stored materials. The policy by its own terms or by endorsement shall specifically permit partial or beneficial occupancy or use prior to completion or acceptance of the entire work. This insurance shall include Builder's Risk "all risk" insurance, which shall include the Owner and the Contractor as named insureds, and all subcontractors as insureds or named insureds. Such insurance shall be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of laws and regulations; and water damage, If insurance against mechanical breakdown, boiler

explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, then such insurance may be provided through other insurance policies acceptable to the Owner.

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

Insurance carried by the Contractor on the insurable portions of the work shall not relieve the Contractor of the responsibility for the protection of all materials, equipment, work, and other property in the vicinity of the work until the project has been accepted by the Owner, and shall not limit the Contractor's liability for failure to do so. Any loss suffered on the project by reason of the perils named under Article 3.D. or under this sub-part of Article 3 shall be borne by the Contractor and the Insurance Company providing the coverage for the Contractor, and the Owner shall not be liable for any cost of replacement of lost or damaged work or material.

F. Contractor's Pollution Liability Insurance: The Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from the Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final payment.

G. The coverage requirements for specific policies of insurance identified above must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

H. Umbrella or Excess Liability Insurance: The Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability (including products completed operations), and automobile liability insurance described in the paragraphs above. Such coverage afforded shall follow form as to each and every one of the underlying policies. The coverage requirements for specific policies of insurance identified above must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

I. Notice of Cancellation or Change in Coverage. All policies of insurance required by this article shall 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 the Contractor and each Additional Insured.
Within three days of receipt of any such written notice, the Contractor shall provide a copy of the notice to the Owner, the Engineer, and each other insured under the policy.

J. Protection of the Owner and the Engineer. The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as Additional Insureds the Owner and Engineer, and include coverage for their respective officers, directors, members, partners, employees, agents, consultants, and

subcontractors; and the insurance afforded to these Additional Insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Coverage for Additional Insureds shall not be limited to claims, suits, damages, or liabilities caused be the sole negligence of the Contractor and shall include coverage for all claims, suits, damages, and liabilities that result in whole or in part from any act or omission of the Contractor, any of the Contractor's subcontractors or suppliers, or any other person or entities for whose acts or omissions any of them is or may be responsible. The Contractor shall obtain all necessary endorsements to support these requirements.

In the event that the Contractor or his/her Surety is prevented by law or by charter from naming the Owner and his/her agents, and the Engineer, as insureds in the policies providing the coverages listed under this Article, the Contractor shall purchase and maintain during the life of this agreement Owner's & Contractor's Protective Liability Insurance in amount of not less than $1,000,000.00; and the Additional Insureds shall be the Owner, the Engineer, and their respective agents and employees. The insurance shall protect the Owner, the Engineer, and their respective agents and employees from any claim or loss arising in whole or in part from any act of the Contractor or his/her subcontractors, or any failure to act on the part of the Contractor or his/her subcontractors, during the performance of work under this Contract.

4. INDEMNIFICATION

4.1 To the fullest extent permitted by law, and in addition to any other obligations of the Contractor under the Contract Documents or otherwise, the Contractor shall defend, indemnify, and hold harmless the Owner and the Engineer, and their respective officers, directors, members, partners, employees, and agents (collectively, the "Indemnitees") from and against all claims, suits, demands, liabilities, judgments, 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) (collectively, "Indemnified Losses") arising out of or relating to the performance of the work, including any work performed or undertaken by 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 responsible. The Contractor's obligations to defend, indemnify, and hold harmless the Indemnitees shall not be excused solely because the negligence or other breach of a legal duty by an Indemnitee also caused or contributed to the Indemnified Loss, but the Contractor's indemnification obligation to an Indemnitee may be proportionately reduced to the proportionate extent that the Indemnified Loss is adjudicated to have been caused solely by the independent negligent acts or omissions of such Indemnitee.

5. PATENTS AND ROYALTIES

5.1 The Contractor shall pay the costs of all royalties, license fees and patent fees involved by use, or manner of use in the work, of all designs, devices, materials, equipment or processes, and the Contractor shall provide for such use or manner of use by legal agreement with the owner of the patent or a duly authorized licensee of such owner. All such costs referred to hereinabove shall be included in the price bid for the work under this Contract.

5.2 The Contractor shall save harmless the Owner and the Engineer from any and all loss or expense by reason of use, or manner of use, in the work of any design, device, material, equipment or process covered by letter of patent or copyright; and the Contractor shall defend all suits resulting from claims for royalties, license fees or patent fees on designs, devices, materials, equipment or processes purchased by the Contractor for use in the work, and from claims for royalties, license fees or patent fees involved by use, or manner of use, of such items by the Owner.

6. LICENSES AND PERMITS

6.1 All licenses, fees, inspections and permits necessary for the prosecution of the work shall be secured and paid for by the Contractor at no expense to the Owner other than as reflected in the price bid for the work.

7. COMPLIANCE WITH LAWS, ORDINANCES AND REGULATIONS

7.1 The Contractor shall comply with all Federal, State, and Local laws, ordinances and regulations which in any manner affect the work or the conduct of the work, and shall comply with all orders and decrees as may have been adopted or as may be enacted by bodies or tribunals having any legal jurisdiction or authority over the work. The Contractor shall maintain all documentation, file all reports, and give all notices as required for compliance with the above. The Contractor shall defend, indemnify and save harmless the Owner and the Engineer against any suits or actions of any kind or nature brought, or which may be brought, against them for any claim or liability arising from or based upon the violation of any such laws, ordinances, work regulations, safety and health regulations, orders or decrees by the Contractor, his/her subcontractors, his/her suppliers, his/her agents, his/her representatives, his/her employees, or employees of his/her subcontractors or suppliers.

7.2 By signing this Contract, the contracting parties affirm, for the duration of the Contract, that they will not violate federal immigration law or knowingly employ, hire for employment or continue to employ an unauthorized alien within the state of Alabama. Furthermore, a contracting party found to be in violation of this provision shall be deemed in breach of the agreement and shall be responsible for all damages resulting therefrom.

7.3 Prior to starting work and in accordance with the Code of Alabama 39-2-14, a nonresident Contractor is required to register and deposit 5 percent of the Contract Amount with the Alabama Department of Revenue or provide a surety bond approved by the Commissioner of Revenue as provided in Code of Alabama 39-2-14. Within 30 days after registration, a nonresident Contractor shall file statement with Department of Revenue itemizing machinery, materials, supplies, and equipment that will be on hand at time work begins where such tangible property has been brought, shipped, or transported from outside the State of Alabama and upon which neither use taxes or ad valorem taxes have been paid and shall pay tax due at time of filing and thereafter shall report and pay tax as required by Commissioner of Revenue.

8. SAFETY

8.1 The Contractor, in the prosecution of his/her work under the Contract, is bound by the requirements of "Safety and Health Regulations for Construction" of the Occupational Safety and Health Administration, U.S. Government Department of Labor, and of other authorities having jurisdiction in safety matters.

8.2 Under the terms and conditions of this Contract, the Engineer shall not act as Safety Supervisor for the Contractor, since such responsibility remains solely with the Contractor. The Engineer shall not be responsible for establishing safety practices or for prescribing safety measures for the Contractor.

8.3 The Contractor is solely and completely responsible for conditions of the work site, including safety of all persons and property affected directly or indirectly by his/her operations during the performance of the work; and this requirement is not limited in application to normal working hours, but applies continuously twenty-four (24) hours per day until final payment, and thereafter at any time the Contractor (or any of his/her subcontractors or suppliers) are present at the site of the work to perform continuing obligations of the Contractor.

8.4 The Engineer's duty to the Owner to review the work in order to determine its acceptability in accordance with the Contract Documents and to conduct construction review of the Contractor's performance for the benefit of the Owner, shall not be construed as a duty to review the adequacy of the Contractor's safety measures on or near the construction site and/or to direct the actions of the Contractor's employees in the performance of the work as such duties are not included among the responsibilities of the Engineer.

9. WARNING SIGNS AND BARRICADES

9.1 The provision by the Contractor of warning signs, warning lights, barricades and watchmen is subject to the requirements of "Safety and Health Regulations for Construction" of the Occupational Safety and Health Administration, U.S. Government Department of Labor, of the State "Manual on Uniform Traffic Control Devices for Streets and Highways," and of other authorities having jurisdiction in the areas of safety and traffic control. The Contractor is solely responsible for satisfying the safety and traffic control requirements of authorities concerned with or affected by this work.

10. PUBLIC CONVENIENCE

10.1 The Contractor is required to conduct his/her work as to ensure the least possible obstruction to traffic, to ensure the least possible inconvenience to the Owner and the general public and the residents in the vicinity of the work, and to ensure the protection of persons and property. Permission of the proper authority is required before any road or street is closed to the public. The maintenance of accessibility of fire-fighting equipment to fire hydrants and to such areas as are necessary for the provision of fire protection is a requirement of the Fire Department of the authority having jurisdiction. The provision of temporary measures as required to ensure the safe use of sidewalks and streets by the public is the responsibility of the Contractor. The proper functioning of all gutters, sewer inlets, drainage ditches and irrigation ditches is to be ensured by constant clean-up along with the work and by provision of temporary facilities where required for the maintenance of natural surface drainage. The implementation of all such maintenance measures and safety precautions is the sole responsibility of the Contractor.

11. SANITARY PROVISIONS

11.1 The Contractor is responsible for the maintenance of proper sanitary conditions in the area of his/her work. The provision and maintenance of such sanitary accommodations as may be required for the use of his/her employees and of his/her subcontractor's employees is subject to the Rules and Regulations of the State Board of Health and to all local Codes and Ordinances. Refer to Article 7.

12. EXISTING CONSTRUCTION AND FACILITIES

12.1 Where work under this Contract is adjacent to or crosses highways, railroads, streets, roads, access facilities, or utilities under the jurisdiction of State, County, City or other public agency, public utility or private entity, the Contractor is required to secure written permission from the proper authority and to furnish such bond (cash or surety as required), or insurance agreement as may be required before executing such construction work. A copy of the written permission and bond or insurance agreement (when required) must be filed with the Owner before any work is done. The Contractor is responsible for the replacement and repair of all existing construction, utilities, equipment, and facilities of the Owner or others that are damaged in the execution of work under this Contract. The Contractor will be required to furnish releases from all authorities affected by the work before final acceptance of the work under this Contract.

12.2 The type, size and physical location of existing facilities are shown from available records and the accuracy of said information is not guaranteed. The Contractor shall make additional investigations as needed to verify type, size and physical location. These investigations shall include, but are not limited to, site visits, pot-holing/location, exploratory drilling/geotechnical work, discussions with Owner personnel, and review of site records/record drawings. These investigations shall occur prior to bidding the work, and prior to development of submittals/ordering equipment and materials, and prior to beginning work. The Contractor shall assume all risks arising from, or out of, performing work in the vicinity of existing facilities, or connection to existing facilities.

13. COMMENCEMENT, PROSECUTION, AND COMPLETION OF THE WORK

13.1 Following the execution of the Contract by the Owner and the Contractor, a written Notice to Proceed will be given to the Contractor by the Owner. The Contractor shall commence work on the project in good faith within the number of days specified in the Contract Agreement; and the Contractor, in accordance with the terms and provisions of the Contract Agreement, will be required to prosecute the work in such a manner and with such forces as will enable him/her to secure the satisfactory completion of the work within the time period stated in the Contract Agreement.

13.2 The time allowed for commencement of the work shall be the number of consecutive calendar days specified in the Proposal and in the Contract Agreement; and the number of days shall be reckoned from the date of the Notice to Proceed. The time allowed for the completion of the work shall be the number of consecutive calendar days as specified in the Contract Agreement; and the number of days shall be reckoned from the date specified in the Notice to Proceed for commencement of work.

13.3 Should the work under this Contract not be completed within the time specified, it is understood and agreed that the Contractor shall be liable for liquidated damages computed at the rate per day as shown in the Contract Agreement, beginning from the stated date of completion and extending to the date of final acceptance of the work. Such liquidated damages may be deducted from the Contractor's monthly or final estimates, or may be recovered directly from the Contractor and its performance bond surety. It is understood and agreed that the liquidated damages are not a penalty, but are instead money due to compensate and reimburse the Owner for the extra costs and expenses and other losses caused by the delay in the completion of the work. It is also understood and agreed that, in the event that the work should be completed in advance of the scheduled date of completion, the Contractor will make no claim for extra payment therefor. The remedies provided above do not limit, and are without prejudice

to, the Owner's rights to declare the Contractor in default for failure to make satisfactory progress and to make demand upon the Contractor's surety under the performance bond.

13.4 The Owner may grant an extension of time for completion of the work when prosecution of the work is unavoidably delayed or halted by occurrences that are entirely beyond the control of Contractor or its subcontractors or suppliers, including unjustified actions by the Owner, fire, or other catastrophes, but the Contractor shall not be entitled to any extension of time unless the Contractor shall, within seven days after the first occurrence of any of the conditions resulting in the delay, give written notice to the Engineer of the cause of the delay and its probable effect on progress of the entire work.

13.5 Abnormally adverse weather conditions that are more severe than could have been anticipated for the locality of the work during any given month may entitle the Contractor to an extension of the time for completion, but only if:

(1) the abnormal weather conditions had an unavoidable adverse effect on work scheduled to be performed when the adverse weather occurred, and which in reasonable and scheduled sequence would necessarily delay completion of the entire work, and

(2) the Contractor shall, within ten days after the end of the month in which the delay occurs, give the Engineer specific written notice of the delay caused by abnormal adverse weather that occurred during that month and its effect on progress and completion of the Work, and

(3) Promptly (but not more than fourteen days) after giving notice of the delay, the Contractor provides the Engineer with sufficient data and documentation to establish that the weather conditions experienced were unusually severe for the locality of the work during the month in question and that such unusually severe weather directly impacted the work such that completion of the entire work is unavoidably delayed. Unless otherwise provided in the Contract Documents, data documenting unusually severe weather conditions shall compare actual weather conditions to the average weather conditions for the month in question during the previous five years as recorded by the National Oceanic and Atmospheric Administration (NOAA) or similar record-keeping entities.

13.6 Adjustments, if any, of the time for completion pursuant to this Article shall be incorporated into the Contract by a Contract Change Order prepared by the Engineer and signed by the Contractor, Owner, and Engineer or, at closeout of the Contract, by mutual written agreement between the Contractor and Owner. The adjustment of the time for completion shall not exceed the extent to which the delay necessarily and unavoidably extends the time required to complete the entire work of the Contract.

13.7 The Owner shall not suffer any loss or expense as a result of such occurrences or delays, except when caused solely by unjustifiable affirmative actions by the Owner, and the Contractor shall not be allowed any damages or claims for extra compensation resulting from such occurrences or delays, except to any extent proved to have been actually caused solely by unjustified affirmative actions on the part of the Owner.

14. CONSTRUCTION SCHEDULE

14.1 The Contractor shall submit to the Engineer, prior to initiating the work but not later than thirty days after the execution of the Contract, a schedule of construction operations so planned as to ensure completion of the work within the time limit specified in the Contract Agreement. The maintenance of such schedule in order to fulfill the terms of the Contract Agreement is the responsibility of the Contractor, and he shall employ such reasonable and proper measures, subject to other conditions of these Contract Documents, as he deems to be required to expedite the work and to ensure that it will be fully and satisfactorily completed within the stated time limit. If the Contractor's progress falls materially behind the currently approved construction schedule and, in the opinion of the Engineer or Owner, the Contractor is not taking sufficient steps to regain schedule, the Engineer may, with the Owner's concurrence, issue the Contractor a Notice to Cure. In such a Notice to Cure the Engineer may require the Contractor to submit a revised construction schedule to demonstrate the manner in which schedule will be regained. The Contractor shall not be allowed additional compensation for employment of such measures.

14.2 The Contractor will be required to show in the schedule the proposed dates of commencement and completion of the various subdivisions of the work, and also to show in the schedule the estimated amount of each monthly payment (periodic estimate) that will become due to the Contractor as he maintains the progress schedule prepared by him. The preparation and submittal of the progress and payment schedule to the Owner is of benefit both to the Contractor and the Owner in that it will enable the Owner to anticipate the periodic financial needs of the project and facilitate the making of timely payments for the work. Submission of a schedule showing a completion date beyond the contract completion date should not be interpreted as approval of a contract extension by the Owner.

14.3 The Contractor shall prepare and keep current a schedule of submittals coordinated with the Contractor's schedule of construction operations. The submittal schedule is subject to approval by the Owner and shall allow the Owner/Engineer reasonable time the review submittals.

15. SUPERVISION OF THE WORK

15.1 The Contractor shall be solely responsible for planning, scheduling, organization and prosecution of the work in accordance with the Contract Documents. Observations, construction reviews, tests, recommendations or comments made by the Engineer, or by persons other than the Contractor, shall in no way relieve the Contractor of his/her obligation to timely complete all work in accordance with the Contract Documents. All work shall be done under the direct supervision of the Contractor. The Contractor shall be solely responsible for construction means, methods, techniques, sequences and procedures. The Contractor is solely responsible for safe access to the work, safe use of the work, safe working conditions, and safe occupancy of the work by and/or for all authorized persons.

15.2 The Contractor shall maintain on the project (full time) a qualified superintendent who is acceptable to the Engineer and the Owner, and who is capable of providing the efficient supervision required for the successful, timely, and satisfactory completion of the work. The superintendent shall have full authority to act in behalf of the Contractor, and all communication with the superintendent shall be considered a communication with the Contractor. The Contractor's superintendent is responsible for coordinating the work of all subcontractors, and his/her presence at the site of the work is necessary for the adequate performance of his/her supervisory duties and for the coordination of the work of all subcontractors.

15.3 The responsibilities of the Contractor relating to supervision of the work as outlined hereinabove, and the duties of the Contractor as outlined hereinabove, are all a part of the General Conditions of this Contract as referred to in the Contract Agreement.

16. SUBCONTRACTORS

16.1 The Contractor may utilize the services of specialty subcontractors on those parts of the work which, under normal contracting practices, are performed by subcontractors. No part of the work, however, shall be sublet by the Contractor without the prior written consent of the Owner. Following the execution of the Contract, the Contractor shall submit in writing for review by the Engineer and the Owner the names of subcontractors to whom he proposes to subcontract portions of the work. The Engineer shall promptly reply to the Contractor in writing stating whether or not the Owner or the Engineer has reasonable objection to any proposed subcontractor. If the Owner or the Engineer has reasonable objection to a listed subcontractor, then the Contractor shall propose another which is acceptable to the Owner and the Engineer, without an increase in the Contract amount.
The early selection of subcontractors, in the case where the Contractor proposes to subcontract any part of the work, is essential to the proper organization of the work, and the Contractor shall therefore submit any names of proposed subcontractors upon or before request by the Owner or Engineer.

16.2 The names of proposed subcontractors so submitted shall not be changed by the Contractor after submittal of the list to the Engineer and Owner unless the consent of the Owner is first obtained.

16.3 The Contractor shall be responsible to the Owner for the acts, deficiencies, and omissions of his/her subcontractors, suppliers, and vendors (of every tier), and those of their direct and indirect employees, to the same extent as he is responsible for the acts, deficiencies, and omissions of his/her own and those of his/her employees.

16.4 The Contractor shall bind all subcontractors to the terms of the General Conditions and other Contract Documents insofar as they are applicable to the work under subcontract, and shall insert in all agreements with subcontractors appropriate provisions such as to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the Contract Documents. The Contractor is required to submit evidence of compliance with such conditions to the Owner before commencement of work by the particular subcontractors.

16.5 Nothing contained in the Contract Documents shall be construed as creating any contractual relationship between any subcontractor and the Owner.

16.6 For convenience of reference, to facilitate organization of the work, and for convenience in evaluating work in progress, the Specifications have been separated into titled Sections. Such separation shall not, however, operate to make the Owner or the Engineer an arbiter to establish limits of work in the contracts between the Contractor and subcontractors. The general charge to the Contractor is that all work be fully completed in accordance with the Contract Documents, and that the Contractor adhere to the terms and provisions of the Contract Agreement, of which these Conditions are a part.

17. CONTRACTOR'S RESPONSIBILITIES WITH RESPECT TO WORK BY OTHERS

17.1 The Owner reserves the right to perform construction or operations related to the project with his/her own forces, and to place portions of the work on the project under separate contracts. The Owner and the Contractor shall be mutually responsible for coordination of the activities of the Owner's own forces or separate contractors with the work of the Contractor. The Contractor shall cooperate with other contractors with regard to use of the site, storage or materials, and execution of their work.

17.2 It is the Contractor's responsibility to inspect thoroughly all work performed by other contractors which may in any manner affect his/her work, and to notify the Engineer and the Owner in writing of the existence of any irregularities or discrepancies which will not permit him/her to complete his/her work in a satisfactory manner. Such written notice shall be provided within seven days after the Contractor first observes or suspects any irregularity or discrepancy. The failure of the Contractor to notify the Owner of the existence of such irregularities or discrepancies shall indicate that the work of other contractors has been satisfactorily completed and is in condition to receive his/her work.

17.3 The Contractor is required to keep himself/herself informed of the progress and performance of other contractors; and, where the lack of progress or poor performance (defective workmanship) on the part of other contractors will affect the Contractor in the performance and completion of his/her work, he shall immediately notify the Engineer and Owner in writing of the existence of such conditions. Failure of the Contractor to keep himself/herself informed of the status and condition of work being performed by other contractors on the project, where the status or condition of such work may affect the performance of his/her work, and failure of the Contractor to notify the Owner of status or conditions unfavorable to the proper coordination, performance, and completion of his/her work shall be construed to be acceptance by the Contractor that the status and condition of work being performed by other contractors is satisfactory for the proper coordination, performance, and completion of his/her work.

18. SATURDAY, SUNDAY, HOLIDAY, NIGHT AND OVERTIME WORK

18.1 Work on Saturdays, Sundays and Holidays, or at night, will be permitted only when the Contractor has received the written permission of the Owner. Work at such times may be required when special connections to existing systems are to be made, when new facilities are to be placed in service, when existing facilities are to be taken out of service, when it is more advantageous to the utilities involved, or when an emergency arises in the work schedule. In such cases the permission of the Owner must be secured prior to beginning work at such times, the work scheduled well in advance, and arrangements made for prosecution of the work with all safety and minimum inconvenience to the Owner and the public. All work necessary to be performed on Saturdays, Sundays and Holidays, or at night shall be so performed without additional expense to the Owner.

Except as described above (e.g. as required for special connections, emergencies, and/or operational constraints), the time and expense associated with the Owner's on-site field representative, and other costs resulting from Saturday/Sunday/Holiday/Night work shall be deducted from the Contractor's monthly pay application(s).

18.2 Holidays for the purposes of this project shall be defined as those holidays normally observed by the Owner.

18.3 It is understood that the Contractor's proposed construction schedule is based on a 40 hour work week occurring within 10 hour days, Monday through Friday, less recognized holidays. The Contractor shall be responsible for additional expenses incurred by the Owner for the Engineer's field representative

overtime premium associated with work hours in excess of the 40 hour work week. This cost will be deducted from the Contractor's monthly payment request, and will be $45 per hour. No overtime pay will be charged to the Contractor for work performed at night or on weekends, when, due to operational conditions of the Owner's facilities, the work must be performed during these non-standard work hours.

18.4 Maintenance work normally required for protection of persons, or for protection of the work or property, will be permitted at any time.

18.5 For work during an emergency threatening bodily injury, loss of life, or damage to property refer to Article 19 of these General Conditions.

19. EMERGENCY WORK

19.1 It is the Contractor's responsibility at all times to guard against bodily injury, loss of life, damage to the Owner's property, damage to his/her own work on the site, and damage to adjacent property. In the case of the development of an emergency which threatens loss of life, injury to persons, or damage to property, it is the Contractor's responsibility to furnish and install all necessary materials and equipment, and to perform all work as could possibly be accomplished to prevent loss of life, bodily injury, or damage to property. In all such cases the Contractor shall immediately notify the Engineer and Owner of the emergency, but he need not wait for advice or authorization from the Engineer or the Owner before proceeding to employ all measures necessary to protect life and property. Nothing stated hereinabove shall be construed as limiting the Contractor's responsibility under the terms and provisions of the General Conditions and other Contract Documents to protect life and property and to pay claims resulting from loss of life, bodily injury, or damage to property. The substance of this Article of the General Conditions is that, in case of an emergency, the Contractor will act reasonably and responsibly with all speed, with all force, and in an expeditious manner, to avert loss of life, bodily injury, and property damage.

20. CHANGES IN WORK

20.1 The Owner shall have the right to make additions, deletions, or changes to the work, and to require the Contractor to perform Extra Work. These may be accomplished by Change Order, Construction Change Directive, or by written order for minor changes in the work, and shall be performed under applicable provisions of the Contract Documents. If the Contractor believes that any addition, deletion, change, or Extra Work entitles the Contractor to additional compensation or a time extension, then the Contractor shall so notify the Engineer and the Owner in writing within seven days after the addition, deletion, change, or Extra Work is first proposed, and then shall not proceed unless he thereafter receives a written directive to do so that is signed by the Engineer and the Owner. The Contractor shall not be entitled to any additional compensation or additional time unless he has fully complied with these requirements. Such increases, decreases, changes, and Extra Work shall not invalidate the Contract.

20.2 Where new items of work which could not have been anticipated are found to be necessary for the satisfactory completion of the project, and where the character of the work is such that a reasonable price for the performance of the work cannot be established by use of contract prices or combinations thereof, such new and unanticipatable items of work shall be classed as Extra Work. No Extra Work shall be undertaken except by written order in the form of a Change Order or Construction Change Directive signed by the Engineer and the Owner. The Contractor shall, upon receipt of written order from the Owner, perform such Extra Work and furnish such materials as may be required for the proper completion

of construction of the whole work contemplated. In the absence of such written order no claim for extra compensation or a time extension by reason of performance of Extra Work shall be allowed. Extra Work shall be performed in accordance with the Contract Documents, insofar as they are applicable; and where such Extra Work is not covered by the Contract Documents, the performance of the work shall be consistent with the intent of these Contract Documents.

21. FAULTY WORK AND DEFECTIVE WORK

21.1 The performance of satisfactory work that complies with and conforms to all requirements and provisions of the Contract Documents is the obligation of the Contractor, and the Contractor hereby provides the Owner a warranty and guaranty against faulty and defective work. Any faulty work or defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, will neither be accepted nor paid for and shall constitute a breach of the Contractor's warranty and guaranty. The terms "faulty work" or "defective work" include, but are not limited to:

(1) Any product, material, system, process, equipment, or service, or its installation or performance, which does not conform strictly to the requirements of the Contract Documents.

(2) In-progress or completed work the workmanship of which does not conform to the quality specified and also to the quality produced by skilled workers performing work of a similar nature on similar projects in the state.

(3) Substitutions and deviations not properly submitted and approved or otherwise authorized by the Owner.

(4) Materials or equipment rendered unsuitable for incorporation into the work due to improper storage or protection or other causes.

(5) Any work that does not fulfill its intended function and purpose. The Contractor and its performance bond surety shall bear and be responsible for all losses, damages, costs, and expenses related to faulty or defective work, including but not limited to:

(a) correction, remediation, or replacement of the faulty or defective work
(b) additional testing and inspections, including repeating specified inspections and tests
(c) reasonable services and expenses of the Engineer
(d) the expense of making good all work done by the Contractor, Owner, or separate contractors which is destroyed, damaged, or altered by the correction of the faulty or defective work.

Payment for faulty or defective work will not be made until such work has been removed, re-executed, and corrected in a manner and form satisfactory to the Engineer and the Owner and in accordance with the Contract Documents. The existence of any known faulty or defective work will prevent the acceptance of the work. The fact that the Engineer may have previously inspected and failed to reject such faulty or defective work shall not constitute acceptance of any part of it. Neither the failure by the Engineer to discover faulty or defective work prior to the making of final payment by the Owner to the Contractor, or the discovery or appearance of faulty or defective work after the making of said final payment, shall relieve the Contractor (or his/her performance bond surety) of responsibility for faulty or defective work.

21.2 If the Contractor fails to correct faulty or defective work within a reasonable time to the satisfaction of the Engineer, then the Owner may, at the Owner's sole discretion, and upon written notice

to the Contractor, have the faulty or defective work corrected by others and recover all losses, damages, costs, and expenses associated with the correction of the faulty or defective from the Contractor and its performance bond surety.

22. UNCOVERING WORK

22.1 If any portion of the work is covered by the Contractor or his/her subcontractors contrary to the requirements expressed in the Contract Documents or the Engineer's specific request, it shall be uncovered for the Engineer's observation and recovered at the Contractor's expense without change in the Contract Amount or time for completion.

22.2 The Engineer may request to see covered work which has not been specifically requested by the Contract Documents or the Engineer to remain uncovered until observed by the Engineer. If such work has been properly installed according to the Contract Documents, then the actual direct costs for uncovering and replacement shall be charged to the Owner. However, if such work is in whole or in part not in accordance with the Contract Documents, then the Contractor shall bear all costs for uncovering and replacement.

23. USE OF COMPLETED PORTIONS OF THE WORK

23.1 The Owner shall have the right to take possession of and use any completed or partially completed portion of the work, provided all insurers and authorized public authorities having jurisdiction over the project consent to this partial possession and use, notwithstanding that the time for completing the entire work or such portions of the work may not have expired; but such taking possession and use shall not be deemed to be acceptance of any work not completed in accordance with the Contract Documents. The Owner and the Contractor shall agree in writing on the equitable assignment of security, maintenance, utilities, commencement of warranties, insurance and damages to the areas of work to be used by the Owner. If the Contractor believes that any such prior use will increase the cost of, or delay the completion of, uncompleted work, or cause re-finishing of completed work subjected to such prior use, then the Contractor shall so notify the Engineer and the Owner in writing promptly and before the prior use begins. The Contractor shall not be entitled to extra compensation or an extension of time on account of any such prior use unless the Contractor has complied with this requirement, and the Contractor and the Owner have mutually agreed upon such additional compensation or extension of time.

23.2 Prior to occupancy or use by the Owner of any partially completed work, the Owner, the Contractor and the Engineer shall inspect the portion of work to be occupied and used by the Owner to record the condition of the work.

24. CUTTING AND PATCHING OF WORK

24.1 The Contractor shall perform all necessary cutting and patching as required to connect new work to existing work and as required in new work to properly receive the work of the various trades involved in the entire work; and the Contractor shall restore all such cut and patched work, and shall refinish all surfaces affected by such work, to conditions acceptable to the Engineer. Cutting of the existing work, or any work, in such a manner as would endanger the work, adjacent property, the workmen, or the public, is contrary to the provisions of Article 8, SAFETY.

25. CLEANING UP THE WORK

25.1 During performance of the work, the Contractor shall keep the property and the surrounding areas free from the accumulation of waste materials or rubbish caused by the Contractor's operations. If the Contractor fails to keep the site clean, the Owner may do so at the expense of the Contractor.

25.2 At completion of the work the Contractor shall remove from the property of the Owner, and from all public and private property, all temporary structures, rubbish, and waste materials, and surplus materials resulting from his/her operations or caused to be in such locations by actions of his/her employees, subcontractors, suppliers, or vendors. The Contractor shall remove all of his/her equipment, tools, and supplies from the property of the Owner. The entire work shall be clean and finished as specified. The site shall be clean, true to finished contours given, and improved as specified. The entire work shall be ready for permanent occupancy and/or use before acceptance of the work can become fact. Should the Contractor fail to remove his/her equipment, tools and supplies from the property of the Owner, the Owner shall have the right to remove them at the expense of the Contractor.

26. CONTRACTOR'S RESPONSIBILITY FOR PERFORMANCE AND ACTIONS OF WORKMEN

26.1 The Contractor is responsible for the conduct, performance, acts, and omissions of all persons and entities on the project site who are engaged in work on behalf of the Contractor under this Contract. All workmen should have such skill, training, and experience as will enable them to reliably, safely and properly perform the particular work or task assigned to them. It is in the best interest of the Contractor to terminate the employment of workmen whose performance endangers the safety of other workmen or any person, or results in unsatisfactory work, or contributes to delay in the progress of the work, before the Contractor bears the burden of re-executing unsatisfactory work and suffers the cost of delays in the prosecution of the work.

26.2 The Contractor may be requested by the Owner to remove or to have removed from the job site for the duration of the project any of his/her employees, or any of his/her subcontractors, or any of the employees of his/her subcontractors, who acts in a disorderly or intemperate manner, or who is abusive to representatives of the Owner or of the Engineer or of any Agency having jurisdiction over the project, or who acts in such a manner as would endanger the safety of any person or of the work, all of which acts could give cause for concern for the safety of any person or of the work, for which safety the Contractor is solely responsible.

27. GUARANTY

27.1 The Contractor warrants and guarantees to the Owner that all of the Contractor’s work will strictly comply with the Contract Documents, will be free from faulty work and defective work, and will perform as intended. The Contractor and his/her performance bond surety shall be obligated and liable for the correction of any work that does not comply with this warranty and guaranty, together with the cost of repairing or replacing any other work, equipment, facilities or property damaged in connection with the correction of work that does not comply with this warranty and guaranty, and all losses, damages, and expenses incurred by the Owner as a result of any failure of the Contractor’s work to comply with this warranty and guaranty.

27.2 Without limiting any other obligation of the Contractor, including, but not limited to, those provided in Article 21 and those provided in Section 27.1 above, and with without limiting any other right

or remedy of the Owner, the Contractor agrees that as a separate and independent affirmative obligation, the Contractor shall return to the project and correct any faulty work, defective work, or work that otherwise does not comply with the Contractor's warranty or guaranty, that is identified within one year after the date that the Final Payment Application is signed by the Owner. This separate and independent obligation shall not be construed as a time limit for enforcement by the Owner of any of the Contractor's warranties, guaranties, or other obligations under the Contract Documents.

27.3 No progress payment or final payment, or certificate of payment, or any provision of the Contract Documents, or partial or entire occupancy or use of the work by the Owner, shall constitute an acceptance of work not done in accordance with the Contract Documents or relieve the Contractor of any responsibility or liability in respect to any warranties, guaranties, or other obligations or responsibilities for faulty work or defective work.

27.4 The Contractor's performance bond surety is bound and liable to the Owner to the same extent as the Contractor for performance of the foregoing warranty and guaranty obligations (and the obligations provided in Article 21), and for any damages arising from any breach of or failure to comply with any such obligations. The Contractor's surety shall remain bound and liable for such obligations and damages notwithstanding the completion or acceptance of the work, final payment, or any otherwise applicable time restrictions or other limitations (including the time for filing suit) recited in the surety's bond.

28. MATERIALS AND EQUIPMENT

28.1 The materials and equipment incorporated or installed in the work shall be new and of good quality, free from defects and irregularities, and shall meet all requirements of the Contract Documents, including, but not limited to, those in Articles 21 and 27 above. All materials and equipment shall be subject to review by the Engineer, and no materials and equipment shall be ordered until information relating to such materials and equipment has been reviewed by the Engineer. The Contractor shall be responsible for furnishing and installing all materials and equipment required for the complete work, and all materials and equipment so furnished and installed shall be warranted and guaranteed by the Contractor in accordance with the provisions of Articles 21 and 27 above.

28.2 It is essential that all material, manufactured articles, and equipment be applied, installed, erected, connected, cleaned, conditioned for use and placed in service in accordance with the instructions of the particular manufacturer of such materials, articles, and equipment.

28.3 Only those manufactured and fabricated items fully complying with applicable standards of the Occupational Safety and Health Administration may be offered, and the manufacturer's or fabricator's certificate to that effect will be required with the submittal of each item by the Contractor.

28.4 Items of equipment, articles or materials which are not equal to samples reviewed by the Engineer, do not conform to the requirements of the Drawings or Specifications or the requirements of applicable standards, or are in any way unsatisfactory or unsuitable for the purpose or service for which they are intended, shall neither be furnished nor installed.

28.5 In order to establish standards of quality, the detailed Specifications, or the Drawings, may include references to certain products by name or by name and catalog number. This procedure is not to be construed as eliminating from competition other products of equivalent or better quality as manufactured by other companies, unless specifically stated that no other manufacturers will be acceptable. Materials

or articles which, according to the judgment of the Engineer, will fully meet the design criteria, are equivalent in function and durability, and are suitable for use in arrangement as shown on the Drawings, may be acceptable.

28.6 It must be understood that equipment and articles of different manufacturers, although they may be equivalent in construction, quality, durability and performance, may not have the same dimensions, configurations and arrangement of connections. It then becomes the responsibility of the Contractor to take into consideration any variations in dimensions and connection arrangement of the equipment or articles that he proposes to offer from those of equipment shown on the Drawings, or called for in the Specifications, and make certain that the proposed equipment or article can be installed in a neat and efficient arrangement in the space available. In the layout of the equipment and connections thereto, accessibility for proper maintenance is a requirement in order to ensure satisfactory operation.

28.7 Substitution of equipment, articles or materials other than those shown on the Drawings or specifically named in the Specifications, when requested by the Contractor, will be considered, provided that the design and construction of such equipment, articles, or materials establish that they will meet the requirements of the Specifications and Drawings. By tender of a request for a substitution, the Contractor represents that he has fully investigated and analyzed the product, and that he guarantees that the product will fully meet the design criteria of the product specified, has the durability and life expectancy of the product specified, is equivalent in function and performance to the product specified, and is suitable for installation in efficient arrangement in the space shown on the Drawings. The Engineer will review the proposed substitutions and make his/her recommendations within a timely manner as defined below. The Contractor shall abide by the Engineer's decision when proposed substitute equipment, articles or materials are not recommended for installation and, in such case, shall furnish the specified article, item of equipment or material. The decision of the Engineer to accept the substitute product shall not relieve the Contractor of his/her warranty, guaranty, and other obligations provided in the Contract Documents with respect to the Contractor’s work.

28.8 In order to be considered by the Engineer, any request by the Contractor for substitution of products must be made in a timely manner. By "timely" it is meant that any such requests should be made as early after the commencement of the work as is possible so that sufficient time will be allowed for: review by the Engineer along with review of other submittals in connection with the project; in case of rejection of the submittal, preparation of succeeding submittals covering other substitute products; reviews of the succeeding submittals; ordering and manufacture of an acceptable product; delivery of product to job site well in advance of the time that it is scheduled to be installed.

29. SHOP DRAWINGS AND PRODUCT DATA

29.1 Shop drawings are drawings, diagrams, and other data prepared for the work by the Contractor, subcontractor, or supplier to illustrate some portion of the work. Product data are illustrations, schedules, charts, brochures, instructions or other information furnished by the Contractor, subcontractor, or supplier to illustrate materials or equipment for some portion of the work. Shop drawings and product data are submitted to demonstrate how the Contractor proposes to conform to the requirements of the Contract Documents.

29.2 The Contractor shall provide all shop drawings and product data as may be necessary for the proper and satisfactory prosecution of the work, all in accordance with the intent of the Contract Documents to secure a complete and operable project capable of satisfactory performance of the service

intended. The shop drawings and product data shall be submitted in accordance with an orderly schedule based upon time required for review, approval, ordering, and fabrication or manufacture, and delivery, and upon the time at which materials, fabricated items, or manufactured items will be required to be incorporated in the work. The Contractor shall perform no portion of the work requiring submittal and review of shop drawings and product data prior to receipt of the Engineer's approval. Ordering material or equipment by the Contractor prior to receipt of concurrence from the Engineer will be fully at the Contractor's risk, even if the materials or equipment ordered are identical to the items listed in the Specifications or shown or the Drawings. No consideration will be made for reimbursement to the Contractor for restocking fees, purchase costs, delivery costs, or any other expenses caused by the Contractor's decision to place premature orders for materials or equipment.

29.3 The Engineer's review of shop drawings is not intended to verify the accuracy and completeness of details such as dimensions and quantities or to substantiate installation instructions or performance of equipment or systems, all of which remain the responsibility of the Contractor. Deviations from the Contract Documents shall be specifically and conspicuously called to the attention of the Engineer by the Contractor at the time when such shop drawings or product data are first submitted to the Engineer for his/her consideration. The Engineer's review of any drawings shall not release the Contractor from responsibility for such deviations, or any subsequent deviations not noted by the Contractor or the Engineer.

29.4 During the bid period and again prior to submitting/ordering and installing materials, products and equipment, the Contractor and all manufacturers and suppliers shall thoroughly review the materials, products and equipment being supplied and shall familiarize themselves with the existing and proposed/new facilities, as well as connections to existing facilities/utilities. This shall include field verification of the location, nature, size/dimensions, current and intended future use, etc. Prior to ordering and installation, the Contractor shall coordinate with all manufacturers and suppliers to provide all needed information including field dimensions, photographs, information on related materials and equipment, etc.). The Contractor and all manufacturers and suppliers shall confirm the following:

1. The materials, products, and equipment being supplied are of the correct size, materials and type

2. The materials, products and equipment being supplied do not conflict with existing or proposed/new facilities.

3. The products/equipment being supplied are intended for use in this application.

All manufacturer(s) and supplier(s) shall provide (either with submittals or separately) written concurrence/acknowledgement of their review/coordination and concurrence with the items above.

Shop drawings and product data submitted for review by the Engineer shall bear the Contractor's certification that he has reviewed, checked, and approved the submittals, that they comply with the requirements of the project and with the provisions of the Contract Documents, and that he has verified all sizes, dimensions, locations, field measurements, construction criteria, materials, catalog numbers, and similar data. Field dimensions, sizes and other pertinent information shall be clearly shown on the shop drawings/submittals. The Contractor shall also certify that the work represented by the shop drawings is recommended by the Contractor and that the Contractor's warranty and guaranty will fully apply.

29.5 All shop drawings and product data submitted to the Engineer shall be numbered by the Contractor using a three part numbering methodology. The three part number shall include a submittal number, the specification section number where the submitted item is described, and an indication of whether the information is an initial submittal or a resubmittal.

30. PROJECT RECORD DOCUMENTS

30.1 The Contractor shall maintain at the site one record copy of the Contract Documents, approved Shop Drawings, Product Data, Samples and other required submittals. These are to be in good order and marked to record changes made during construction. When required in other Division 1 sections (Project Record Documents and/or Project Closeout Procedures), the Contractor shall, upon Substantial Completion and prior to Final Completion, engage a licensed surveyor to perform a topographic and planimetric survey as required to document/record the "as-built" location of the Work. The survey shall be provided in digital (CAD/dwg or dgn) format. All site documents shall be delivered to the Engineer for submittal to the Owner at the completion of the work.

31. TEST REPORTS AND CERTIFICATES

31.1 Certified statements of compliance, where required by the Specifications, shall be furnished by the Contractor.

31.2 Certified mill test reports, where required by the Specifications, shall be furnished by the Contractor.

32. STORAGE OF MATERIALS AND/OR EQUIPMENT

32.1 Materials or equipment to be incorporated in the work shall be properly housed or otherwise protected from corrosion and damage so as to ensure the preservation of their finish, quality, and fitness for the work, all in accordance with the manufacturer's recommendations. Where considered necessary to secure proper protection, the materials shall be placed on racks, platforms, or hard clean surfaces not subject to surface drainage or excessive moisture. Factory finished items shall be stored above ground, covered, individually sealed, or housed indoors as required. Materials not properly stored, housed and maintained in condition for service as intended will neither be paid for as stored materials nor as materials incorporated in the work.

32.2 Stored materials and equipment shall be located and arranged so as to facilitate observation. Private property shall not be used for storage purposes without the written consent of the owner or lessee of said property. When the Contractor desires to accept delivery of material or equipment which cannot be accommodated or housed on the site of the work he may, but only with the permission of the Engineer and the Owner, store such material and/or equipment in an adequately insured warehouse. Any agreement for rental of such storage space by the Contractor shall contain a provision that the material and/or equipment thus stored shall not be subject to a lien for payment of storage. The Owner shall be protected against loss of or damage to such stored equipment by the terms and endorsements of the Contractor's insurance policies.

33. LANDS AND RIGHTS-OF-WAY

33.1 The Owner will provide the lands (property, easements and /or rights-of-way) shown on the Drawings, or described in the Specifications, upon which the work under the Contract is to be performed, and which are to be used for access to the work. Any delay in furnishing these lands by the Owner that would prevent the Contractor from beginning the work or continuing the prosecution of the work, may be deemed to be proper cause for adjustment of the time for completion of the work or for adjustment of the Contract Amount.

33.2 Any land and access thereto not specifically shown to be furnished by the Owner that may be required for temporary construction facilities or for storage of materials shall be provided by the Contractor with no cost or liability to the Owner. The Contractor shall confine his/her equipment, apparatus, and storage to such additional areas as he may provide at his/her own expense.

33.3 The Contractor shall not enter upon private property for any purpose without obtaining permission; and the Contractor shall be responsible for the preservation of all public property, trees, monuments, structures and improvements, along and adjacent to the street and/or right-of-way, and shall use every precaution necessary to prevent damage or injury thereto. The Contractor shall use suitable precautions to prevent damage to pipes, conduits, other underground structures, and utilities. The Contractor shall carefully protect from disturbance or damage all monuments and property marks until an authorized agent has witnessed or otherwise referenced their location; shall not remove such monuments and property marks until authorized to do so; and, in the event that they should be removed, shall replace them in original location when the work in the area has been completed.

34. ACCESS TO THE WORK

34.1 The Engineer and his/her representatives shall have free access to the work at all times and shall be given full opportunity to observe the work in progress and to examine such records of the Contractor as may have bearing on the proper review and observation of the work. The Contractor shall provide at the site of the work such space as would be reasonably adequate to serve as a field office for representatives of the Engineer and as storage area for their equipment and supplies.

35. OBSERVATION OF THE WORK

35.1 The Engineer will decide questions which may arise as to the quality and acceptability of materials and/or equipment furnished, the quality and acceptability of work performed, interpretations of the Contract Documents, and all questions with respect to the acceptable fulfillment of the Contract on the part of the Contractor. The Contractor shall abide by these decisions. The duties and responsibilities of the Engineer as set forth herein shall not be extended except through signed written consent of the Engineer and the Owner.

35.2 All materials and each part or detail of the work shall be subject at all times to observation by the Engineer and the Owner, and the Contractor shall be held strictly to the intent of the Contract Documents in regard to quality of materials, equipment and workmanship, and also in regard to the diligent execution of the Contract. Observations may be made at the site, or at the sources of supply, of material whether mill, plant or shop. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make his/her observations and construction review.

35.3 The Engineer's decision as to the acceptability or adequacy of the work shall be final and binding upon the Contractor. The Contractor agrees to abide by the Engineer's decision relative to the performance of the work.

35.4 All claims made by the Contractor shall be submitted to the Engineer for his/her decisions. Such decisions shall be final except that, in cases where time and/or financial considerations are involved, the claims shall also be submitted to the Owner for his/her review and shall be subject to the approval of the Owner. Meritorious claims shall be resolved, if possible, by mutual agreement between the Contractor and the Owner. Regardless of whether the Engineer or the Owner has actual or constructive notice of any claim of the Contractor for additional compensation, time, or other consideration, the Contractor agrees that such claim is waived and forfeited unless it is set forth in detail in a written notice to the Engineer, and delivered to the Engineer as soon as practicable in the circumstances, but in any event no later than ten days after the first occurrence of any of the conditions out of which such claim arises.

35.5 During the construction of the work, as defined by the Drawings and Specifications therefor, the Owner/Engineer may assign a Field Representative to the project. The duties of the Field Representative shall consist of visual review of materials, equipment and construction work for the purpose of ascertaining that the product of the Contractor's work conforms to the Drawings and is conformance with the intent of the Specifications for the project. The presence of the Field Representative at the site of the work shall not be relied upon by others as acceptance of the work, nor shall it be so construed as to relieve the Contractor in any way from his/her obligations and responsibilities under the Contract Documents. Review of the construction work by the Field Representative or by the Engineer shall not require either the Engineer or the Field Representative to assume responsibilities for the means and methods of construction nor for safety on the project site, in areas adjacent to the project site, or in other areas affected by the work performed on the project.

36. SCHEDULE OF VALUES & UNIT PRICES

36.1 The Contractor shall, within ten days of receipt of Notice to Proceed, submit a Schedule of Values showing the value assigned to each part of the work, the total of the assigned values of all parts or components being equal to the total Contract Price. The Schedule of Values shall be consistent with the line item amounts in the Contractor’s Proposal form. Such breakdown, or division of the work into parts or components according to trades or sections of the Specifications, shall have the concurrence of the Engineer before being used as the basis for estimating partial payments for work performed under the Contract. No partial payment will be made to the Contractor until an acceptable Schedule of Values is approved by the Owner. The costs shown in the Schedule of Values shall not, however, be considered as fixing a basis for additions to or deductions from the Contract Price, nor shall they be considered as fixing a basis for computing the cost of Extra Work.

36.2 The Schedule of Values shall correlate with the construction categories which make up the Application for Payment and shall be updated and resubmitted when a Change Order or Construction Change Directive is issued which results in a change to the Contract Amount.

36.3 Where unit prices form the basis for payment under the Contract, such unit prices as set forth in the Proposal, when applied to the corresponding quantities of work performed during a given estimate period, shall represent the value of work performed during that estimate period. It shall be understood, however, that the estimated quantities of work shown in the Proposal to be paid for on unit price basis are given for the purposes of determining the approximate value of the work and comparing bids, that

the Owner reserves the right to increase or decrease the estimated quantities of work as may be deemed reasonably necessary or desirable by the Owner to complete the work contemplated under this Contract, and that such increase or decrease in the estimated quantities of work shall in no way, either vitiate this Contract or give cause for claims or liability for damages.

37. APPLICATIONS FOR PAYMENT

37.1 No later than the fifth (5th) calendar day of each month (or the next business day if such date falls on a weekend or legal holiday), and not more often than once a month, the Contractor shall submit to the Engineer for review an Application for Payment filled out and signed by Contractor covering the work completed as of the date of the end of the preceding month, accompanied by such supporting documentation as is required by the Contract Documents or otherwise reasonably requested by the Engineer. 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 the Owner has received the materials and equipment free and clear of all liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to the Engineer and the Owner.

The Contractor shall submit three (3) executed copies of each Application for Payment to the Engineer. The Contractor shall complete every entry on the form, including notarization and execution by the person authorized to sign legal documents on behalf of the Contractor. Amounts of Change Orders and Construction Change Directives approved prior to the last day of the construction period covered by the Application shall be included. Entries shall match the data on the Schedule of Values and the construction schedule, and shall include waivers of mechanics liens and similar attachments when required by the Owner.

37.2 The Engineer's review and recommendation of the Contractor's Application for Payment shall be subject to the following:

A. That the Contractor or his/her superintendent on the work shall have agreed with the representative of the Engineer regarding value of work performed during the period covered by the Application for Payment before the Application for Payment is submitted to the Engineer.

B. That the payment application contains a line item for each of the following deductions:

1. Costs incurred by the Owner/Engineer due to Saturday/Sunday/Holiday/Overtime Work.

2. Other miscellaneous costs incurred by the Owner/Engineer (due to re-inspection, rework, evaluation due to insufficient documentation of claims for weather delays, etc.).

3. Liquidated Damages for missing the Substantial Completion Date

4. Liquidated Damages for missing the Final Completion Date

The Contractor shall obtain these costs from the Owner/Engineer each month and incorporate them into the estimate (pay application) before submitting the estimate to the Engineer for review.

C. That payment may not be made for work on which satisfactory test reports have not been received before the submittal of the Application for Payment.

D. That payment shall not be made for defective work or for faulty work not completely corrected before the submittal of the Application for Payment.

E. That retainage of 5% shall be withheld until 50% of the work, including the value of materials and/or equipment stored, has been completed to the satisfaction of the Engineer and the Owner, after which no additional deductions for retainage will be made from the succeeding periodic payments made to the Contractor. Retainage shall be withheld until the Contract has been completed and the work has been accepted, subject, however, to other provisions of these General Conditions.

Should the Contractor fail at any time to maintain satisfactory progress and quality of work, the five percent (5%) retainage will be reinstated until the progress and quality of work is consistent with the Contract Documents.

F. That, following a certification by the Engineer that the work has been substantially completed in accordance with the provisions of the Contract Documents but has not yet been fully completed and accepted, the retainage may be reduced to such an amount as would reasonably cover 150% the cost of correction and completion of minor items of work found to be faulty or incomplete and the cost of the work remaining to be done in order to effect the completion of all of the work in full accordance with the provisions of the Contract Documents. The consent of the Surety shall be obtained prior to any reduction in retainage.

G. That in addition to retainage, the amount otherwise due on any Application for Payment may be reduced by amounts reasonably necessary to protect the Owner from any loss, cost, or expense that might arise from:
   (1) any faulty work, defective work, or work that does not comply with the Contractor's warranty and guaranty;
   (2) existing or anticipated claims against the Owner arising from the work;
   (3) reasonable evidence that the work cannot be completed for the unpaid balance of the Contract Amount;
   (4) reasonable evidence that the work cannot be completed within the time allowed by the Contract; or
   (5) any failure by the Contractor to strictly comply with any requirement or obligation provided in the Contract Documents.

37.3 Ten days after submission of the Application for Payment to the Owner with Engineer's certification and recommendation, the amount recommended and certified by the Engineer will become due and when due will be paid by the Owner to the Contractor.

37.4 The value of preparatory work done and the value of materials and/or equipment stored in accordance with the Contract Documents may be taken into consideration in the preparation of estimates, provided that materials stored meet the requirements of the Contract Documents.

37.5 The Contractor shall timely pay all bills, invoices, and charges for all labor, services, work, equipment, and materials acquired or used by the Contractor for the work. The Contractor agrees that he will indemnify and save the Owner harmless from all claims arising out of the lawful demands of subcontractors, laborers, workmen, mechanics, and suppliers of machinery, parts, equipment, power tools, fuel, materials and other construction items, incurred in the performance of work under this Contract. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all obligations of the nature hereinabove described have been paid, discharged, or waived. If the Contractor should fail to do so, then the Owner may, after having served written notice on the Contractor, either directly pay those unpaid bills of which the Owner has received written notice, or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is presented that all such liabilities have been fully discharged, whereupon payment to the Contractor shall be resumed in accordance with the terms of this Contract, but, in no event, shall the provisions of this sentence be construed to impress upon the Owner any obligations to the Contractor, his/her surety, or to any of the Contractor's subcontractors, laborers, workmen, mechanics, or suppliers of any tier. In paying any unpaid bills of the Contractor, the Owner shall be deemed to be the temporary agent of the Contractor for this specified purpose; and any payment so made by the Owner shall be considered as a payment made under the Contract by the Owner to the Contractor, and the Owner shall not be liable to the Contractor for any such payments made in good faith.

38. PAYMENT FOR MATERIALS STORED

38.1 Payment for materials and equipment stored shall be subject to the requirements of these General Conditions.

38.2 No materials or supplies for the work shall be purchased by the Contractor or by any subcontractor subject to any chattel mortgage or security agreement, or under a conditional sale contract or other agreement by which an interest is retained by the seller. The Contractor warrants that he has good title to all materials, equipment, and supplies used by him/her in the work, and that such title is free from all liens, claims or encumbrances.

38.3 Payment for materials stored may be conditioned upon evidence submitted to establish the Contractor's title to materials and/or equipment stored, such as paid invoices, receipts of payment, satisfied purchase agreements, etc. When value of materials stored is allowed to be included in the Contractor's periodic estimates, the materials and/or equipment represented by such value shall become the property of the Owner, and the Contractor shall be responsible for safeguarding and using such materials and/or equipment in accordance with the provisions of the Contract Documents and shall retain all risk of loss or damage.

39. PAYMENT FOR EXTRA WORK

39.1 Extra Work shall be undertaken and prosecuted in accordance with the provisions of Article 20 of these General Conditions.

39.2 Payment for Extra Work may be made by use of one of the following methods:

A. Unit prices or combinations of unit prices which formed the basis of the original Contract.

B. A lump sum based upon the Contractor's estimate and accepted in writing (and signed) by the Owner.

C. Work Performed by the Contractor: Actual direct costs incurred solely, reasonably, and necessarily to perform the work plus fifteen percent (15%) of such actual direct cost to cover supervision, overhead, bond, other indirect costs, and profit. The Contractor shall submit to the Engineer and the Owner itemized cost sheets and documentation establishing the actual direct costs of performance of the Extra Work. Actual direct costs are defined as follows:

1. Actual documented labor costs, excluding supervisory personnel except for any time such personnel are at the project solely to supervise performance of the Extra Work and not for any other purpose.

2. Actual Labor-based Insurance and Workmen's Compensation Benefits costs attributable solely to labor actually and necessarily engaged in the performance of the Extra Work.

3. Social Security and unemployment contributions required by law for labor actually and necessarily engaged in the performance of the Extra Work.

4. Rental costs and charges for construction plant and/or equipment while actually and necessarily used in the performance of the Extra Work. Such costs or charges shall not exceed the lesser of AED Green Book standard rental rates, rental rates prevailing in the area of the work, or the Contractor’s internal job cost charges for such equipment. For equipment that is also on the project for work other than the Extra Work, only the documented time that such equipment is actually and necessarily engaged in performance of the Extra Work may be included, and no stand-by or idle time may be included. Daily rates shall be determined by dividing monthly rates by twenty-two (22); and hourly rates shall be determined by dividing monthly rates by one hundred and seventy-six (176). Rental rates or use rates shall not be charged for equipment having a value of less than $100.00 since equipment and tools having values of less than $100.00 are classed as small tools and as such are considered to be part of overhead.

5. Actual documented costs of materials and/or equipment entering permanently into the work.

6. Actual documented costs of power and consumable supplies for the operation of power equipment where such costs are not included in rental rates or use charges, and only for the incremental portions of such charges that are shown to have resulted solely from uses that were actually and necessarily required for performance of the Extra Work.

D. Work Performed by a Subcontractor for the Contractor: The Contractor shall eligible to receive five (5%) percent of its subcontractors' direct costs that are incurred solely, necessarily, reasonably to perform the Extra Work to cover all of the Contractor's costs of insurance, supervision, management, and other indirect costs. The subcontractor shall be entitled to its documented actual direct costs incurred solely, reasonably, and necessarily to perform the Extra Work plus fifteen percent (15%) of such actual direct costs to cover supervision, overhead, bond, other indirect costs, and profit. The Contractor shall submit to the Engineer and Owner itemized cost documentation showing the subcontractor's actual direct costs of performance of the work. Actual costs are defined above in C.1. through C.6 above.

40. SUBSTANTIAL COMPLETION

40.1 Substantial Completion is the point at which all (or a portion designated by the Engineer and the Owner) of the work has been sufficiently completed in accordance with the Contract Documents so the Owner can occupy and use the work for its intended purpose without any limitations or restrictions. Generally, and unless specifically stated otherwise in the Contract Documents, Substantial Completion must include all significant Work items such as demolition, site work, piping/utilities, equipment, concrete, masonry, buildings, miscellaneous metals, instrumentation and controls, fencing/gates, lighting/electrical, and access roads. Unless otherwise specifically stated in the Contract Documents, Substantial Completion does not include minor items such as signage, grassing, minor repairs and/or adjustments that do not affect performance/operation or use of the facilities, and other punch-list items.

On occasion, the Owner will designate a portion of the Work to be substantially complete so it can be occupied/placed into service, but this does not relieve the Contractor of responsibility achieve Substantial Completion and Final Completion on the remainder of the Work in accordance with the Contract Documents.

40.2 When the Contractor considers the work to be substantially complete, then the Engineer will observe the Work to determine whether or not the Owner will accept the work as being substantially complete. Repeat inspections, if required, will be performed by the Engineer at the Contractor's expense. The Engineer will notify the Owner when in the judgement of the Engineer the Work has reached substantial completion. The Owner may then elect to accept the Work as substantially complete, and the Engineer will issue a written Certificate of Substantial Completion.

40.3 Final Completion: After written Substantial Completion has been achieved, the Contractor and the Engineer will develop a list ("punch list") of remaining work items that must be completed in order to achieve Final Completion. Repeat "punch list" inspections, if required, will be performed by the Engineer at the Contractor's expense. Once the Contractor has completed all of the Work items (including punch list items) in accordance with the Contract Documents, the Engineer will notify the Owner when in the judgement of the Engineer the Work has reached Final Completion. The Owner may then elect to accept the Work as complete, and the Engineer will issue a written Certificate of Final Completion.

Additional requirements relating to Substantial Completion are contained in other sections of these General Conditions and in Division 1 sections of the Specifications.

40.4 Failure of the Contractor or the Engineer to include an item on the list of items to be completed for final acceptance does not alter the Contractor's responsibility to complete all work in accordance with the Contract Documents, or limit the Contractor's warranty or guaranty.

41. ACCEPTANCE AND FINAL PAYMENT

41.1 When the Contractor shall have completed all of the work in accordance with the terms of the Contract Documents, he shall so certify to the Engineer and the Owner that he has completed all of the work in accordance with the provisions of the Contract Documents. The Contractor shall also prepare and submit to the Owner a Final Request for Payment in an amount which shall be the Contract Amount plus all approved additions, less all approved deductions and less previous payments made.

41.2 The Contractor shall give notice of the completion of the work by advertisement in a newspaper of general circulation in the area in which the work has been performed and said notice shall appear once each week for a period of four (4) consecutive weeks. Proof of publication of said notice shall be furnished by the Contractor to the Owner by affidavit of the publisher of the newspaper, to which affidavit shall be attached a copy of the Notice.

41.3 When the Owner and the Engineer have completed a review of the work and of the request for final payment, and have determined that all of the work appears to completed in accordance with the provisions of the Contract Documents, final payment of the amount determined to be due under the Contract will be made to the Contractor, provided that:

A. Any deficiencies in the work, including outstanding warranty work, noted during the review shall have been satisfactorily corrected.

B. Final acceptance has been achieved.

C. The Contractor shall have submitted satisfactory evidence that all payrolls, all amounts due for labor and materials, and all other indebtedness connected with the work shall have been fully paid and satisfied; that there are no outstanding claims or demands against the Contractor in any manner connected with the work; submitted written consent of the Contractor's surety to final payment; and performed all other requirements relating to final acceptance as contained in other sections of these General Conditions and in Division 1 sections of the Specifications.

D. The Contractor shall have submitted an Affidavit of Release of Liens, and Affidavit of Payment of Debts and Claims, both as outlined below; and satisfactory evidence that there are not outstanding claims or demands against the Contractor in any manner connected with the work.

1. The Affidavit of Release of Liens shall include the following wording: "The undersigned hereby certifies to the best of his/her knowledge, information, and belief, the Releases of Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of work, labor, or services who have or may have liens against any property of the Owner arising in any manner out of the performance of the referenced Contract."

2. The Affidavit of Payment of Debts and Claims shall include the following wording: "The undersigned hereby certifies that he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and service performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced for which the Owner or his/her property might in any way be held responsible."

41.4 Final acceptance of the work shall be achieved (a) when all punch list items are accounted for by their completion or correction by the Contractor and acceptance by the Engineer and the Owner and, (b) all then-known warranty items have been satisfactorily addressed.

41.5 Acceptance of final payment by the Contractor shall be, and shall operate as, a release of the Owner from all claims and all liability to the Contractor for all things done or furnished in connection with the work, and for every act and neglect of the Owner and others relating to or arising out of the work. No payments, final or otherwise, shall release the Contractor or his/her sureties from any obligations under this Contract or under the Performance and Payment Bonds.

42. TESTS AND INSPECTIONS

42.1 Tests, inspections and approvals of portions of the work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at appropriate times. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing entity acceptable to the Engineer, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals.

43. TESTING OF COMPLETED WORK

43.1 After completion of the work and before acceptance of the work by the Owner, the Contractor shall perform all tests as required by the Specifications. The cost of all labor, tools, materials and equipment necessary for making the required tests, including the initial supply of treatment chemicals from a vendor approved by the Engineer, shall be borne by the Contractor. Any work found to be defective, faulty, or otherwise unsatisfactory shall be corrected by the Contractor without additional compensation. All work shall be guaranteed against defects as provided in the Contract Documents.

44. INCIDENTALS ABSORBED

44.1 All work and material covered by the Specifications or the Drawings, and any work, materials, or equipment that may be reasonably inferable from the information given upon Drawings or in the Specifications and that is necessary to complete the work or for the work to function and perform as intended, together with any tools, or appliances, or structures that may be needed or constructed by the Contractor for carrying out the work, shall be furnished by the Contractor, and the cost of all of the above shall be included in and absorbed by the prices and amounts included in the Contractor's Proposal.

44.2 The Contractor shall arrange and pay for all water, power, gas, sewer, telephone, cable, or other utility services used in his/her construction operations. The Contractor shall also establish and pay for all temporary/permanent utility services for the work until acceptance of the completed work by the Owner.

45. ASSIGNMENT OF CONTRACT

45.1 The Contractor shall not assign his/her Contract, nor any part thereof, nor any monies due, or to become due hereunder, without prior written consent of the Owner. In case the Contractor, with the consent of the Owner, assigns any or all of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to valid claims of all persons, firms, and corporations for services rendered or materials supplied for the performance of work under this Contract.

46. ORAL AGREEMENTS

46.1 No oral order, objection, claim or notice given by any party to the others shall affect or modify any of the terms or obligations contained in any of the Contract Documents, and no condition, requirement, obligation, right, or remedy in the Contract Documents shall be held to be waived or modified by reason of any act whatsoever, other than by a definitely agreed upon waiver or modification made in writing and signed by the party against whom the waiver or modification is to be enforced, and no evidence of any other waiver or modification shall be introduced in any proceeding.

47. NOTICE AND SERVICE THEREOF

47.1 All notices, demands, requests, instructions, approvals and claims shall be in writing.

47.2 Any notice to or demand upon the Contractor shall be sufficiently given if actually received (including receipt via email) or if delivered at the local office of the Contractor, or by personal service upon the Contractor's superintendent or project manager assigned to the work, or by certified or registered United States mail in a properly addressed sealed envelope with sufficient postage prepaid, or by delivery to a reputable overnight courier with charges prepaid and addressed to the Contractor at the address stated by the Contractor in the Proposal, or at the local address used by the Contractor during the process of the work (or at such other address as the Contractor may from time to time designate to the Owner in writing). Any notice to or demand upon the Owner shall be sufficiently given only if delivered to both the Owner and the Engineer at the addresses provided in the Contract Documents by one of the methods described above.

48. SUSPENSION OF WORK

48.1 The Owner shall have the right to suspend the work, wholly or in part, for such periods of time as he may deem necessary. The Contractor may be eligible for an equitable adjustment of the time for completion and/or the Contract Amount for direct costs or delays unavoidably caused solely by the suspension, unless the suspension was attributable in whole or in part to the performance or non-performance of the Contractor or unless an adjustment in the time for completion or the Contract Amount is made or denied under another provision of the Contract Documents.

49. TERMINATION FOR BREACH

49.1 In the event that the Contractor (including his/her subcontractors or vendors of any tier) violates or fails strictly to comply with any obligation or requirement in the Contract Documents, the Owner may serve written notice upon the Contractor and his/her surety of its intention to terminate the Contract or

exercise any other remedy allowed by or provided in the Contract Documents, such notices to be signed by the Owner and to contain the reasons for such intentions. Unless within ten days after serving of such notice upon the Contractor such violation or non-compliance is cured in a manner satisfactory to the Owner and the Engineer, the Owner exercise any remedy allowed by or provided in the Contract Documents, or the Owner may terminate the Contract by giving to the Contractor notice of such termination for the reasons stated in the initial notice. In the event of any such termination, the Owner shall immediately serve notice thereof upon the Contractor's surety.

49.2 The Owner may terminate the Contract if the Contractor persistently fails to supply enough properly skilled workers or proper materials; fails to maintain the construction schedule; persistently performs faulty or defective work; fails to promptly remedy any faulty work or defective work; fails to make payment to subcontractors, suppliers, or vendors for materials or labor; disregards laws, ordinances or regulations of a public authority having jurisdiction; or otherwise is guilty of substantial breach of a provision of the Contract Documents.

50. ADDITIONAL OR SUBSTITUTE BONDS

50.1 If, at any time after the execution of the Contract Agreement and the Surety Bonds attached thereto, the Owner should, for justifiable cause, deem the Surety or Sureties then upon the Performance and/or Payment Bonds, to be unsatisfactory, the Contractor shall within five (5) days after notice from the Owner to do so, furnish an acceptable bond (or bonds) in such form as may be satisfactory to the Owner and with such Surety or Sureties as may be satisfactory to the Owner. The premiums on such bond (or bonds) shall be paid for by the Contractor. No further payments to the Contractor shall be deemed to be due until such new and/or additional security for the performance of the work and/or for the payment for labor and materials shall have been furnished in form and amount satisfactory to the Owner.

51. HAZARDOUS MATERIALS

51.1 The term "hazardous materials" shall mean any substances, including but not limited to asbestos, toxic or hazardous waste, PCBs, combustible gases and materials, petroleum or radioactive materials (as each of these is defined in applicable federal statutes) or any other substances under any conditions and in such quantities as would pose a substantial danger to persons or property exposed to such substances at or near the work site.

51.2 If reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a hazardous material encountered at the site, then the Contractor shall, upon recognizing the condition, immediately stop work in the affected area and report the condition to the Owner and Engineer in writing.

51.3 The Contractor is responsible for being aware of and complying with the Asbestos National Emission Standard for Hazardous Air Pollutants (NESHAP). The Contractor shall perform all work activities in accordance with the Asbestos NESHAP regulation and any other applicable federal, state or local codes, laws, and regulations.

52. SCHEDULE OF WORK

52.1 All activities associated with the work requiring partial or complete shutdown of the existing facilities shall be scheduled by the Contractor and approved the Owner. The schedule approved by the

Owner must include the exact time and duration of any and all periods of shutdown of the existing facilities.

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 UNIT PRICES

A. Unit prices are based on estimated quantities of items, but the Contractor shall be paid based on the actual measured quantity of each unit price item that is furnished and/or installed. Unit prices shall include all labor, delivery, materials, equipment, services, overhead, and profit attributable to each unit price item. Once the actual quantities are known, then a Change Order will be issued to incorporate the quantity increase or decrease into the Work.

B. Refer to individual Specification Sections for additional information.

C. The Contractor shall measure the unit price quantities furnished and/or installed, but the Owner shall have the right to verify the Contractor's measurements with Owner's forces and/or independently at Owner's expense.

D. List of Unit Price Bid Items: A schedule and description of the unit price bid items included in this Contract is provided below:

1. Mobilization/Demobilization: Moving equipment and materials to job location and all bonds and insurance. Limited to 5 percent of the total contract amount.
2. Sanitary Sewer Lift Station: The sanitary sewer lift station will be considered accepted for payment on a percent complete basis. Payment will be made for the sanitary sewer lift station using the lump sum price in the proposal form. Such payment will be considered compensation for furnishing and installing, but not limited to: what is detailed on the contract documents, fittings, piping, valves, submersible pumps, site fencing, wet well, valve vault, flow meter vault, lighting fixtures, electrical materials and field wiring, clearing and grubbing as required to install the lift station infrastructure as described per the Plans and Specifications, gravel, asphalt, grading, culvert piping, headwalls, rip rap, access road, erosion control BMPs, and all other appurtenances required. Lump sum payment will be paid for all material and labor required to install the sanitary sewer lift station to the limits indicated on the Contract Drawings and description included herein.
3. PVC Pipe for Sanitary Sewer Collection (Installed on Grade): The accepted length of installed pipe is measured along the pipe centerline and shall include manholes installed along the line. Terminal points on the measurements shall be the ends of the existing pipe lines to which the new pipe is connected; the centerlines of manholes (5 ft. diameter or less); the inside face of any junction box or of manholes with diameters greater than 5 ft.; and the outlet face of headwalls. The depth of cuts shall be measured from the invert of the new pipe to the original ground surface. Unless specifically indicated otherwise, pipe installed at a depth of cut equal to the limit of cut range shall be considered to fall within the shallower cut range. Such payment will be considered compensation for furnishing and installing, including but not limited to: the accepted length of pipe, fittings, spacers, cleanouts, seals, wash pipe, supports, vents, bulkhead, slurry,

tracing device, methods to install, digging of test holes to determine location of existing utilities, the specified lateral stub out connections, all required clearing and grubbing, and all erosion control BMPs using the unit prices in the proposal form.

4. PVC Force Main Pipe: The accepted length of installed pipe of a particular size is measured along the pipe centerline. Terminal points on the measurements shall be the ends of existing pipes, valves, or fittings to which the new pipe is connected, and the points of beginning and ending for lump sum items of work. Such payment will be considered compensation for furnishing and installing, but not limited to; what is indicated on the Plans, the accepted length of pipe, PVC pipe fashioned for fittings, spacers, cleanouts, seals, wash pipe, supports, vents, bulkhead, slurry, tracing device, methods to install, digging of test holes to determine location of existing utilities, all required clearing and grubbing, and all required erosion control BMPs using the unit prices in the proposal form. Contractor may elect to horizontal directional drill portions or all of the PVC force main. Payment will be considered the same for open cut installation.
5. Creek Crossings: Each specific crossing indicated for payment will be considered accepted for payment when it has been completed. Payment will be made for each specific crossing using the linear foot prices in the proposal form. Such payment will be considered compensation for furnishing and installing casing pipe, carrier pipe, spacers, supports, vents, bulkheads, erosion control BMPs, clearing and grubbing as required, and all other miscellaneous items required within the indicated limits of the crossing.
    a. Crossings are unclassified as to the material encountered; therefore the Contractor shall install crossings at the locations indicated, or at other locations approved by the Owner, at no additional cost to the Owner. If the Contractor is unable to complete a crossing at a given location and elects to move to another location (approved by the Owner) no additional compensation will be paid by the Owner for uncompleted crossings or work required to appropriately abandon uncompleted crossings.
6. Manhole Base Sections: The accepted payment will be per each for the particular diameter of manhole base section/type including the transition section if required. Payment will be made for the total number of manhole base sections installed using the unit prices in the proposal form. Such payment will be considered compensation for furnishing and installing all manhole bases, bedding, gaskets, connectors, boots, invert construction, steps, excavation, backfilling, surface restoration, testing, and all other miscellaneous appurtenances.
7. Manhole Riser Sections: The accepted payment depth will be the vertical distance from the manhole top of the base section or transition to the top of the cone section (or top of flat concrete cover slab) for each particular diameter of manhole. Payment will be made for the total vertical feet of manhole installed using the unit prices in the proposal form. Such payment will be considered compensation for furnishing and installing all manhole sections, bedding, steps, excavation, backfilling, surface restoration, testing, and all other miscellaneous

appurtenances, except manhole rings and covers, required for installation of the manhole. Payment for manhole rings and covers will be made separately.

8. Manhole Ring and Cover: The number of furnished and installed ring and cover assemblies of particular size and type installed shall be counted for payment. Payment will be made for furnishing and installing each size and type of ring and cover assemblies using the unit prices in the proposal form.
9. Automatic Air Release Valve Assemblies: The number of complete automatic air release valve assemblies installed and placed into service will be counted for payment. Payment will be made for each automatic air release valve assembly using the unit prices in the proposal form. Such payment will be considered compensation for furnishing and installing the tap, saddle, corporation stop, tubing, automatic air release valve, manhole base section, manhole riser section, manhole ring and cover, crushed stone, and all other miscellaneous items required.
10. Schedule 80 PVC Water Service: The accepted length of installed pipe of particular size is measured along the pipe centerline. Terminal points on the measurements shall be the ends of existing pipes, valves, or fittings to which the new pipe is connected, and the points of beginning and ending for lump sum items of work. Such payment will be considered compensation for furnishing and installing, but not limited to; what is indicated on the Plans, the accepted length of pipe, Sch. 80 PVC pipe, fittings, seals, supports, materials required for connection to ex. system, and any other items required for the installation of the water service as shown in the Contract Drawings using the unit prices in the proposal form.
11. Connections to Existing System: Each specific connection to the existing system indicated for payment will be considered accepted for payment once the connection has been completed. Payment will be made for each specific connection using the lump sum unit prices in the proposal form. Such payment will be considered compensation for furnishing and installing, pipe, grout fill for existing manhole inverts, bypass pumping, coring existing manholes, and all other miscellaneous items required.
12. Record Survey: Upon substantial completion, prior to the project's final closeout, a record survey is required as specified in the 01 78 39 Project Record Drawings section.
13. Clearing and Grubbing: The accepted payment will be for the clearing and grubbing all vegetation (trees, brush, etc.) required to install the gravity sewer, force main, and manholes per the Plans and Specifications. Such payment will be considered compensation for the following (including but not limited to): providing all labor, materials, equipment, and tools required to clear a swath the width of the respected easement and pump station site, unless otherwise stated. All cleared materials and debris are to be removed and disposed of properly by the Contractor.
14. Lift Station Access Road: The accepted payment will be for the installation of the access road in accordance with the Contract Documents. Payment will be made for the equipment, materials, and all other required items to install the access road outside of the lift station site fence in accordance with the Contract Documents.
15. Erosion Control Measures: The accepted payment will be for furnishing and installing the erosion control best management practices (BMPs) as indicated on

the drawings and as additionally required by the project phasing and disturbed areas. Payment will be made based on the total percentage of erosion control measures that have been installed, maintained, and removed after final stabilization.

16. Excavation of Unsuitable Materials and Disposing Off-Site: Acceptable volume of excavation shall be the volume required by the Engineer for the removal and legal disposal of unsuitable material and soils. Payment will be made for each cubic yard of soils, debris, or other unsuitable backfill material removed using the unit price in the Proposal Form. Such payment will be considered compensation for the excavation, removal, and legal disposal of unsuitable materials and all other miscellaneous items required to complete the work.
17. Backfilling Unsuitable Materials with Suitable Soils to Include Hauling and Compaction: Acceptable volume of backfill with suitable soils shall be the volume required by the Engineer for the replacement of the removed unsuitable materials. Payment will be made for each cubic yard of suitable materials placed and compacted in accordance with the Contract Documents using the unit price in the Proposal Form. Such payment will be considered compensation for furnishing the suitable soils, placement, compaction, and all other miscellaneous items required to complete the work.

END OF SECTION 01 22 00

SECTION 01 23 00 – ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. The Owner reserves the right to select or reject alternates that are considered to be advantageous to the Owner.
B. No adjustments to the pricing for other components of the Work will be made.
C. No adjustments to the schedule or Contract completion dates will be made unless specifically identified for an alternate.
D. Only those alternates selected by the Owner and incorporated into the Contract Agreement are included in the Work.

1.2 SCHEDULE OF ALTERNATES

A. The alternates shown in the Proposal Form are listed and described below:
1. Alternate Bid Item No. 1: Installation of approximately 974 linear feet of 8-inch PVC gravity sewer, demolition of existing pump station and rerouting of existing Force mains as specified in the Bid Documents. Payment for installation shall be the same as noted in the Unit Price section of the Bid Documents.

PART 2 - PART 2 - PRODUCTS (Not Used)

PART 3 - PART 3 – EXECUTION (Not Used)

END OF SECTION 01 23 00

SECTION 01 26 00 - CONTRACT MODIFICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for Contract modifications (Change Orders).
B. Change Orders must be in the form of a written document that changes the Contract scope, time, and/or Amount. Change Orders must be signed by the Contractor, Owner, and Engineer. Additional Change Order requirements can be found in the General Conditions.
C. The Engineer may issue instructions for minor changes in the Work without changes to the Contract Time and without changes to the Contract amount. The Engineer may provide job sketches or other additional information for these minor changes. The Contactor shall incorporate the minor changes into the Work in a timely manner.
D. The Contractor shall not stop work or execute the proposed change(s) unless and until a written Change Order has been executed.

1.2 CHANGE ORDER REQUESTS

A. If the Engineer or Owner requests a Change Order, then the Engineer will issue a description of proposed changes in the Work. The Engineer may also provide additional information in the form of drawings or specifications. The Contractor shall submit a proposed Change Order within 14 days of receipt of the Change Order request (unless otherwise specified).
B. Change Order proposals shall include the proposed changes to the Contract Amount and Contract Time. The Change Order proposal(s) shall be detailed, and shall include the following at a minimum:

    1. Quantities for materials and equipment.
    2. Units and unit costs.
    3. Labor man-hours and unit costs.
    4. Detailed list of equipment (and hours/days, unit cost for each).
    5. Subcontractor costs (include quotes from subcontractors).
    6. Vendor/supplier costs (include quotes from vendors/suppliers.
    7. All applicable taxes and shipping/delivery.
    8. Credits and/or offsets
    9. Mark-up for Overhead and Profit (in accordance with requirements in General Conditions)
    10. Updated construction schedule to reflect the change(s) and the impacts on start and finish times, critical path, and float. Additional Contract time will not be granted unless no float is available and critical path is impacted.
    11. If Change Order request is initiated by the Contractor, then include a description of the reasons and justification for the request.

1.3 CHANGE ORDERS FOR ALLOWANCES AND UNIT PRICE WORK

A. Administrative change orders will be issued to incorporate the actual cost of allowances and/or to reflect the actual quantities of unit price items incorporated into the Work. Refer to those specification sections for procedures and requirements.

1.4 CONSTRUCTION CHANGE DIRECTIVE AND TIME AND EXPENSE CHANGE ORDERS

A. When there is not enough time for the Contractor to develop a Change Order proposal or when the Owner and Contractor disagree on the terms of a Change Order proposal, the Engineer may issue a written directive instructing the Contractor to proceed with changes in the Work. These changes will be performed on a time and expense basis, and will be incorporated into the Contract at a later date with a written Change Order.

B. The Contractor is to promptly proceed with the changes in the work outlined in the Construction Change Directive. Should the Contractor disagree with the method provided for determining the proposed adjustments in the Contract Amount and/or Contract Time, he shall advise the Engineer of this disagreement. A Construction Change Directive signed by the Contractor indicates his agreement with the method for determining the proposed adjustments in the Contract Amount and/or Contract Time; however, the Contractor is to proceed with the work described in the Construction Change Directive regardless if the Contractor signs the Construction Change Directive or not.

C. The Contractor shall track and document the time and expense associated with the Work and shall maintain detailed records of the time and expense associated with the change(s).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. General coordination procedures.
   2. Requests for Information (RFIs).
   3. Project meetings.

1.2 GENERAL COORDINATION PROCEDURES

A. The Contractor shall coordinate construction operations with other contractors, the Owner, and other entities, to ensure efficient and orderly installation of each part of the Work.
B. The Contractor shall prepare and coordinate the following administrative items with other contractors, the Owner and the Engineer in order to ensure that the Work is completed in a smooth and orderly manner:

   1. Construction schedule.
   2. Schedule of values.
   3. Temporary facilities and controls.
   4. Submittals and coordination drawings.
   5. Progress meetings.
   6. Pre-installation meetings.
   7. Startup and commissioning
   8. Project closeout.

1.3 REQUESTS FOR INFORMATION (RFIs)

A. The Contractor shall prepare and submit an RFI immediately upon discovery of the need for interpretation or additional information.
B. The Engineer will review and respond to each RFI within seven (7) days of receipt of the RFI. The Engineer's review may include a request for additional information, in which case the Engineer will respond within seven (7) days of receipt of the requested additional information.
C. The Engineer will not review or respond to requests for approval of submittals, requests for approval of substitutions, requests for approval of Contractor's means and methods or incomplete RFI's.
D. The Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.
E. If the Contractor believes that an RFI response warrants a Change Order, then the Contractor shall notify the Engineer in writing within ten (10) days of receipt of the RFI response. Requests for Change Orders shall be handled in accordance with the requirements in the Contract Documents.
F. RFI Log: The Contractor shall prepare and maintain an RFI log, and shall update it monthly for review at the progress meetings. The Engineer may also prepare and maintain a separate RFI log.

G. The Contractor shall notify the Engineer within seven (7) days if he/she disagrees with the response. Otherwise, the Contractor shall immediately distribute RFI responses to subcontractors, vendors and suppliers, as applicable.

1.4 PROJECT MEETINGS

A. Pre-Construction Meeting: The Engineer will schedule and conduct the pre-construction meeting, and will prepare and distribute meeting minutes.

1. Attendees: Attendees shall include the Contractor (project manager and superintendent, at a minimum), major subcontractors, the Owner, and Engineer.
2. Agenda: The Engineer will prepare and distribute an agenda, which will include the following:

a. Construction schedule and phasing (if applicable).
b. Critical work sequencing and long-lead items.
c. Substantial completion (if Contractor has questions regarding specific work items that are required to be complete before Owner accepts the project as being Substantially Complete.
d. Key personnel and lines of communication.
e. RFI procedures.
f. Procedures for applications for payment.
g. Submittal procedures.
h. Use of the existing facilities and work restrictions/working hours.
i. Temporary facilities and controls.
j. Planned disruptions/shutdowns.
k. Security.
l. Progress cleaning.

B. Monthly Progress Meetings: The Contractor will schedule and conduct regular project progress meetings at the Project site unless otherwise indicated, and will inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. The Contactor will coordinate the meeting dates and times with the Owner and Engineer. The Engineer will prepare and distribute meeting minutes.

1. Attendees shall include the Contractor (project manager and superintendent, at a minimum), major subcontractors, the Owner, and the Engineer.
2. Agenda: The agenda will typically include the following:
   a. Review and approve meeting minutes from previous meeting.
   b. Review of construction progress.
   c. Review of upcoming/planned construction activities.
   d. Status of RFI's and Change Orders.
   e. Status of Submittals
   f. Review of potential weather impacts or other scheduling impacts/delays.
   g. Other pertinent items.

C. Pre-installation and/or Pre-startup Meetings: Conduct pre-installation and/or pre-startup meetings before each major construction activity and/or startup of equipment and new

facilities. Attendees shall include, at a minimum, the key Contractor personnel, key subcontractor personnel, the installer and/or manufacturer's representative, Owner and Engineer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Preconstruction photographs and video.
   2. Periodic construction photographs and video.

1.2 INFORMATIONAL SUBMITTALS

A. Digital Photographs and Video: Submit image files within 7 days of taking photographs/video.

B. Provide information on date and location of photos/videos.

1.3 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer to Owner and Engineer for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 1600 by 1200 pixels and 400 dpi.

B. Digital Video Recordings: Provide high-resolution, digital video in a format acceptable to Engineer.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS AND VIDEO

A. Preconstruction Photographs: Prior to mobilizing and beginning Work, take photographs of the Project site and surrounding properties, including buildings and existing items to remain during construction, from different vantage points. Flag limits of disturbance prior to taking photographs. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

B. Periodic Construction Photographs: Take photographs monthly and as required to document construction progress.

C. Vantage Points: Coordinate with Engineer to select vantage points. During each of the following construction phases, take photographs from same vantage point each time to create a time-lapse sequence.

D. Date/Time Stamp: Include date/time stamp on photos and videos.

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUBMITTAL REVIEW AND COORDINATION

A. Submittal Development and Contractor Review: Contractor shall develop and submit submittals as required to allow adequate time for review without delaying/affecting the schedule for the Work. No Contract extension will be allowed for submittal development and/or review/resubmittals. Contractor shall thoroughly review and familiarize himself with the existing facilities and shall obtain/incorporate all necessary field dimensions into the submittals prior to submitting and prior to beginning Work.

B. The Contractor shall be solely responsible for coordinating preparation and review/processing of the submittals with manufacturers and suppliers and for ensuring that they are developed and approved as required to complete the Work on schedule.

C. Time for submittal review shall begin upon receipt of complete submittal by Engineer. Contractor shall allow a minimum of 14 days for submittal review when no concurrent consultant review (e.g. electrical review) is required. Where concurrent consultant submittal review is required, allow an additional 7 days (total of 21 days).

D. Resubmittal Review: Allow 14 days for review of each resubmittal.

E. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received. No extension of Contract time will be granted for this.

F. Engineer will maintain a submittal log throughout the project.

1.2 ENGINEER'S DIGITAL CAD FILES

A. Engineer's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals.

B. Engineer makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

C. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD (.dwg) format.

D. Contractor shall execute a data licensing/use agreement provide by the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL SUBMITTAL REQUIREMENTS AND PROCEDURES

A. Contractor shall prepare and submit submittals in accordance with requirements in each Specification Section.

B. Electronic submittals (pdf format) are acceptable and can be submitted via email or other means.

C. Action Submittals (Requiring Review and Comments): Submit five (5) paper copies. Engineer will return two (2) copies unless Contractor indicates that it is for informational purposes only.

D. Submittals shall include the following information:

1. Project name, Owner Name and Date.
2. Name of Engineering Firm and name/contact information for Engineer.
3. Name, Addresses and Contact Information for Contractor, Subcontractor, Supplier and Manufacturer
4. Submittal number or other unique identifier, including revision identifier. Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
5. Number and title of appropriate Specification Section.
6. Drawing number and detail references, as appropriate.
7. Location(s) where product is to be installed, as appropriate.
8. Other necessary identification.

E. During the bid period and again prior to submitting/ordering and installing materials, products and equipment, the Contractor and all manufacturers and suppliers shall thoroughly review the materials, products and equipment being supplied and shall familiarize themselves with the existing and proposed/new facilities, as well as connections to existing facilities/utilities. This shall include field verification of the location, nature, size/dimensions, current and intended future use, etc. Prior to ordering and installation, the Contractor shall coordinate with all manufacturers and suppliers to provide all needed information including field dimensions, photographs, information on related materials and equipment, etc.). The Contractor and all manufacturers and suppliers shall confirm the following:

1. The materials, products, and equipment being supplied are of the correct size, materials and type
2. The materials, products and equipment being supplied do not conflict with existing or proposed/new facilities.
3. The products/equipment being supplied are intended for use in this application. All manufacturer(s) and supplier(s) shall provide (either with submittals or separately) written concurrence/acknowledgement of their review/coordination and concurrence with the items above.

2.2 TYPES OF SUBMITTALS

A. Contractor's Construction Schedule: Prepare the construction schedule for review by the Engineer prior to the first progress meeting and prior to submitting an application for payment.

B. Schedule of Values – Prepare a schedule of values for review by the Engineer prior to submitting an application for payment.

C. List of Subcontractors and Major Equipment Suppliers: Prepare a written list of significant subcontractors and equipment suppliers to include name and contact information, and brief description of work and/or equipment being provided.

D. Application for Payment

E. Product Data: Develop and submit information as a single submittal for each component of the Work. Product data shall include the following:

1. Indicate which options are available and which ones are being furnished.
2. Manufacturer's catalog cuts, product specifications, and color charts.
3. Statement of compliance with specified referenced standards.
4. Testing data.
5. Delivery/availability/schedule information.
6. Availability and delivery time information.
7. Wiring diagrams.
8. Performance curves.
9. Other relevant information.

F. Shop Drawings: Shop drawings shall be developed/drawn to scale and shall include the following:

1. Name/Number/Identification.
2. Drawings shall be in sufficient detail to determine size and configuration.
3. Dimensions in plan and section/elevation, where applicable.
4. Requirements for coordination.
5. Signed and sealed, if required, by professional engineer.

G. Samples: Submit samples that are representative of the type, color, pattern and texture to be furnished/installed. Samples shall include the following:

1. Name/Number/Identification/Description
2. Product name, manufacturer name, and source of sample.
3. Location to be installed (include reference to specification numbers and/or drawings).
4. Samples for related components shall be submitted as a single package.

H. Welding Certificates: Prepare and submit welding certificates to certify that welding personnel are qualified and that welding was performed in accordance with all applicable standards.

I. Product/Material Certificates and Test Reports: Submit written reports on supplier/manufacturer letterhead to certify that products/materials and/or test reports comply with the Contract Documents and all other applicable codes/standards.
Field Test Reports.

PART 3 – EXECUTION

3.1 CONTRACTOR'S REVIEW

A. The Contractor shall review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. The Contractor shall note corrections and field dimensions, and shall include an approval stamp before submitting to Engineer.

B. The Contractor’s approval stamp shall include the following:

1. Project name and location.
2. Submittal number and specification title/number.
3. Name of reviewer and date of Contractor approval.
4. Statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S REVIEW

A. Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will either stamp each submittal with an action stamp and will mark stamp appropriately to indicate action or will provide an electronic stamp including comments pertaining to the submittal. Each submittal will be marked with one of the items below:

1. No Exceptions Taken: The Engineer has no comments to provide the Contractor. Contractor may proceed with current submittal acting as final submittal.
2. Make Corrections: The Contractor shall include any corrections provided by the Engineer and shall proceed with current submittal acting as final submittal.
3. Amend & Resubmit: Contractor shall make all necessary revisions as indicated by the Engineer and shall submit the corrected submittal to the Engineer for approval.
4. Rejected: Contractor shall resubmit based on the Engineer’s comments.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary utilities, temporary support facilities, and temporary security.

1.2 USE CHARGES

A. The Contractor shall include all transfer and use charges and associated costs for temporary facilities (including setup, installation and removal) and permanent facilities in the Contract, unless specifically indicated otherwise.

1.3 QUALITY ASSURANCE

A. For all electric power service, Contractor shall comply with all applicable codes (NECA, NEMA, and UL standards and regulations, and NFPA).

B. Contractor shall obtain the required permits for all utilities.

C. Contractor shall comply with all applicable OSHA and ADA provisions for temporary ingress/egress.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

PART 3 - PRODUCTS

3.1 GENERAL

A. Coordinate with the Owner to locate the temporary facilities.

B. Isolate and protect Work areas and/or occupied facilities to prevent dust and fume entry.

C. Provide temporary fire protection as necessary to protect against fire losses during construction.

D. Do not remove temporary facilities until they are no longer needed.

3.2 INSTALLATION OF TEMPORARY UTILITIES

A. The Contractor shall provide temporary toilets, wash stations, and potable water for use of construction personnel.

B. Provide temporary lighting as needed for construction operations, inspections and security.

END OF SECTION 01 50 00

SECTION 01 73 00 – EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Existing Conditions
2. Preparation and Construction layout.
3. Installation of the Work.
4. Cutting and patching.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: All materials used for cutting and patching shall be identical to in place materials. When identical materials are not available, new materials shall match existing (visually/aesthetically) as closely as possible, and shall be as durable in nature and as functional as existing materials.

PART 3 - EXECUTION

3.1 EXISTING CONDITION

A. The Contractor shall visit the site prior to bidding the Work and shall become familiar with the existing facilities, including sizes, locations, materials and other features of existing utilities/facilities. The Prior to beginning work, the Contractor shall verify the location, sizes, and other features of existing utilities at connection points, crossing locations and/or other key locations. The existence and location of underground and other utilities and construction indicated as existing are not guaranteed, so the Contractor shall fully investigate the existence, size, location and features (e.g. materials) as required to accurately price the Work prior to bidding the Work, and as required to execute the Work prior to orderings/installation.

B. Prior to bidding the Work, and prior to ordering materials and beginning Work, the Contractor shall examine all existing conditions (utilities, structures, finishes, etc.) and verify compatibility and suitability of materials, equipment and systems for all Work. Include all relevant information (including potential conflicts and/or issues such as compatibility, sizing) in a submittal(s) for review by the Engineer. Proceed with ordering and installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION AND CONSTRUCTION LAYOUT

A. The Contractor shall coordinate with the Owner and/or local utilities regarding the need to relocate existing utilities.

B. The Contractor shall be solely responsible for taking field measurements required to complete the Work, and shall incorporate the field measurements into submittals for review by Engineer prior to ordering materials and equipment and prior to beginning Work

C. The Contractor shall verify that no conflicts exist prior to ordering materials and equipment and prior to beginning Work. If conflicts and/or different field conditions are discovered, then the Contractor shall notify the Engineer immediately.

D. Construction Layout: The Contractor shall engage a land surveyor to verify and/or establish benchmarks, to verify layout information shown on the Drawings, and to lay out the Work. The Contractor shall check the location and correctness of the Work as it progresses.

3.3 INSTALLATION

A. The Contractor shall always confirm with manufacturer and shall follow manufacturer's written instructions and recommendations for installing products.

B. Bracing and Supports: The Contractor shall furnish and install all necessary anchors, fasteners, braces and supports required to securely anchor/support the Work. If size, quantity and/or type of anchor/support/brace is not shown, verify with manufacturer(s).

C. All components of the Work shall be installed plumb, straight, and level, and to maximize clearance(s) for access and/or maintenance. The Contractor shall also make provisions for thermal expansion and contraction.

3.4 CUTTING AND PATCHING

A. The Contractor shall employ skilled and experienced workers and shall do the following with respect to cutting and patching:

1. Patch the Work as quickly as possible after cutting.
2. Restore surfaces/cuts to their original condition or better.
3. Provide temporary bracing and supports.
4. Protect adjacent areas and/or other new construction.
5. Minimize interruption of existing utilities/facilities and coordinate with Owner prior to cutting/patching.
6. Patch in a manner that minimizes evidence of the Work.
7. Clean affected areas after cutting and patching is complete.

3.5 PROGRESS CLEANING

A. The Contractor shall maintain a clean project site and shall clean daily.

B. The Contractor shall not hold/accumulate waste(s) and shall dispose of waste in accordance with all applicable regulations/requirements. Waste materials shall not be buried or burned on site.

C. The Contractor shall clean and protect installed Work.

3.6 STARTING AND ADJUSTING

A. The Contractor shall coordinate startup and testing of equipment with the manufacturer, subcontractors, Engineer and the Owner.

B. The Contractor shall obtain manufacturer concurrence/approval of installation prior to startup. Malfunctioning/defective materials and equipment shall be replaced with new materials and equipment at no cost to the Owner.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. The Contractor shall protect and maintain the Work in new condition (without damage or degradation) until Final Completion. This includes maintaining cleanliness and avoiding staining of concrete walls and slabs due to construction activities. The Contractor shall be solely responsible for maintaining and/or cleaning to achieve a new finish, even if it requires resurfacing/recoating and/or replacing the affected Work.

3.8 CORRECTION OF THE WORK

A. The Contractor shall repair or remove and replace defective equipment, materials and/or construction at no cost to the Owner. All Work shall be restored and/or maintained in new condition until Final Completion.

END OF SECTION 01 73 00

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. The following requirements must be met/completed before closing out the project:

1. Substantial Completion: The Contractor must have achieved written Substantial Completion in accordance with the requirements in the General Conditions.
2. Prepare and submit Project Record Documents.
3. Prepare and submit Operation and Maintenance Manuals.
4. Deliver tools, spare parts, extra materials, salvaged materials, etc. to Owner.
5. Completion of all equipment start-up and training.
6. Complete all punch list items.
7. Warranties: Obtain and submit specific equipment and product warranties. Overall project warranty and individual equipment/system warranties shall begin upon approval (date of Owner signature) of the Final Payment Application unless specifically stated otherwise.
8. The Contractor must satisfactorily address outstanding warranty items before Final Payment will be made.
9. Obtain and submit release permitting Owner unrestricted use of the Work and include occupancy permits/certificates, where applicable.
10. Removal of temporary facilities from Project site.
11. Notify Owner of insurance changeover/transfer requirements, where applicable.
12. Place any permanent utilities in Owner's name.
13. Final Cleaning: Employ experienced and skilled workers, or a professional cleaning service. Cleaning shall include the project site, grounds, buildings and all other facilities and areas affected by the construction. HVAC systems (including ducts) shall be inspected and cleaned and filters replaced.
14. Advertise for completion in accordance with the requirements in the General Conditions.
15. Written Consent of Surety: The Contractor shall have submitted written consent of Surety Company to final payment;
16. Affidavits: The Contractor shall have submitted affidavits (see General Conditions) and satisfactory evidence that there are no outstanding claims or demands against the Contractor in any manner connected with the work.
17. Submit a Final Application for Payment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 77 00

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the requirements for the following:

1. Record Drawings
2. Record Specifications and Product Data.
3. Record Survey

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Maintain one set of marked-up hard copies of the Contract Drawings and Shop Drawings. Mark-ups should show where actual installation was different than what was shown on Construction Drawings. Note related field directives, change orders or modifications, and include/attach photos if needed. Submit the Record Drawings to the Engineer at Substantial Completion.

2.2 RECORD SPECIFICATIONS AND PRODUCT DATA

A. Maintain one set of mark-up hard copies of the Contract Specifications and any miscellaneous product data to indicate where the actual installation was different than what was shown in the Construction Specifications. Note related field directives, change orders, or modifications, and include/attach photos if needed. Submit the Record Specifications and Product Data to the Engineer at Substantial Completion.

2.3 RECORD SURVEY

A. Engage a licensed surveyor to prepare a Record Survey of the site and submit the Record Survey to the Engineer at Substantial Completion.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The section includes demolition and removal of selected portions of existing buildings, structures or equipment.

1.2 DEFINITIONS

A. Demolish: Disconnect and dispose of off-site as described herein.

B. Return to Owner: Disconnect without damaging and deliver to Owner at location approved by the Owner.

1.3 MATERIALS OWNERSHIP

A. Demolition waste is the property of the Contractor unless otherwise indicated.

B. Anything of value, as determined by the Owner or Engineer, found during the progress of the work shall become the property of the Owner who will determine the manner of disposal.

1.4 PRE-DEMOLITION MEETING

A. Conduct meeting at a predetermined location before starting demolition work. This meeting may be held in conjunction with a general Pre-Construction meeting

B. Contractor shall provide proposed schedule and procedures to be used during demolition activities.

C. Owner and Engineer will provide comments on proposed schedule and procedures.

D. Contractor shall adjust schedule and procedures as necessary to avoid conflict with Owner’s operations and address Owner’s concerns.

1.5 FIELD CONDITIONS

A. Selective demolition activities by Contractor shall not disrupt Owner's operations or activities.

B. If potentially hazardous materials are found, the Contractor shall notify the Owner and Engineer immediately before disturbing possible hazardous materials. Removal and/or remediation of hazardous materials will be undertaken by the Contractor either as Extra Work or by the Owner under separate contract.

C. Existing utility services and equipment operation shall be protected by Contractor as necessary to prevent damage or interruption of service.

1.6 EXISTING WARRANTIES

A. Contractor shall conduct his activities in a manner that does not impact existing warranties on items not being demolished.

1.7 REGULATORY REQUIREMENTS

A. All demolition activities shall be completed in accordance with applicable requirements of governmental or regulatory authorities having jurisdiction.

PART 2 - EXECUTION

2.1 PRELIMINARIES

A. Confirm utilities or equipment potentially affected are disconnected, protected, and or removed and stored in a secure location before initiating demolition work.

B. Provide temporary supports or bracing as necessary to prevent damage to existing adjacent structures or equipment during demolition activities.

2.2 UTILITIES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Arrange to turn off utilities which will be affected by demolition work in accordance with schedule approved by the Owner.

B. Provide temporary service or temporary systems for utilities and systems as needed to provide service to portions of buildings or structures not being demolished.

C. Remove refrigerant from mechanical equipment to be demolished according to the regulations of authorities having jurisdiction.

2.3 SELECTIVE DEMOLITION, GENERAL

A. Demolish, remove, and dispose of existing structures, equipment and materials as indicated. Use methods required to complete the Work within limitations of governing regulations and as described herein.

B. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction.

C. Protect existing areas from falling debris, cuttings, weld spatter and all other forms of material which could potentially cause issues with facility operations.

2.4 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from the construction site all materials and debris resulting from the demolition work.

B. Make all necessary arrangements for disposal of the materials and debris from demolition work. Fully satisfy the requirements of landowners whose property is used as disposal site(s) for material and debris removed from the project site.

C. If materials and debris removed from the project site are disposed of at a landfill meeting requirement of the Alabama Department of Environmental Management and/or a local Authority having jurisdiction, said materials shall be handled and disposed of at the landfill in accordance with the rules and regulations established by the Authorities and/or Agencies operating the landfill.

2.5 CLEANING

A. Clean all structures, buildings, and improvements as necessary to remove all dust, dirt, and debris caused by demolition work. Return said structures, buildings, and improvements to the condition which existed before demolition work was initiated.

END OF SECTION 02 41 19

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete including but not limited to, building frame members, floors, shear walls, elevator shaft walls, foundation walls, supported slabs, and footings.

B. Reinforcing Steel and Accessories.

1.02 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 302 - Guide for Concrete Floor and Slab Construction.

C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

D. ACI 305R - Hot Weather Concreting.

E. ACI 306R - Cold Weather Concreting.

F. ACI 308 - Standard Practice for Curing Concrete.

G. ACI 3 Building Code Requirements for Reinforced Concrete.

H. ANSI/ASTM D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type).

I. ANSI/ASTM D1190 - Concrete Joint Sealer, Hot-Poured Elastic Type.

J. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

K. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

L. ASTM C33 - Concrete Aggregates.

M. ASTM C94 - Ready-Mixed Concrete.

N. ASTM C150 - Portland Cement.

O. ASTM C330 - Light Weight Aggregates For Structural Concrete.

P. ASTM C494 - Chemicals Admixtures for Concrete.

Q. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

R. CRSI Manual of Standard Practice for placement of reinforcing steel.

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with these specifications and ACI 301.

B. Acquire cement and aggregate from same source for all work.

C. Conform to the requirements of these specifications and ACI 305R when concreting during hot weather.

D. Conform to the requirements of these specifications and ACI 306R when concreting during cold weather.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I.

B. Fine Aggregate: ASTM C33, natural quartz sand; sand made from crushing stone shall not be acceptable. Fine aggregates shall be graded to the following limits:

	Sieve Size	Percent Passing
1.	3/8 "	100
2.	#4	95-100
3.	#8	80-100
4.	#16	50-85
5.	#30	25-60
6.	#50	10-30
7.	#100	2-10

C. Coarse Aggregate: ASTM C33, hard, durable, dense particles of stone or gravel. Course aggregates shall be graded to the following limits except where smaller gradations are pre-approved in structural elements with congested steel.

	Sieve Size	Percent Passing
1.	1 1/2 "	100
2.	1 "	95-100
3.	1/2"	25-60
4.	#4	0-10
5.	#8	0-5

D. Water: Clean and not detrimental to concrete. No water shall be added at the job site unless approved by the ENGINEER'S representative.

2.02 ADMIXTURES

A. Chemical: When approved by the ENGINNEER, Provide admixtures certified by manufacturer to be compatible with other admixtures and that will contribute water-

soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water Reducing: ASTM C494, Type A.
2. Retarding: ASTM C494, Type B.
3. Water Reducing and Retarding: ASTM C494, Type D.
4. High Range, Water Reducing: ASTM C494, Type F.
5. High Range, Water Reducing and Retarding: ASTM C494, Type G.

B. Fly Ash: ASTM C618; Type F with a loss on ignition of 6% maximum. Maximum allowable alkalies as Na2 shall be 1.5%.

C. Air Entraining Admixture: ASTM C260.

2.03 AIR ENTRAINED CONCRETE

A. Concrete used shall be air entrained. When approved by the Engineer, concrete shall contain an admixture for controlling the setting rate. Testing shall be in accordance with ASTM Standards.

B. In general, for the course aggregate size specified above, the air content shall be 6% plus or minus 1%.

2.04 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94 and ASTM C1116. When the air temperature is between 85 and 90 degree F, reduce the maximum mixing and delivery time from 90 minutes to 75 minutes. When the air temperature is above 90 degrees F, reduce the maximum mixing and delivery time to 60 minutes.

B. Select proportions for normal weight concrete in accordance with ACI 301 2. Unless specifically indicated otherwise in the Plans, all reinforced concrete shall be Class ‘A’. Non-reinforced, buried concrete for encasements, fills, thrust blocks, etc. may be Class ‘B’.

C. Provide concrete mix Class 'A' to the following criteria:

1. Compressive Strength (28 days): 4500 psi
2. Slump: 4 to 6 inches
3. Maximum Water/Cement Ratio: 0.45
4. Minimum cementitious material 611 lb/cy

D. Use accelerating admixtures in cold weather only and/or when approved by Engineer. Use of admixtures will not relax cold weather placement requirements.

E. Use set retarding admixtures during hot weather only when approved by Engineer.

F. Fly Ash: Type F ASTM C618; 15% minimum and 25% maximum, by weight.

G. The concrete shall be furnished from only one supplier for the entire project.

2.05 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars, plain.

B. Reinforcing Steel Mat: ASTM A615, 60 ksi yield grade; steel bars or rods, plain finish.

C. Stirrup Steel: ANSI/ASTM A82, plain.

D. Welded Steel Wire Fabric: ASTM A497 Welded Deformed Type; in flat sheets or rolls; plain finish.

2.06 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify all site conditions affecting the proposed work.

B. Verify requirements for concrete cover over reinforcement.

C. Verify that anchors, seats, plates, reinforcement, pipes, conduits, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.02 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. Subgrade and/or surface to be poured against shall be thoroughly wetted by sprinkling, free of sawdust, debris, water, ice, snow, frozen material, extraneous oil, mortar or any other materials that may be deleterious to the concrete.

C. Earth surfaces shall be firm and damp.

D. Do not place Class A concrete on mud, dried earth, uncompacted fill, or frozen subgrade.

E. Any flow of water into or through the forms shall be diverted through proper side drains into a sump or removed by other approved methods which will prevent washing the freshly deposited concrete.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 304.

B. Notify Engineer minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed joint fillers, joint devices and

conduit are not disturbed during concrete placement.

D. Do not interrupt successive placement; do not permit cold joints to occur.

3.04 PUMPING OF CONCRETE

A. General: 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.

B. Pumping Equipment: The pumping equipment must have 2 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.

C. The minimum diameter of the hose (conduits) shall be 4-inches.

D. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

E. Aluminum conduits for conveying the concrete will not be permitted.

F. Proportioning: Minimum compressive strength, cement content, and maximum size of aggregates shall be as specified herein.

G. Water and slump requirements shall conform to the requirements of this Section.

H. Cement and admixtures shall conform to the requirements of this Section.

I. Field Control: Concrete samples for slump per ASTM C 143 and test cylinders per ASTM C 31 and C 39.

3.05 PLACING CONCRETE IN HOT AND COLD WEATHER

A. Comply with ACI 306.1 and ACI 301 noting the following.

B. Concrete, when placed in forms, shall have a temperature greater than 50 degrees F and less than 90 degrees F.

C. Concrete shall not be poured until the ambient temperature is 40 degrees F and rising, as measured at the Engineer's trailer at the job site.

D. When the temperature is between 35degrees F and 50 degrees F, the Contractor shall take measures that may include insulation of the poured concrete structure, protective covers and heat sources capable of maintaining temperature of the poured structure at 50 degrees F for the time period specified below.

E. The protective covers and heat services shall be maintained before the pour and a minimum of seventy-two (72) hours after the pour as agreed upon with the ENGINEER.

3.06 EQUIPMENT BASES AND SUPPORTS

A. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

END OF SECTION 03 30 00

SECTION 03 94 00 - CONCRETE SAWING AND CORING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Concrete Sawing
2. Concrete Coring

1.2 SUBMITTALS

A. Include Material Safety Data Sheets, if applicable

B. Shop Drawings: For temporary shoring and supports, prepared by or under the supervision of a qualified professional engineer. Design and engineering of temporary shoring and supports are Contractor's responsibility. Indicate proposed schedule and sequence for removal of temporary shoring and supports.

C. Qualification Data: For installers, professional engineer, and testing agency to demonstrate their capabilities and experience.

1.3 QUALITY ASSURANCE

A. Cutting Contractor Qualifications: In addition to other requirements in Division 1 Section "Quality Requirements," retain cutting contractors that are licensed professionals.

B. Cutting Contractor shall adhere to applicable safety guidelines in accordance with Federal, State, and Local Ordinances.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Notify Engineer seven days in advance of dates when areas of sawing or coring concrete and reinforcing bars will be located.

B. Mark areas of concrete for removal.

2.2 PREPARATION

A. Temporary Support and shoring: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting or coring operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Sawing Area: Lay out area to be cut using a color that does not conflict with color representing other utilities. Spray marking with a clear coat.

E. Coring Area: Lay out area to be cored using a color that does not conflict with color representing other utilities. Spray marking with a clear coat.

F. Over-cut: All cuts shall be within the perimeter of the area to be removed. Approval for any over-cut shall be given by the Engineer prior to any cutting.

2.3 PERFORMANCE

A. General: Employ skilled workers to perform sawing and coring. Proceed with sawing and coring at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
2. Avoid existing utilities located in areas to be cut.
3. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting operations.
4. Utilities: Locate and turn off all services within the work area.

B. Sawing: Cut existing construction by sawing using methods least likely to damage elements retained or adjoining construction.

1. In general, use hand or small power tools designed for sawing. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Tools: Gas operated saws will only be permitted for use in the outdoors.
3. Concrete Masonry: Cut using a cutting machine, such as an abrasive saw.
4. Use water or a lubricant to cool the saw blades.

C. Coring: Core existing construction by using coring methods least likely to damage elements retained or adjoining construction.

1. Drill holes over 1 inch in diameter with a non-impact rotary tool in order to minimize spalling at the exit point.
2. Use diamond-core drill bits of the proper size.
3. Use rotary tools that operate below OSHA noise standards.
4. Use water or a lubricant to cool the drill bits.
5. Hole diameter requirements

a. For Installation of Ductile Iron Pipe:

Pipe Size (nominal inches)	Inside Diameter (inches)
2	4
4	8
6	10
8	12
10	14
12	18
14	20
16	22
18	24
24	30
30	36
36	43
42	49
48	56

b. Diameter of the cored hole shall be as indicated by the following:

1) Sizing Charts for Standard Pipe - LINK-SEAL

6. Sealing:

a. Install a watertight seal between the pipe and the cored hole.
b. Seal shall be LINK-SEAL or approved equivalent.

D. Clean-up:

1. Wash or vacuum slurry or tailings generated from [coring][sawing] operations to remove them from the work area. Slurry and tailing shall be disposed of in a location approved by the Engineer.

2. Collect, treat, and dispose of water used in [coring][sawing] operations.

3. Thoroughly clean removal areas of loose concrete, dust, and debris.

PART 3 - EXECUTION – NOT USED

END OF SECTION 03 94 00

SECTION 09 90 00 - PAINTING AND COATING

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. This specification covers preparation of surfaces, performance, and completion of painting of all surfaces as required by the drawings and as specified herein.

B. All Materials delivered to job site shall be in original sealed and labeled containers of the paint manufacture.

1.02 SUBMITTALS

A. Product Data, Samples, and Painting Schedule.

1.03 REFERENCES

A. ANSI/NSF 61 Drinking Water System Components – Health Effects

B. ASTM D 16 Terminology Relating to Paint, Varnish, Lacquer, and related Products

C. AWWA D102 Coating Steel Water-Storage Tanks

D. NACE SPO 188 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

E. SSPC Society of Protective Coatings

1.04 DEFINITIONS

A. Terms used in this Section:
1. Definition of Painting Terms: ASTM D16, unless otherwise specified
2. DFT – Dry Film Thickness
3. Mils – Thousandth of an inch
4. VOC – Volatile Organic Compounds
5. SP – Surface Preparation

1.05 ENVIRONMENTAL CONDITIONS

A. Coatings shall be applied during good painting weather. Air and surface temperatures shall be within limits prescribed by the manufacture for the coating being applied and work areas shall be reasonably free of airborne dust at the time of application and while coating is drying.

1.06 ENVIRONMENTAL REGULATIONS

A. All materials specified herein meet the current VOC Regulations and National AIM Regulations in effect. Shop applied materials to meet current HAPS requirements.

B. All products in contact with potable water must be certified by ANSI/NSF to Standard 61.

1.07 QUALITY ASSURANCE

A. Certification Requirements:
   1. All coatings shall conform to OSHA requirements for allowable exposure to lead and other hazardous substances.
   2. All coatings in contact with potable water or within potable water reservoirs shall be certified according to NSF Std. 61.

B. Product Manufacturer:
   1. Manufacturer shall be a company that specializes in producing high quality industrial coating materials. This company shall have 10 years or more experience demonstrated by case histories in the designated field of application.

C. Applicator Qualifications:
   1. Engage an experienced applicator with 5 years or more experience that has successfully completed coating system applications similar in material and extent to those indicated.

D. Single Source Responsibility:
   1. Provide coating material and thinners produced by the same manufacturer for each system on all surfaces of the tank.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Material shall be delivered to the site in original containers with labels intact and seals unbroken. Labels should provide the following information: material name, coating manufacturer, color name and number, batch or lot number, date of manufacture, mixing and thinning instructions.

B. All coatings shall be stored in an enclosed structure to protect them from weather and excessive heat or cold. Flammable coatings must be stored to conform to City, County, State and Federal safety codes for flammable coatings or paint materials. At all times coatings shall be protected from freezing.

C. All empty containers shall be disposed of in accordance with local, state and federal regulations.

1.09 PROJECT/SITE CONDITIONS

A. Climate:
   1. No paint shall be applied when the air or surface temperature, as measured in the shade, is below that which is recommended by the manufacturer. Paint shall not be applied to wet or damp surfaces, and shall not be applied in rain, snow, fog, mist, or when the surface temperature will be less than 5 F above the dew point. No paint shall be applied when it is expected that the surface temperature will drop below the manufacturer's recommendation within 2 - 4 hours after the application of the paint. Dew or moisture condensation should be anticipated, and if such conditions are

prevalent, painting shall be delayed until it is certain that the surfaces are dry. In addition, the days painting shall be completed well in advance of the probable time of day when moisture condensation will occur in order to permit the film the required drying time as specified by the manufacturer prior to the formation of moisture.

B. Dust and Contaminants:

1. Schedule coating work to avoid excessive dust and airborne contaminants. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.10 GUARANTEE

A. The contractor shall guarantee his work for a period of one year to the extent that he shall repair any defects due to faulty workmanship or materials which may appear on the structure during this period.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Products:
1. Induron Coatings
2. TNEMEC Co., Inc

B. Colors shall be as selected by the engineer. All colors shall be certified lead free.

C. Thinning, Mixing, and Tinting:
1. Where thinning is necessary, only the products of the manufacturer furnishing the coating will be allowed. All thinning shall be done in strict accordance with the coating manufacturer's recommendations.
2. Mix in accordance to the manufacturer's recommendations.
3. Each coat shall be slightly different in shade than the preceding coat, unless otherwise noted.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Prepare surfaces in accordance with coating system's specifications. Touch up welds, burned and abraded areas with specified primer before applying field coats.

B. Ensure surfaces are dry.

C. Prior to field touch up of shop primed steel, all surfaces shall be cleaned to remove all surface contamination including oil, grease, dust, dirt and foreign matter. All rusted, abraded, and unpainted areas shall be prepared to specified surface preparation before primer is applied.

D. Allow each coat to dry thoroughly before applying next coat.

E. Finish coats shall be uniform in color and sheen without streaks, laps, runs, sags, or missed areas. Primer and finish coats shall be furnished from the same Manufacturer to ensure compatibility.

3.02 SURFACES NOT SCHEDULED TO BE COATED

A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.03 APPLICATION

A. Materials shall be mixed, thinned, and applied according to the manufacturer's printed instructions and in accordance with AWWA D 102.

B. Abrasive blast cleaned surfaces shall be coated the same day as the cleaning is performed. If rust or contamination appears as a result of delay in primer application, the surface shall be cleaned to specified surface preparation before primer is applied.

C. Apply coatings in accordance with coating manufacturer’s instructions.

D. Keep containers closed when not in use to avoid contamination.

E. Do not use mixed coatings beyond pot life limits.

F. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer’s instructions.

G. After sufficient cure of the field prime coat, apply a stripe coat to the interior wet areas with a brush to critical locations on steel such as welds, corners, and edges using specified intermediate coat.

H. Uniformly apply coatings at spreading rate required to achieve specified DFT.

I. Apply coatings to be free of film defects that would adversely affect performance of the coating system. Apply exterior coatings to be free of characteristics or defect that adversely affect appearance.

3.04 REPAIR

A. Damaged Materials: Repair or replace damaged materials and surfaces not scheduled to be coated.

B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where the result is not visibly different from adjacent surfaces.

C. Coating Defects: Repair in accordance with coating manufacturer’s instructions coatings

that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.05 ACCEPTANCE OF WORK

A. All Surface Preparation and repairs shall be approved by the engineer/owner before primer is applied.

B. Request acceptance of each coat before applying next coat.

C. Correct work that is not acceptable and request re-inspection.

3.06 SYSTEM INSPECTION AND TESTING

A. After application of each coating in the specified system and its surface has cured, measure its thickness with a properly calibrated Nordson Microtest Dry Film Thickness Gauge, or equivalent. Follow standard method for measurement of dry paint thickness with magnetic gauges as outlined in The Society of Protective Coating's SSPC PA2.

B. Make as many determinations as needed to ensure the specified thickness values in each typical area. To all surfaces having less dry film thickness than specified, apply additional coat(s) at no extra cost to Owner to bring thickness up to specifications.

C. Painting contractor shall permit Owner's Representative and/or paint & coating manufacturer (as requested by owner) to inspect his work for conformance to this specification. Owner reserves the right to reject all work that does not comply with this specification.

3.07 CLEANUP

A. Remove and dispose of all rubbish or other unsightly material, in a legal manner, leaving the premises in a clean condition.

3.08 INDURON PAINTING SCHEDULE

A. Ductile Iron Pipe
   1. Exterior Exposed
      a. Surface Preparation – Surface shall be clean and dry. Surface prep in accordance with NAPF 500-03
      b. Shop Prime – PermaClean II Epoxy at 4 – 6 mils DFT
      c. Finish – Indurethane at 2 – 3 mils DFT
   2. Located in Valve or Meter Pits
      a. Surface Preparation – Surface shall be clean and dry. Surface prep in accordance with NAPF 500-03
      b. Shop Prime – PermaClean II Epoxy at 4 – 6 mils DFT
      c. Finish – PermaClean II Epoxy at 4 – 6 mils DFT
   3. Located in Wetwell (Wastewater exposure)
      a. Surface Preparation – Surface shall be clean and dry. NAPF 500-03-04 External Pipe Surface Condition
      b. Shop Finish – Ceramawrap at 20 – 25 mils DFT

c. Field Touch-Up – Cermawrap Field Kit

4. Interior (Between pump and check valve)
   a. Surface Preparation – NAPF-500-03-04 Internal Pipe Surface Condition: Removal of annealing layer
   b. Shop Finish – Ceramapure PL90 at 40 mils DFT

B. Miscellaneous Metals
1. Exterior Exposed
   a. Surface Preparation – SSPC SP 3
   b. Field Prime – PermaClean II Epoxy at 4 – 6 mils DFT
   c. Finish – Indurethane 6600 at 2 – 3 mils DFT
2. Located in Valve or Meter Pits
   a. Surface Preparation – SSPC SP 3
   b. Field Prime – PermaClean II Epoxy at 4 – 6 mils DFT
   c. Finish – PermaClean II Epoxy at 4 – 6 mils DFT
3. Located in Wetwell (Wastewater exposure)
   a. Surface Preparation – SSPC SP 10
   b. Shop Prime – PermaClean II Epoxy at 4 – 6 mils DFT
   c. Finish – Ceramasafe 90 Ceramic Epoxy at 25 – 35 mils DFT

C. Porous Masonry
1. CMU Interior
   a. Surface Preparation: Surface shall be clean and dry. Stone rub to remove loose and small particles from surface.
   b. 1st Coat: Polyfill Epoxy Block Filler at 60 - 80 square foot per gallon.
   c. 2nd Coat: PermaClean II Epoxy at 4 - 6 mils DFT.

3.09 TNEMEC PAINTING SCHEDULE

A. Ductile Iron Pipe
1. Exterior Exposed
   a. Surface Preparation – Surface shall be clean and dry. Surface prep in accordance with NAPF 500-03
   b. Shop Prime – Series N140 at 4 – 6 mils DFT
   c. Finish – Series 1047U at 2 – 4 mils DFT
2. Located in Valve or Meter Pits
   a. Surface Preparation – Surface shall be clean and dry. Surface prep in accordance with NAPF 500-03
   b. Shop Prime – Series N140 at 4 – 6 mils DFT
   c. Finish – Series 66 at 4 – 6 mils DFT
3. Located in Wetwell (Wastewater exposure)
   a. Surface Preparation – Surface shall be clean and dry. NAPF 500-03-04 External Pipe Surface Condition
   b. Shop Prime – Series N140 at 4 – 6 mils DFT
   c. Shop Finish – Series 431 at 25 – 35 mils DFT
   d. Field Touch-Up – Series 435 at 25 – 35 mils DFT
4. Interior (Between pump and check valve)
   a. Surface Preparation – NAPF-500-03-04 Internal Pipe Surface Condition: Removal of annealing layer

b. Shop Finish – Series 431 at 40 mils DFT

B. Miscellaneous Metals
1. Exterior Exposed
a. Surface Preparation – SSPC SP 3
b. Field Prime – Series 135 at 4 – 6 mils DFT
c. Finish – Series 1047U at 2 – 4 mils DFT
2. Located in Valve or Meter Pits
a. Surface Preparation – SSPC SP 3
b. Field Prime – Series 135 at 4 – 6 mils DFT
c. Finish – Series 66 at 4 – 6 mils DFT
3. Located in Wetwell (Wastewater exposure)
a. Surface Preparation – SSPC SP 10
b. Shop Prime – Series N140 at 4 – 6 mils DFT
c. Finish – Series 435 at 25 – 35 mils DFT

C. Porous Masonry
1. CMU Interior
a. Surface Preparation: Surface shall be clean and dry. Stone rub to remove loose and small particles from surface.
b. 1st Coat: Series 130 Envirofill at 60 - 80 square foot per gallon.
c. 2nd Coat: Series 66 HS Hi Build Epoxoline at 4 - 6 mils DFT.

3.10 COLORS

A. Colors: All colors shall be as selected by the Owner.

END OF SECTION 09 90 00

DIVISION 26/27
ELECTRICAL

2/22/2023

SECTION 26 05 00 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Conditions:

1. The accompanying General Conditions (front-end specifications) shall apply to and form a part of this section.

B. General Requirements:

1. Carefully examine General Conditions, other specification sections, and other drawings (in addition to Electrical) in order to be fully acquainted with their effect on electrical work.
2. Do all work in compliance with all applicable codes, laws, and ordinances, the National Electrical Safety Code, the National Electrical Code (hereinafter referred to as "Code"), applicable energy codes, and the regulations of the local utility companies. Obtain and pay for any and all required permits, inspections, certificates of inspections and approval, and the like.
3. Cooperate with other trades and contractors at job. Perform work in such manner and at such times as not to delay work of other trades. Complete all work as soon as the structure and installations of equipment will permit. Patch, in a satisfactory manner and by the proper craft, any work damaged by electrical workmen.
4. The Owner shall be provided access to all software to include copies of software for all systems provided under this division of the specifications. Software shall be password protected where applicable.
5. Only qualified electrical sub-contractors will be allowed to submit proposals for this project. In order to be considered qualified, contractor shall have completed a minimum of five (5) projects of similar type/scope and equal or greater magnitude and complexity within the last ten (10) years. Sub-contractors without qualifications will be rejected. If desired, potential electrical sub-contractors may submit qualification evidence for review and pre-bid approval a minimum of ten (10) days prior to bid. Previous projects used to meet this experience requirement must have included similar (or greater) scopes of work for each of the following areas:
   a. Power Systems.
   b. Control Systems.
   c. Instrumentation Systems.
6. Electrical contracting firm shall be licensed as an electrical contractor in the state where work will be performed

1.2 GENERAL SCOPE OF ELECTRICAL WORK (REFER TO DRAWINGS FOR OTHER SPECIFIC SCOPE ITEMS)

A. Furnish all labor and materials to complete electrical work as shown on drawings and/or herein specified.

B. Remove all existing electrical equipment and wiring made obsolete by this project and remove or relocate all electrical services located on or crossing through the project property, either above or below grade, which would obstruct the construction of the project or conflict in any manner with the completed project or any code pertaining thereto. Dispose of salvageable materials as directed by the Engineer. Contractor shall schedule meeting to review scope of electrical demolition and to confirm scope and phasing of proposed demolition with the owner in the presence of the prime consultant prior to start of any electrical demolition.

C. Furnish and install complete power, telephone and other electrical services as shown on drawings and/or specified herein.

D. Pay all electrical utility company service charges (if any) in connection therewith, including permanent meter deposit. Meter deposits will be refunded to Contractor at time of Owner's acceptance.

E. Furnish and install complete power distribution system as shown on drawings and/or specified herein.

F. Furnish and install disconnect switches for motors as shown on drawings and/or specified herein.

G. Furnish and install complete electrical grounding systems as shown on drawings and/or specified herein.

H. Install and connect electrical equipment mentioned in Division 26/27/28 Specifications or noted in drawings, whether furnished by electrical contractor or by others.
   1. Where shown or specified, equipment furnished by others shall be installed and connected under this Contract.
   2. Where shown or specified, Contractor shall receive, unpack, check and assume custody of equipment furnished by Others. Contractor shall assume responsibility for care and safekeeping of this equipment, when delivered into his custody. He shall protect it from moisture, dust and damage during construction and until Owner acceptance of project.

I. Furnish and install complete electrical lighting systems as shown on drawings and/or specified herein.

J. Furnish and install all electrical items shown on drawings and/or herein specified, unless shown or specified otherwise.

K. Furnish and install complete controls, instrumentation & auxiliary systems as shown on drawings and/or specified herein.

L. Procure and pay for permits and certificates as required by local and state ordinances and fire underwriter's certificate of inspection.

M. Balance loads as equally as practicable on services, distribution feeders, circuits and buses. Provide typewritten directory for each panel.

N. Unless specifically indicated or required otherwise, terminate all circuitry/cabling provided within this contract at associated equipment/devices/etc. in accordance with all applicable codes, standards and supplier requirements, whether associated equipment/device/etc. is furnished within this contract or by others.

O. Complete field testing, adjustment & startup of all systems listed above as shown on drawings and/or specified herein.

PART 2 - PRODUCTS

2.1 APPROVED MATERIALS AND DEVICES

A. Where not otherwise specified, provide only new, standard, first-grade materials/systems

throughout, conforming to standards established by Underwriter's Laboratories, Inc., and so marked or labeled, together with manufacturer's brand or trademark. All equipment/systems subject to approval of Engineer before installation. All like items and associated equipment/systems shall be of one manufacturer.

B. To ensure proper coordination, it is intended that all electrical equipment and materials specified in Division 26/27/28 of these specifications and shown on the electrical drawings be furnished and installed by the electrical sub-contractor. It will not be permissible for any of these items to be furnished directly by the general contractor without the electrical contractor's coordination.

C. To ensure commonality of spare parts, it is required that the electrical contractor provide the same brand for all circuit breakers, starters, power equipment, etc. provided under the following divisions of these specifications:

2.2 SUBMITTALS

A. All submittals to the design team shall be accompanied by a letter summarizing all proposed deviations from specified products or pre-approved substitutions. The absence of such a letter shall be understood to indicate that the contractor intends to meet all contract requirements, regardless of cut-sheets/data-sheets provided within the submittal.

B. Submit to Engineer ten (10) days prior to bid date three (3) copies of any items and/or manufacturers which are proposed as substitutes for those specified.

C. Submit to Engineer promptly after award of Contract and prior to purchasing, the number of copies required by the contract. All drawings of a specific item or system shall be made in one submittal, and within thirty (30) days after award of Contract. Shop drawings of all power equipment shall contain exact details of device placement, phasing and numbering, in form of elevations, for each major piece of equipment. Shop drawings shall be submitted on the following:
   1. SECTION 26 28 16: SAFETY SWITCHES AND FUSES
   2. SECTION 26 29 00: MANUFACTURED CONTROL PANELS
   3. SECTION 26 32 13: GENERATOR SETS
   4. SECTION 26 36 23: AUTOMATIC TRANSFER SWITCHES
   5. SECTION 26 50 00: LIGHTING MATERIALS AND METHODS
   6. ALL POWER DISTRIBUTION EQUIPMENT (i.e. SWITCHBOARDS, PANELBOARDS, DRY TYPE TRANSFORMER, ETC.)
   7. ALL ELECTRICAL AND TELECOMMUNICATION EQUIPMENT LAYOUTS - Submittals shall include ¼" = 1'-0" CAD drawings (hand drawn sketches will not be accepted) of each electrical room, IT room, electrical equipment stand, generator area, or any other similar area with electrical equipment. Drawings shall indicate all panelboards, transformers, switchboards, generators, equipment racks, control panels, HVAC equipment, etc. that are located in each electrical/IT area. Layouts shall show that each piece of electrical equipment has the clearances, working space and dedicated equipment space required by applicable codes. No conduits to equipment within these areas shall be installed until submittals have been provided and returned without exception by the design team.
   8. ALL CONTROL ITEMS & SYSTEMS

D. The contractor shall fully review, comment upon and correct all shop drawings as required to assure compliance with contract documents prior to submittal to Engineer. The failure of the contractor to properly review and correct shop drawings prior to submittal will result in rejection of shop drawings by the engineer. Review by the Engineer will be for general conformance with

contract documents. The contractor shall be fully responsible for correctness of all submitted dimensions, details, quantities and locations.

E. None of the above items shall be installed until shop drawings or catalog data have been reviewed by Engineer without rejection or required resubmittal. Any listed item not submitted, even if specified, shall be considered not acceptable and shall be removed if directed.

F. Any required resubmittal will be reviewed by the Engineer for conformance with previously issued comments only. The contractor shall be responsible for verifying that all items not specifically requiring resubmittal have not been altered from the previously reviewed submittal.

G. Material proposed for substitution shall be of the same quality, perform the same functions, conform to such physical dimensions and appearance as are required by the Engineer. All material proposed for substitution is subject to the approval of the Engineer and his authority for approval is final. No material proposed for substitution will be considered unless all submittal data complies with the drawings and specifications of Section 16 as to time of submission, number of copies of submittal, and detail requirements.

H. Samples of material shall be furnished where required by drawings or Division 26/27/28 Specification, or as requested by the Engineer on items proposed as substitutes.

I. Submit to Engineer a certificate of final inspection from local inspection department.

PART 3 - EXECUTION

3.1 SITE VISIT

A. The Contractor shall visit the site to determine existing dimensions and conditions affecting electrical work. Failure to do so in no way relieves Contractor of his responsibility under Contract.

3.2 CLEARANCE WITH UTILITIES

A. It shall be the responsibility of this Contractor, prior to bid, to reaffirm with the utility companies involved, that the locations, arrangement (and with power company voltage, phase, and metering required) and connections to utility service are in accordance with their regulations and requirements. If their requirements are at variance with these drawings and specifications, the Contract price shall include any additional cost necessary to meet those requirements without extra cost to Owner after a contract is entered into.

B. On many projects the utility company may levy charges due to locations, size or type service involved. The Contractor shall be responsible for these charges (including permanent meter deposit), unless such charges are not available prior to bid and Contractor so documents as described below. The meter deposit will be refunded to the contractor at time of Owner's acceptance.

C. Should above cost not be available, prior to bid, Contractor must submit a letter signed by a responsible utility company person so stating with his bid and in turn must be submitted by Prime Contractor with his bid to Owner. The cost will then be deleted from the Contract and become responsibility of the Owner.

D. Arrange with utility companies for such services as shown or herein specified and installation of meter where shown. Furnish with shop drawings a signed document from utility companies describing the location and type of services to be furnished and any requirements they may have. This document shall be signed for each utility company by a person responsible for granting such

service.

3.3 WORKMANSHIP

A. All work shall be in accordance with the latest editions of NFPA 70 (National Electrical Code), NFPA 101 (Life Safety Code), National Electric Safety Code, International Building Code, applicable NECA standards and the rules and regulations of State and Local Authorities Having Jurisdiction.
B. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance upon completion.
C. All equipment, devices, etc. shall be installed in accordance with manufacturer's recommendations.
D. All items shall be installed straight and plumb in a workmanlike manner and care shall be exercised so that like items are mounted the same position, heights and general location.
E. Keep site clean of accumulation of cartons, trash and debris.

3.4 SAFETY

A. The contractor is solely responsible for all job safety. Engineer assumes no responsibility for job safety. Maximum consideration shall be given to job safety and only such methods as will reasonably insure the safety of all persons shall be employed. The codes and regulations of OSHA shall be given strict compliance as well as such other codes, laws, and regulations as may be applicable.

3.5 CONTRACT DOCUMENTS

A. Contract documents indicate diagrammatically, extent, general character and approximate location of work. Where work is indicated but minor details omitted, furnish and install it complete so as to perform its intended functions. For details and mechanical equipment, follow drawings provided by other disciplines (Architectural, Mechanical, Structural, Civil, etc.) and fit electrical work thereto.
B. Contract documents consist only of the hardcopy documents issued by the Prime Engineer. Electronic documents issued directly by the electrical engineer to the contractor and/or its sub-contractors/vendors are issued for convenience only (electronic documents are not formal contract documents).
C. If the contractor and/or one of its suppliers require a one-time transfer of electronic files of the current electrical construction documents to prepare shop drawings (or for another similar purpose), it shall:
    1. Sign a waiver prepared by the electrical engineer prior to the transmittal of these files.
    2. Agree to pay the electrical engineer a fee of $50.00 per drawing, up to a maximum of $400 per transfer, payable upon receipt of the files.
    3. To the fullest extent permitted by law, indemnify, hold harmless, and defend JRA from all claims, damages, losses and expenses, including attorneys' fees arising out of or resulting from the use of the CAD files.
D. Take finish dimensions at job in preference to scaled dimensions.
E. Except as above noted, make no changes in or deviations from work as shown or specified except on written order of Engineer.

3.6 UNDERGROUND UTILITY/EQUIPMENT COORDINATION

A. Prior to commencement of work, verify exact locations of all existing or proposed underground utilities and/or underground equipment and verify that proposed electrical installation does not

conflict with these items. Notify Engineer immediately if any conflict is found.

3.7 EQUIPMENT STORAGE

A. Store all electrical equipment in dry, covered locations as directed by equipment manufacturers. Contractor shall be responsible for replacing or repairing improperly-storted equipment as directed by Engineer.

3.8 EXCAVATION, CUTTING AND PATCHING

A. Perform all cutting and excavating as necessary for installation of electrical systems, unless specifically covered under another section. After Engineer's observation, complete all excavation, filling and backfilling as directed under specifications for preparation of site and earthwork. Foundations for equipment shall be as specified under concrete section. Concrete pads shall be minimum of 6" thick; unless greater thickness required by equipment manufacturer. Obtain specific approval of Engineer before cutting into any structural members.

B. For all such work employ competent workmen, and finish up in neat and workmanlike manner, equal to quality and appearance to adjacent work.

3.9 PENETRATIONS

A. All penetrations in water tight barriers shall be made so that barrier rating is not compromised. Furnish roof flashing for all equipment installed under Division 26/27/28 that penetrates through the roof. Appropriate flashing is specified under roofing and sheet metal section. Supply these flashings for installation under roofing and sheet metal section.

B. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly to maintain the fire/smoke rating of the associated membrane.

C. Where penetrations are required through structural elements, verify penetration locations and sizes with structural engineer. In no case shall the structural integrity be compromised without written approval from structural engineer.

3.10 INSTALLATION OF EQUIPMENT - GENERAL

A. Care shall be exercised in exact routing and location of all items so as not to obstruct access to equipment, personnel walkways, or expose it to potential mechanical damage.

B. Items shall be securely anchored and/or fastened. Provide proper support for all equipment, devices, conduits, boxes, panels, etc. as required by code and for a workmanlike installation. Provide guy wiring for wood poles where required to prevent leaning. All construction shall meet the seismic design requirements of the building code. Items (especially transformers, light fixtures, equipment racks, freestanding gear, etc.) installed in seismic zones C, D, E or F shall be supported and braced per applicable codes and standards.

C. All wall, pole or frame-mounted electrical equipment shall be mounted to metal unistrut (or similar) frames of same material as electrical equipment. For example, pole-mounted stainless steel disconnect switches shall be mounted to stainless steel unistrut frames.

D. All electrical equipment, furnished by Contractor or by others shall be covered and protected during construction.

E. All control cabinets, panels, motor control centers and other electrical cabinets and enclosures shall have all trash removed and be vacuumed clean. All foreign paint, etc., shall be removed from exterior and all scratches in finish touched up with same color and material as original. Any rusted areas shall be sanded, primed and repainted.

F. All relays, starters, push-button and other control devices shall be cleaned and if necessary,

lubricated with CRC 2-26 to assure free operation.

3.11 MOTORS, STARTERS AND CONTROLS

A. Unless otherwise specified or shown, all motors will be furnished and installed under other sections of this specification.

B. Electrical Contractor shall install all starters and all electrical power wiring and connections to motors and starters.

C. Unless otherwise specified or shown, all control items for motors shall be furnished, installed and wired in conduit by the electrician.

3.12 CIRCUITS AND BRANCH CIRCUITS

A. Outlets shall be connected to branch circuits as indicated on drawings by circuit numbers. No more outlets than are indicated shall be connected to a circuit.

B. Branch circuit homeruns shall be installed as shown on drawings. Multiple homerun conduits shall not be combined by contractor into larger, single homerun conduits unless specific permission is granted by the Engineer.

3.13 LUG/TERMINAL RATINGS

A. All lug/terminal ratings, sizes, locations, types, etc. shall be coordinated with the associated conductor sizes, types, routings, etc. by the contractor.

B. All lugs/terminals/etc. shall be rated for 75 degree C terminations (minimum, unless specified otherwise).

3.14 EQUIPMENT FAULT CURRENT RATINGS

A. All equipment and breakers shall meet the minimum RMS symmetrical interrupting capacity ratings shown on plans for the associated distribution equipment. All interrupting ratings shall be full ratings. Where new devices or breakers are added to existing distribution equipment, the new devices/breakers shall have interrupting ratings matching or exceeding that of the existing distribution equipment.

3.15 OUTLET LOCATION

A. Symbols shown on drawings and mounting heights indicated on drawings and in specifications are approximate only. The exact locations and mounting height must be determined on the job and it shall be the Contractor's responsibility to coordinate with other trades to insure correct installation.

3.16 IDENTIFICATION

A. Each panel shall have each circuit identified. Panels without branch circuit nameplates shall have typewritten directories.

B. Each individually mounted switch, circuit breaker, starter and/or any other control or protective device shall identify equipment fed and fuse size, if any, by engraved plastic nameplate, white with black letters, screw attached.

C. See Specification Section 26 05 53 for additional requirements.

3.17 GROUNDING

A. All equipment shall be grounded and bonded in accordance with all state/local regulations, The National Electrical Code and as specified herein.

3.18 PAINTING

A. Refer to Painting/Finishing specifications for requirements regarding field painting of exposed conduit. Any scratches, dents or rust spots in conduit electrical enclosures, panels, motor control or any other electrical items shall have the dents removed, and they, along with any rust spots or scratches, sanded and touched up with the same exact color paint as original finish.

3.19 ACCEPTANCE TESTING

A. Upon completion of work, the entire electrical system installed within this project shall be tested and shall be shown to be in perfect working condition, in accordance with the intent of the specifications and drawings. It shall be the responsibility of the Electrical Contractor to have all systems ready for operation and to have an electrician available to operate same in accordance with and under the supervision of the observation representative(s) of the Engineer. The Electrician shall be available to assist in removal of panel fronts, etc., to permit inspection as required.

B. The electrical sub-contractor shall include in bid price start-up assistance and training from a certified representative of the manufacturer for the following systems:

3.20 OPERATION AND MAINTENANCE DATA

A. One set of marked “AS BUILT” drawings, three (3) sets of all equipment catalog and maintenance data and three (3) sets of all final shop drawings, on all equipment requiring same shall be turned over to owner. These items shall be bound in hard back book. Contractor shall explain and demonstrate all systems to Owner’s representative.

3.21 GUARANTY-WARRANTY

A. Furnish a written Guarantee-Warranty, countersigned and guaranteed by General Contractor, stating:
   1. That all work executed under this section will be free from defects of workmanship and materials for a period of one (1) year from date of final acceptance of this work.
   2. Above parties further agree that they will, at their own expense, repair and replace all such defective work, and all other work damaged thereby, which becomes defective during the term of the Guaranty-Warranty.

END OF SECTION 26 05 00

SECTION 26 05 19 – POWER CONDUCTORS AND CABLES 51V-600V

PART 1 - GENERAL

1.1 DESCRIPTION

A. Power Wires and Cables

B. Low Voltage Wires and Cables

PART 2 - PRODUCTS

2.1 POWER WIRES AND CABLES - 600 VOLT

A. General: Conductors shall have current carrying capacities as per N.E.C. and with 600 volt insulation, #12 minimum except for controls and fixture wire. Conductors shall be copper.

B. General Application (see below for exceptions):
   1. At or Below Grade (including within slab-on-grade):
      a. #8 or larger conductors:
         1) XHHW or RHH/RHW/USE stranded (in conduit).
      b. #10 or smaller conductors for circuits terminating at motors:
         1) THHN/THWN or XHHW stranded (in conduit).
      c. #10 or smaller conductors (excluding circuits terminating at motors):
         1) THHN/THWN or XHHW stranded (in conduit).
   2. Above Grade:
      a. #8 or larger conductors:
         1) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
      b. #10 or smaller conductors for circuits terminating at motors:
         1) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
      c. #10 or smaller conductors (excluding circuits terminating at motors):
         1) THHN/THWN, XHHW or RHH/RHW/USE stranded (in conduit).
   3. Power Wire and cable shall be as manufactured by Southwire, Rome, Encore Wire, American Insulated Wire, Okonite, Phelps-Dodge, Amercable, Aetna or approved equal.

C. Class 1 Control Cabling (120VAC Control Circuits, Etc.)
   1. Unless specified otherwise, Class 1 control cabling shall:
      a. Be rated for exposed cable tray installation.
      b. Be plenum rated (Class 1 Control cabling and Instrumentation cabling installed in conduit or exposed in cable tray in non-plenum areas is not required to be plenum-rated).
      c. Be UL-rated for the proposed application.
      d. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation. Conductors with green insulation shall not be used for conductors other than ground.
      e. Utilize copper conductors.
      f. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
      g. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
      h. Where required for specific systems, meet the specific requirements (conductor

quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.

i. Be rated for 600V.
j. Be industrial grade.
k. Have stranded conductors.
l. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.

2. Control cabling shall be as manufactured by Belden, AlphaWire or General Cable.

2.2 WIRE CONNECTIONS:

A. All connector types:
   1. Shall be properly rated for the proposed application by UL and per the manufacturer.
B. At Motor Connections (within motor terminal boxes):
   1. On Unshielded Wire:
      a. Single conductor per phase: shall be made with insulated set screw connectors or 3M 5300 Series 1kV Motor Lead Connections kits with mechanical lugs as required.
      b. Multiple conductors per phase: shall be made with insulated mechanical lugs, rated for the associated motor cable types, by Polaris or Ilsco.
   2. On Shielded Power Wire:
      a. The braided shields and internal grounding conductors of shielded power (not instrumentation) cables shall be grounded at BOTH ends (at VFD/starter and at motor) with a termination kit provided by the cable supplier. This termination kit shall include a connection ring that makes contact around the full circumference of the braided shield, and connects all internal grounds to a common external ground point.
C. Other Dry locations:
   1. On Wire larger than #10: shall be made with solderless, non-insulated compression-type connectors meeting requirements of Federal Specification WS-610e for Type II, Class 2 and shall be covered with Scotch #33 electrical tape so that insulation is equal to 150% of conductor insulation.
   2. On Wire #10 and smaller: shall be made with one of the following:
      a. Ideal Wing Nuts or equal by 3M .
      b. Ideal Push-In Wire Connectors (for #12 and smaller only).
D. Other Wet/Damp locations:
   1. On Wire larger than #10: shall be made with underground/direct-burial, waterproof rated EPDM or TPE-insulated connectors by Ilsco, Burndy or T&B.
   2. On Wire #10 and smaller: shall be made with one of the following:
      a. Ideal Weatherproof or Underground Wire Connectors pre-filled with 100% silicone sealant as required by the application.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. All wires and cables shall be installed in conduit unless specifically noted otherwise.
B. All joints and splices on wire shall be made with solderless connectors, and covered so that insulation is equal to conductor insulation.
C. No splices shall be pulled into conduit.
D. No conductor shall be pulled until conduit is cleaned of all foreign matter.

E. Wire and cable shall be neatly formed, bundled and tied in all panelboards, wireways, disconnect switches, pullboxes, junction boxes, cabinets and other similar electrical enclosures.

F. All wires and cables installed in underground or other wet locations shall be rated by the manufacturer for wet locations.

G. Network cabling shall be continuous from endpoint to endpoint and shall not be spliced unless specifically noted otherwise.

H. All conductors/cabling (including spare conductors) shall be properly terminated unless specifically directed otherwise. See above for general termination hardware requirements.

3.2 POWER WIRE AND CABLE INSTALLATION:

A. No power conductor shall be smaller than #12 except where so designated on the drawings or hereinafter specified.

B. Multi-wire lighting branches shall be used as indicated.

C. Where more than three current-carrying conductors are installed in a single raceway or cable, conductors shall be derated as indicated in NEC Table 310.15(B)(3)(a).

D. Raceways/cables shall generally not be installed exposed to sunlight on roofs unless specifically required. Where raceways or cables are installed exposed to sunlight on roofs, conductors shall be derated with ampacities adjusted per NEC Table 310.15(B)(3)(c).

E. In installing parallel power conductors, it is mandatory that all conductors making up the feeder be exactly the same length, the same size, the same type of conductor with the same insulation. Each group of conductors making up a phase or neutral must be bonded at both ends in an approved manner.

F. In installing overhead main power services, a minimum of 5’-0” of cable per run shall be extended beyond the weatherhead(s) for connection to service drop. Confirm exact requirements with local utility company.

3.3 WIRE CONNECTIONS

A. See Part 2 above for material types.

B. Aluminum Wire Connections:

1. Where aluminum wiring is allowed, connections shall utilize compression fittings, no exceptions (Anderson Versa Crimp or equal).

C. Any stranded wire connection to wiring devices shall be made with crimp type terminals.

D. All electrical connections and terminals shall be tightened according to manufacturer’s published torque-tightening values with calibrated torque wrenches as required to clearly indicate final torque value to the contractor. Where manufacturer’s torque values are not provided, those specified in UL 486A & 486B shall be used.

E. All connections and connector types shall be installed in strict compliance with all requirements of the connector manufacturer.

F. Under no condition shall the specified conductors be connected to terminals rated less than 75°C. Where conductors sized #1 or smaller are shown to be terminated at equipment and the terminals of that equipment are rated for less than 75°C, contractor shall install junction ox near equipment to capture the specified conductors, splice with compression connections (rated for a least 75°C) and extend conductors with ampacity rating as required by NEC (based on terminal temperature rating) to equipment terminals. The length of the conductors to be terminated shall be as directed by the AHJ but not less than 48 inches.

3.4 SHIELDED CABLE INSTALLATION

A. Shielded instrumentation (low voltage) cables:
   1. The outer foil of shielded instrumentation cables shall be grounded at the PLC/control panel end only (not at the field device end) with a termination kit as directed by the PLC/control panel supplier.

3.5 LOW VOLTAGE (LESS THAN 50V) CONTROL AND NETWORK CABLE INSTALLATION:

A. All wires and cables shall be installed in conduit unless specifically noted otherwise. Low voltage control and/or network cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
   1. Cabling shall be plenum-rated, multi-conductor.
   2. Cabling shall be supported by cable tray or with J-hook supports on intervals not to exceed 5'-0" on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
   3. Cabling shall be properly bundled with plenum-rated Velcro straps on intervals not to exceed 30" on center.
   4. Properly-sized conduit(s) shall be provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings or through walls). End bushings shall be provided on both ends of all raceway terminations. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.

3.6 CIRCUITS AND BRANCH CIRCUITS

A. Outlets shall be connected to branch circuits as indicated on drawings by circuit number adjacent to outlet symbols, and no more outlets than are indicated shall be connected to a circuit.

3.7 LABELING AND COLOR CODING OF WIRE AND CABLE

A. Refer to Specification Section 26 05 53 for all labeling requirements.

B. A color coding system as listed below shall be followed throughout the network of branch power circuits as follows:

PHASE	120/208/240/ COLOR	120/240 HIGH LEG DELTA COLOR	277/480 VOLT COLOR
A	BLACK	BLACK	BROWN
B	RED	ORANGE (FOR HI-LEG)	ORANGE
C	BLUE	BLUE	YELLOW
NEUTRAL	WHITE	WHITE	GRAY
GROUND	GREEN	GREEN	GREEN

C. Where dedicated neutrals are installed for multi-wire branch circuits, the neutral conductors shall be color coded as follows:

	120/208/240/	120/240 HIGH LEG	277/480 VOLT
PHASE	COLOR	DELTA COLOR	COLOR
NEUTRAL A	WHITE W/ BLACK TRACER	WHITE W/ BLACK TRACER	GRAY W/ BROWN TRACER
NEUTRAL B	WHITE W/ RED TRACER	WHITE W/ ORANGE TRACER (FOR HI-LEG NEUTRAL)	GRAY W/ ORANGE TRACER
NEUTRAL C	WHITE W/ BLUE TRACER	WHITE W/ BLUE TRACER	GRAY W/ YELLOW TRACER

D. Control Conductors: Shall be color coded by use of colored "tracers". No control circuit shall contain two identical conductors. For example, a set of five (5) control conductors for a pushbutton station represents one (1) control circuit which would require five (5) uniquely-colored control conductors.

3.8 TESTING

A. The insulation resistance of all feeder conductors (feeding electrical distribution equipment such as switchboards, panelboards, transfer switches, transformers, etc.) shall be tested at the load side of the feeder breaker with a 1000-volt DC Megger Tester prior to energization or final termination. Any feeder conductor with an insulation resistance less than the recommended minimums in the latest version of NETA Acceptance Testing Specification ("ATS") standard shall be replaced by the contractor at the contractor's expense. All final test results shall be clearly documented (with date, time, feeder, results, test equipment, etc.), and the final test results shall be submitted to the design team for review.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING

PART 1 - GENERAL

1.1 GENERAL

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO GROUNDING OF THE FOLLOWING:
   1. Service Equipment.
   2. Transformers.
   3. Non-current carrying conductive surfaces of equipment.
   4. Metal Buildings.
   5. Structures.
   6. Other Equipment.

1.2 GENERAL REQUIREMENTS

A. All equipment, building steel, and main service shall be effectively and permanently grounded with a conductor cross section as required by the National Electrical Code and of capacity sufficient to insure continued effectiveness of the ground connections for fault current. Ground conductors shall be as short and straight as possible, protected from mechanical injury and, if practicable, without splice or joint.

B. All grounding connections shall be installed in accordance with the National Electrical Code and all local codes and requirements. Such codes shall be considered minimum requirements and the installation of the grounding system shall insure freedom from dangerous shock voltage exposure and provide a low impedance ground fault path to permit proper operation of overcurrent and ground fault protective devices.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. All grounding conductors shall be insulated with green colored, 600 volt insulation unless noted otherwise.

B. Motors having power supplied by single conductor wire in conduit shall be grounded through the conduit system. Flexible conduit shall be “jumpered” by an appropriate bonding conductor.

C. Supplemental grounding system conductors shall be bare, softdrawn, stranded, single conductor copper wire, and generally sized as follows (unless shown otherwise on plans):
   1. Switchgear, motor control centers, and power transformer #4/0 minimum or as shown on plans.
   2. Power panels, #2/0.
   3. Control panels and consoles, #4.
   4. Process Motors, #1/0.
   5. Building Columns, #4/0.
   6. Light Poles, #2.
   7. Telephone Backboard & Cabinet ground busses, #2.

2.2 GROUNDING ELECTRODES

A. Grounding electrodes shall be copper-clad steel rods 3/4 inch in diameter and ten feet long. Where longer electrodes are necessary to reduce the ground resistance, Contractor

shall provide sectional rods, connectors, drive heads, etc.

2.3 CONNECTIONS

A. All conductor-to-conductor, conductor-to-ground rod, conductor-to-structure, conductor-to-fence connections of #6 and larger sized conductors and underground ground connections shall be permanent exothermic welded connections (Cadweld or equal) unless otherwise noted on applicable drawings.

B. Connections to equipment shall be by bolted compression type lugs (except for motors). When the conductor is #6 and larger, the lug shall be joined to the conductor by an exothermic weld (Cadweld or equal).

C. Motors to be grounded by the grounding conductors run with the power conductors shall have a split-post grounding stud installed in the connection box.

D. Each cast pull box or junction box shall have a ground lug, connected to largest ground conductor to enter box.

E. Ground connections at conduit terminations shall be made by approved grounding bushings (see Raceways Specification Section for additional requirements).

2.4 MANUFACTURERS

A. Conduit clamps and connectors shall be manufactured by Raco, OZ., or Ercon.

B. Lugs shall be as manufactured by Square “D”, Burndy, or T and B.

C. Exothermic weld connections shall be as manufactured by Cadweld, or approved equal.

D. Ground rods shall be as manufactured by Joslyn or McGraw Edison.

E. Split post grounding shall be as manufactured by Burndy or T and B.

PART 3 - EXECUTION

3.1 MAIN SERVICE GROUND

A. The main service grounding electrode system shall consist of the following items bonded together by the grounding electrode conductor:

1. The main underground cold water pipe (metal).
2. The metal frame of the building.
3. Driven ground rods. Ground rods shall be embedded at the lowest point in the building and below the permanent moisture level. Ground rods shall be spaced a minimum of ten (10) feet apart and connected in parallel until resistance to ground does not exceed five (5) ohms.

B. The grounding electrode system shall be connected to the grounded conductor (neutral) on the supply side of the service disconnecting means by a grounding electrode conductor not smaller than that shown in Table 250.66 of the N.E.C. The main service equipment grounding conductor shall be connected to the grounding conductor on the supply side of the service disconnecting means in accordance with Table 250.122 of the N.E.C. for the ampere rating of the service entrance equipment. Where in a service entrance switchboard, the equipment grounding conductor shall not be less than 25% of the main bus rating. These connections shall be made inside the service entrance equipment enclosure.

3.2 TRANSFORMER GROUNDS

A. Dry type insulation transformers with a grounded conductor in the secondary shall be grounded in accordance with N.E.C. Section 250-30.

3.3 EXPOSED NON-CURRENT-CARRYING METAL PARTS

A. General: Ground connections to equipment or devices shall be made as close to the current carrying parts as possible, that is, to the main frame rather than supporting structures, bases or shields. Grounding connections shall be made only to dry surfaces that are clean and dry. Steel surfaces shall be ground or filed to remove all scales, rust, grease, and dirt. Copper and galvanized steel shall be cleaned to remove oxide before making welds or connections. Code size ground conductors shall be run in all power conduits and properly terminated at each end.

B. Ground conductors shall be routed as straight as possible. Where possible, ground conductors shall be routed such as to avoid bends exceeding 90 degrees or with a radius of less than 8".

C. Motors: Exposed non-current-carrying metal parts, shall be grounded by a grounding conductor either run with power conductors, and/or separate grounding conductors. Drawings will show method(s) to be used. The ground conductors with all motor conductors shall be connected to the ground buss in the motor connection box. Jumper connections shall be installed between frames and rigid conduit for equipment having flexible conduit connections (sealtight). All AC motor grounds shall provide a low impedance path to ground. Connections from the supplemental grounding system (when specified) shall be made directly to the motor frame. Additionally, utilization equipment connected to the motor (pump, fan, mixer, etc.) shall be bonded to the motor with flexible braid-type bonding strap to ensure equalization of ground potentials.

D. Raceways & boxes: All raceways, conduits, armored or shielded cable and all exposed non-current carrying metal parts shall be grounded. Such items shall be bonded together and permanently grounded to the equipment ground buss. Metallic conduits shall be connected by grounding or clamps to ground buss. Flexible "jumpers" shall be provided around all raceway expansion joints. Bonding straps for steel conduit shall be copper. Jumper connections shall be provided to effectively ground all sections or rigid conduit connected into plastic pipe. No metallic conduit shall be left ungrounded. In conduit systems interrupted by junction or switch boxes where locknuts and bushings are used to secure the conduit in the box, the sections of conduit and box must be bonded together. If conduit, couplings or fittings have a protective coating or non-conductive material, such as enamel, such coating must be thoroughly removed from threads of both couplings and conduit and the surface of conduit or fitting where the ground clamp is secured.

E. Enclosures: Metal conduits entering free standing motor control centers, switchboards or other free standing equipment shall be grounded by bare conductors and approved clamp. Any conduits entering low voltage (480 volts or below) equipment through sheet metal enclosure and effectively grounded to enclosure by double locknut or hub need not be otherwise bonded.

F. Equipment: In addition to equipment grounding provisions mandated by code requirements, additional equipment grounding provisions (including local ground rods, connections, etc.) shall be provided by the contractor as directed by equipment suppliers.

G. Both ends of ground busses in motor control centers, switchboards, etc., shall be separately connected to the main ground buss to form two separate paths to ground.

H. Fences and Grills: Fences and metal grills around equipment carrying voltage above 500 volts between phases shall be bonded together and to ground. Fences and grill work shall be grounded at every post, column, or support, and on each side of every gate.

3.4 ACCEPTANCE DOCUMENTATION AND TESTING

A. Contractor shall take and store photographs of all underground grounding system connections prior to burial of connections, for review by Engineer.

B. Upon completion of work, the entire ground system shall be shown to be in perfect working condition, in accordance with the intent of the Specifications.

C. Contractor shall measure the resistance between the main ground bonding jumper to true earth ground using the Fall of Potential method as described by ANSI/IEEE Standard 81 ("Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of an Earth System"). If the measured value is greater than five ohms, additional grounding electrodes shall be installed as described in Part 3.1 above. The final ground resistance value shall be submitted in writing, and documented via picture of the meter reading from the Fall of Potential test, to the Engineer prior to the final observation, and shall be included in final O&M documentation.

END OF SECTION 26 05 26

SECTION 26 05 33 – RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
   1. Conduits
   2. Conduit Fittings
   3. Couplings & Connectors
   4. Bushings
   5. Raceway Hardware, Conduit Clamps & Supports
   6. Watertight Entrance Seal Devices

PART 2 - PRODUCTS

2.1 CONDUITS

A. PVC-Coated Rigid Steel:
   1. The PVC coated rigid metal conduit must be UL Listed. Hazardous location fittings, prior to plastic coating must be UL listed. All conduit and fittings must be new, unused material. Applicable UL standards may include: UL 6 Standard for Safety, Rigid Metal Conduit, UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.
   2. The PVC-coated rigid metal conduit shall be ETL PVC-001 listed.
   3. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.
   4. Form 8 Condulets®, 3/4" through 2" diameters, shall have a tongue-in-groove “V-Seal" gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours shall be available.
   5. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
   6. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.
   7. Form 8 Condulets® shall be supplied with plastic encapsulated stainless steel cover screws.
   8. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.
   9. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30deg.F (-1deg.C).
   10. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.
   11. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.

12. Independent certified test results shall be available to confirm coating adhesion per ETL PVC-001 standards under the following conditions:
    a. Conduit immersed in boiling water with a minimum mean time to adhesion failure of 200 hours. ASTM D870)
    b. Conduit and condulet exposure to 150deg F (65deg C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D11513.
    c. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
    d. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
    e. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1.
    f. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
13. Water tight flex connectors used in areas where PVC coated metal conduit is utilized shall be PVC coated also.
14. Shall be as manufactured by Perma-Cote, Plastibond, Korkap, Ocal or Okote.

B. Rigid Galvanized Steel and I.M.C.:
1. Shall be galvanized outside and inside by hot dipping.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

C. Rigid Aluminum:
1. Shall be manufactured of 6063 Alloy, T-1 temper.
2. Shall be as manufactured by Republic, Wheatland, Triangle, Pittsburg Standard, Youngstown, Allied or equal.

D. Schedule 40 and 80 PVC:
1. Shall be composed of polyvinyl chloride and shall be U.L. rated type 40 or 80 for use with 90 degree rated conductors. Conduit shall conform to NEMA Standards and applicable sections of N.E.C.
2. The conduit manufacturer shall have had a minimum of 5 years experience in the manufacture of the products. Non-metallic raceways shall be as manufactured by Carlon, Triangle, Can-Tex, Allied or equal.

E. Liquidtight Flexible Metallic Conduit:
1. Shall be galvanized steel-core sealtite, code approved for grounding.
2. Shall have an outer liquidtight, nonmetallic, sunlight-resistant jacket over an inner flexible metal core.
3. Shall be as manufactured by Electric-Flex, Anaconda or equal.

2.2 FITTINGS, COUPLINGS & CONNECTORS

A. Rigid Galvanized Steel and I.M.C. couplings and connectors shall be standard threaded type, galvanized outside and inside by hot dipping. Threadless and clamp type are not acceptable. Couplings/connectors shall be as manufactured by Raco, Efcor, or Appleton or equal.

B. All fittings, couplings and connectors (including, but not limited to, conduit couplings, connectors, hubs, nipples, unions, expansion fittings, explosion proof seal-offs, threaded hole closures, and seal-tight connectors, etc.) used in areas where PVC-Coated Rigid

conduit is used shall also be PVC-coated.

C. All fittings, couplings and connectors (including, but not limited to, conduit couplings, connectors, hubs, nipples, unions, expansion fittings, explosion proof seal-offs, threaded hole closures, and seal-tight connectors, etc.) installed in other wet, exterior or process areas where PVC-coated conduit systems are not required, shall be aluminum or stainless steel type. Standard steel fittings will not be acceptable.

D. All rain tight connectors shall be threaded Myers or approved equal, rated for outdoor application.

E. Rigid Aluminum couplings and connectors shall be standard threaded type, of the same alloy as the associated conduit. Threadless and clamp type are not acceptable. Fittings shall be as manufactured by Thomas & Betts, Crouse-Hinds, Appleton, Pyle-National or equal.

F. All PVC couplings, adapters, end bells, reducers, etc., shall be of same material as conduit.

G. Liquidtight Flexible Metallic Conduit connectors shall be liquidtight with insulating throat or end bushing, designed for application with Liquidtight Flexible Metallic Conduit. Fittings shall be as manufactured by Efcor, Raco, Midwest or equal.

H. All LB unilets sizes 1 ¼" or larger shall have rollers.

I. Miscellaneous conduit fittings shall be as manufactured by Appleton, Crouse-Hinds, Pyle-National,Russell & Stoll or equal.

2.3 BUSHINGS

A. All non-grounding rigid bushings 1-1/4" and larger shall be the insulating type (O-Z/Gedney type "BB" or equal by T&B, Midwest Electric or Penn Union).

B. All non-grounding rigid bushings 1" and smaller shall be threaded malleable iron with integral noncombustible insulator rated for 150°C. Non-grounding rigid conduit bushings shall be O-Z/Gedney type "B" or equal by T&B, Midwest Electric or Penn Union.

C. All grounding rigid bushings shall be threaded malleable iron with integral noncombustible insulator rated for 150°C. All grounding rigid conduit bushings shall be O-Z/Gedney type "BLG" or equal by T&B, Midwest Electric or Penn Union.

2.4 HARDWARE, CONDUIT CLAMPS AND SUPPORTS

A. All hardware such as expansion shields, machine screws, toggle bolts, "U" or "J" bolts, machine bolts, conduit clamps and supports shall be of corrosion resistant materials (stainless steel, aluminum, galvanized or plated steel, or other approved materials).

B. Hardware in contact with aluminum handrails, plates or structural members and all hardware in exterior, wet or corrosive areas shall be type 316 stainless steel or aluminum (with bitumastic paint coating to isolate aluminum from contact with concrete where necessary) unless specifically noted otherwise.

C. Supports in exterior, process, wet or corrosive locations shall be type 316 stainless steel or aluminum (with bitumastic paint coating to isolate aluminum from contact with concrete where necessary) unless specifically noted otherwise.

D. Supports in extremely corrosive environments (such as chlorine or fluoride storage rooms) shall be PVC-Coated steel unless specifically noted otherwise.

E. Hardware and conduit clamps shall be as manufactured by Efcor, Steel City, G.A., Tinnerman or equal.

2.5 WATERTIGHT ENTRANCE SEAL DEVICES

A. For new construction, seal devices shall consist of oversized sleeve and malleable iron

body with sealing rings, pressure rings, sealing grommets and pressure clamps as required (O-Z/Gedney type FSK/WSK or equal).

B. For cored-hole applications, seal devices shall consist of assembled dual pressure disks with neoprene sealing rings and membrane clamps as required (O-Z/Gedney type CSM or equal).

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Minimum Diameter: 3/4-inch.

B. Raceway Type: Raceway types shall be as specified below, unless indicated otherwise on drawings:

1. Exterior, Exposed: Rigid Aluminum unless otherwise noted.
2. Exterior, Used for Instrumentation Circuits: See Below.
3. Other Exterior (Concrete-Encased or Direct Earth Buried): Schedule 40 PVC. PVC conduit shall convert to metallic conduit prior to exiting concrete-encasement or direct earth burial. See "transition" items below for additional requirements. Conduits shall be left exposed until after Engineer's observation.
4. Raceways used for Instrumentation Circuits:
   a. Typical Dry or Wet Locations: Rigid Aluminum .
   b. Underground or Locations Embedded inside Poured Concrete: PVC-Coated Rigid Steel.
   c. Extremely Corrosive Locations (Chlorine Storage Rooms, Fluoride Storage Rooms and other similar areas): PVC-Coated Rigid Steel.
5. Terminations at motors, transformers and other equipment which has moving or vibrating parts:
   a. Exterior or Wet Locations (including, but not limited to, Pump Rooms, Wet Wells, Underground Vaults, and other similar locations): Liquidtight Flexible Metallic Conduit (shall generally not exceed 24 inches in length) with watertight fittings.
   b. Dry, Interior Locations: Flexible Metallic Conduit (shall generally not exceed 24 inches in length).
6. Terminations at instruments:
   a. Liquidtight Flexible Metallic Conduit (shall generally not exceed 12 inches in length) with watertight fittings.
7. Terminations at fixtures mounted in grid-type ceilings:
   a. Flexible Metallic Conduit or MC cabling (shall generally not exceed 72 inches in length and shall run from junction box to fixture, not from fixture to fixture).
8. Transition from underground or concrete-encased to exposed:
   a. Convert PVC to PVC-Coated Rigid Steel utilizing PVC-Coated Rigid Steel 90 degree bends (and vertical conduits as required by application) prior to exiting concrete/grade (except at outdoor pull boxes and under freestanding electrical equipment, where terminations shall be by PVC end bells installed flush with top of slab). Exposed portions of these coated conduits shall extend a minimum of 6" above floor level, and shall be installed at uniform heights.

3.2 RACEWAY INSTALLATION

A. General:

1. Follow methods which are appropriate and approved for the location and conditions involved. Where not otherwise shown, specified, or approved in a particular case, run all wiring concealed.
2. Where conduit crosses a structural expansion joint an approved conduit expansion fitting shall be installed.
3. Where any run of rigid aluminum conduit (including bends) exceeds 50' in length, an approved conduit expansion fitting shall be installed (beginning at center of run) at intervals not to exceed 50' on center.
4. A non-conductive polypropylene pull string, properly tied/secured at either end, shall be installed in all empty conduits.
5. Metal conduit field-cuts shall be cut square with a hacksaw and the ends reamed after threading.
6. PVC conduit field-cuts shall be made with hacksaw, and ends shall be deburred.
7. All PVC joints shall be made as follows:
    a. Clean the outside of the conduit to depth of the socket, and the inside of socket with an approved cleaner.
    b. Apply solvent cement as recommended by the conduit manufacturer to the interior of the socket and exterior of conduit, making sure to coat all surfaces to be joined.
    c. Insert conduit into the socket and rotate 1/4 to 1/2 turn and allow to dry.
8. All metallic conduit installed below grade or within concrete shall be coated with two (2) spiral-wrapped layers of 3M Scotchrap 50 PVC tape or two coats of asphaltum paint prior to installation.
9. Install ground wire sized per N.E.C. Table 250.122 in all conduits.
10. Use of running threads is absolutely prohibited. Conduit shall be jointed with approved threaded conduit couplings. Threadless and clamp type not acceptable.
11. Conduits shall be sized in accordance with latest National Electrical Code except when size shown on drawings.
12. Exposed, field-cut threads on all metal conduits shall be painted with zinc primer (for Galvanized Rigid or I.M.C.) or urethane paint (for PVC-Coated Rigid Steel) as recommended by conduit manufacturer .
13. Installation of PVC coated conduit systems shall be performed in strict accordance with the manufacturer's installation instructions. Damage to PVC coated conduit coating shall be touched up with patching compound as directed by manufacturer. To assure correct installation, the installer shall be certified by the manufacturer to install coated conduit.

B. Routing/Locating:

1. Exposed conduit runs shall be run level and plumb and shall, on interior of buildings, be run parallel and/or at right angles to building walls and/or partitions.
2. Conduit with an external diameter larger than 1/3 the thickness of a concrete slab shall not be placed in the slab. Conduits in slab shall not be spaced closer than 3 diameters on center.
3. Conduit run in ceiling spaces shall be run as high as possible, all at same level, and shall be supported from building structure. Do not support conduit from any other installation.
4. Conduit run within exterior CMU, concrete or other similar walls shall be run

within the CMU cells / concrete structure / etc. Conduits shall not be run on the outside surface of CMU cells / concrete structure / etc. underneath exterior veneers / etc., which could cause a thermal break in the wall insulation or a future water intrusion problem.

5. Install conduit runs to avoid proximity to steam or hot water pipes. In no place shall a conduit be run within 6" of such pipes except where crossing is unavoidable, then conduit shall be kept at least 3" from the covering of the pipe crossed.
6. Before installing raceways for motors, HVAC equipment and other fixed equipment, check location of all equipment connections/terminal boxes with equipment supplier and locate and arrange raceways appropriately.
7. No conduit for instrumentation shall be run closer than 12 inches to parallel power conduits.
8. A minimum of 12" of clearance (or more as required by associated utility companies) shall be provided between the finished lines of exterior, underground conduit runs and exterior, underground utilities (gas, water, sewer, etc.).
9. Where any portion of raceway is installed in a wet environment (such as below grade) and located at a higher elevation than the raceway termination point in a dry environment, install watertight compound inside raceway at termination around cabling to prevent transfer of water through conduit system. Watertight compound shall be rated for the potential water head pressure, based on the assumption that ground water level would be at grade level.

C. Bends:

1. Do not make bends (in any raceway, including flexible conduits) that exceed allowable conductor bending radius of cable to be installed or that significantly restrict conductor flexibility.
2. All bends within concrete-encased ductbanks installed in exterior locations shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
3. All bends in raceways containing multi-conductor power cables (such as shielded VFD cables) shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
4. Where numerous exposed bends or grouped together, all bends shall be parallel, with same center and shall be similar in appearance
5. All PVC elbows, bends, etc., shall be either factory bends or made with an approved heat bender.

D. Support:

1. Anchor conduit securely in place by means of approved conduit clamps, hangers, supports and fastenings. Arrangement and methods of fastening all conduits shall be subject to Engineer's direction and approval. All conduits shall be rigidly supported (wire supports may not be used in any location). Use only approved clamps on exposed conduit.
2. Rigid Aluminum Conduits shall be supported at intervals not to exceed 5' on center.
3. Conduit in riser shafts shall be supported at each floor level by approved clamp hangers.
4. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameters of conduits.

5. Where installed in seismic zones, suspended raceways shall be braced in two (2) directions as required to prevent swaying and excessive movement.
6. Raceways installed on top of flat roofing shall be supported a minimum of 3 ½" above roof with rubber block supports (Cooper B-Line Dura-Blok or equal). Installation shall be in strict accordance with support manufacturer's instructions and recommendations.

E. Terminations:
1. All conduit connections to sheet metal cabinets or enclosures located in exterior or wet locations shall terminate by use of rain tight (Meyers) hubs.
2. In wet, exterior or process areas, conduits shall NOT enter tops of enclosures. All conduits shall enter enclosures from bottom, left or right sides of the enclosure (utilizing rain-tight Meyers hubs as indicated above).
3. Where rigid or I.M.C. conduits enter sheet metal boxes, they shall be secured by approved lock nuts and bushings.
4. Where metal conduits enter outdoor pull boxes, manholes, under freestanding electrical equipment or other locations where direct metal-to-metal contact does not exist between enclosure and conduit, grounding bushings shall be installed. Each grounding bushing shall be connected to the enclosure ground and all other grounding bushings with properly sized grounding conductors.
5. Where E.M.T. enters sheet metal boxes they shall be secured in place with approved insulating fittings.
6. Where PVC enters outdoor pull boxes, manholes or under freestanding electrical equipment, PVC end bells shall be installed.
7. Contractor shall be responsible for coordinating required conduit sizes with equipment hubs/conduit entry provisions (such as at motor tap boxes) prior to installation of conduit systems. Contractor shall field adjust final conduit sizes at terminations where so required (only as allowed by code) from those indicated on plans to coordinate with equipment hubs/conduit entry provisions.
8. Where conduit terminates in free air such that associated cabling/circuitry becomes exposed (such as at cable trays, etc.), conduit shall generally terminate in a horizontal orientation (to prevent dust/debris/etc. from entering conduit system). Where vertical conduit termination is necessary, the termination shall be provided with cord-grip conduit terminations to seal the conduit system.
9. Conduit ends shall be carefully plugged during construction.
10. Permanent, removable caps or plugs shall be installed on each end of all empty raceways with fittings listed to prevent water and other foreign matter from entering the conduit system.

F. Penetrations:
1. All penetrations shall be at right angles unless shown otherwise.
2. Structural members (including footings and beams) shall not be notched or penetrated for the installation of electrical raceways unless noted otherwise without specific approval of the structural engineer.
3. Dry-packed non-shrink grout or watertight seal devices shall be used to seal openings around conduits at all penetrations through concrete walls, ceilings or aboveground floors.
4. All raceways entering structures shall be sealed (at the first box or outlet) with polyurethane grout compound that expands to form a flexible foam seal that prevents the entrance of gases or liquids from one area to another (Prime Resins

Prime-Flex or equal).

5. All raceways passing through concrete roofs or membrane-waterproofed walls or floors shall be provided with watertight seals as follows:
   a. Where ducts are concrete encased on one side: Install watertight entrance seal device on the accessible side of roof/wall/floor as directed by equipment manufacturer.
   b. Where ducts are accessible on both sides: Install watertight entrance seal device on each side of roof/wall/floor as directed by equipment manufacturer.
6. All raceways passing through walls of rooms containing/storing noxious chemicals (chlorine, ammonia, etc.) or through hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS or equal).
7. All raceways terminating into electrical enclosures/devices/panels/etc. located in hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS, EZS or equal) within 18" of the termination.

END OF SECTION 26 05 33

SECTION 26 05 34 – OUTLET BOXES, JUNCTION BOXES, WIREWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Outlet and Junction Boxes
B. Pull Boxes
C. Wireways

PART 2 - PRODUCTS

2.1 OUTLET BOXES & JUNCTION BOXES (THROUGH 4-11/16")

A. Sheet Metal: Shall be standard type with knockouts made of hot dipped galvanized steel as manufactured by Steel City, Raco, Appleton, Bowers or equal.
B. Cast: Shall be type FS, FD, JB, GS, or SEH as required for application as manufactured by O-Z/Gedney,Appleton, or equal.
C. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal.

2.2 JUNCTION AND PULL BOXES (LARGER THAN 4-11/16")

A. Oil-Tight JIC: Shall be Hoffman Type CH box or approved equal.
B. Galvanized Cast Iron or Cast Aluminum: Shall be O-Z/Gedney or approved equal.
C. Stainless Steel: Shall be as manufactured by O-Z/Gedney, Hoffman or approved equal. Boxes shall have continuous hinges, seamless foam-in-place gaskets and screw-down clamps.
D. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal. Boxes shall have hinged covers and screw-down clamps.
E. Wireways: Shall be standard manufacturer's item as manufactured by Hoffman, Square "D", Burns, B & C or equal. Wireways shall have hinged covers and screw-down clamps.

PART 3 - EXECUTION

3.1 APPLICATION

A. General
    1. All boxes and wireways shall be of sufficient size to provide free space for all enclosed conductors per NEC requirements. Fill calculations shall be performed by contractor per NEC requirements.
B. Outlet Boxes & Junction Boxes (through 4-11/16")
    1. Sheet metal boxes shall be used on concealed work in ceiling or walls.
    2. Cast boxes shall be used wherever Rigid or I.M.C. conduits are installed.
    3. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
    4. Except when located in exposed concrete block, switch and receptacle boxes shall

be 4" square for single gang installation. Appropriate gang boxes shall be used for mounting ganged switches.

5. When installed in exposed concrete block, switch and receptacle boxes shall be square type designed for exposed block installation.
6. Ceiling outlet boxes shall be 4" octagon 1-1/2" deep or larger required due to number of wires.
7. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.

C. Junction & Pull Boxes (larger than 4-11/16")

1. For all below grade exterior use and elsewhere as shown:
   a. In areas subject to future vehicular traffic: shall be galvanized cast iron (rated AASHTO H-20 Loading unless noted otherwise).
   b. In areas not subject to vehicular traffic: shall be galvanized cast iron or pre-cast polymer concrete (rated for Tier 15 Loading unless noted otherwise).
2. All boxes installed exposed in exterior or wet areas shall be stainless steel (NEMA 4X).
3. All boxes installed exposed in corrosive areas shall be stainless steel (NEMA 4X).
4. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
5. Padmounted Pull Boxes shall be installed as shown on Plans or as required by project conditions. Transclosure-style Padmounted boxes shall be installed wherever required by the quantities and sizes of conductors. Contractor shall submit all Padmounted Pull Box types prior to ordering for engineer's review and comment.
6. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.
7. All others shall be oil tight JIC box not less than 16 gauge.

3.2 INSTALLATION

A. General

1. All boxes and wireways shall be securely anchored.
2. All boxes shall be properly sealed and protected during construction and shall be cleaned of all foreign matter before conductors are installed.
3. All boxes and wireways shall be readily accessible. Contractor shall be responsible for furnishing and installing access panels per architect's specifications. Locations shall be as directed by the architect as required to make boxes, wireways, electrical connections, etc. accessible where above gypsum board ceilings or in other similar locations.
4. All metallic boxes and wireways shall be properly grounded.
5. Refer to Specification Section 26 05 53 for identification requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16")

1. Boxes shall be provided with approved 3/8" fixture studs were required.
2. Recessed boxes for wiring devices, surface fixtures, or connections, shall be set so that the edge of cover comes flush with finished surface.
3. There shall be no more knockouts opened in any sheet metal box than actually used.
4. Any unused opening in cast boxes shall be plugged.

5. Back to back boxes to be staggered at least 3 inches.
6. Under no circumstances shall through-the-wall boxes be used.

C. Junction & Pull Boxes (larger than 4-11/16")

1. Pull boxes shall be installed as indicated on plans and/or as required due to number of bends, distance or pulling conditions.
2. Boxes to be imbedded in concrete shall be properly leveled and anchored in place before the concrete is poured.
3. All pull boxes and/or junction boxes installed exterior below grade, shall have their tops a minimum of 1-1/2 inches above surrounding grade and sloped so that water will not stand on lid. A positive drain shall be installed, to prevent water accumulation inside.
4. Above grade pull boxes shall be installed on concrete anchor bases as shown on Plans.

D. Wireways and/or wall-mounted equipment

1. Mount each wireway to channels of the same metal type as the wireway.
2. Conductors serving a wireway shall be extended without reduction in size, for the entire length of the wireway. Tap-offs to switches and other items served by the wireway shall be made with ILSCO type GTA with GTC cap.

END OF SECTION 26 05 34

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wire and cable identification.
B. Pullbox & Junction Box Identification
C. Electrical distribution & utilization equipment identification.
D. Emergency and Standby Power receptacle identification.
E. Instrument and control device identification.
F. Raceway identification.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE IDENTIFICATION

A. Intermediate Locations:
   1. Wires and cable labels shall be white, thermal transfer, halogen-free, flame-retardant marker plates (sized to accommodate three lines of text) permanently affixed to the associated cable with UV-resistant plastic wire ties. Labels shall be Panduit #M200X/300X series or equal.
B. Circuit/Cable Termination Locations:
   1. Wires and cable labels shall be non-ferrous identifying tags or pressure sensitive labels unless noted otherwise.

2.2 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. Labels on electrical distribution & utilization equipment shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment with rivets or silicone adhesive unless noted otherwise.

2.3 INSTRUMENT AND CONTROL DEVICE IDENTIFICATION

A. Instruments and control device labels shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment or the adjacent, visible mounting surface with silicone adhesive or stainless steel wire ties.

2.4 RACEWAY IDENTIFICATION

A. Raceway labels shall be white thermal transfer marker plates permanently affixed to the associated raceway with stainless steel wire ties, with two wire ties (one on either end of marker plate to provide a flush installation) where possible. Labels shall be Panduit #M300X series or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Any proposed deviation in identification methods and materials from those described herein shall be submitted to Engineer for review and comment prior to installation.
B. Contractor shall provide all labeling or identification required by applicable local, state and national codes. These specifications do not intend to itemize all code-required labeling or identification requirements.

C. All labels/identification shall be positioned such as to be readable from the normal perspective without adjusting wiring/cables/labels. For example, labels/identification of wires/cables within cable trays shall be positioned to point towards the viewer (typically downward for overhead cable trays, or upward for cable trays within trenches).

D. All labels/identification (except for handwritten labels on concealed pullbox/junction box covers as noted below) shall be typewritten/printed/engraved in a neat, workmanlike, permanent, legible, consistent and meaningful manner. Labels shall not be handwritten unless specific approval is granted by engineer.

3.2 WIRE AND CABLE IDENTIFICATION

A. General:
   1. Where cabling is exposed (such as within cable trays), provide two wire ties per cable (one on either end of marker plate to provide a flush installation). Where cabling is concealed (such as within pullboxes/wireways), one wire tie per cable will be acceptable.

B. Intermediate Locations:
   1. Thermal transfer labels shall be securely fastened to all wiring and cabling in the following locations:
      a. Wireways
      b. Pullboxes/Junction boxes larger than 4-11/16”
      c. Pullboxes/Junction boxes through 4-11/16” where wires and cables are not easily identifiable via the color coding and box labeling
      d. Vaults & Manholes
      e. Approximately every 50 feet within cable trays (especially at locations where cables exit or diverge). Labels within cable trays shall be grouped (rather than being pre-labeled on cables and pulled into cable trays).
      f. Other similar intermediate locations.
   2. Labels shall be stamped or printed with the following data so that the feeder or cable can be readily identified and traced:
      a. From where the circuit originates (including panel designation and circuit number):
         1) Ex: “FROM: PP-A CIR. 3 (IN MAIN ELEC ROOM)”
      b. To where the circuit extends (using the common name of the equipment):
         1) Ex: “TO: RTU-6 (ON ROOF)”
      c. The purpose of the circuit:
         1) Ex: “POWER”
      d. The set number (If parallel power feeds are used).
         1) Ex: “SET NO. 3 OF 4”

C. Circuit/Cable Termination Locations:
   1. Where multiple termination points exist within a circuit origination point (panelboard, switchboard, MCC, starter, etc.) or other similar circuit endpoint (control panel, etc.), labels shall be securely fastened to all ungrounded and neutral conductors to clearly identify the terminal and/or circuit number associated with each conductor. For example, within lighting panels, each phase and neutral conductor shall be labeled near the terminals at a clearly visible location with the associated circuit number(s), so that if all conductors were unterminated, the labels would clearly indicate which conductor was associated

with each circuit.

D. Refer to Specification Section 26 05 19 for all color-coding requirements of wires and cables.

3.3 PULLBOX & JUNCTION BOX IDENTIFICATION

A. Concealed pullboxes/junction boxes:
   1. Front surface of all pullbox/junction box covers in concealed areas (such as above lay-in ceilings) or within mechanical/electrical rooms (and other similar areas where appearance of boxes is not an issue) shall be neatly marked with the ID of circuits/cables contained with permanent black marker on cover of box (Ex: "RP-1A Cir. 1, 2 & 3"). Additionally, front surface of box shall be painted red where box contains fire alarm system cabling.

B. Exposed pullboxes/junction boxes:
   1. Interior surface of all pullbox/junction box covers in exposed areas shall be labeled "Power", "Telecommunications", "Fire Alarm" or with other similar general text neatly with permanent black marker to indicate function of box. Circuit/cable labeling within box (see above) shall identify specific cables contained. Additionally, interior surface of cover shall be painted red where box contains fire alarm system cabling.

C. Where pullboxes/junction boxes are named on contract documents (Ex:"PULLBOX #3"), an engraved nameplate shall be installed on the front surface of the box to identify the name.

3.4 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. General:
   1. All new and existing equipment modified by this project shall include arc-flash warning labels in accordance with NEC article 110.16.

B. All Panels, Motor Control Centers, Switchboards, Switchgear, Transformers, Etc.:
   1. Engraved nameplates identifying name of equipment, nominal voltage and phase of the equipment and where the equipment is fed from shall be installed on front surface of all panels, motor control centers, switchboards, switchgear, transformers, etc.:
      a. Ex: First Line: "NAME: RP-A", Second Line: "120/208V-3Ø-4W", Third Line: "FED FROM: PP-A CIR. 4 (IN MAIN ELEC ROOM)"
   2. Refer to Panelboard Specification Sections for additional labeling requirements (circuit directory cards, permanent circuit labels, permanent circuit numbers, etc.) required inside panelboards.

C. Safety/Disconnect Switches and Utilization Equipment (HVAC Equipment, Pumps, Powered Valves, Control Panels, Starters, Etc.)::
   1. Engraved nameplates identifying equipment being fed and where the equipment is fed from shall be installed on front surface of all disconnect switches (including both visible blade type switches and toggle-type switches) and on utilization equipment (where not clearly identified by immediately adjacent local disconnect switch):
      a. Ex: First Line: "RTU-6", Second Line: "FED FROM: PP-A CIR. 5"
   2. Where safety/disconnect switches are installed on the load side of variable frequency drives, the safety/disconnect switch shall be furnished with an additional engraved nameplate to read: "WARNING: TURN OFF VFD PRIOR

TO OPENING THIS SWITCH".

3. Safety/Disconnect switches feeding equipment that is fed from multiple sources (such as motors with integral overtemperature contacts that are monitored via a control system) and Utilization Equipment fed from multiple sources shall be furnished with an additional BLACK-ON-YELLOW engraved nameplate to read: "WARNING: ASSOCIATED EQUIPMENT FED FROM MULTIPLE SOURCES – DISCONNECT ALL SOURCES PRIOR TO OPENING COVER".

D. Services:

1. All Service Equipment:
   a. Engraved nameplates identifying maximum available fault current, including date the fault current calculation was performed, in accordance with NEC article 110.24.
      1) Ex: First Line: "AVAILABLE FAULT CURRENT: 16,154 AMPS", Second Line: "DATE CALCULATED: JULY 8, 2013"
   b. All service entrance equipment shall be clearly labeled as being service entrance rated.
2. Where a building or structure is supplied by more than one service (or any combination of branch circuits, feeders and services), a permanent plaque or directory shall be installed at each service disconnect location denoting all other services, feeders & branch circuits supplying that building or structure and the area served by each, per NEC requirements.

3.5 INSTRUMENT AND CONTROL DEVICE IDENTIFICATION

A. New Instruments and control devices (whether furnished by contractor or not) shall be labeled with black-on-white engraved nameplates permanently affixed to the equipment or to the adjacent, readily-visible mounting surface with silicone adhesive or stainless steel wire ties.
   1. Instruments and process control devices (float switches, etc.) shall be labeled with instrument name and, where available, instrument ID number.
   2. Pushbutton stations shall be labeled with equipment being controlled. Labels shall be installed on front surface (or adjacent mounting surface) of all pushbutton stations.
   3. Thermostats and other similar HVAC control devices installed in process areas shall be labeled with equipment being controlled. Labels shall be installed on front surface (or adjacent mounting surface) of all thermostats and other similar HVAC control devices.

3.6 RACEWAY IDENTIFICATION

A. Each exposed raceway shall be labeled at the point where it becomes concealed, such as where it enters a concrete floor slab, a concrete wall, the ground, etc.

B. Each raceway entering in-grade or on-grade pullboxes/junction boxes, where the conduits are only visible inside the box, shall be labeled within the box at the point where the raceway becomes concealed.

C. Raceway nameplates shall identify:
   1. The location of the other end of the raceway ("TO MCC-1" or similar). If the other end of the raceway is at an intermediate, named pullbox ("INSTRUMENTATION PULLBOX #4" or similar), that pullbox name shall be labeled rather than the endpoint of the circuitry.

3.7 OTHER IDENTIFICATION

A. Factory-engraved coverplates identifying functions of light switches and other similar devices shall be installed where so required by plans/specifications.

END OF SECTION 26 05 53

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wiring Devices
B. Plates
C. Finishes

PART 2 - PRODUCTS

2.1 WIRING DEVICES AND PLATES

A. Switches shall be AC type, extra-heavy duty industrial grade (unless otherwise shown) of ratings shown on drawings. Switches shall be as manufactured by Hubbell, P & S, Sierra, Bryant, GE, Arrow Hart or equal.
B. Receptacles shall have blade configuration and shall be extra-heavy duty industrial grade (unless otherwise shown) of current and voltage rating as shown on drawings. Receptacles shall be as manufactured by Hubbell, P & S, Sierra, Bryant, GE, Arrow Hart or equal.
C. All GFCI-type receptacles shall continuously self-test and shall trip/deny power if the receptacle does not provide proper GFCI protection or if the line/load terminations are miswired and shall provide visual indication of power status, trip conditions, ground fault conditions and end-of-life status.
D. Each wiring device shall have a plate (see "Finishes" section below for specific requirements).

2.2 FINISHES

A. All wiring devices (switches, receptacles, etc.) shall be colored to match the coverplates described below. For instance, all items covered by stainless steel, aluminum or malleable iron plates shall be gray in color.
    1. Exceptions:
        a. Emergency wiring devices shall be red.
        b. Isolated ground wiring devices shall be orange.
B. Coverplates for recessed, wall-mounted electrical items (switches, receptacles, telephone outlets, etc.) shall be stainless steel unless shown otherwise.
C. Coverplates, trim rings, etc. for recessed, floor-mounted electrical items (floor outlets, underfloor duct junctions, etc.) shall match finish of building hardware (302/304 stainless steel, brass, etc.) in area installed.
D. Coverplates for exposed electrical items (switches, receptacles, telephone outlets, etc.) shall be of same material as exposed boxes (see Outlet Box Specification for required material type) and shall have beveled edges.
E. Coverplates for receptacles in wet locations shall be metallic, in-use type, rated for wet locations per NEC requirements unless noted otherwise.
F. See "Electrical Identification" specification section for coverplate labeling requirements.

PART 3 - EXECUTION

3.1 GENERAL MOUNTING

A. Symbols on drawings and mounting heights are approximate. The exact locations and mounting heights shall be determined on the job, and it shall be the Contractor's responsibility to coordinate with all trades to secure correct installation. For example, Contractor shall coordinate exact mounting heights over counters, in or above backsplashes, in block walls, and at other specific construction features.

B. Verify all door swings with Architectural. Locate boxes for light switches within four inches of door trim on swing side (not hinge side) of door.

C. Devices and associated plates shall not be used as support; outlet boxes shall be rigidly supported from structural members.

D. Mount all straight-blade receptacles vertically with ground pole up, unless specifically noted otherwise.

E. Unless otherwise shown or required by local handicap codes, outlet boxes shall be the following distances above the finished floor unless otherwise noted.

1. Receptacles and telephone outlets in offices and other finished areas: 1’-6” to the center of the box.
2. Receptacles and telephone outlets in equipment rooms and other unfinished areas: 4’-0”to the center of the box.
3. Receptacles over counters: As Noted
4. Switches, general: 4’-0” to the top of the box.
5. Push-button, etc., general: 4’-0” to the top of the box.

END OF SECTION 26 27 26

SECTION 26 28 16 – SAFETY SWITCHES AND FUSES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Safety Switches
B. Fuses
C. Branch Feeders
D. Feeders

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

A. Safety switches shall be quick-make, quick-break, NEMA heavy duty type HD, fused or nonfused as shown. Switch blades shall be fully visible in the off position.
B. Safety switches shall be furnished with transparent internal barrier kits to prevent accidental contact with live parts. Barriers shall provide finger-safe protection when the switch door is open and shall allow use of test probes and removal of fuses without removing barrier.
C. Fused switches shall have provisions for class R, rejection type fuses.

2.2 FUSES (600V)

A. Fuses for all branch switches shall be Bussman Mfg. Co., Dual Element, Class “R” Fusetron.
B. Fuses for main switch/switches shall be Bussman Mfg. Co. Hi-Cap.

2.3 MANUFACTURER

A. Safety switches shall be as manufactured by Square 'D' or Cutler Hammer.
B. Fuses shall be as manufactured by Bussman Mfg. Co. or equal.

PART 3 - EXECUTION

3.1 SAFETY SWITCHES

A. Safety switches shall be installed as shown on the plans and in accordance with N.E.C.
B. Locations shown for safety switches on plans are diagrammatical only. Exact locations shall be field coordinated by contractor as required to provide code-required clearances.
C. Switch enclosures shall be rated NEMA I indoors in dry locations and NEMA 4 stainless steel outdoors and in wet or process areas.
D. Adequate support shall be provided for mounting safety switches. Safety switches shall not be mounted to the associated equipment (unless the safety switch is furnished with the equipment).

3.2 FUSES

A. Fuses shall be sized as shown on drawings, unless a smaller size is required by the associated equipment supplier, in which case the contractor shall provide fuses sized as directed by the associated equipment supplier at no additional cost.
B. Provide not less than one spare set of fuses for each size used. Provide an additional spare set for each five sets of same size fuses used.

END OF SECTION 26 28 16

SECTION 26 29 00 – MANUFACTURED CONTROL PANELS

PART 1 - GENERAL

1.1 SCOPE

A. This section describes control stations, PLC panels, motor control panels, manufactured control panels, and other similar panels specified herein. Specifications herein are intended as an extension of requirements in other Divisions of these specifications where reference is made to Electrical Specifications.

1.2 DEFINITIONS

A. "Control Stations": Enclosures (with all required accessories) containing only door-mounted pushbuttons, indicator lights and/or selector switches (no electronic components or starter/controller equipment).

B. "Control Panels": Enclosures (with all required accessories) containing equipment/devices other than door-mounted pushbuttons, indicator lights and/or selector switches (such as electronic components, starter/controller equipment, etc.).

1.3 SUBMITTALS

A. Provide the following for each control panel:
   1. A job-specific, custom wiring diagram
      a. The wiring diagram shall clearly show all components (whether the components are mounted internal or external to the control panel enclosure).
      b. All wires and terminal blocks shall be clearly labeled.
      c. Diagram shall be in accordance with NEMA/ICS standards.
   2. Size, type and rating of all system components.
   3. Unit frontal elevation and dimension drawings.
   4. Internal component layout diagrams.
   5. Manufacturer's product data sheets for all components.

B. A Bill of Materials shall be included with catalog information on all components.

C. Information shall be included on any proprietary logic component sufficient to demonstrate its ability to perform the required functions.

D. The following calculations shall be submitted:
   1. Thermal calculations showing amount of air conditioning or ventilation and heating required for each control panel, per ambient requirements listed below and operating temperature limitations of all equipment/devices within each control panel. Where possible, forced air ventilation shall be utilized rather than air conditioning. Panel shall be oversized, interior equipment/devices shall be derated, and solar shielding shall be provided as required to allow the use of forced air ventilation as the cooling method. Air conditioning, ventilation, and/or heating equipment shall each have ratings/capacities at least 20% larger than required by calculations below unless noted otherwise:
      a. Thermal calculations used for sizing cooling/ventilation systems for each control panel located in exterior or non-conditioned spaces shall assume:
         1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.
         2) Full solar contact where applicable (not applicable where

enclosures are fully protected from solar contact using solar shields separated from panel enclosure with standoffs or similar).

3) No wind.

4) Heat loss from interior equipment (electronics, etc.) per equipment supplier's information.

b. Thermal calculations used for sizing heating systems for each control panel shall assume:

1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.

2) No heat loss by interior components of control panel.

3) No solar gain on exterior of control panel.

4) Doubling of heating wattage required to account for wind where control panels are located outdoors.

5) Minimum temperature difference (due to heating) of 10 degrees F to prevent condensation, regardless of equipment temperature limitations.

2. Load calculations showing the sizing of all power supplies provided (with spare capacity as specified). Power supplies shall each have ratings/capacities at least 20% larger than required by load calculations unless noted otherwise.

3. Load calculations showing the sizing and anticipated runtime of all Uninterruptible Power Supply systems provided (with spare capacity as specified).

PART 2 - PRODUCTS

2.1 GENERAL

A. Control panels shall be Underwriters' Laboratories labeled by the panel manufacturer. Control panel manufacturers not capable of applying the U.L. label to their products are unacceptable.

B. All human interface equipment/devices (indicator lights, selector switches, pushbuttons, time switches, displays, keypads, and other similar items used for control, adjustments or monitoring) shall be mounted on the non-energized side of enclosure door(s) in such a way as to be accessible without exposing the user to energized parts.

2.2 RATINGS

A. All Control Panels shall have short circuit current ratings at least equal to the lesser of the following, unless noted otherwise on plans:

1. The short circuit current rating of the electrical distribution equipment that feeds the Control Panel.

2. 150% of the available fault current at the Control Panel as determined by a Short Circuit Current study prepared by a licensed professional electrical engineer.

B. All equipment/devices installed within control panels shall be rated to operate in ambient temperatures of 50 degrees C (122 degrees F) or higher.

2.3 ENCLOSURES

A. All enclosures (with any required accessories or auxiliary items) shall fit within the space shown on the Plans. Any costs associated with furnishing equipment which exceeds the available space shall be borne by the Contractor.

B. Enclosures (with any required accessories or auxiliary items) shall be suitable for the environment where installed.

C. Enclosure materials shall be as follows unless noted otherwise:

1. Control Stations:
   a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
   b. Where located in other wet, process or outdoor areas: NEMA 4X of type 304 stainless steel construction (with stainless steel hardware).
   c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 of die cast zinc/aluminum construction.
2. Control Panels:
   a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
   b. Where located in other wet, process or outdoor areas: NEMA 4X of type 316 stainless steel construction (with stainless steel hardware).
   c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 or 12.

D. Control Panel Enclosure Construction:

1. Non-metallic control panel enclosure material, where specified, shall be reinforced polyester resin or equivalent, with a minimum thickness of 3/16 inch for all surfaces except those requiring reinforcement. Panels shall be precision molded to form a one piece unit with all corners rounded. Exterior surfaces shall be gel-coated to provide a corrosion-resistant maintenance-free satin finish which shall never need painting. Color pigments shall be molded into the resin. Color shall be grey.
2. Metallic control panel enclosures, where specified, shall be fabricated using a minimum of 14 gauge steel for wall or frame mounted enclosures and a minimum of 12 gauge for freestanding enclosures. Continuously weld all exterior seams and grind smooth. Reinforce sheet steel with steel angles where necessary support equipment and ensure rigidity and preclude resonant vibrations.
3. Use pan-type construction for doors.
4. Door widths shall not exceed 36-inches.
5. Mount doors with full length, heavy duty piano hinge with hinge pins.
6. Provide gasket completely around each door opening.
7. Mount and secure all internal components to removable back plate assembly.
8. For NEMA 1 or 12 enclosures, provide handle-operated key-lockable three point stainless steel latching system for each door.
9. For NEMA 4X enclosures, provide provisions for padlocking all doors and provide clamps on three (3) sides of each door.

E. Control panel enclosures (and associated backpanels and other similar accessories) shall be manufactured by Hoffman Engineering Co., or Saginaw Control & Engineering.

2.4 CONTROL PANEL ACCESSORIES:

A. Cooling systems shall be provided if so required by the application to maintain temperatures within the acceptable ranges of the interior equipment. In no case (regardless of temperature ratings of internal equipment) shall maximum temperatures

within control panels be allowed to exceed 50 degrees C (122 degrees F). Thermostats shall be provided to control cooling without need of manual operation. Thermostat setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Cooling units shall be as manufactured by Hoffman Engineering Co., Rittal or approved equal and shall be thermostatically controlled.

B. Space heaters shall be provided for condensation and temperature control. Thermostats AND hygrostats (or combination hygrotherm controllers) shall be provided to control heating requirements (based on temperature and relative humidity within enclosure) without need of manual operation. Setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Space heaters and associated control devices shall be as manufactured by Hoffman Engineering Co., Rittal, Stego or approved equal.

C. NEMA 4X control panels shall be provided with vapor-phase corrosion inhibitor(s) (chemical combinations that vaporize and condense on all surfaces in the enclosed area, to protect metal surfaces/devices within the enclosed area from corrosion). Corrosion inhibitor shall be Hoffman #AHCI series (sized as required by the enclosure volume to be protected) or equal.

D. For outdoor panels, stainless steel solar shields for front, top and each side of panel, supported to associated panel face with standoffs as required (to allow free air flow between solar shield and panel enclosure), shall be provided where required to limit solar loading on panel to allow use of a ventilated panel design rather than an air-conditioned panel design.

E. Provide a sun shield over all LCD displays in exterior-mounted panels. Sun shield shall be collapsible to fully protect LCD display from UV light when not in use, shall provide side and top shielding when in use, shall be constructed of stainless steel and shall be installed such as to maintain NEMA 4X ratings of enclosures.

F. Provide a clear polycarbonate gasketted hinged door or window to encompass all indicators, controllers, recorders, etc. mounted on NEMA 4 and 4X enclosures.

G. Provide interior mounting panels and shelves constructed of minimum 12 gauge steel with white enamel finish. Provide metal print pocket with white enamel finish on inside of door.

H. Provide interior LED light kit, mounted at top of interior of panel, and switched to turn “ON” when door is opened for the following control panels:
   1. Control panels with outer dimensions greater than 20” wide or 30” high.
   2. Control panels containing PLCs or other similar programmable devices.

I. Control panels containing VFDs or Reduced Voltage Soft Starters shall include a door mounted digital keypad for adjusting the starter parameters and viewing process values and viewing the motor and starter statuses without opening the enclosure deadfront door.

2.5 CONTROL COMPONENTS

A. General:
   1. All pushbuttons, pilot lights, selector switches and other control devices shall be separate, standard size (full 30mm) and shape, heavy duty oil-tight units.
      a. Devices in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.) shall be of non-metallic construction.
      b. Devices in other areas shall be of chrome-plated construction.
   2. All components and devices so that connection can be easily made and so there

is ample room for servicing each item.

3. Door-mounted indicators, recorders, totalizers and controllers shall be located between 48” and 72” above finished floor level.
4. Door-mounted indicator lights, selector switches and pushbuttons shall be located between 36” and 80” above finished floor level.
5. All devices and components shall be adequately supported to prevent movement. Mounting strips shall be used to mount relays, timers and other devices suitable for this type of mounting.

B. Pilot Lights:
   1. All pilot lights to be cluster LED type & push to test.

C. Pushbuttons:
   1. All STOP operators within control stations located at equipment shall be provided with lockout provisions and a minimum of two (2) sets of contact blocks.
   2. Emergency shutoff pushbutton devices shall be as follows unless noted otherwise:
      a. 2 ¼” diameter, mushroom-style, maintained contact push buttons
      b. With a minimum of one (1) normally open dry contact and three normally closed dry contacts.
      c. Connections made such that pushing “in” the button will shutoff the associated equipment.
      d. Provided with a red engraved nameplate with ½” lettering to read “Emergency Shutoff”.

D. Relays:
   1. Control relays shall have the following characteristics, unless noted otherwise:
      a. General purpose, plug-in type.
      b. Minimum mechanical life of 10 million operations.
      c. Coil voltage as indicated or required by application.
      d. Single-break contacts rated 12 amperes, resistive at 240 volts.
      e. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each individual relay shall have 3PDT contacts. Where required, multiple control relays shall be provided (to provide the required quantities of contacts) for each “relay” function shown on plans/diagrams.
      f. Furnished with RC transient suppressor to suppress coil-generated transients to 200% of peak voltage.
      g. LED on/off indicator light and manual operator.
      h. Industry standard wiring and pin terminal arrangements.
      i. Equal to Square D 8501KP series with matching plug-in socket.
   2. Interposing/isolation relays used to isolate discrete output field wiring (and where required for voltage translation for other discrete signals) to/from PLC inputs/outputs shall be terminal-block style. Terminal-block style relays shall have the following characteristics, unless noted otherwise:
      a. Minimum mechanical life of 10 million operations.
      b. Single-break contacts rated 6 amperes, resistive at 120 volts.
      c. One (1) N.O. contact per relay.
      d. Furnished with integral transient protection.
      e. LED on/off indicator light.
      f. DIN-rail mounted.

g. Equal to Square D type Zelio RSL.

3. Timer relays shall be electronic, adjustable plug-in devices meeting the following characteristics, unless noted otherwise:
   a. General purpose, plug-in type.
   b. Minimum mechanical life of 10 million operations.
   c. Single-break contacts rated 10 amperes, resistive at 240 volts.
   d. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each relay shall have DPDT contacts (2 N.O. & 2N.C.). Where required, multiple timer or control relays shall be provided (to provide the required quantities of contacts) for each "relay" function shown on plans/diagrams.
   e. Rotary-thumbwheel adjustments for time value, timing range and function.
   f. Time value adjustments from .05 seconds to 999 hours
   g. Selectable Timing Functions, including the following:
      1) On Delay
      2) Interval
      3) Off Delay
      4) One Shot
      5) Repeat Cycle-Off
      6) Repeat Cycle-On
      7) On/Off Delay
      8) One Shot Falling Edge
      9) Watchdog
      10) Trigger On Delay
   h. Accuracy shall be + 2% and repeatability shall be + 0.1%.
   i. Furnished with integral transient protection.
   j. LED indicator light(s) for "timing" and "on/off status"
   k. Held in place with hold-down spring
   l. Equal to Square D type JCK with matching plug-in socket.

2.6 CONFORMAL COATINGS

A. All printed circuit boards within electronic devices (PLCs, RTUs, controllers, I/O modules, power supplies, touchscreens, Ethernet switches, radios, etc.) installed in panels located in non-conditioned or exterior/process areas shall be conformal-coated for harsh environments.

2.7 DC POWER SUPPLIES

A. DC Power supplies shall be provided where specified elsewhere, or as required by design of system. Power supplies shall be industrial type, AC-to-DC switching, output voltage as required, 120vac input, size as required for the initial application plus 50% spare capacity.

B. Redundant power supplies with diode isolation shall be provided so that the loss of one power supply does not affect system operation. The back-up supply systems shall be designed so that either the primary or the back-up supply can be removed, repaired, and returned to service without disrupting the system operation.

C. Power supply output shall be protected by secondary overcurrent protection device(s).

D. The power distribution from multiloop supplies shall be selectively fused so that a fault in

one instrument loop will be isolated from the other loops being fed from the same supply.

E. Each power supply shall meet the following requirements.
   1. Regulation, line: 0.4% for input from 105 to 132vac.
   2. Regulation, load: 0.8%
   3. Ripple/Noise: 15mV RMS / 200 mV peak to peak
   4. Operating temperature range: 0 deg C - 60 deg C
   5. Overvoltage protection
   6. Overload Protection
   7. Output shall remain within regulation limits for a least 16ms after loss of AC power at full load.
   8. Output status indicator.
   9. UL listing

F. Power supplies shall be manufactured by Puls, Sola, Phoenix Contact or equal.

2.8 UNINTERRUPTIBLE POWER SUPPLIES

A. Uninterruptible power supplies (UPSs) shall be provided where specified elsewhere, or as required by design of system. Power supplies shall be industrial type, size as required for the initial application plus 50% spare capacity unless noted otherwise.

B. Battery runtime shall be as specified elsewhere. If no other specification for battery runtime is specified, battery runtime shall be 12.5 minutes at full load.

C. UPSs shall be double-conversion, on-line type.

D. UPSs shall be rated for operation in -20 degrees C to 55 degrees C ambient temperatures.

E. UPS batteries shall be hot-swappable and 12-year rated when installed in 25 degrees C environment and 4-year rated when installed in 50 degrees C environment.

F. UPSs shall include dry contacts for the following alarm points:
   1. Loss of Input Power Alarm
   2. Low Battery Alarm

G. UPSs shall be manufactured by Falcon UPS or approved equal.

2.9 DISCONNECTS

A. A main disconnect switch or circuit breaker shall be supplied integral to all control panels. The main disconnect or circuit breaker shall be accessible/operable without exposing the operator to energized sections of the control panel(s).

B. Individual circuit breakers shall be provided integral to the manufactured control panel for each separate power circuit originating within the control panel.

C. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated (or can be adjusted to is 1200A or higher, breakers shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.

D. Manufacturers:
   1. Square 'D' or Cutler Hammer.

2.10 COMBINATION STARTERS

A. All combination starters shall utilize a unit disconnect. Magnetic starters shall be furnished in all combination starter units unless specifically shown otherwise. All starters shall utilize full NEMA/EEMAC rated contactors (size 1 minimum).

B. Starters shall be provided with a three-pole, external (door mounted) manual reset, solid

state overload relay. Solid state overload relay shall have switch-selectable trip class and shall provide protection from:

1. Overload.
2. Phase Unbalance.
3. Phase Loss.
4. Ground Fault (Class II detection).

C. Unless specifically shown otherwise, each combination starter shall be furnished with a control circuit transformer including two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads (including motor space heaters and other similar loads where specified). The transformer rating shall be fully visible from the front when the unit door is opened. Unless otherwise indicated, control voltage shall be 120V AC. Control power shall be provided by individual unit control power transformers.

D. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.

E. Auxiliary control circuit interlocks shall be provided where indicated. Auxiliary interlocks shall be field convertible to normally open or normally closed operation.

F. NEMA/EEMAC Size 1-4 starters shall be mounted directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger starters shall be arranged so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.

G. Each starter shall be equipped with a minimum of the following control devices:

1. Door-mounted reset button.
2. Two (2) field-reversible (N.O./N.C.) auxiliary contacts
3. For reversing and two-speed starters: Four (4) field-reversible (N.O./N.C.) auxiliary contacts
4. Additional control devices as indicated on plans.

H. Control Wiring Terminal Blocks

1. Terminal blocks shall generally be:
   a. Feed-thru, screw-in type
   b. DIN rail mounted
   c. Furnished with the stationary portion of the block secured to the unit bottom plate
   d. Furnished with unit-mounted control terminal blocks for each field wire.
   e. Rated for the voltage and current of the proposed application per UL/NEC standards.
   f. Sized (by supplier) for the associated wire gauges/types/quantities.
   g. Phoenix Contact UT-4 series, Weidmuller WDU-4 series (or equivalent) unless required otherwise by application.

I. Nameplates

1. Each unit shall be properly labeled with an engraved phenolic nameplate with a white background and black letters.

2. Each pilot device shall be properly labeled with a legend plate or an engraved phenolic nameplate.

J. Manufacturers:

1. Square 'D' or Cutler Hammer.

2.11 WIRING

A. Refer to Section 26 05 19 for all wiring types/applications.

B. All wiring shall be identified on each end with hot stamped, shrink tube type, or self-laminating vinyl permanent wire markers to correspond with numbering shown on wiring diagrams.

C. All connections shall be made on terminals with no splices.

D. All wiring runs shall be along horizontal or vertical routes to present a neat appearance. Angled runs will not be acceptable. Group or bundle parallel runs of wire in plastic wire duct where practical.

E. All wiring runs shall be securely fastened to the panel or wire duct by means of plastic wire ties. Adequately support and restrain all wire runs to prevent sagging or movement.

F. AC power wiring and instrumentation/analog wiring shall be run separate.

G. Color code all internal wiring (not field wiring) as follows:
   1. Line and load circuits: Black (B)
   2. AC control wiring: Red (R)
   3. Externally-Powered control wiring: Yellow (Y)
   4. Neutral wiring: White (W)
   5. Low voltage DC(+)pos: Blue (BL)
   6. Low voltage DC(-)neg: Blue/White Tracer (BL/W)
   7. Grounding: Green (G)

H. Terminal strips shall be provided for all input and output wiring. No more than two (2) wires shall be connected to one (1) terminal block.

2.12 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. General
   1. Function: Protect the system against damage due to electrical surges.

B. Application: As a minimum, provide surge and transient protection (with proper grounding) at the following locations as described below:
   1. Power Input High Frequency Noise Filtering:
      a. 120VAC Control panels with integral UPSs, PLCs, or other electronic/microprocessor equipment that is susceptible to failure or improper operation due to high frequency/harmonic input transients shall be provided with series-connected high-frequency noise filters on the line input (downstream of any panel main disconnects/breakers). Filters shall be as manufactured by Edco/Emerson/Islatrol or equal (exact type(s) as required by application).
   2. Power Input Surge Protection:
      a. Provide surge protection device at any connection of 120VAC power to panels containing programmable logic controllers, remote I/O equipment, UPS's, transmitters, radios, VFDs, Reduced Voltage Soft Starters or other electronic equipment. Device shall:
         1) Be mounted internal to the associated panel, with dedicated overcurrent protection.
         2) Be of two-part (base and SPD), DIN-rail mountable construction.
         3) Have 15kA total nominal discharge current per line (based on 8/20µs waveform).
         4) Have maximum continuous operating voltage (MCOV) rating as required by the associated circuit voltage.

5) Visually indicate operational status.
6) Be Dehn DEHNguard series or equal by MTL Technologies, or may be combined with the High Freqency Noise Filtering device required above.

b. Provide surge protection device at any connection of multi-pole AC power to panels containing programmable logic controllers, remote I/O equipment, UPS's, transmitters, radios, VFDs, Reduced Voltage Soft Starters or other electronic equipment. Device shall:
1) Be mounted internal to the associated panel, with dedicated overcurrent protection.
2) Provide protection for all phases.
3) Have 40kA (per phase) peak surge current rating.
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated circuit voltage.
5) Visually indicate operational status.
6) Be Square D SDSA or HWA series or equal.

3. Analog I/O Panel Terminations Surge Protection:
a. Provide surge protection device at the PLC (or similar) panel connection of each analog I/O signal. Device shall:
1) Be mounted internal to the associated panel.
2) Be of two-part (base and SPD), DIN-rail mountable construction.
3) Have 10kA total nominal discharge current per line (based on 8/20µs waveform).
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated signal.
5) Be Dehn Blitzductor XT series or equal by MTL Technologies.

4. Discrete I/O Panel Terminations Surge Protection:
a. Provide isolation relay at the PLC (or similar) panel connection of each discrete output signal (within the associated panel). See above for isolation relay requirements.

5. Low Voltage Power Supply Load Side Surge Protection:
a. Provide surge protection device at the PLC (or similar) panel on the load side of each low voltage power supply that has low voltage connections extending external to the panel. Device shall:
1) Be mounted internal to the associated panel.
2) Be of two-part (base and SPD), DIN-rail mountable construction.
3) Have 10kA total nominal discharge current per line (based on 8/20µs waveform).
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated utilization voltage.
5) Be as manufactured by Dehn, MTL Technologies, or Phoenix Contact.

6). Network Panel Terminations Surge Protection:
a. Provide surge protection device at the PLC (or similar) panel connection of each network cable. Device shall:
1) Be mounted internal to the associated panel.
2) Be of DIN-rail mountable construction.
3) Have 1kA total nominal discharge current per line (based on

8/20µs waveform).

4) Be designed specifically for the associated network connection type (Ethernet, RS485, RS232, etc.).

5) Be MTL Zonebarrier series or equal.

7. Antenna Cable Terminations Surge Protection:

a. Provide surge protection device at the connection of antenna cable to the radio panel. Device shall:

1) Be mounted internal to the associated panel.

2) Provide coarse protection via replaceable gas-filled surge voltage arrestor

3) Be Phoenix Contact COAXTRAB series or equal.

C. Installation and grounding of suppressor: As directed by manufacturer. Provide coordination and inspection of grounding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide enclosure mounting supports as required for floor, frame or wall mounting. All supports in exterior, wet or process areas shall be stainless steel unless noted otherwise. All floor-mounted panels or other similar distribution equipment shall be mounted on 6" concrete housekeeping pads unless specifically shown otherwise.

B. All enclosures used outside shall be solid bottom unless otherwise specified. All cable and piping openings shall be sealed watertight. Cable and piping shall enter the enclosure as shown on drawings or specified herein.

C. All equipment and components shall be solidly grounded to the control panel. One grounded terminal unit shall be provided in each control panel for connection to plant ground system. Grounding digital and analog components shall be performed in accordance with the instrument supplier's installation recommendations. Signal ground shall be solidly connected to the ground system so as to prevent ground loops

3.2 PAINTING

A. For enclosures other than NEMA 4X stainless steel or fiberglass:

1. Completely clean all surfaces so that they are free of corrosive residue. Then, phosphatize all surfaces for corrosion protection.

2. Prime with two (2) coats and finish with one coat of factory finish textured polyurethane. Paint shall be Sherwin-Williams Polane "T' or approved equal.

3. Color to be selected during shop drawing review phase.

3.3 IDENTIFICATION & DOCUMENTATION

A. Refer to specification section 26 05 53 for additional requirements.

B. Control panel power supply source, type, voltage, number or circuit ratings shall be identified inside control panels and on drawings.

C. All interior devices and components shall be identified with thermal transfer labels with black letters on white background. Labels shall be placed on the subpanel and not the component. Marking system shall be a Brother "PTouch II" or equal. Lettering shall be 1/4" high.

D. All front panel mounted devices such as push buttons shall be identified by the use of engraved bakelite nameplates or legend plates. Nameplates shall be 1/8" thick, white

with black core.

E. Where a panel includes a PLC or other network-connected device that is intended to be connected to another system (such as a plant SCADA system) via a network connection, the panel supplier shall provide an Interface Control Document (ICD) to the other system supplier (such as the SCADA Integrator). This document shall itemize the following for each networked parameter that is capable of being monitored or controlled by the other system:
   1. Parameter Name/Function (ex: Pump No. 1 On/Off Status)
   2. Parameter Type (discrete or analog, input or output)
   3. Parameter register ID/location

F. Where a panel includes a touchscreen or other programmable HMI display and is to be monitored by another system (such as a plant SCADA system), the panel supplier shall provide copies of the HMI display code and screenshots of all proposed HMI screens to the other system supplier (such as the SCADA Integrator) for their use in duplicating the associated HMI. G. A job-specific, custom wiring diagram for each control panel (not including control stations without relays) shall be provided to the contractor prior to installation for making the appropriate electrical connections. The wiring diagram shall clearly show all control components connected to the panel (whether the components are mounted internal or external to the enclosure). All wires and terminal blocks shall be clearly labeled. A laminated copy of the final wiring diagram for each unit shall be installed inside the door of the associated panel, and submitted to the owner with the as-built documentation.

3.4 OWNER TRAINING

A. Fully train the owner in the proper operation of all control panels/equipment, describing and demonstrating full operation, including function of each door-mounted device.

3.5 SPARE EQUIPMENT

A. Provide the following spare equipment:
   1. Fuses: 10% (minimum of 3) of each size and type utilized, mounted within a pocket within the associated control panel.
   2. Where control panel contains programmable controller (or similar equipment): Flash drive containing copies of all final programs utilized within the control panel, with provisions/cable assemblies as required to connect the flash drive provided to the controller to download the programs. Flash drive shall be attached to retractable cord (long enough to reach the associated port) attached to the inside of the panel door.

END OF SECTION 26 29 00

SECTION 26 32 13 – GENERATOR SETS

PART 1 - GENERAL

1.1 SCOPE

A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.

B. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.2 CODES AND STANDARDS

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of the latest editions of the following standards/codes where applicable:
   1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings
   2. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
   3. International Building Codes.
   4. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
   5. NFPA99 – Essential Electrical Systems for Health Care Facilities.
   6. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the latest editions of the following standards where applicable:
   1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
   2. UL142 – Sub-base Tanks
   3. UL1236 – Battery Chargers
   4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

C. The generator set and supplied accessories shall meet all applicable Environmental Protection Agency (EPA) TIER Emission Level or Emission Certification requirements and any local requirements in effect at the time the generator set is ordered (for the proposed location of the generator).

D. The control system for the generator set shall comply with the following requirements.
   1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
   2. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.

3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
4. FCC Part 15, Subpart B.
5. IEC8528 part 4. Control Systems for Generator Sets
6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
8. UL1236 –Battery Chargers.

E. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3 ACCEPTABLE MANUFACTURERS

A. Caterpillar
B. Cummins/Onan
C. Generac
D. Kohler

PART 2 - PRODUCTS

2.1 GENERATOR SET

A. Ratings
1. The generator set assembly (including both the motor/engine assembly and the generator assembly) shall operate at 1800 rpm, and the generator shall produce a 60 Hz waveform.
2. Voltage and phase ratings shall be as shown on plans.
3. Minimum kW rating (and associated alternator sizing) shall be the greater of the following:
   a. Minimum kW rating listed on plans.
   b. Ratings required to provide skVA as follows (shall be documented with reports in submittals using generator sizing software described in Part 3 below):
      1) If so listed on plans, the step loads fed by the generator at voltage/frequency dip criteria specified.
      2) If so listed on plans, the skVA rating specified.
      3) If neither of the above are listed on plans, generator shall be sized to accommodate a block load of 100% of the Total Demand Load listed on plans, with a maximum voltage dip of 20% and a maximum frequency dip of 10%.
4. kVA rating shall be 1.25 times the kW rating (based on .8 PF).
5. Unless shown otherwise on plans, the generator set shall be rated based on the following site conditions:
   a. Altitude of project site.
   b. Ambient temperatures up to 120 degrees F.
6. The generator set rating shall be based on emergency/standby service unless noted otherwise.

B. Performance

1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.5%.
3. The engine-generator set shall be capable of accepting a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
4. Minimum motor starting capability shall be as shown on plans. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified skVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 20% unless shown otherwise on plans.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.
6. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.

C. Construction
1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-downclamps within the rails.
2. The engine-generator set shall be rated for the seismic conditions for the installation location as mapped by the US Geological Survey and required by local building codes.
3. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

D. Connections
1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept compression terminations of the number and size as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required overcurrent protection located at panelboard(s) external to the generator set unless shown otherwise on plans. Where a load center or panelboard is shown within the generator enclosure on the plans, this load center/panelboard shall be furnished with the generator and shall comply with the applicable panelboard and identification sections of this specification.
3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

2.2 ENGINE AND ENGINE EQUIPMENT

A. The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:

1. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed and operating in various isochronous or parallel states. The governing system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.
2. Skid-mounted radiator and cooling system rated for full load operation in 120 degrees F (49 degrees C) ambient as measured at the generator air inlet. Radiator fan shall be suitable for use in a system with 0.5 in H2O restriction. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.
3. Electric starter(s) capable of three complete cranking cycles without overheating.
4. Positive displacement, mechanical, full pressure, lubrication oil pump.
5. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
6. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.
7. Replaceable dry element air cleaner with restriction indicator.
8. Flexible supply and return fuel lines.
9. Engine mounted battery charging alternator and solid-state voltage regulator.
10. Block heater
    a. Engine mounted, thermostatically controlled, block heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
    b. The block heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The block heater installation shall be specifically designed to provide proper venting of the system. The block heaters shall be installed using quick disconnect couplers to isolate the heaters for replacement of the heater element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to

be replaced without draining the engine cooling system or significant coolant loss.

c. The block heater shall be provided with a DC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the block heater system.

d. The block heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification. If the heater quantities or wattage ratings are different than shown on plans, contractor shall be responsible for providing the properly-rated circuits (with circuit breakers) as required to the heater(s).

11. Provide vibration isolators, spring & pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

12. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.

13. Provide critical-grade exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

14. A UL listed/CSA certified voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be located at the generator unless shown otherwise on plans. Output amperage, Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:
    a. Loss of AC power - red light
    b. Low battery voltage - red light
    c. High battery voltage - red light
    d. Power ON - green light and N.O. relay contact

2.3 FUEL TANK

A. Refer to "Sub-Base Fuel Tank" Paragraph below for fuel tank requirements.

2.4 AC GENERATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

D. AC generator shall be 12-lead reconnectable type to provide the following voltage output configurations:
   1. 277/480V-3Phase-4Wire
   2. 120/208V-3Phase-4Wire
   3. 120/240V-3Phase-4Wire
   4. 120/240V-1Phase-3Wire

E. The subtransient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

2.5 GENERATOR SET CONTROL

A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

B. The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

C. The generator set mounted control shall include the following features and functions:
   1. Control Switches
      a. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
      b. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.
      c. EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
      d. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
      e. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
   2. Generator Set AC Output Metering. The generator set shall be provided with a

metering set including the following features and functions:

a. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output.

b. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.

c. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

3. Generator Set Alarm and Status Display.

a. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright exterior day lighting conditions.

b. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. Conditions required to be annunciated shall include:

1) low oil pressure (warning)
2) low oil pressure (shutdown)
3) oil pressure sender failure (warning)
4) low coolant temperature (warning)
5) high coolant temperature (warning)
6) high coolant temperature (shutdown)
7) high oil temperature (warning)
8) engine temperature sender failure (warning)
9) low coolant level (warning or shutdown - selectable)
10) fail to crank (shutdown)
11) fail to start/overcrank (shutdown)
12) overspeed (shutdown)
13) low DC voltage (warning)
14) high DC voltage (warning)
15) weak battery (warning)
16) low fuel (warning)
17) high AC voltage (shutdown)
18) low AC voltage (shutdown)
19) under frequency (shutdown)
20) over current (warning)
21) over current (shutdown)
22) short circuit (shutdown)
23) ground fault (warning) (if genset breaker is rated 1000A or greater)
24) over load (warning)
25) Genset circuit breaker tripped (warning)
26) emergency stop (shutdown)

4. Engine Status Monitoring.

a. The following information shall be available from an analog status panel on the generator set control :
   1) engine oil pressure (psi or kPA)
   2) engine coolant temperature (degrees F or C)
   3) battery voltage (DC volts)

5. Engine Control Functions.
   a. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
   b. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
   c. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
   d. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
   e. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

6. Alternator Control Functions:
   a. The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, with local indication of setting level.
   b. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

c. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445. This protection may be provided using a microprocessor-based programmable relay system designed to protect the alternator system from damage, or using programmable electronic-trip LSI breaker(s), programmed/set by the generator supplier to ensure full protection of the alternator system.

d. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

e. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

f. When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

7. Other Control Functions

a. The generator set shall communicate with the Automatic Transfer Switch via hardwired control connections as required.

b. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.

c. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is out of acceptable limits. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

8. Dry Contacts/Relays for Remote Monitoring:

a. The control system shall provide ten (10) programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. Five (5) of these relays shall be preconfigured (and labeled accordingly) to indicate:

1) generator set operating at rated voltage and frequency
2) common warning
3) common shutdown
4) load shed command and
5) low fuel warning.

b. A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

2.6 GENERATOR REMOTE MANUAL STOP STATION

A. Each generator set shall be furnished with a remote manual stop station of a type to prevent inadvertent or unintentional operation per NFPA 110 requirements.

B. Stop station pushbutton shall be red, non-illuminated, push-pull, mushroom-type, maintained-contact,1 5/8" diameter, 30mm base, heavy-duty, oil-tight, water-tight unit) mounted within guarded enclosure to prevent inadvertent operation and labeled with engraved nameplate (white letters on red background) to read: "GENERATOR EMERGENCY STOP" (or similar with specific generator name where so identified on drawings).

C. Exact stop station type shall be coordinated with generator controls supplier to ensure a fully-functional system per NFPA 110 requirements.

2.7 GENERATOR MAIN LINE CIRCUIT BREAKER(S)

A. The generator set shall be provided with a mounted main line circuit breaker(s), sized as shown on plans. The circuit breaker(s) shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

B. The main line circuit breaker(s) shall be provided with auxiliary contacts to indicate trip/off alarm conditions to the generator set control system.

2.8 OUTDOOR WEATHER-PROTECTIVE ENCLOSURE

A. The generator set shall be provided with a weatherproof, sound-attenuated, outdoor enclosure, with the entire package listed under UL2200. The package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing. The total assembly of generator set, enclosure, and sub-base fuel tank (if applicable) shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100F. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable, and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.

B. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 76 dBA (including exhaust noise) at any location 7 meters from the generator set in a free field environment:

C. The enclosure shall include vertical air discharge hoods as required to redirect discharge air upwards and reduce noise accordingly.

D. The enclosure shall be insulated with non-hydroscopic materials.

E. The enclosure shall be rated for the wind and seismic conditions for the installation location as mapped by the US Geological Survey and required by local building codes.

F. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two step electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:

1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
2. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
3. Crosshatch adhesion, per ASTM D3359-93, 4B-5B.
4. Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.
5. Salt Spray, per ASTM B117-90, 1000+ hours.
6. Humidity, per ASTM D2247-92, 1000+ hours.
7. Water Soak, per ASTM D2247-92, 1000+ hours.

G. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

H. Enclosure shall be constructed of minimum 12 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel.

I. A factory-mounted critical exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.

J. The enclosure shall include the following maintenance provisions:

1. Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure, with internal drain valves
2. External radiator fill provision.

K. If so shown on the plans, provide a factory-mounted and wired electrical distribution panel to serve the generator set and enclosure. The provisions required include:

1. 100-amp distribution panelboard installed inside enclosure and fed by a 120/208VAC power feeder installed by the contractor (unless shown otherwise on plans).
2. Two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure (all factory-wired).
3. Two three-way switches controlling three AC lamps mounted in vapor tight and gasketted fixtures (all factory-wired).
4. Factory-wired normal AC service from the panelboard to the engine coolant and alternator heaters, and battery charger.

2.9 SUB-BASE FUEL TANK

A. Provide a sub-base fuel tank for the generator set, sized to allow for full load operation of the generator set for 24 hours. The sub-base fuel tank shall be UL142 listed and labeled. Installation shall be in compliance to NFPA37. The fuel tank shall be a double-walled, steel construction and include the following features:

1. Emergency tank and basin vents.

2. Mechanical level gauge.
3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to UL2200 and NFPA 37 requirements.
4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.
5. High and low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level
6. Basin drain.
7. Integral lifting provisions.

B. The equipment, as installed, shall meet all local and regional requirements for above ground tanks.

C. Where the generator design/layout, sub-base fuel tank height, and/or concrete housekeeping pad for the generator set causes any circuit breaker handle, control device, metering display or other similar item to be located higher than 6'-7" above finished floor, the supplier shall provide an aluminum grating platform complete with stairs and handrails meeting all applicable code requirements for proper access to these items. The platform and stairs shall be permanently mounted to a concrete base as recommended by the system supplier. Alternatively, the supplier may relocate (at the factory) these items to be below 6'-7" above finished floor.

2.10 SEQUENCE OF OPERATION

A. The maximum elapsed time allowed from loss of normal power to restoration of power to emergency circuits from generator through transfer switch shall be 10 seconds.

B. Generator set shall start upon receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control.
1. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.

C. The generator set shall complete a time delay start period as programmed into the control.

D. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:
1. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.
2. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate "fail to start".
3. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.
4. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand or load govern state.

E. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

F. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.

G. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

PART 3 - EXECUTION

3.1 SUBMITTALS.

A. Within 10 days after award of contract, provide six sets of the following information for review:

1. Manufacturer’s product literature and performance data, sufficient to verify compliance to specification requirements.
2. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
3. Manufacturer's certification of prototype testing.
4. Manufacturer's published warranty documents.
5. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
6. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
7. Generator sizing software report(s) showing compliance with all specification requirements and any additional motor starting requirements indicated in contract documents.
8. Time-current-curves demonstrating that the generator alternator relaying or breaker protective device(s) provide proper protection for the alternator by a comparison of the trip characteristic of the breaker with the thermal damage characteristic of the alternator.
9. Manufacturer's installation instructions.

3.2 FACTORY TESTING.

A. The generator set supplier shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

B. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks notice for testing.

C. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

3.3 INSTALLATION

A. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as

required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

B. Installation of equipment shall include furnishing and installing all interconnecting wiring, fuel lines, etc. between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

C. Generator equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

D. Remote stop station type, labeling and location shall be submitted by contractor to engineer and local fire marshal for approval prior to rough-in. Location shall be outside the room housing the prime mover (where so installed within a room) or elsewhere on the premises where the prime mover is located outside the building. Contractor shall provide all interconnections from remote stop station to generator set as required by generator set supplier for a fully-functional system.

E. Equipment shall be initially started and operated by representatives of the manufacturer.

F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

3.4 ON-SITE ACCEPTANCE TEST:

A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

B. Installation acceptance tests to be conducted on-site shall include the following (performed in accordance with NFPA 110):

1. "Cold start" test.
2. Four (4) hour full load test. Provide resistive load banks and make temporary connections as required.
3. One step rated load pickup test.
4. Power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

C. Upon completion of the manufacturer's site start-up and checkout, the contractor shall leave the diesel tank half full of fuel for use by the owner.

3.5 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to not less than 5 persons. Training date shall be coordinated with the facility owner.

3.6 SERVICE AND SUPPORT

A. The manufacturer of the generator set shall maintain service parts inventory at a central

location which is accessible to the service location 24 hours per day, 365 days per year.

B. The generator set shall be distributed and serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer of the generator set shall own, maintain and make available (to engineer, free of charge) generator set sizing software that calculates voltage dip, frequency dip, THDI and THDV of proposed generator/alternator set using the following inputs:
   1. Summary of step loads including load type (across-the-line motor, VFD, Fire Pump, Fluorescent Lighting, UPS, etc.).
   2. Generator Set Duty (Standby, Prime, Continuous).
   3. Maximum Ambient Temperature.
   4. Project site altitude.
   5. Generator Fuel type.
   6. Voltage/Phase/Frequency.

D. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.7 WARRANTY

A. The generator set and associated equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION 26 32 13

SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: voltage sensors on all phases of both sources, power switch mechanism, permanently attached manual operation provisions, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.

B. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product shall service the transfer switches.

1.2 CODES AND STANDARDS

A. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
   1. CSA 282, Emergency Electrical Power Supply for Buildings
   2. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
   3. NFPA99 – Essential Electrical Systems for Health Care Facilities
   4. NFPA110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
   5. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
   6. NEMA ICS10-1993 – AC Automatic Transfer Switches.

B. The transfer switch assembly shall comply with the following standards:
   1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
   2. EN55011, Class B Radiated Emissions
   3. EN55011, Class B Conducted Emissions
   4. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity.
   5. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
   6. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
   7. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
   8. IEC 1000-4-6 Conducted Field Immunity
   9. IEC 1000-4-11 Voltage Dip Immunity.
   10. IEEE 62.41, AC Voltage Surge Immunity.
   11. IEEE 62.45, AC Voltage Surge.
   12. UL1008 – Transfer Switches. Transfer switches shall be UL1008 (latest edition) listed. UL1008 transfer switches may be supplied in UL891 enclosures if necessary to meet the physical requirements of the project.

C. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3 ACCEPTABLE MANUFACTURERS

A. Cummins/Onan

B. Caterpillar

C. Generac
D. Kohler
E. Zenith
F. Russelectric
G. ASCO
H. Eaton

PART 2 - PRODUCTS

2.1 POWER TRANSFER SWITCH

A. Ratings
   1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, voltage and ampere ratings, enclosure type, and accessories.
   2. Main contacts shall be rated for 600 Volts AC minimum.
   3. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000M).
   4. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes equal to or greater than the required ratings shown on the drawings (at the specified voltage). The transfer switch shall be third party listed and labeled for use with the specific protective device(s) (both normal and emergency) installed in the application. All rating information including associated overcurrent devices shall be submitted with shop drawings. Where WCR is dependent on setting of upstream overcurrent device, transfer switch shall be field marked with the required settings of the associated device. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. The transfer switch and its upstream protection shall be coordinated.

B. Construction
   1. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.
   2. Transfer switches shall be of the Programmed (Delayed) Transition type. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.
   3. The switch shall completely disconnect the load from both sources for an adjustable period of time to allow regenerative voltage to decay to a safe level prior to connecting to the new source.
   4. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
   5. All wiring shall be UL listed 105 degree C, 600 volt rated, and sized as required.

Each wire, device or function shall be identified with a source and destination by silk-screen or similar permanent identification. Circuit boards shall be connected wiring harnesses by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.

6. Bus structures shall be constructed from silver plated copper or tin plated aluminum with bolted joints for all three phases, with a full neutral, and a 1/4 x 2 inch ground bus extending through all sections.
7. The framework and all other sheet metal components of the system shall be primed with a rust-inhibiting primer, and finished with two coats of satin finish ANSI 61 gray enamel, or manufacturer's standard color.
8. All door mounted control components shall be industrial type oil-tight devices with contact ratings a minimum of twice the maximum circuit ampacity they are controlling. Toggle switches and other light duty and durability control devices are not acceptable. Indicator lamps shall be high intensity LED type devices. Indicator lamp condition (on or off) shall be easily visible in bright room lighting conditions.
9. Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation or shall be indicated by mechanical flags. Barriers shall be provided to prevent inadvertent contact with any voltage of greater than 50VDC.
10. Transfer switches shall be 3-pole with a solid neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

C. Connections

1. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

2.2 TRANSFER SWITCH CONTROL

A. Operator Panel. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.

1. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
2. High intensity LED lamps to indicate that the transfer switch is "not in auto" (due to control being disabled or due to bypass switch (when used) enabled or in operation) and "Test/Exercise Active" to indicate that the control system is testing or exercising the generator set.
3. "OVERRIDE" pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.
4. "TEST" pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
5. "RESET/LAMP TEST" pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.

6. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via an operator display panel.
7. Vacuum fluorescent alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The Alphanumeric display panel shall be capable of providing the following functions and capabilities:
    a. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance. Line to neutral voltages shall be displayed for 4-wire systems.
    b. Display source status, to indicate source is connected or not connected.
    c. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
        1) Set nominal voltage and frequency for the transfer switch.
        2) Adjust voltage and frequency sensor operation set points.
        3) Set up time clock functions.
        4) Set up load sequence functions.
        5) Enable or disable control functions in the transfer switch, including program transition.
        6) Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
    d. Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall be incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
    e. Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
    f. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

B. Internal Controls
1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
2. Transfer switch voltage sensors shall be close differential type, providing source

availability information to the control system based on the following functions:

a. Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).
b. Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
c. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for voltage imbalance.
d. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for loss of a single phase.
e. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for phase rotation.
f. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).
g. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.

3. The transfer control shall incorporate a series of diagnostic LED lamps.
4. The transfer switch shall be configurable to control the operation time from source to source (program transition operation. The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature. The program/delayed transition time setting (time in which load is not connected to either source during transfer) shall be initially set at 10 seconds to allow motors to properly decay per MG-1 standard
5. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cooldown) (adjustable in a range of 0-30 minutes).
6. The transfer switch shall be configurable to accept a relay contact signal from an external device to prevent transfer to the generator service.
7. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage surge and RFI/EMI standards.
8. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

C. Control Interface

1. The transfer switch shall provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
2. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.
3. Provide one set Form C auxiliary contacts on both sides, operated by transfer

switch position, rated 10 amps 250 VAC.

4. The transfer switch shall provide additional relay contacts to indicate the following conditions: Utility Source Available, Load Connected to Utility, Generator Source Available, Load Connected to Generator, Pre-Transfer Warning (adjustable 0-59 second time delay).

2.3 ENCLOSURE

A. Enclosures shall be UL listed. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70. The cabinet door shall include permanently mounted key type latches.

B. If not specifically indicated otherwise on plans, transfer switch equipment enclosures shall meet the following minimum requirements:
   1. For dry interior locations: NEMA 1 or better (unless shown otherwise on plans).
   2. For wet interior (pump stations, etc.) or exterior locations: NEMA 3R or better (unless shown otherwise on plans).

C. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

D. Note size and access requirements for the transfer switch (and associated equipment) and provide equipment that will fit into the space allowed and comply with code-specified access requirements.

2.4 BATTERY CHARGING

A. The transfer switch/generator set combination shall be provided with a battery charger for the generator set starting batteries. Refer to Generator Sets Specification Section 26 32 13 for specific requirements. Supply power failed indication shall be displayed on the ATS control panel.

2.5 SEQUENCE OF OPERATION

A. Programmed (Delayed) Transition Sequence of Operation
   1. Normal State:
      a. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is connected to source 1 (connected to the utility), and no start signal is supplied to the genset.
   2. Normal Power Failure and Restoration:
      a. When the transfer switch senses a power failure on source 1, it shall complete a pre-programmed time delay start sequence, and then send a start signal to the generator set.
      b. The generator set shall immediately start and accelerate to rated voltage and frequency.
      c. If the generator set fails during this period and normal source is available, the transfer switch shall automatically reconnect the system loads to the normal service.
      d. The transfer switch shall operate the generator set unloaded for a

cooldown period, and then remove the start signal from the generator set.

3. Generator Set Exercise (Test) With Load Mode (Delayed (programmed) Transition). The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:
   a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
   b. The transfer switch shall issue a compatible start command to the generator set as follows:
      1) On generators rated 50kW and greater, the transfer switch shall cause the generator set to start and run at idle until it has reached normal operating temperature. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
      2) On generators rated less than 50kW, the generator set shall immediately start and accelerate to rated voltage and frequency.
   c. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard). The timing sequence for the contact operation shall be programmable in the controller.
   d. The generator set shall operate connected to the load for the duration of the exercise period.
   e. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard). The timing sequence for the contact operation shall be programmable in the controller.
   f. The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set.
   g. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.
   h. If the generator set fails during the exercise period and normal source is available, the transfer switch shall automatically reconnect the system loads to the normal service.
4. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:
   a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
   b. The transfer switch shall issue a compatible start command to the

generator set as follows:

1) On generators rated 50kW and greater, the transfer switch shall cause the generator set to start and run at idle until it has reached normal operating temperature. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
2) On generators rated less than 50kW, the generator set shall immediately start and accelerate to rated voltage and frequency.

c. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.

d. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

PART 3 - EXECUTION

3.1 POWER COMPANY APPROVAL

A. The transfer switch shall be designed to meet all applicable power company requirements for connection to the power company's system, and if applicable, shall be on the power company's approved list of automatic transfer switches. Contractor shall ensure that transfer switch is specifically approved by power company for connection to their system prior to purchasing the transfer switch.

3.2 FACTORY TESTING

A. The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be submitted. Test process shall include calibration of voltage sensors.

3.3 SERVICE AND SUPPORT

A. The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The transfer switch shall be serviced by a local service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

D. After generator set installation, the generator set supplier shall conduct a complete operation, basic maintenance, and emergency service seminar for up to 5 persons employed by the facility owner. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures. The class duration shall be at least 4 hours in length, and include practical operation with the installed equipment.

3.4 WARRANTY

A. The automatic transfer equipment shall be warranted (by the generator supplier when a generator is supplied within the project) for a period of not less than 2 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION 26 36 23

SECTION 26 50 00 – LIGHTING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Lighting
B. Ballasts/Drivers
C. Lamps

1.2 SUBMITTALS

A. Complete submittals shall be provided identifying all lighting fixture types and options, all lamp types (where applicable) and compliance with all contract requirements. The absence of clear submittal information specifically listing exceptions/deviations from detailed contract requirements will be understood to indicated that the contractor/supplier intends to meet all contract requirements. Refer to specification section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Lighting fixtures shall be furnished as shown on plans and specified herein. It shall specifically be the responsibility of Contractor to verify exact types ceilings, walls, etc. and recessing depth of all recessed fixtures and furnish the specific mounting trims and accessories of the specified and/or accepted fixture specifically for the ceiling, wall etc. in which each fixture is to be installed.
B. Base bid manufacturers are listed on the lighting fixture schedule. Manufacturers listed without accompanying catalog numbers are responsible for meeting the quality standards, efficiency, maximum wattages and photometric distributions set by the specified product.
C. All lighting fixtures shall be so designed and shall have ballasts, drivers and other similar items so installed as to function without interruptions or failures when operating in the environment in which they are proposed to be installed. Special attention shall be given to environments with potentially high ambient temperatures such as attic spaces, exterior soffits, confined interior soffits, coves, unconditioned spaces, etc. and shall be addressed by providing fixtures with suitable high ambient temperature ratings, remote mounting of drivers/ballasts, providing approved ventilation, etc. as directed by fixture manufacturer and approved by engineer, at contractor's expense.
D. All fixtures installed such as to create penetrations through fire rated ceiling or wall assemblies shall be labeled as suitable for that purpose or installed with covers, tenting or other means as required to maintain the fire rating of the assembly.

2.2 LED LUMINAIRES

A. For the purpose of these specifications, LED Luminaires shall be defined as the entire LED fixture assembly including LED array, drivers, housing, electronics, etc. that compose the lighting fixture.
B. Furnish and install LED Luminaire of proper size, type, efficacy, delivered lumen output, color temperature, distribution pattern, operational life, and CRI as shown on drawings.
C. LED Luminaires shall be tested in accordance with LM-79 and LM-80 standards.

D. LED drivers shall comply with NEMA 410 standards for inrush current, etc.

E. Exterior, pole mounted LED Luminaires shall be provided with an easily-serviceable, UL recognized surge protection device that meets a minimum 10kA Category C Low operation (IECC C62.41.2-2002). Device shall be wired in front of light engine(s) and driver(s) and shall fail "open" such as to prevent fixture operation after a surge protection failure.

F. LED Luminaires shall have a guarantee-warranty of at least five years unless specifically noted otherwise on contract documents.

G. LED Luminaire assembly shall comply with ambient temperature requirements specified in General section above.

2.3 MANUFACTURER

A. Fixtures and stems shall be manufactured as shown in fixture schedule or approved equals.

B. Ballasts/drivers shall be as manufactured by Philips/Advance, GE, Lutron, Magnatec, Motorola, EldoLED or approved equal.

C. Lamps shall be as manufactured by General Electric, Sylvania, Philips or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Support:

1. Support of all lighting fixtures shall be responsibility of electrical contractor. All lighting fixture supports shall be installed in accordance with lighting fixture supplier's recommendations.

B. Coordination:

1. Contractor shall coordinate all dimensions & locations of light fixtures prior to rough-in to insure proper fit and coordination with other trades.
2. Contractor shall verify exact ceiling types being installed and shall adjust fixture trim types accordingly (prior to submitting light fixture shop drawings).

END OF SECTION 26 50 00

SECTION 27 05 00 – AUXILIARY SYSTEM CABLES, 0-50V

PART 1 - GENERAL

1.1 DESCRIPTION

A. Cables rated for 0V-50V application

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless specified otherwise, all cables within the scope of this specification section shall:
   1. Be rated for exposed cable tray installation.
   2. Be plenum rated (Class 1 Control cabling and Instrumentation cabling installed in conduit or exposed in cable tray in non-plenum areas is not required to be plenum-rated).
   3. Be UL-rated for the proposed application.
   4. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation. Conductors with green insulation shall not be used for conductors other than ground.
   5. Utilize copper conductors.
   6. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
   7. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
   8. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.

2.2 INSTRUMENTATION CABLING

A. In addition to above requirements, and unless specified otherwise, Instrumentation cabling shall:
   1. Be #16awg minimum.
   2. Be rated for 300V.
   3. Have aluminum foil shielding.
   4. Have stranded, twisted conductors.
   5. Have PVC insulation/jacket with ripcord.
   6. Be manufactured by Belden, AlphaWire or General Cable.

2.3 CLASS 1 CONTROL CABLING (120VAC CONTROL CIRCUITS, ETC.)

A. In addition to above requirements, and unless specified otherwise, Class 1 control cabling shall:
   1. Be rated for 600V.
   2. Be industrial grade.
   3. Have stranded conductors.
   4. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.
   5. Be manufactured by Belden, AlphaWire or General Cable.

2.4 CLASS 2 & 3 CONTROL CABLING (FED FROM CLASS 2 OR 3 POWER SUPPLIES)

A. In addition to above requirements, and unless specified otherwise, Class 2 & 3 control cabling shall:
   1. Be rated for 300V.
   2. Be shielded if so recommended by the system supplier/integrator.
   3. Have twisted conductors.
   4. Have plenum-rated insulation/jacket with ripcord.
   5. Be manufactured by AlphaWire, Belden, General Cable, Superior Essex or West Penn.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Routing:
   1. All wires and cables shall be installed in conduit unless specifically noted otherwise. Where conduit is not otherwise required by contract documents, 0-50V Cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
      a. Cabling is plenum-rated, multi-conductor.
      b. Cabling is supported by cable tray or with J-hook supports on intervals not to exceed 5'-0" on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
      c. Cabling is neatly formed, bundled and tied with plenum-rated Velcro straps on intervals not to exceed 30" on center.
      d. Properly-sized conduit(s) are provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings, within walls or through walls).
      e. Cabling is not a part of a Fire Alarm System, Smoke Control System, Emergency Generator Control System or other life-safety related system.
   2. End bushings shall be provided on both ends of all raceway terminations.
   3. No splices shall be pulled into conduit.
   4. No cabling shall be pulled until conduit is cleaned of all foreign matter.

B. Penetrations:
   1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.
   2. For cabling not installed in conduit:
      a. Fire/smoke barrier penetrations shall be sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.
   3. For cabling installed within conduit from endpoint to endpoint:
      a. Fire/smoke barrier penetrations shall sealed utilizing fire caulk or other equivalent firestop systems around perimeters of conduits per UL

requirements.

C. Excess Cabling:
   1. Excess cabling shall be neatly coiled within all junction boxes, pullboxes, wireways, etc. and at all terminations as required to allow future re-termination of cabling.

D. Terminations:
   1. All conductors/cabling (including spare conductors) shall be properly terminated unless specifically directed otherwise. See below for general termination hardware requirements.
   2. Cabling shall be neatly formed, bundled and tied at all terminations.

3.2 SPLICES/CONNECTIONS/TERMINATIONS:

A. Control Cabling:
   1. Connections shall be made with T & B Sta-Kon wire joints EPT66M, complete with insulating caps. To be installed with WT161 Tool or C nest of WT11M Tool, Ideal Super - Nuts (not wire nuts), Ideal Wing Nuts, or Buchanan Elec. Products B Cap or Series 2000 Pressure connectors complete with nylon snap on insulators to be installed with C24 pressure tool.

B. Shielded cabling:
   1. Unless directed otherwise by the system supplier, 0-50V cable shielding shall be grounded at the PLC/control panel end only (not at the field device end) with a termination kit as directed by the PLC/control panel supplier.
   2. Shielded cabling shall be continuous from endpoint to endpoint and shall not be spliced without prior written approval from the Engineer.

3.3 LABELING

A. Refer to Specification Section 26 05 53 for all labeling requirements.

END OF SECTION 27 05 00

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Erosion control best management practices (BMP's).
   2. Protecting existing trees and vegetation designated to remain.
   3. Clearing and grubbing.
   4. Topsoil stripping.
   5. Demolition of existing above-grade and below-grade site improvements.
   6. Disconnecting, capping or sealing, and abandoning site utilities in place.
   7. Demolition of existing site utilities.

1.3 MATERIALS OWNERSHIP

A. Anything of value found during the progress of the work, as determined by the Owner, shall become the property of the Owner.

B. Except for anything of value, materials indicated to be stockpiled or materials indicated to remain the Owner's property, cleared materials shall become the Contractor's property, be removed from the site and legally disposed of by the Contractor.

1.4 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
   1. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
      a. Use sufficiently detailed photographs or videotape.
      b. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction over the site.

B. Limit of Construction Activity: Unless specifically authorized by the Owner, the Contractor shall confine all construction activity within the boundary of the Project property, adjacent public rights-of-way and prescribed rights-of-way or easements. Work within

public rights-of-way is subject to permit. If clearing and grubbing limits are indicated, the Contractor shall confine all construction activity within those limits.

C. Improvements on Adjoining Property: Authority for performing any indicated work on property adjoining the Owner's property shall be obtained by the Owner before award of the Contract.

D. Items to be Salvaged: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

E. The Contractor shall utilize utility locator services for the Project site before any site clearing work is commenced.

PART 2 - PRODUCTS

2.1 EROSION CONTROL MATERIALS

A. Silt Fence Materials: Silt fences shall consist of a geotextile filter fabric attached to posts by means of adjustable belts or loops or other means that will securely hold the fabric in an upright position. The filter fabric shall be a polymeric fabric formed from a plastic yarn of long-chain synthetic polymer composed of at least 85% by weight of propylene ethylene, amide, ester or vinyledene chloride and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure for at least six months. The filter fabric roll shall be a minimum of three feet in width.

1. The filter fabric shall conform to the following physical requirements:

Physical Property	**Test Method**	**Test Results**
Grab Tensile Strength, lbs, min.	ASTM D-4632	120
Grab Elongation, %, max.	ASTM D-4632	40
Mullen Burst Strength, psi, min.	ASTM D-3786	175
Apparent Opening Size, max., U.S. Standard Sieve	ASTM D-4751	30
Flow Rate, max. gal/minute/ft^2	ASTM D-4751	30
UV Resistance, %, min.	ASTM D-4632 ASTM D-4355	70

B. Riprap Materials:

1. Riprap shall be limestone conforming to the requirements of ALDOT Specifications Section 814.01, Class 2 Riprap (unless otherwise specifically shown on Drawings).
2. Riprap bedding, where required, shall consist of gravel or crushed stone ALDOT Size #467. All stone for riprap and bedding, such as shot rock, quarry rock, quarry waste or other materials, shall be sound, durable, and free from seams, cracks or other structural defects.

C. Grouted-In Riprap Materials: Riprap stone to be grouted in place shall be of the same size

and placed in the same manner as specified for riprap. Grout for grouted-in riprap shall consist of 1 part hydraulic cement to 3 parts sand, thoroughly mixed with water to produce a thick, creamy consistency.

D. Geotextile Riprap Bedding Materials: The geotextile shall be of nonwoven construction. The geotextile shall be mildew, insect, and rodent resistant and shall be inert to chemicals commonly found in soil.

1. The geotextile shall conform to the physical property requirements listed in the table below:

Physical Property	**Test Method**	**Test Results**
Grab Tensile Strength, lbs, min.	ASTM D-4632	120
Puncture Strength, lbs, min.	ASTM D-4833	70
Grab Elongation, %, max.	ASTM D-4632	50
Mullen Burst Strength, psi, min.	ASTM D-3786	240
Apparent Opening Size, max., U.S. Standard Sieve	ASTM D-4751	70
Flow Rate, max. gal/minute/ft^2	ASTM D-4751	135

2. The geotextile shall be furnished in a protective wrapping which shall protect the fabric from ultraviolet radiation and from abrasion due to shipping and handling. The fabric shall be ultraviolet stabilized.

E. Hay Bale Materials: Hay bales shall be rectangular and may be either hay or straw securely bound with twine or wire. Bales shall contain a minimum of 5 cubic feet of material and shall weigh a minimum of 35 pounds when dry.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain and to be protected. All work shall be performed within the limits shown.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.2 EROSION CONTROL BEST MANAGEMENT PRACTICES (BMP's)

A. General:

1. The Contractor shall utilize erosion control best management practices (BMP's) to prevent the discharge of sediment-bearing water runoff or airborne dust from the project site in accordance with all federal, state and local regulations during

construction.

2. The Contractor shall be responsible for obtaining an NPDES Permit for stormwater discharge from the construction site(s) for all work described in these Specifications and shown on the Drawings. It shall be the Contractor's responsibility to meet all requirements and obligations of the Permit. The Contractor shall be responsible for all costs associated with making application for the permit and for meeting the requirements of the Permit.
3. The Contractor shall be responsible for the inspection and maintenance of all BMP's in accordance with the requirements of the permitting authority.
4. The Contractor shall ensure that all downslope BMP's are installed and functional before any land disturbing activity is commenced on any portion of the site.
5. The Contractor shall be responsible for the installation and maintenance of additional BMP's if required by field conditions, the Engineer or a permitting authority having jurisdiction over the site.

B. Silt Fence:

1. The installation of silt fences shall be in conformance with the silt fence manufacturer's recommendations. Particular care shall be exercised to ensure that all silt fencing is properly keyed into the earth at the toe.
2. The Contractor shall maintain, clean, repair or replace silt fence as may be required during the construction period. If a line of silt fencing exceeds its capacity to function properly and the need for a back-up fence becomes evident, the Contractor shall install a secondary line of silt fence at the affected area as required and authorized by the Engineer. Failure to maintain a silt fence shall not be cause for the Contractor to claim additional compensation.

C. Riprap:

1. Placement: Riprap shall be placed in accordance with ALDOT Specifications Section 610 for Class 2 riprap. Riprap shall be placed in such a manner as to produce a reasonably well graded mass or rock having the minimum practical percentage of voids. Riprap shall be placed to its full course thickness in one operation, and in such a manner as to avoid displacement of bedding material if bedding is required. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. The dumping of riprap shall be allowed provided that riprap bedding material, if required, is not displaced and that mechanical equipment is used to dress the stones to a reasonably uniform slope.
2. Riprap placed in unauthorized locations without prior approval of the Engineer shall be considered to have been wasted, and, therefore, placed at no cost to the Owner.
3. The Contractor shall maintain all riprap protection until the project is accepted, and any material displaced by any cause prior to acceptance of the project shall be replaced at the Contractor's expense.

D. Grouted-In Riprap:

1. Care shall be exercised during placement to keep fine materials from filling the voids between the stones.
2. After the stones are in place, the voids between them shall be completely filled with grout from bottom to top and the surface swept with a stiff broom.
3. No riprap shall be grouted in freezing weather. In hot, dry weather the grout work shall be protected and kept moist for at least 3 days by the use of saturated

burlap.

4. Grouted-in riprap placed in unauthorized locations without prior approval of the Engineer shall be considered to have been wasted, and, therefore, placed at no cost to the Owner.
5. The Contractor shall maintain all grouted-in riprap protection until the project is accepted, and any material damaged or displaced by any cause prior to acceptance of the project shall be replaced at the Contractor's expense.

E. Geotextile Riprap Bedding: The fabric shall be placed in the manner described and in accordance with the manufacturer's recommendations.

1. The surface to receive the geotextile shall be prepared to a smooth condition free of obstructions, depressions and debris.
2. The fabric shall be placed loosely, not in a stretched condition.
3. The riprap shall be carefully placed so that the geotextile is not punctured.
4. The riprap shall completely cover the fabric.
5. The fabric shall be placed on the slopes so as to provide a minimum overlap of 18 inches at seams.
6. The geotextile may be placed with seams either parallel or perpendicular to the direction of the flow. If placed perpendicular to the flow, the upstream or higher panel shall overlap the downstream or lower panel. At the top of the bedding installation the fabric shall be keyed into the ground a minimum of 18 inches.
7. If a cushion layer is required, the bottom toe shall be finished by lapping the fabric back onto the cushion layer and securing with riprap.

F. Hay Bales: Hay bales shall be installed using keyways cut into grade or aggregate fill bedding as required. All hay bales shall be properly oriented and staked. Hay bales shall be removed and properly disposed of when the project area upslope from them has been stabilized.

1. The Contractor is responsible for the periodic checking and maintenance of hay bale installations. Silt trapped by hay bale installations shall be removed and properly disposed of.

G. Rock Check Dams: Rock check dams shall be carefully installed in the drainage ditch. Rock check dams shall be removed and properly disposed of when the project area upslope from them has been stabilized.

1. The Contractor is responsible for the periodic checking and maintenance of rock check dam installations. Silt trapped by rock check dam installations shall be removed and properly disposed of.

H. Sediment Traps: Sediment traps shall be backfilled and any associated granular material removed and properly disposed of when the project area upslope from them has been stabilized.

1. The Contractor is responsible for the periodic checking and maintenance of sediment trap installations. Silt trapped by sediment trap installations shall be removed and properly disposed of.

I. Temporary Sediment Basins: Temporary sediment basins which are installed at locations other than permanent storm water detention basins shall be backfilled and any associated granular material removed and properly disposed of when the project area contributing runoff to them has been stabilized.

1. Permanent storm water detention basins with temporary modifications to their outlet structures may serve as temporary sediment basins. The Contractor shall remove the temporary outlet structure modifications and properly dispose of the

associated materials when the project area contributing runoff to the permanent storm water detention basin has been stabilized.

2. The Contractor is responsible for the periodic checking and maintenance of temporary sediment basin installations. Silt trapped by temporary sediment basin installations shall be removed and properly disposed of.

J. After stabilization of the disturbed area has been achieved, the Contractor shall remove and dispose of all temporary BMP's and dress out those areas to the proper line and grade.

3.3 PROTECTION OF DESIGNATED VEGETATION OR INDIVIDUAL TREES

A. The Contractor shall erect and maintain a clearly marked temporary fence around designated areas of the site, the perimeter drip line of groups of trees or the drip line of individual trees designated to remain and be protected.

1. Do not store construction materials, debris, or excavated material within the above-described fenced areas.
2. Do not permit vehicles, equipment, or foot traffic within the above-described fenced areas.
3. Remove temporary fencing around the above-described areas upon substantial completion.

B. Where excavation for new construction is required within areas designated to remain and be protected, the Contractor shall hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to the excavation limits as possible.

1. Cover exposed roots with burlap and water regularly.
2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
3. Clean cut limbs which obstruct the work. Minimize limb cutting as much as practicable.
4. Coat cut faces of roots or limbs more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
5. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.

C. Repair or replace trees and vegetation indicated to remain and be protected that are accidentally damaged by construction operations.

1. Replace trees that cannot be repaired and restored to full-growth status, as determined by the Engineer.

3.4 UTILITIES

A. The Contractor will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.

1. Contractor shall coordinate with utility companies to shut off indicated utilities.
2. Contractor shall arrange for utility company to locate, identify, disconnect, and seal or cap off utilities indicated to be removed, or shall receive written permission from utility companies to perform work.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify utility companies in accordance with their policies in advance of any proposed utility interruption.
2. Do not proceed with utility interruptions without written permission from the Engineer.

3.5 CLEARING AND GRUBBING

A. Clearing and grubbing shall consist of cutting, removing and disposal of all trees, tree stumps, brush, grass, roots and other organic material within areas to be subject to earthwork and/or occupied by proposed structures or facilities. If clearing and grubbing limits are indicated, those lines shall define the extent of clearing and grubbing activity on the site.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated. Contractor shall replace all damaged tees, shrubs, or other vegetation at no cost to the Owner.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
   3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
   4. Roots projecting from the walls of excavations shall be either cut or removed to provide a minimum clearance of 3 feet for the outside line of structures.

B. Fill depressions caused by clearing and grubbing operations with fill material in accordance with Division 2 Section “Earthwork” unless area is designated for further excavation.

3.6 TOPSOIL STRIPPING

A. Strip topsoil to the depths indicated in the geotechnical report or a minimum depth of 6 inches.
   1. The stripping layer may include topsoil, muck, trash, debris, grass, weeds, roots and other organic materials.
   2. The stripping process should result in a clean subgrade surface free from organic material and ready for earthwork operations.

B. Stockpile topsoil materials in areas which will prevent intermixing with subgrade or fill soils. If topsoil is stockpiled on site, the stockpile locations must be acceptable to the Engineer and the Owner. Stockpile locations shall allow for access for the re-loading and spreading of topsoil.
   1. Grade and shape stockpiles to drain surface water.
   2. Stockpiles shall be protected from wind erosion by periodic water sprinkling, covering or temporary seeding.
   3. Dispose of excess topsoil as specified for waste material disposal.

3.7 DEMOLITION OF EXISTING SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate construction. Break holes in structures as required to prevent collection of groundwater.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

C. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.8 DISPOSAL

A. Disposal: The Contractor shall remove cleared vegetation, surplus soil material, surplus topsoil, demolition debris, and waste materials including trash and dispose of them off of the Owner's property. All disposal shall conform to all applicable federal, state and local regulations.

B. Disposal of Wood Chips: If permitted by the Owner, processed wood chips may be left on the site. The location of wood chip stockpiles or spreading areas shall be as designated by the Owner.

C. Disposal by Burning: The burning of material on the Project site, when permitted by the Owner, shall be performed in accordance with the "Air Pollution Control Rules and Regulations" of the Alabama Department of Environmental Management (ADEM) and with the "Air Pollution Control Rules and Regulations" of the County Department of Health. The Contractor shall secure written approval of burning and the proposed method of burning from the County Health Officer or appropriate local authority before any burning is commenced.

1. The burning of stumps, timber, logs, trimmings, brush, or other combustible materials where allowed shall be accomplished in such a manner that there shall be no smoke or flyash nuisance.
2. Burning shall not be initiated or continued when atmospheric conditions will cause or are causing a static smoke cover in the area.
3. Burning shall be strictly controlled to prevent damage to trees and/or growth adjacent to the cleared area or to facilities or structures located in the surrounding area. The quantities of materials being burned shall be strictly limited to ensure that fires are within the control of the personnel and equipment present. Fires shall be attended at all times.

END OF SECTION 31 10 00

SECTION 31 20 00 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes excavation and backfill for structures, pipelines, embankments and other areas.

B. If the Owner has engaged a geotechnical engineer to investigate the subsurface conditions, then the Owner may share this information with the Contractor. However, the Contractor shall only rely on this information at their own risk, and the Contractor shall make whatever additional investigations they believe to be necessary for bidding and construction purposes. If the Contractor desires to make their own investigations prior to bidding the project, then the Contractor shall coordinate this work with the Owner. The Owner/Engineer is not responsible for variations in subsurface conditions (soil, rock, groundwater, etc.).

1.3 DEFINITIONS

A. Backfill: Suitable soil materials used to fill an excavation.

B. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

C. Base Course: Layer placed between the subgrade and slabs-on-grade, walkways, and pavements.

D. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

E. Borrow: Suitable soil imported from off-site for use as fill or backfill.

F. Crushed Stone Backfill: Crushed stone, where specified to be used as backfill or a stone cushion for structures shall be crushed stone meeting Alabama Department of Transportation Gradation [#8910 or #410] [#57] .

G. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

H. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No. 8 sieve.

I. Excavation: Removal of material encountered above subgrade elevations.

1. Earth Excavation: Removal of all materials, not including that specified under the "Clearing and Grubbing" and "Rock Excavation" items. Rocks and boulders eight (8) cubic feet or less in volume shall be classified as earth.
2. Rock Excavation: loosening, removing, and disposing of all rock in original bed, in well defined ledges, or in boulder form. Boulders having a volume of eight (8) cubic feet or less shall not be classified as rock. Material that can be loosened, separated, or ripped by means of heavy duty power tools or excavating equipment shall not be classified as rock.
3. Additional Excavation: Excavation below subgrade elevations as directed by Engineer.

4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

J. Fill: Suitable soil materials used to raise existing grades.

K. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

M. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

N. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base, drainage fill, or topsoil materials.

O. Suitable Soils: As defined in the geotechnical report (if applicable), or the following ASTM D 2487 soil classification groups as a minimum; GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

P. Unsuitable Soils: As defined in the geotechnical report (if applicable), or the following soil classification groups as a minimum; ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols. Unsuitable soils also include suitable soils not maintained within 2 percent of optimum moisture content at time of compaction.

Q. Utilities include on-site underground pipes, conduits, ducts, and cables.

1.4 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by the Owner and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission.
   3. Contact utility-locator service for area where Project is located before excavating.
   4. All existing underground utilities may not be indicated. Contractor is responsible for locating all underground utilities before beginning excavation.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

1.5 BLASTING SUBMITTALS

A. Contractor shall submit the following items for approval (where blasting will be allowed):
   1. The name and qualifications of the blasting consultant selected for approval 30 days prior to commencement of construction.
   2. The results of the preblast survey.
   3. Blasting program and supporting data.
   4. Blasting log and reports.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient suitable soil materials are not available from excavations.

B. Structural Backfill:

1. Suitable backfill materials shall be within moisture limits required for compaction; silty-clay, weathered shale or other suitable soil mixtures; and such soils shall not contain rock or stone in sizes greater than ½".
2. Native soils as excavated from the site may be used provided that they satisfy the criteria specified herein. If native soils are unsuitable, then Contractor shall furnish and install suitable soils from off-site at Contractor's expense.
3. Material for structural and general backfill may be that excavated on the site; but in the event that the excavated material is not in suitable condition at the time when it is required for backfilling purposes, or the quantity of material excavated is not sufficient to make the finished fills indicated, the Contractor shall provide, at his own expense, such additional suitable material as is required.
4. If paved areas (or areas to be paved) abut structures, then backfill material under these areas shall be crushed stone.
5. Contractor is responsible for removing and disposing of unsuitable materials off-site, unless otherwise specifically shown to be disposed of on-site.

C. Utility Trench Bedding and Backfill:

1. Bedding Materials
   a. Where trenches are excavated in soil, bedding material shall be #57 stone to a depth of approximately 4" under barrel of pipe.
   b. Where trenches are excavated in rock, bedding material shall be #57 stone, placed and compacted to a depth of approximately 6" under barrel of pipe.
2. Backfill Materials
   a. Where trenches are excavated in soil, backfill material shall be #57 stone to ½ the depth of the pipe, then the remainder shall be suitable soil placed and compacted as described in these Specifications.
   b. #57 stone shall be used in the following locations:
      1) For backfill where trenches are excavated in rock (to a depth of 12 inches above the top of the pipe)
      2) For backfill in trenches cut in paved streets, in paved areas, areas to be paved as part of this Contract or future work, beneath footings, beneath slabs, or as specifically indicated.
      3) For backfill (to a depth of 12" above the highest pipe) in areas of general excavation (where pipe lines are installed and where, because of proximity of several pipe lines, individual trenches cannot be excavated), and in areas where two or more utilities cross.
   c. The top foot of depth of all trenches (except under slabs, footings, roads, walks and paved areas, along road shoulders and other areas where crushed stone may be specified or directed to be used) shall be backfilled with soil that can be smoothly dressed to match surface of ground adjoining the edges of the trench, and that will support the vegetation desired for the finished surface and required by the finished grading and

grassing requirements.

D. Embankment and Fill Work:
   1. The material used in embankments and fills shall be free from frost, stumps, trees, roots, sod, muck or debris of any kind.
   2. Only materials as specified herein and/or approved by the geotechnical engineer shall be used.
   3. Fill and embankment materials shall not be placed on frozen ground.
   4. Embankment and fill materials shall be provided as follows:
      a. Underneath grass and planted areas: Use suitable soils.
      b. Underneath walks and pavements: Use suitable soils.
      c. Underneath footings, foundations, building slabs, steps and ramps: Use suitable soils, crushed stone, or ALDOT #57 stone or as indicated in the geotechnical report.
      d. Dikes and/or Embankments Intended to Hold Water: Use an impervious fill such as a sandy-clay or clayey sand or as indicated in the geotechnical report.
   5. Rock greater than two (2) inches in any dimension shall not be placed in compacted fills for embankments, dikes or earth sections forming the walls of water containing structures (holding ponds, reservoirs, lagoons, etc.) unless all voids are filled with fine material and the complete fill is compacted to a dense mass as specified hereinabove.
   6. Rock greater than one (1) cubic foot in volume, or having any dimension greater than one (1) foot, shall not be placed in compacted fills in areas to be occupied by structures, bearing slabs, footings, roadways, walks, etc.
      a. Rock of permissible size deposited in such fills shall be placed in layers not greater than one (1) foot in depth, and such rock layers shall be separated by not less than one (1) foot (compacted thickness) of clay or other acceptable backfill material.
      b. Rock shall not be placed nearer than two (2) feet to the surface of any fill, nor nearer than three (3) feet to the wall or surface of any structures.
   7. Rock shall not be placed in fill areas which pipes, conduits, cables, etc., are to be laid, nor shall rock be placed in trench backfill except as described in these Specifications.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways in accordance with Division 2 Section “Site Clearing.”

3.2 SITE DRAINAGE

A. Prevent surface water and ground water from entering excavations, from ponding on

prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
   2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.
   3. The Contractor shall complete all dewatering operations and dispose of the water from the work in a manner that will not cause damage to adjacent properties or environment, nor restrict access to any new or existing facilities. No water shall be drained into work under construction.
   4. The Contractor shall keep excavations and work dry until the structures or facilities to be constructed are completed and the Engineer is in agreement with the Contractor to discontinue dewatering operations.

C. Drainage Ditches:
   1. New ditches shall be cut and existing ditches shall be cleaned out and extended as required to provide for surface drainage around structures and to divert water away from excavations.
   2. New (permanent) ditches:
      a. Flowlines shall be graded as indicated.
      b. The cross-sections of the ditches shall conform to details specified.
   3. Temporary ditches:
      a. When temporary ditches have served their purpose, all such ditches shall be filled and finished to conform to existing contours or finished contours.
      b. It shall be the Contractor's responsibility to provide and maintain drainage ditches during the progress of the work.

3.3 EXPLOSIVES

A. Explosives: The use of explosives will be allowed. Contractor must obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
   1. It shall be the sole responsibility of the Contractor to observe all laws and regulations relating to explosives, including but not limited to all federal laws, all OSHA regulations, and all state and local laws, regulations and ordinances applicable to explosives.
   2. Persons responsible for blasting shall be present and supervise all blast design, loading, and shot firing.
   3. All blasting shall be done by competent experienced blasters.
   4. Persons responsible for directing blasting operations shall have sufficient insurance to cover the responsibilities associated with blasting operations.
   5. The successful bidder shall carry sufficient liability insurance to cover damages and claims caused by his actions or those of his employees. This coverage shall apply, but shall not be limited to, all properties or persons on, or adjacent to, the site of the construction activity that might be damaged or injured as a result of blasting operations.
   6. All laws and regulations pertaining to blasting, if more stringent than specified

herein, shall become the minimum standards.

7. The Contractor shall be solely and completely responsible for the conditions on, in or near the job site, including safety of all persons and property during performance of the work.
8. The required duty of the Engineer to conduct construction review of the Contractor's performance does not, and is not intended to, include review of the adequacy of the Contractor's safety measures in, on or near the construction site.
9. Precautions shall be exercised at all times by the Contractor for the protection of persons, employees and property.
10. The observation of safety provisions of applicable laws and local building and construction codes shall be the responsibility of the Contractor.
11. Do not damage adjacent structures, property, or site improvements or weaken the bearing capacity of rock subgrade when using explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
   1. All excavation for this Project is unclassified.
   2. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. General Rock Excavation:
   1. All rock excavated from the site shall be designated as rock spoil. Rock spoil must be removed and disposed of off-site unless Contractor receives written permission from Engineer to use it for rip rap on-site, or to dispose of it on-site in non-structural fill areas.
   2. The permission of the Owner shall be secured before any rock spoil is disposed of on site.

C. The Contractor is reminded that all excavation is under the protective guidelines and requirements of OSHA "Safety and Health Regulation for Construction", as set forth in the Federal Register, latest revision, and all such protections are the responsibility of the Contractor and shall be provided at the Contractor's expense.

3.5 SHEETING, SHORING, AND BRACING

A. Sheeting, shoring, bracing and sloping are methods of excavation, and such methods may vary according to the Contractor's methods of dewatering, excavating and installing the work.

B. All such methods of accomplishing the work are the sole responsibility of the Contractor, in accordance with the OSHA guidelines referred to hereinabove, and the sole responsibility of the Engineer is to review the finished work for compliance with the requirements of the Plans and Specifications.

3.6 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Earth Excavation for Footings, Foundations, and Floor slabs: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing

concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

a. In the event that, at the elevation indicated, soil over the general area to be occupied by a bearing slab is found to be unsuitable for supporting the design load, the Contractor shall remove such soil and replace it with backfill material (compacted as specified herein), crushed stone, or concrete as concurred with the Engineer.

b. In the event that, at the elevation indicated, soil over the area to be occupied by footings is found to be unsuitable for supporting the design load, the Contractor shall remove such soil and replace it with backfill material (compacted as specified herein), crushed stone, or concrete as concurred with the Engineer.

c. Excavations shall not be exposed to rainfall and must be protected to keep dry. Excavations that are exposed to excessive moisture must be re-worked or soil must be replaced at Contractor's expense.

2. Rock Excavation for footings, foundations, and floor slabs: Where rock is found to be the supporting material for footings, foundations, or floor slab, the Contractor shall reasonably clean the foundation area in order that proper inspection and evaluation of foundation conditions can be made.

a. If unusual conditions such as would be indicated by presence of seams, fissures or voids should be found, the Contractor may be directed to perform additional cleaning work, utilizing air jets, water jets, or other suitable methods.

b. All seams, voids or fissures found shall be filled with crushed stone of gradation suitable for the particular situation encountered.

c. In the event that, when excavation to grade line has been completed, it is found that the footing, foundation or slab would bear partly on soil and partly on rock, the rock shall be excavated to depth of six inches (6") below the gradeline indicated and/or specified herein, and a compacted crushed stone cushion shall be placed on the rock surface before the concrete is poured. The compacted cushion shall be wetted before placement of concrete.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. All trenches for pipe shall be excavated in open cut to such depths as indicated or as required to secure the specified minimum cover over the pipe.

B. Where trenches are excavated in native soil, excavation shall be carried to a depth of approximately 4" under barrel of pipe for placement of the specified bedding material.

C. The trench shall have a uniform cross section and bottom conforming to the grades as indicated.

D. The pipe shall be laid on firmly compacted approved bedding material, and the barrel of the pipe shall have uniform bearing for its full length.

E. Any part of the trench excavation below the grade specified shall be corrected with bedding material placed and compacted in accordance with the requirements of these Specifications.

F. Where unsuitable or unstable material is encountered at the elevation indicated, the Contractor shall excavate below the grade (or elevation) shown and backfill such excavation with bedding or stabilizing material.

G. Boulders and large stones, rock or shale, shall be removed to provide a clearance of at least six (6) inches below all parts of the pipe or fittings and to clear width of at least six (6) inches on each side of all pipe and appurtenances.

H. Where the trench is excavated in rock or shale, the six (6) inch space below the pipe shall be filled with crushed stone firmly compacted in accordance with these Specifications to form a cushion for the pipe.

I. Bell holes of ample dimensions shall be dug to permit joining to be properly made and to insure that the pipe is evenly supported throughout its length rather than on joints or couplings.

3.8 SUBGRADE

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Engineer.

B. In the event that the Contractor should excavate below the grade specified, and excess excavation is not authorized by the Engineer, such excess excavation shall be backfilled to the grade specified and/or indicated with compacted crushed stone or compacted backfill material. All such backfilling of excess excavation shall be done at the Contractor's expense.

C. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
2. Stockpile soil materials in a manner that will not cause damage to adjacent properties or environment, nor obstruct access to any new or existing facilities.
3. Drainage lines shall not be obstructed nor shall natural drainage of the surrounding ground be altered or obstructed.
4. If Contractor mixes suitable and unsuitable soil materials, then Contractor shall furnish and install equivalent amount of suitable materials from off-site at no additional cost to the Owner.

3.11 BACKFILL, EMBANKMENTS, AND FILL WORK

A. General: Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for record documents.
   3. Inspecting and testing underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.
   7. Embankments and fills shall not be started without the concurrence of the Engineer.
   8. If embankment or fill is to be placed on a surface which slopes more than 4:1, the surface shall be scarified and compacted to provide bond with the new material.
   9. Steep slopes may require the existing surface to be benched.
   10. Wet ground to be covered by fill shall be drained.

B. Compaction Requirements:
   1. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
   2. Under structures, building slabs, steps, and pavements, scarify and recompact top 6 inches of existing subgrade and each layer of backfill or fill material at 98 percent.
   3. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 95 percent.
   4. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 90 percent.
   5. Place base course material over subgrade.
   6. Compact base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 1557.
   7. Shape base to required crown elevations and cross-slope grades.
   8. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
   9. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

C. Drainage Courses: Under slabs-on-grade, place drainage course on prepared subgrade and as follows:
   1. Compact drainage course to required cross sections and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698.
   2. When compacted thickness of drainage course is 6 inches or less, place materials
   3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.12 STRUCTURAL BACKFILL

A. General:
   1. Backfill shall be made around the walls of the structures as indicated; and backfill shall be placed only after the walls have gained sufficient strength to support the

load.

2. No rock shall be placed in fill within three (3) feet of the walls of structures.
3. In all fill work the best dirt shall be used as top soil for any planting, sprigging, or sodding that may be required.
4. Backfill material shall be placed within foundation walls, under footings or slabs, under and around piping installed under footing or slabs, under and around piping located in areas of general excavation (where because of proximity of several pipe lines individual trenches could not be excavated) as indicated.
5. All such backfill material for purposes specified hereinabove, whether obtained from suitable on-site soils, crushed stone, or from suitable off-site soils, shall be furnished and placed by the Contractor at the Contractor's expense.
6. The Contractor shall be responsible for maintenance of the backfill; and shall promptly re-work and/or refill any areas where settlement of backfill has occurred.
7. All backfill around structures shall be sloped and graded as indicated or as requested by the Engineer.
8. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
9. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
10. The surface of each layer shall be kept parallel to the elevation of the finished compacted fill by use of blade graders. In proximity to existing structures, leveling shall be accomplished by use of small spreaders, bulldozers, or hand method.
11. Each layer shall be compacted by use of heavy earth compaction equipment suitable for the particular type of soil/stone.
12. Each layer shall be rolled and compacted to the specified density before the succeeding layer is placed.
13. The final layer shall be brought to elevation of finished compacted fill before topsoil or pavement is placed to conform to the finished contour specified.

3.13 UTILITY TRENCH BACKFILL

A. General:

1. The Contractor shall notify the Engineer prior to backfilling any trench in which pipe has been installed.
2. No extra compensation will be allowed for backfill as specified herein.
3. Trench backfill materials shall be thoroughly compacted by means of pneumatic tampers or mechanical tampers.
4. Each layer of trench backfill shall be carried up to the same level on both sides of the pipe so as to avoid unbalanced loading.
5. Each layer of trench backfill shall be evenly compacted on both sides of pipe before the next layer is placed.
6. Backfill for pipe line trenches shall be placed in 4" layers from the bottom of the trench to a level 12" above the top of the pipe.
7. Backfill above a level 12" above the crown of the pipe shall be placed in layers not exceeding 6" in areas beneath pavement, slabs, footings, etc. and 12" in thickness elsewhere.
8. After the pipe has been covered to elevation three (3) feet above top of pipe,

backfilling may be accomplished by use of bulldozer, bucket or other mechanical equipment if carefully performed in a manner suitable to the Engineer.

9. #57 stone backfill shall extend out from either end (or side) of the paved areas, slab or footing and along the trench on a 1:1 slope.

B. Special Trench Conditions: Where the character of the soil is such that the employment of proper and adequate drainage of the work will not enable the Contractor to secure a suitable bed for the pipe, the Engineer may request the Contractor to excavate below the specified bedding depth, and backfill the excess excavation with #57 stone. Backfill throughout remainder of trench depth shall be as specified.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Provide a smooth transition between adjacent existing grades and new grades. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

C. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Owner will select a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

1. The cost of initial sampling and testing shall be bourne by the Owner.
2. Subsequent re-testing of any samples or locations failing the initial test shall be performed at the expense of the Contractor.

B. Allow testing agency to inspect and test subgrades and to test each lift of fill or backfill as frequently as recommended by the geotechnical engineer, or as recommended by Engineer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements. Contractor shall be responsible for scheduling testing at the required intervals as work progresses.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: The Contractor shall remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off of Owner's property.

B. The Contractor shall make all necessary arrangements for disposal areas, and pay all costs incidental to securing permission for their use and shall dispose of all surplus material without cost to the Owner, other than as reflected in the prices bid.

END OF SECTION 31 20 00

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes construction dewatering.

B. Groundwater conditions are likely to fluctuate. The Contractor is solely responsible for all dewatering, including groundwater, leaks from process structures, piping, and/or other sources. The Contractor is also solely responsible for making provisions to prevent flotation of structures, piping, equipment and appurtenances during construction. The Contractor shall make whatever investigations he/she deems necessary (before bidding and during construction) to quantify groundwater and to develop sufficient plans for dewatering.

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.

B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.
B. Field quality-control reports.
C. Other Informational Submittals:
    1. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.
B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.
C. Preinstallation Conference: Conduct conference at Project site.
    1. Review methods and procedures related to dewatering including, but not limited to, the following:
        a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
        b. Geotechnical report.
        c. Proposed site clearing and excavations.
        d. Existing utilities and subsurface conditions.
        e. Coordination for interruption, shutoff, capping, and continuation of utility services.
        f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
        g. Testing and monitoring of dewatering system.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
B. Project-Site Information: A geotechnical report has not been prepared for this Project and is available for information only. Contractor is responsible for test borings or other exploratory operations necessary for dewatering.
C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
    1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
   1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
   2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Monitor dewatering systems continuously.

E. Promptly repair damages to adjacent facilities caused by dewatering.

F. Protect and maintain temporary erosion and sedimentation controls.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
   1. Space well points or wells at intervals required to provide sufficient dewatering.
   2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
   1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
   1. Maintain piezometric water level a minimum of 24 inches below surface of excavation.

E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.
   1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 FIELD QUALITY CONTROL

A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.
   1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
   2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
   3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 31 23 19

SECTION 32 12 16 - HOT MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Hot-mix asphalt paving.
   2. Hot-mix asphalt patching.
   3. Hot-mix asphalt paving overlay.
   4. Asphalt surface treatments.
   5. Pavement-marking paint.
   6. Cold milling of existing hot-mix asphalt pavement.

1.2 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to the standard specification for definitions of terms.
B. DOT: Department of Transportation.
C. ALDOT: Alabama Department of Transportation.

1.3 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of the standard specifications of the state DOT.
   1. Standard Specification: Standard Specifications for Highway Construction, Alabama Department of Transportation, 2001 Edition.
   2. Standard Specification for Mix Design: Standard Specifications for Highway Construction, Alabama Department of Transportation, 1992 Edition.
   3. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
C. Job-Mix Designs: For each job mix proposed for the Work.
D. Product Data: For each type of product indicated. B. Shop Drawings: Include the following.
   1. Detail each equipment assembly, include make, model weight, and indicate installation details, dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Complete catalog information, descriptive literature, materials of construction, wheels, gears and bearing, trolley drive system, brakes, stating system, variable speed drive system, conductors (bus bar, festoon, cable reel), controls, remote control system, and accessories.
   3. Power and control wiring diagrams, including terminals and numbers.
   4. Motor nameplate data in accordance with NEMA MG 1 and include any motor modifications.
   5. Factory finish system.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.
   1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.
B. Regulatory Requirements: Comply with Alabama Department of Transportation for asphalt paving work, delivery, storage, and handling.
C. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
D. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or frozen or if the following conditions are not met:
   1. Prime and Tack Coats: Minimum surface temperature of 40 deg F (4 deg C).
   2. Asphalt Base Course: Minimum surface temperature of 45 deg F (8 deg C) and rising at time of placement.
   3. Asphalt Surface Course: Minimum surface temperature of 55 deg F (13 deg C) at time of placement.
B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4 deg C).

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Crushed Aggregate: Conforming to ALDOT Standard Specifications Section 825 for crushed aggregate base materials, Type A.

2.2 ASPHALT MATERIALS

A. Binder Course: Conforming to ALDOT Specifications Section 410.
B. Wearing Surface Course: Conforming to ALDOT Specifications Section 410.
C. Prime Coat: Conforming to ALDOT Specifications Section 401.
D. Tack Coat: Conforming to ALDOT Specifications Section 405.

2.3 AUXILIARY MATERIALS

A. Pavement-Marking Paint: Class 1, Type B (non-reflectorized) designating paint conforming to ALDOT Specifications Section 856.
B. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

2.4 MIXES

A. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes in accordance with ALDOT Specifications Section 410:
   1. Binder Course: Mix 2.
   2. Wearing Surface Course: Mix 3.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
B. Proof-roll subgrade using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
C. NotifyEngineer in writing of any unsatisfactory subgrade conditions.
D. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PLANING (MILLING)

A. Plane existing pavement surface in accordance with ALDOT Specification Section 408. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
    1. Repair or replace curbs, manholes, and other construction damaged during cold milling.
    2. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
    3. Transport milled hot-mix asphalt to asphalt recycling facility or lawful disposal facility.

3.3 PAVEMENT REPLACEMENT

A. Replaced pavement:
    1. Shall be of the same type and thickness as the original pavement
    2. However, the replaced pavement shall be at least equal to that specified herein.
B. Materials for base course under pavement shall be:
    1. Crushed stone meeting the requirements of Alabama Department of Transportation Specifications Section 825.
    2. Premixed in accordance with the requirements of Alabama Department of Transportation Specifications Section 301.03(c) And shall conform to the following requirements:
        a. Material shall be uniform in color and gradation
        b. Material shall have moisture content suitable for attainment of the desired compacted density.
C. Base course for replaced pavement shall conform to the following requirements:
    1. Thickness:
        a. Not less than that of the original pavement,
        b. Or a minimum acceptable compacted thickness of not less than 6".
        c. If the thickness of the existing pavement base should be greater than 6", the new base material shall be placed in layers not exceeding 6" in thickness.
    2. Each layer of base material shall be compacted to approximately 98% of Standard Proctor Density.
    3. Protection and maintenance of base layers prior to the placement of bituminous pavement shall be the responsibility of the Contractor.
D. Where the original pavement was of the bituminous plant mixed type:
    1. The Contractor shall replace the original pavement with hot bituminous plant mix meeting the requirements of Alabama Department of Transportation Specifications Section 411, Articles 411.01 - 411.02.
    2. Construction of the replaced pavement shall conform to the requirements of

Alabama Department of Transportation Specifications Section 410, Articles 410.01 - 410.07.

3. A prime coat shall be placed prior to the placement of the bituminous plant mix, and prime coat shall conform to the requirements of Alabama Department of Transportation Specifications, Section 401.
4. Thickness of layer of plant mix (Mix A) shall be equal to that of the original pavement, but shall not be less than 2½" (+-1/4") in thickness.

E. Where the original pavement was of the bituminous surface treatment type:
1. The Contractor shall replace the original pavement with double surface treatment type conforming to the requirements of Alabama Department of Transportation Specifications Section 401, Articles 401.01 - 401.04
2. Pavement shall be of Type AL in accordance with Bituminous Treatment Table, Article 401.01(b).
3. The Contractor, at his or her option, may elect to replace the surface treatment type with plant mix type as specified hereinabove.
4. In such case, thickness of replaced pavement shall be approximately 1" (approximately 105#/SY).

F. Replacement of bituminous surface course in the City of right-of-ways or Highways shall conform to the following requirements:
1. The Contractor shall pour an eight (8") inch concrete slab in accordance with details shown on the Drawings.
2. Backfill under this eight (8") concrete slab shall be crushed stone as described in BACKFILL FOR TRENCHES.
3. Concrete shall be Class "A" concrete, as defined in these Specifications.
4. If the pavement is to be opened to traffic in less than 14 days,
    a. High-Early Strength Portland Cement shall be used in the concrete mixture.
    b. If Type I Portland Cement is used, the cement factor shall be increased to 7 bags per cubic yard and the quantity of water set to give slump of 2" or less.
5. Where bituminous pavement is cut in private drives or areas outside of public Right-of-Ways, the eight (8") inch slab may be omitted if approval of the Public Authority having jurisdiction over such matters is obtained in writing.
    a. If the concrete slab is omitted, the Contractor shall replace bituminous surface courses in accordance with these Specifications.
6. Upon placement of the concrete slab, and after allowance of sufficient time for curing:
    a. The surface of the concrete slab be primed in accordance with Section 402 of the ALDOT Specifications.
    b. A tack coat shall be thoroughly applied to the edge of the existing pavement at the sides of the patch by utilizing the same material used for prime coat on the concrete slab.

G. Should the Contractor delay or postpone the final paving over the trenches, he shall provide a temporary wearing surface for service until such time as the final paving replacement is performed.
1. Temporary paving shall conform to the following requirements:
    a. Paving shall be bituminous surface treatment type, single or double, or layer of bituminous mix, according to the Contractor's judgment as to the

time interval between temporary and final paving.

b. It shall be the Contractor's responsibility to maintain the temporary paving in such condition as to prevent hindrance or hazard to traffic.

c. When final paving is undertaken:

1) The temporary surfacing materials shall be removed to accommodate final paving of types and thicknesses as specified hereinabove.

2) The edges of the existing paving shall be neatly and uniformly trimmed

3) The permanent pavement shall be placed.

4) No extra compensation will be allowed for provision and maintenance of temporary paving.

H. Where the pipelines traverse or cross streets, highways, roads or driveways:

1. The Contractor shall conduct his construction operations in such a manner as to minimize interference with traffic and public convenience.

2. All travelways (highways, roads, streets, driveways, etc.) adjacent to or in the vicinity of the construction work shall be kept free from soil or mud resulting from wash or other movement of stored excavated materials or from transport of materials associated with the construction work.

3. It shall be the responsibility of the Contractor to employ such measures as would reasonably prevent the development of traffic hazards and/or air pollution resulting from his construction operations, such as:

a. Cleaning and washdown of paved surfaces.

b. Sprinkling of unpaved streets affected by his construction operations.

I. Paving replacement on Public Rights-of-Way:

1. Shall meet the requirements of the Public Authority having jurisdiction

2. Shall be subject to inspection and acceptance by the Public Authority having jurisdiction.

3.4 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.

2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching Single Course Asphalt: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

E. Patching Multi-Course Asphalt: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
   1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course in accordance with ALDOT Standard Specification Section 401.

D. Tack Coat: Apply uniformly to surfaces of existing pavement or binder course in accordance ALDOT Standard Specification Section 405.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 PAVING GEOTEXTILE INSTALLATION

A. Paving geotextiles shall be placed shall be placed in accordance with ALDOT Standard Specification 607.

3.7 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface in accordance with ALDOT Standard Specification Section 410. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

3.8 JOINTS

A. Construct joints in accordance with ALDOT Standard Specification Section 410. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 180 deg F (82 deg C).
B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
   1. Average Density: 94 percent of reference laboratory density according to AASHTO T 209, but not less than 92 percent nor greater than 96 percent.
   2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 1559 (Marshall Method), but not less than 90 percent nor greater than 96 percent.
D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Binder Course: Plus or minus 1/4 inch.
   2. Surface Course: Plus or minus 1/4 inch.
B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 16-foot straightedge applied transversely or longitudinally to paved areas:
   1. Surface Course: 1/4 inch.

3.11 SURFACE TREATMENTS

A. Slurry Seals: Apply slurry coat in accordance with ALDOT Standard Specification Section 402.

3.12 PAVEMENT MARKING

A. Apply pavement-marking paint using layout, colors, and placement indicated.
B. Allow paving to cure before starting pavement marking.
C. Sweep and clean surface to eliminate loose material and dust.
D. Apply paint with mechanical equipment to produce pavement markings, of dimensions

indicated, with uniform, straight edges. Apply, in two coats, at manufacturer's recommended rates.

3.13 WHEEL STOPS

A. Securely attach wheel stops into pavement as indicated. Recess head of dowel beneath top of wheel stop.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to [ASTM D 979] [or] [AASHTO T 168].
   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188, ASTM D 1559 or ASTM D 2726.
      a. One core sample will be taken for every 500 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188, ASTM D 1559 or ASTM D 2726.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.15 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 32 12 16

SECTION 33 11 16.11 - PLASTIC PIPE AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for Plastic pipe and fittings including the following:

1. Plastic pipe and fittings
2. Cleanouts

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, the submittals shall include, but not be limited to the pipe size, dimensionality, pressure class, color, recommended bend radius, recommended maximum safe pull force, fusion technician qualifications indicating conformance with this specification.

B. Shop Drawings: Include the following.

1. Detail each equipment assembly, include make, model weight, and indicate installation details, dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
2. Complete catalog information, descriptive literature, materials of construction, wheels, gears and bearing, trolley drive system, brakes, stating system, variable speed drive system, conductors (bus bar, festoon, cable reel), controls, remote control system, and accessories.
3. Power and control wiring diagrams, including terminals and numbers.
4. Motor nameplate data in accordance with NEMA MG 1 and include any motor modifications.
5. Factory finish system.

1.4 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall provide the proper equipment, tools and facilities necessary for the efficient prosecution of the work. Material shall be delivered, handled, and stored in accordance with the manufacture's recommendations.

1. Materials damaged in unloading, handling or installation shall be promptly discarded and removed from the area of the work.
2. No pipe shall be unloaded or moved by allowing the pipe to roll, slide or fall to the ground or to cushions placed on the ground.
3. No pipe, fittings, valves, etc., shall be unloaded by inserting loader blades, teeth, etc., into the pipe interior.

B. Pipe shall be stored on racks or timbers in such a manner that pipe ends are above the ground surface.

1. When pipe is to be moved it shall not be dragged or rolled but shall be lifted by use of a sling designed to prevent damage to the pipe coatings.
2. Should an intermediate placement of the pipe along the side of the trench be required, the pipe shall be placed on racks or timbers along the side of the trench in manner as specified hereinabove.

C. Each length or section of pipe shall be cleaned immediately before being placed in the trench and joined.
    1. Cleaning shall be accomplished by use of a tight swab or other suitable cleaning device.
    2. If necessary, a brush pig shall be run through the section of pipe prior to final swabbing.
    3. Pipe ends shall be wiped clean before the pipe is joined.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL AND FITTINGS

A. The contractor shall carefully examine all pipe and piping materials before placing them in the work. If any such pipe or materials should be found to be defective, the Contractor shall promptly notify the Engineer and discard such pipe and materials.

B. The interior of all pipe, fittings, valves and accessories shall be kept free from dirt and foreign material.
    1. Suitable bulkheads shall be used to block or plug ends of piping at the close of each work day and when work on a particular section of piping is temporarily discontinued.
    2. Should dirt, mud, concrete, latence, paint or other foreign materials be allowed to enter the piping or any section of piping, such piping or section of piping shall immediately be cleaned.

C. Piping materials shall be of the types, classes and sizes shown or as specified in the Contract Documents.

D. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.

2.2 PLASTIC PIPE AND FITTINGS

A. Gravity Sewer Service
    1. PVC gravity sewer pipe shall conform in all respects to Standard Specifications for Type PSM Polyvinylchloride (PVC) Sewer Pipe and Fittings ASTM D 3034, latest revision, (sizes 4” -15”); ASTM F 679, latest revision, (sizes 18”-36”) covering requirements and test methods for materials, dimensions, workmanship, flattening resistance, impact resistance, pipe stiffness, extrusion quality, joining systems and form marking.
    2. Pipe conforming to ASTM D3034, latest revision, shall have a minimum wall thickness of SDR 26.
    3. Pipe conforming to ASTM F679, latest revision, shall have a minimum pipe stiffness (PS) of 115 psi and minimum T-1 wall.
    4. Pipe shall be furnished in sections not less than fourteen (14) feet in length.
    5. Pipe and fittings shall be inspected and tested in accordance with ASTM D 3034 or ASTM F679, latest revisions, by a testing laboratory acceptable to the Owner and certified copies of the test reports and test results shall be furnished to the Owner.
    6. Pipe and fittings shall be clearly marked in accordance with Section 12 of ASTM D 3034, or Section 11 of ASTM F679.
    7. Pipe shall be furnished with bell and spigot end with elastomeric seals.
    8. Spigot (plain) ends shall be marked to indicate when a "full-home" position of

spigot in bell has been attained.

9. Seal rings or gaskets shall be continuous elastomeric rings meeting the requirements of ASTM D 3212, latest revision.
10. Material for seal ring shall be specifically formulated for wastewater service.
11. The joints shall meet all test requirements of ASTM D 3212, latest revision, and certificates of compliance shall be furnished to the Owner.

PART 3 - EXECUTION

3.1 JOINING OF PIPE

A. Pipe joining procedure shall be in accordance with these Specifications and in accordance with the recommendations of the manufacturer of the particular type of joint.

B. Push-On Joint Pipe

1. The joining of Push-On Joint pipe shall be performed in accordance with the AWWA Standard for Underground Installation of PVC Pressure Pipe and Fittings for Water, C606 and in accordance with the manufacturer's instructions and/or recommendations for the particular joint furnished.
2. The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter.
3. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the socket.
4. A thin coat of gasket lubricant shall be applied to either the inside surface of the gasket or outside surface of the spigot, or both.
5. Gasket lubricant shall be as supplied by the particular manufacturer and reviewed by the Engineer.
6. The spigot end of the pipe shall be carefully inserted in the socket so that the joining surfaces will not come in contact with the ground, trench bed or trench sides.
7. The joint shall then be completed by forcing the spigot end to the bottom of socket by methods as recommended by the particular manufacturer and concurred with by the Engineer.
8. All pipe shall be furnished with a depth mark to indicate a 'full-home' assembly.
9. The Contractor shall provide special transition sleeves or transition pieces of pipe for connecting pipe of different classes; and those special pieces shall be clearly identified with suitable marking.
10. If the Contractor desires to cut lengths in the field to make closures, he shall have on hand an adequate number of lengths of pipe of the various classes having the exterior of the barrel gauged to fit the socket of pipe.

C. Fusion Joints

1. Unless otherwise specified, fusible polyvinylchloride pipe lengths shall be assembled in the field with butt-fused joints. The Contractor shall follow the pipe supplier’s written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

3.2 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. Work Plan Information shall be provided by the Contractor for each connection to existing system and for each slipline installation. Work plan shall include all pit excavation locations, interfering and abandoned utilities, excavation dimensions, flow bypass

pumping, and traffic control schematics, if required.

B. PVC Sewer Pipe and Fittings shall be as follows:
   1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
   2. Install according to ASTM D 2321.

3.3 WARRANTY

A. The pipe shall be warranted for a minimum of 1 year.

END OF SECTION 33 11 16.11

SECTION 33 11 16.12 – HIGH DENSITY POLYETHYLENE PIPE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes requirements for the following:
   1. High Density Polyethylene (HDPE) Pipe

1.2 DELIVERY, STORAGE AND HANDLING

A. The Supplier shall provide the proper equipment, tools and facilities necessary for the delivery of materials.
   1. Materials damaged in unloading, handling or installation shall be promptly discarded and removed from the area of the work.
   2. No pipe shall be unloaded or moved by allowing the pipe to roll, slide or fall to the ground or to cushions placed on the ground.
   3. No pipe, fittings, valves, etc., shall be unloaded by inserting loader blades, teeth, etc., into the pipe interior.
   4. Pipe shall be off-loaded and handled in accordance with the pipe manufacturer's recommendations.

B. Pipe shall be stored on racks or timbers in such a manner that pipe ends are above level ground surface.
   1. When pipe is to be moved it shall not be dragged or rolled but shall be lifted by use of a sling designed to prevent damage to the pipe coatings.
   2. Should an intermediate placement of the pipe along the side of the trench be required, the pipe shall be placed on racks or timbers along the side of the trench in manner as specified hereinabove.

1.3 WARRANTY

A. Pipe suppliers shall provide a one-year (12 month) warranty covering defects in product material and workmanship. A successful pressure test prior to the expiration of the warranty shall not relieve the supplier of warranty responsibility for the full warranty term. The warranty shall be evidenced by written letter from the supplier. Warranty term shall begin upon installation of pipe by General Contractor. Warranty shall be fully transferable to the chosen General Contractor.

1.4 PRODUCT SUBMITTALS

A. The following information shall be provided:
   1. Pipe and product data indicating conformance with this specification, applicable standards, and warranty provisions, including written documentation regarding any intended variance from this specification and applicable standards.
   2. Pipe delivery schedules.
   3. Name of pipe manufacturer and list of piping and quantities to be provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. High Density Polyethylene Pipe – Pressure Rated HDPE Pipe
    a. WL Plastics
    b. JM Eagle
    c. Approved Equivalent

2.2 GENERAL REQUIREMENTS

A. The Supplier shall carefully examine all pipe and piping materials before delivery to the Owner. If any such pipe or materials should be found to be defective, the Supplier shall promptly notify the Engineer and discard such pipe and materials.

B. The interior of all pipe and accessories shall be kept free from dirt and foreign material.
    1. Suitable bulkheads shall be used to block or plug ends of piping at the close of each work day and when work on a particular section of piping is temporarily discontinued.
    2. Should dirt, mud, concrete, laitance, paint or other foreign materials be allowed to enter the piping or any section of piping, such piping or section of piping shall immediately be cleaned.

C. Piping materials shall be of the types, classes and sizes shown or as specified in the piping schedule.

D. At culvert crossing locations, the HDPE pipe shall be a minimum of three (3) feet below the invert(s).

2.3 PIPE FOR PRESSURE SEWER SERVICE

A. High-density Polyethylene (HDPE) Pipe
    1. Polyethylene (PE) sewer pipe shall be a minimum PE 4710 HDPE meeting cell classification 445574C per ASTM D3350. All pipe materials shall be green in color or contain coextruded green striping. Materials shall be stabilized against ultraviolet deterioration and shall be suitable for unprotected outdoor storage for at least four (4) years.
    2. HDPE pipe shall meet the requirements of AWWA C901 and AWWA C906 with the same outside diameters for corresponding nominal sizes of ductile iron pipe meeting the requirements of AWWA C151.
    3. DR rating shall be as shown on the drawings; however, pipe shall have a minimum DR rating of 17.
    4. Pipe shall be permanently marked using heat indent printing to include:
        a. Nominal size and sizing system (IPS or DIPS)
        b. DR rating
        c. Extrusion production record
        d. Manufacturer’s Trademark or trade name

B. High-density Polyethylene (HDPE) Fittings and Adapters
    1. Fittings shall be of the same diameter, type, and wall thickness of the pipeline being constructed. Fittings shall be manufactured and tested in accordance with ASTM D 3261
    2. Connections between HPDE and ductile iron pipe shall be made with mechanical joint adapter kits in compliance with AWWA C901 and C906.
    3. HDPE mechanical joint adapters shall be furnished with internal stainless steel stiffeners installed in the mechanical joint end of the fitting.

END OF SECTION 33 11 16.11

SECTION 33 31 14.10 - METAL PIPE AND FITTINGS FOR SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for Metal pipe and fittings including the following:
   1. Ductile Iron pipe and fittings.
   2. Mechanical couplings.
   3. Gripper glands.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. B. Shop Drawings: Include the following.
   1. Detail each equipment assembly, include make, model weight, and indicate installation details, dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Complete catalog information, descriptive literature, materials of construction, wheels, gears and bearing, trolley drive system, brakes, stating system, variable speed drive system, conductors (bus bar, festoon, cable reel), controls, remote control system, and accessories.
   3. Power and control wiring diagrams, including terminals and numbers.
   4. Motor nameplate data in accordance with NEMA MG 1 and include any motor modifications.
   5. Factory finish system.

1.4 DELIVERY, STORAGE AND HANDLING

A. The Contractor shall provide the proper equipment, tools and facilities necessary for the efficient prosecution of the work.
   1. Materials damaged in unloading, handling or installation shall be promptly discarded and removed from the area of the work.
   2. No pipe shall be unloaded or moved by allowing the pipe to roll, slide or fall to the ground or to cushions placed on the ground.
   3. No pipe, fittings, valves, etc., shall be unloaded by inserting loader blades, teeth, etc., into the pipe interior.

B. Pipe shall be stored on racks or timbers in such a manner that pipe ends are above the ground surface.
   1. When pipe is to be moved it shall not be dragged or rolled but shall be lifted by use of a sling designed to prevent damage to the pipe coatings.
   2. Should an intermediate placement of the pipe along the side of the trench be required, the pipe shall be placed on racks or timbers along the side of the trench in manner as specified hereinabove.

C. Each length or section of pipe shall be cleaned immediately before being placed in the trench and joined.
   1. Cleaning shall be accomplished by use of a tight swab or other suitable cleaning device.

2. If necessary a brush pig shall be run through the section of pipe prior to final swabbing.
3. Pipe ends shall be wiped clean before the pipe is joined.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ductile Iron Pipe:
   1. American
   2. U.S. Pipe and Foundry Company
   3. McWane Pipe
B. Ductile Iron Fittings:
   1. American
   2. U.S. Pipe and Foundry Company
   3. McWane Pipe
C. Restraining Gaskets:
   1. Field-lok gaskets as manufactured by U.S. Pipe and Foundry Company
   2. Fast-grip gaskets as manufactured by American Cast Iron Pipe Company
   3. Approved Equivalent.
D. Gripper (Restraining) Glands
   1. "MJ gripper gland" manufactured by U.S. Pipe and Foundry Company
   2. "MegaLug" manufactured by Ebaa Iron, Inc.
E. Mechanical Couplings
   1. Smith Blair
   2. Dresser
   3. Dependo-Lok
   4. Approved Equivalent.

2.2 PIPE MATERIALS AND FITTINGS

A. The Contractor shall carefully examine all pipe and piping materials before placing them in the work.
   1. If any such pipe or materials should be found to be defective, the Contractor shall promptly notify the Engineer and discard such pipe and materials.
B. The interior of all pipe, fittings, valves and accessories shall be kept free from dirt and foreign material.
   1. Suitable bulkheads shall be used to block or plug ends of piping at the close of each work day and when work on a particular section of piping is temporarily discontinued.
   2. Should dirt, mud, concrete, latence, paint or other foreign materials be allowed to enter the piping or any section of piping, such piping or section of piping shall immediately be cleaned.
C. Piping materials shall be of the types, classes and sizes as shown or as specified in the piping schedule.

2.3 DUCTILE IRON PIPE AND FITTINGS

A. Ductile Iron pipe shall be manufactured in accordance with requirements of ANSI A21.51 / AWWA C151.
B. Where ductile iron pipe and fittings are equipped with push-on joints, such joints shall

conform to the requirements of ANSI A21.11 / AWWA C111 latest revision.

C. Where ductile iron pipe and fittings are equipped with mechanical joints, such joints shall conform to the requirements of ANSI A21.11 / AWWA C111 latest revision.

D. All pipe and fittings shall be furnished new from the manufacturer. No recoated or reconditioned pipe will be acceptable.

E. Gaskets

1. Gaskets for flanged, mechanical joint restrained joint, and push-on ductile iron pipe shall meet the requirements of ANSI/AWWA Specification ANSI A21.11/AWWA C111 latest revision.
2. Gasket materials for various service conditions shall be as follows:
   a. Wastewater Service - Styrene Butadine Copolymer (SBR)

F. Pipe

1. In general, ductile iron pipe shall be furnished with push-on joints for buried applications and flanged joints for exposed, above grade applications, unless otherwise shown on Drawings.
2. Ductile iron flanged pipe shall conform to the following requirements:
   a. Shall be manufactured in accordance with the requirements of ANSI A21.15 AWWA C115 latest revision.
   b. Barrels of flanged pipe shall be ductile iron ANSI A21.51/AWWA C151.
   c. Flanges shall be in accordance with ANSI A21.15/AWWA C115 latest revision, and shall have chemical and physical properties specified for ductile-iron fittings under ANSI A21.10/AWWA C110 latest revision.
   d. Pipe and threaded flanges shall meet the requirements of ANSI A21.15 /AWWA C150, latest revision.
   e. Where flanges are cast on ductile-iron pipe they shall conform to ANSI A21.10/AWWA C110 latest revision and shall be ductile-iron as specified for threaded flanges.
   f. All flanges shall be rated for 250 psi working pressure; and the bolt circle and bolt holes shall match those of ANSI B16.1 Class 125 flanges and ANSI B16.5 Class 150 flanges.
   g. Flanged piping connecting to equipment shall have flanges that are compatible with the particular items of equipment to which they are attached.

G. Fittings

1. In general, fittings for use with push-on joint pipe shall be push-on joint unless otherwise shown on the Drawings.
2. Flanged fittings shall have flanges suitable for use with the type of flanged pipe and equipment to which they are connected, and flanges shall meet the requirements stated hereinabove for ductile iron pipe flanges.
   a. Fittings for use with flanged pipe shall conform to the requirements of ANSI A21.10 / AWWA C110 and shall have chemical and physical properties specified for ductile iron under ANSI A21.10 / AWWA C110.
   b. All flanges shall be rated for 250 psi working pressures; and the bolt circle and bolt holes shall match those of ANSI B16.1 Class 125 flanges and ANSI B16.5 Class 150 flanges.
3. All fittings shall be new. No reconditioned or recoated fittings shall be acceptable.
4. The Contractor may elect to use grooved end joints conforming to ANSI A21.10/AWWA C606 in lieu of flanged joints. The Contractor shall be responsible

for making all revisions necessary for a complete installation which is similar in function to a flanged piping system.

5. Couplings for use with grooved end joints shall be ductile iron in accordance with ASTM 536, Grade 65-45-12.
    a. Gaskets shall be the center leg design manufactured of a nitrile compound.
    b. Bolts shall be track head design and manufactured in accordance with ASTM A-183, minimum tensile 110,000 psi.
    c. Couplings shall be Victaulic, or equivalent.
6. Bolting shall conform to Table 10.14 of ANSI A21.10 / AWWA C110 or ANSI A21.15 / AWWA C115 as applicable.
    a. Bolts for use with flat ring type gaskets between gray iron flanges shall conform to the requirements of ASTM A 307-84, Grade B, hex head; and nuts shall be hex type of same grade and finish as the bolts.
    b. Bolts for use with flat full-face type gaskets between either gray iron flanges or ductile iron flanges shall conform to the requirements of ASTM A449-84a, Type 1 hex head; and nuts shall be hex type of same grade and finish as the bolts.
    c. Bolts shall conform to the requirements of ANSI B18.2.1, and nuts shall conform to the requirements of ANSI B18.2.2.
7. Wall pipes shall either be statically cast or fabricated from centrifugally cast ductile iron pipe.
8. Flanges shall be provided in between the ends of the wall pipe to serve as a thrust collar and/or water stop, as required.
9. For fabricated wall pipes, the space between the thrust collar or water stop shall be sealed by full welding on each side.
10. Gaskets for flanged joints shall be of materials as specified herein for various service conditions.
    a. Gaskets shall be 1/8" thick, unless otherwise specified and/or indicated for special conditions, and shall conform to dimensions as given in Table A.1 of Appendix A to ANSI A21.15 / AWWA C115 or Table A.1 of Appendix A to ANSI A21.10 / AWWA C110 latest revision or as applicable.
    b. Gaskets shall be flat ring type and flat full-face type according to service conditions.
    c. Flat ring type shall not be used where working pressures exceed 50 psi.
11. Fittings for use with push-on or mechanical joint pipe shall be compact or full bodies, and shall conform to the requirements of ANSI A21.10/AWWA C110, latest revision or ANSI A21.53/AWWA C153, latest revision.
12. Fittings meeting the requirements of C110 may be either gray iron or ductile iron where working pressures are less than 250 psi; where working pressures exceed 250 psi, fittings shall be ductile iron.
13. Fittings meeting the requirements of C153 shall be ductile iron in all situations.

H. Coatings
1. All ductile iron pipe and fittings shall be furnished with interior lining.
2. The types of lining required for the various conditions of service are listed herein below.
    a. Wastewater service – 100% Solids Epoxy, Permox CTF or pre approved equivalent.

3. All ductile iron pipe and fittings, including pipe and fittings to be submerged in liquids, shall be tar-coated outside except when installed in particular locations as hereinafter specified:
    a. Ductile iron pipe installed in buildings, galleries, vaults or other similar structures or locations where the piping is to be permanently exposed and specified to be painted, shall be furnished with exterior coat of rust-inhibitive primer suitable for application of finish coating as specified in these Specifications.
    b. Ductile iron or gray iron wall-pipes, wall-sleeves or other wall-fittings, and fittings to be encased in concrete, shall be furnished "bare" (without tar-coat).
    c. Ductile iron pipe, where passing through concrete walls, shall have exterior tar-coat removed from that length of the pipe to be encased in the wall.
4. Ductile iron pipe to be installed underground shall be furnished with outside asphaltic coating of 1 mil thickness per ANSI A21.51 / AWWA C151.

I. Quality Control

1. All testing work specified in this section shall be performed by the supplier.
2. The manufacturer shall perform all tests in house as part of their quality assurance/quality control.
3. Test results shall be submitted to the Engineer in accordance with requirements of this section.
4. All pipe shall receive a hydrostatic proof test of 500 psi for a minimum duration of 10 seconds.
    a. Each test cycle shall be recorded on a strip chart.
    b. Each test cycle for pipe 18 inches and greater shall be marked by pipe number.
    c. Each pipe shall be inspected for leaks and pipes which contain evidence of hydrostatic leak shall be scrapped.
    d. Repair welding of hydrostatic leaks is not permitted.
5. Tensile test specimens shall be cut from the midsection of the pipe wall.
    a. These specimens shall be machined and tested at least every three hours in accordance with ASTM E-8, and ASTM A-370 where applicable, using the halt of pointer or 0.2% offset method.
    b. Pipe failing to meet the minimum requirements of these standards shall be rejected.
    c. Adjacent test samples shall be made available to the Owner’s independent testing laboratory upon the Owner’s request.
6. Charpy impact samples shall be taken during each hour of production. Samples shall be selected to properly represent extremes of pipe diameters and wall thickness.
7. Impact tests shall be conducted in accordance with ASTM E-23.
    a. Impact strengths on samples shall be 7 ft.-lb minimum for tests conducted at 70 o±10.
    b. In addition, adjacent specimens shall be taken and made available to the Owner's laboratory for independent testing upon the Owner's request.
8. Each end of each pipe (each pipe socket and pipe spigot) shall be measured and shall conform to the standard dimensions of ANSI A-21.51 (AWWA C-151).

a. In addition, each socket and spigot shall be inspected in a well lighted area for injurious defects which could affect joint performance.
b. Such defects may be removed by cutting off pipe ends.
c. Pipe with injurious defects in the bell must be scrapped.

9. The Owner or his designated inspection agency shall have access to all areas of the pipe manufacturer's plant during production, inspection, and shipping and shall have the opportunity to witness all tests associated with production and inspection of pipe and fittings for any given pipe order. Reasonable facilities shall be provided for this purpose.
10. The Contractor shall provide manufacturers' certifications that all ductile iron pipe and fittings meet provisions of this section and meet requirements of ANSI A21.51 (AWWA C-151).
    a. Product certification shall include tensile and Charpy test results which shall be traceable to pipe numbers and testing periods.
    b. For pipe sizes 18 inches and greater, hydrostatic test charts including pipe numbers for each test cycle shall be furnished as part of the certification test reports.
    c. Chemical analysis shall be furnished for each ladle of iron which will cover each pipe cast and must correlate with the mechanical test results.
    d. For pipe sizes 18 inches and greater, complete traceability is required throughout the certification process and must be clearly legible on each pipe at the point of installation.
11. The Contractor shall provide certifications that all pipe joints have been tested and meet requirements of ANSI A21.11 (AWWA C-151)..

J. Quality Control

1. All testing work specified in this section shall be performed by the supplier.
2. The manufacturer shall perform all tests in house as part of their quality assurance/quality control.
3. Test results shall be submitted to the Engineer in accordance with requirements of this section.
4. Each pipe in the size range 4"-16" shall receive a hydrostatic proof test of 500 psi for a minimum duration of 15 seconds.
5. Each pipe in the size range 18" and greater shall receive a hydrostatic test not less than 85% of the specified minimum yield strength for a duration of not less than 15 seconds.
6. Each test cycle shall be recorded on a strip chart.
7. Each test cycle for pipe 18" and greater shall be marked by pipe number.
8. Each pipe shall be inspected for leaks.
9. Pipes which contain evidence of hydrostatic leak shall be scrapped.
10. Repair welding of hydro-leaks is not permitted.
11. Tensile test specimens shall be cut longitudinally from the midsection of the pipe wall.
    a. These Specimens shall be machined and tested at least every three hours in accordance with ASTM E-8, and ASTM A-370 where applicable, using the 0.2% offset method.
    b. Brinell hardness tests shall be performed at the same frequency as the tensile test and shall meet a maximum Brinell hardness of 230.
    c. Pipe failing to meet the minimum requirements of these standards shall

be rejected.

d. Adjacent test samples shall be made available to the Owner's independent testing laboratory upon Owner's request..

12. Charpy impact samples shall be taken during each hour of production. Samples shall be selected to properly represent extremes of pipe diameters and wall thickness.

13. Impact tests shall be conducted in accordance with ASTM E-23.
    a. Impact strengths on samples shall be 8 ft.-lb minimum for tests conducted at 70o±10.
    b. In addition, adjacent specimens shall be taken and made available to the Owner's laboratory for independent testing upon the Owner's request.

14. Each end of each pipe (each pipe socket and pipe spigot) shall be measured and shall conform to the standard dimensions of ANSI A-21.51 (AWWA C-151).
    a. In addition, each socket and spigot shall be inspected in a well lighted area for injurious defects which could affect joint performance.
    b. Such defects may be removed by cutting off pipe ends.
    c. Pipe with injurious defects in the bell must be scrapped.

15. The Owner or his designated inspection agency shall have access to all areas of the pipe manufacturer's plant during production, inspection, and shipping and shall have the opportunity to witness all tests associated with production and inspection of pipe and fittings for any given pipe order. Reasonable facilities shall be provided for this purpose.

16. The Contractor shall provide manufacturers' certifications that all ductile iron pipe and fittings meet provisions of this section and meet requirements of ANSI A21.51 (AWWA C-151).
    a. Product certification shall include tensile and Charpy test results which shall be traceable to pipe numbers and testing periods.
    b. For pipe sizes 18 inches and greater, hydrostatic test charts including pipe numbers for each test cycle shall be furnished as part of the certification test reports.
    c. Chemical analysis shall be furnished for each ladle of iron which will cover each pipe cast and must correlate with the mechanical test results.
    d. For pipe sizes 18 inches and greater, complete traceability is required throughout the certification process and must be clearly legible on each pipe at the point of installation.

17. The Contractor shall provide certifications that all pipe joints have been tested and meet requirements of ANSI A21.11 (AWWA C-151).

K. Restrained Joint Pipe.

1. The following types of restrained joint pipe will be acceptable:
    a. Flexible, restrained push-on type where joints incorporate ductile iron locking segments, inserted through slots in the bell face, providing a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.
    b. Restraining gaskets for push-on pipe and fittings 4" through 12" diameter. Restraining gaskets shall contain stainless steel locking segments vulcanized into the gasket which shall in all other respects meet the requirements of standard push-on gaskets in ANSI/AWWA C111/A21.11. Restraining gaskets shall be UL listed for a minimum

working pressure of 250 psi.

c. Gripper glands may be used with mechanical joint fittings. Joint restraint shall be provided by a follower gland with mechanism that grips pipe with teeth which are wedged tighter as pressure is applied to the pipeline. Gripper glands shall have a working pressure rating of at least 350 psi up to 16" size and at least 250 psi up to 48" size. Gland shall conform to mechanical joint (ANSI/AWWA a21.11) and be suitable for use with tee-head bolts (ANSI/AWWA c153/a21.5).

2. Maximum allowable deflections shall be per manufacturer's published recommendation.
3. Use of set screws bearing on the pipe wall will not be acceptable except where retainer glands are to be used.

L. Markings
1. Each length or piece of pipe shall be bar coded and clearly marked as to type and class with different colors being used to distinguish between classes.
2. Where the drawings indicate that between specified stations a particular class of pipe will be required, the Contractor will not be permitted to store or string pipe of other classes than that specified for the particular section of the transmission mains.

2.4 MECHANICAL COUPLINGS

A. Pipe couplings shall be threaded, push-on mechanical joint, or bolted as specified herein or as indicated.
B. Harness bolts, where required on lines under pressure where shown shall be one of the following:
1. Joint restraint system as manufactured by Star National Products.
2. Standard system of the pipe manufacturer.
3. Approved equivalent.
C. Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations.
1. A space of at least ¼ inch and not more than one inch shall be left between the pipe ends.
2. Pipe and coupling surfaces which contact gaskets shall be clean and free from dirt and other foreign matter during assembly.
3. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks and all parts of the coupling are square and symmetrical with the pipe.
4. Following installation of the coupling, damage areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of the Engineer.
5. The interior surfaces of the middle rings shall be prepared for painting in accordance with instructions of the paint manufacturer and shall then be coated with liquid epoxy in accordance with AWWA C210.
6. The remaining components shall be cleaned and shop primed with the manufacturer's standard rust-inhibitive primer.

2.5 GRIPPER GLANDS

A. Where gripper glands are indicated for use with mechanical joint fittings, joint restraint shall be provided by a follower gland with a mechanism that grips the pipe with teeth which are wedged tighter as pressure is applied to the pipeline.

B. Gripper gland shall have a working pressure rating of at least 350 psi up to 16" size and at least 250 psi up to 48" size.

C. Gland shall conform to mechanical joint (ANSI/AWWA A21.11) and be suitable for use with tee-head bolts (ANSI/AWWA C153/A21.53).

D. Gripper gland shall be one of the following:
   1. "MJ Gripper Gland" manufactured by U.S. Pipe and Foundry Company.
   2. "Mega Lug" manufactured by EBAA Iron, Inc.
   3. Approved equivalent.

2.6 JOINING MATERIALS

A. Transition Couplings for Underground Piping, NPS 1-1/2 and Smaller:
   1. Shall be manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Transition Couplings for Underground Piping, NPS 2 and Larger:
   1. Shall conform to AWWA C219.
   2. Shall be metal, sleeve-type coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

C. Transition Couplings for Aboveground or Vault Piping:
   1. Pipe fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

D. Brazing Filler Metals:
   1. Shall be AWS A5.8, BCuP Series.

E. Soldering Flux:
   1. Shall conform to ASTM B 813.
   2. Shall be water-flushable type.

F. Solder Filler Metal:
   1. Shall conform to ASTM B 32.
   2. Shall be lead-free type with 0.20 percent maximum lead content.

G. Plastic Pipe-Flange Gasket, Bolts, and Nuts:
   1. Shall be the type and material recommended by piping system manufacturer, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTILE IRON PIPE

A. The Contractor will not be permitted to cut nipples from ungauged pipe in order to make connections.
   1. If the Contractor desires to cut lengths in the field to make up the line, he shall make such cuts from lengths of pipe having exterior of barrel fully gauged to fit bell of pipe of that class.

B. The permissible depth of cover over a pipe of particular size and class is based upon the following:
   1. The trench excavation work being performed by the Contractor in accordance with the requirements of these Specifications.
   2. The bedding and backfill materials being furnished by the Contractor in accordance with the requirements of these Specifications.
   3. The placement of bedding and backfill material being performed by the Contractor in accordance with the requirements of these Specifications.

C. Should the Contractor fail to perform the trench excavation work, or the furnishing and placement of bedding and backfill, or the pipelaying work in accordance with the requirements of these Specifications, he/she will be required to remedy the work by furnishing and placing or installing other materials as may be determined by the Engineer as being necessary to remedy that work not performed in accordance with these Specifications and thereby secure work of the quality specified.

D. Buried ductile iron pipe for all applications shall be furnished and installed in trenches in various locations along the pipeline(s) as indicated and described herein. Pipe thickness and/or class shall meet requirements and recommendations of the manufacturer and ANSI/AWWA C151/A21.51 for depth of cover, working pressure and laying conditions when classes of pipe and depths of cut are not indicated elsewhere.

SCHEDULE OF REQUIRED WALL THICKNESSES FOR PRESSURE PIPING DUCTILE IRON PIPE ANSI A21.51, GRADE 60-42-10	
Pipe Size (Inches)	Cover not Exceeding 16' Wall Thickness
4	0.29"
6	0.31"
8	0.33"
10	0.35"
12	0.37"
14	0.39"
16	0.40"
18	0.41"
20	0.42"
24	0.44"
30	0.47"
36	0.53"
42	0.59"
48	0.65"
54	0.73"

3.2 JOINING OF PIPE

A. Pipe joining procedure shall be in accordance with these Specifications and in accordance with the recommendations of the manufacturer of the particular type of joint.

B. Ductile Iron Pipe

1. Mechanical Joint Pipe

a. The joining of mechanical joint pipe shall be performed in accordance with AWWA standard for installation of Cast Iron Water Mains C600.

b. The ends of the two pieces of pipe to be joined shall first be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter, and then lubricated prior to joining glands shall be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket end.

c. The rubber gasket shall be lubricated and placed on the spigot end with the thick edge toward the gland.
d. The entire section of the pipe shall be pushed forward to seat the spigot end in the bell.
e. The gasket shall then be pressed in place within the bell, care being taken to locate the gasket evenly around the entire joint.
f. The cast iron gland shall be moved along the pipe into position for bolting; all the bolts shall be inserted, and hard tightened.
g. All nuts shall then be tightened with a suitable torque-limiting wrench.
h. The torque for various sizes of bolts shall be per the manufacturer's recommendations.
i. Nuts spaced 100 to 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

2. Push-On Joint Pipe
   a. The joining of Push-on joint pipe shall be performed in accordance with the AWWA Standard for Installation of Cast Iron Water Mains C600 and in accordance with the manufacturer's instructions and/or recommendations for the particular joint furnished.
   b. The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter.
   c. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the socket.
   d. A thin coat of gasket lubricant shall be applied to either the inside surface of the gasket or outside surface of the spigot, or both.
   e. Gasket lubricant shall be as supplied by the particular manufacturer and reviewed by the Engineer.
   f. The spigot end of the pipe shall be carefully inserted in the socket so that the joining surfaces will not come in contact with the ground, trench bed or trench sides.
   g. The joint shall then be completed by forcing the spigot end to the bottom of socket by methods as recommended by the particular manufacturer and concurred with by the Engineer.
   h. All pipe shall be furnished with a depth mark to indicate a 'full-home' assembly.
   i. The Contractor shall provide special transition sleeves or transition pieces of pipe for connecting pipe of different classes; and those special pieces shall be clearly identified with suitable marking.
   j. If the Contractor desires to cut lengths in the field to make closures, he shall have on hand an adequate number of lengths of pipe of the various classes having the exterior of the barrel gauged to fit the socket of pipe.

3. Restrained Joint Pipe
   a. Joints and pipe ends for restrained joint pipe shall be prepared and installed in accordance with the pipe manufacturer's recommendations.

4. Flanged Pipe
   a. The joining of flanged ductile iron pipe shall be in accordance with the requirements of ANSI B31.1.0.
   b. All bolt holes shall so match as to permit free insertion of bolts without

binding.

c. Faces of flanges shall match fully and shall be true both horizontally and vertically before the bolts are tightened.

d. Any misalignment or vertical deviation from a true match shall not be corrected by tightening the bolts but shall be remedied by adjustment of the piping.

e. The same requirements shall apply for connection of flanged pipe to flanged equipment.

f. Gaskets shall be suitable for the particular class of flanges with which the pipe is equipped, and the entire piping system shall be leak-proof.

3.3 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. Ductile-Iron Sewer Pipe with Ductile-Iron Fittings: According to AWWA C600.

C. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

END OF SECTION 33 31 14.10

SECTION 33 39 13 - MANHOLES AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for manholes and appurtenances, including the following:
   1. Precast concrete manholes.
   2. Manhole castings.
   3. Manhole steps.
   4. Flexible joints for manhole-sewer connections.
   5. Manhole testing.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Include plans, elevations, details, and attachments for the following:
      a. Precast concrete manholes.
      b. Manhole frames and covers.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

A. Precast concrete manholes shall be of the following types and sizes (unless otherwise indicated on the drawings):
   1. Standard Manholes: Manhole barrel diameter 4'-0" for use on sewers less than 24 inches in diameter.
   2. Type I Manhole: Manhole barrel diameter 5'-0" for use on sewers 24 inches through 36 inches in diameter.
   3. Type IA Manhole: Manhole barrel diameter 6'-0" for use on sewers 42 inches through 48 inches in diameter.

B. The precast reinforced concrete manholes shall be constructed in accordance with ASTM Standard Requirements for Precast Reinforced Concrete Manholes, ASTM Designation C-478, latest revision.
   1. Concrete: Shall have a minimum compressive strength of 4,000 psi at 28 days.
   2. Cement: Shall be Type II with C3A content of 5.5% or less.
   3. Manhole Surfaces: The interior and exterior surfaces of the manholes shall have smooth hard finish; and shall be free from cracks, chips and spalls.
   4. Ballast: Increase thickness of precast concrete sections or add concrete to base section, if required to prevent flotation.
   5. Base Section:

a. 6-inch minimum thickness for floor slab.
b. 4-inch minimum thickness for walls and base riser section.
c. Having base section with integral floor.
d. For installation on existing storm sewers, having no floor and vertically slotted openings. This base section configuration is commonly referred to as "doghouse".
e. Shall be fabricated with two non-penetrating lifting inserts.
    1) Lifting inserts shall be Manhole Lifting System inserts as manufactured by Press-Seal GASKET Corporation or equivalent.
    2) Lifting eye bolts manufactured by the insert manufacturer shall be supplied to the Contractor.

6. Riser Sections:
    a. 4-inch minimum thickness.
    b. Risers shall be furnished in suitable increments to an elevation (for the particular manhole) not more than 12 inches below the base of the cast iron frame and cover to be set on that particular manhole.
    c. Maximum elevation of riser shall be that which will permit setting top of manhole frame at the appropriate finished grade.
    d. Shall be fabricated with two non-penetrating lifting inserts.
        1) Lifting inserts shall be Manhole Lifting System inserts as manufactured by Press-Seal GASKET Corporation or equivalent.
        2) Lifting eye bolts manufactured by the insert manufacturer shall be supplied to the Contractor.
    e. All riser sections shall be secured with stainless steel anchor assemblies spaced 120 degrees apart at the joint between riser sections.
    f. Manhole diameters shall not be less than that required to maintain minimum dimension between adjacent pipe penetrations in accordance with manhole manufacturer's recommendations.
7. Top Section:
    a. Shall be eccentric-cone type.
    b. Shall be suitable for mounting cast iron manhole frames and covers described in these Specifications.
    c. Shall be fabricated with two non-penetrating lifting inserts.
        1) Lifting inserts shall be Manhole Lifting System inserts as manufactured by Press-Seal GASKET Corporation or equivalent.
        2) Lifting eye bolts manufactured by the insert manufacturer shall be supplied to the Contractor.
8. Coatings:
    a. All manholes shall be lined with Xypex or an approved equivalent.
9. Joints between manhole sections:
    a. Joints between manhole sections shall be offset tongue and groove type.
    b. Joints shall be installed using a prelubricated manhole gasket and 1 row of mastic ring which shall conform to the following requirements:
        1) Gasket shall consist of a compression section and a serrated mantel section which slides over the compression section as the manhole sections are placed together.
        2) Gasket shall meet the requirements of ASTM C 443.
        3) The manhole gasket shall be Tylox Super-Seal manufactured by

Hamilton Kent, Ltd. of Canada, or Engineer-approved equivalent.

c. Exterior seams of all manholes shall be finished with a Conseal or an approved equal.

10. Grade Rings:
    a. Include two or three reinforced-concrete rings.
    b. Rings shall be 6- to 9-inch total thickness.
    c. Rings shall match cast iron manhole frames and covers described in these Specifications.

2.2 MANHOLE CASTINGS

A. Manhole frames and covers shall be cast from gray iron meeting the requirements of ANSI/ASTM A 48-83, not less than Class 30.

B. Manhole frames and covers shall conform to the following requirements:
    1. All castings shall be free from scale, lumps, blisters, sand holes and other defects that would render them unfit for the service for which they are intended.
    2. Manhole covers shall be of the solid indented pattern, and shall be lettered as indicated.
    3. Bearing surfaces of frames and covers shall be machined to secure a solid bearing and to prevent rocking, and the fit of the cover in the frame shall be tight (close) so as to prevent flipping.
    4. Castings having uneven bearing between cover and frame or loose-fitting covers shall be rejected.
    5. The Contractor shall submit for review by the Engineer, pattern drawings of manhole castings.
    6. Frames and covers installed on manholes located in open areas shall weigh not less than 290#, and frames and covers installed on manholes in locations subject to traffic shall weight not less than 375#.
    7. All manhole covers (lids) shall be self-sealing type and shall have no through pick-holes.
    8. Manholes frames and covers shall be equivalent in quality to manufacturer of Neenah Foundry Company or Barry Pattern & Foundry Company.
    9. Manhole frames and covers shall be U.S. Foundry and Manufacturing Corporation Model No. 576 ring and Model BH cover.

C. Where indicated, waterproof (watertight) bolted manhole frames and covers shall be furnished and installed and shall conform to the following requirements:
    1. Waterproof manhole frames and covers shall have bolted-on covers with round rubber gaskets for watertight sealing under sub-aqueous service.
    2. Waterproof manhole frames and covers shall be similar and equivalent to Neenah Catalog No. R-1916-E, or similar product of Barry Pattern & Foundry Company or equivalent.
    3. Bottom flanges of manhole frames shall have three (3) ¾" diameter holes bored and spaced at 120° around flange for anchor bolts when manholes are set in such locations requiring anchorage of covers as specified in the preceding paragraph.
    4. Waterproof manhole frames and covers shall be U.S. Foundry and Manufacturing Corporation Model No. 576 ring and Model BH cover, both tapped for bolts and supplied with gaskets as described above.

D. In order for each manhole to be correctly assembled to suit construction conditions existing at particular locations, all components of each manhole shall be clearly marked.

The rim of each manhole shall be 2'-0" ± 4" above the existing grade. It is the responsibility of the Contractor to field verify the existing surface elevation at each manhole location prior to submitting manhole submittals to the Engineer.

2.3 MANHOLE STEPS

A. Manhole steps shall conform to the following requirements:
   1. All steps shall meet the requirements of the Occupational Safety and Health Standards, U.S. Department of Labor.
   2. All types of steps shall be specially designed and suitable for use in precast concrete manholes.

B. Types of steps shall be as follows:
   1. Gray iron ASTM A 48-83 or ductile iron integrally cast in barrels of manholes.
   2. Gray iron ASTM A 48-83 or ductile iron, equipped with inserts integrally cast in barrels of manholes and having steps bolted on.
   3. Copolymer polypropylene plastic meeting the requirements of ASTM D 2146.
      a. Shall be reinforced with ½" diameter deformed bar meeting the requirements of ASTM A 615, with inserted ends corrugated for bond, and integrally cast in barrels of manholes.

2.4 OPENINGS FOR SEWER PIPES

A. Openings for sewer pipes shall be provided in the manhole sections at positions as required by alignment and elevations.
B. Openings may be cast into the manhole wall or mechanically cored.
C. Sewer pipes that do not require flexible joints shall be sealed into the manhole wall with mortar.
D. Such openings in manhole walls shall be large enough to permit variations in both vertical and horizontal position as field conditions may dictate.

2.5 FLEXIBLE JOINTS FOR MANHOLE-SEWER CONNECTIONS

A. Flexible joints or flexible connectors, for connection of sewers smaller than 24 inches in diameter to manholes shall be as follows:
   1. Complete joint with seal assembly inserted in hole cored in manhole wall and comprised of the following components:
      a. Rubber or neoprene boot.
      b. 2-stainless steel bands at each inlet and outlet pipe.
      c. A bead of silicone shall be placed at each inlet and outlet pipe between the pipe and manhole boo at all manholes.
      d. Stainless steel pipe clamp.
      e. Seal interior seam of boot with non-shrink grout

PART 3 - EXECUTION

3.1 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.
B. Form continuous concrete channels and benches between inlets and outlet.
C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

E. All precast concrete manholes shall be set on foundation bed of compacted crusher run stone, choked with fines, 12-inch minimum thickness, and covering the entire bottom of the excavation for the manhole.

3.2 MANHOLE TESTING

A. All new manholes shall be tested by the Contractor using the vacuum test method, following the manufacturer's recommendations for proper and safe procedures.

B. Any leakage in the manhole or structure, before, during, or after the test shall be repaired.

C. All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole.

D. A vacuum of 10 inches of mercury (Hg) (5.0 psi) shall be drawn on the manhole, and the time shall be measured for the vacuum to drop to 9 inches of mercury (Hg) (4.5).

E. Manholes will be considered to have failed the vacuum test if the time to drop 1 inch of mercury is less than what is shown in the following table:

VACUUM TEST TIMETABLE

	Manhole Diameter			
Depth (ft.)	48 inches	60 inches	72 inches	96 inches
4	10 sec.	13 sec.	16 sec.	19 sec.
8	20 sec.	26 sec.	32 sec.	38 sec.
12	30 sec.	39 sec.	48 sec.	57 sec.
16	40 sec.	52 sec.	64 sec.	76 sec.
20	50 sec.	65 sec.	80 sec.	95 sec.
+ Each 2 ft.	+ 5 sec.	+ 6.5 sec.	+ 8 sec.	+9.5 sec.

F. Manhole depths shall be rounded to the nearest foot.

G. Intermediate values shall be interpolated.

H. For depths above 20 feet, add the values listed in the last line of the table for every 2 feet of additional depth.

I. If the manhole or structure fails the vacuum test, the Contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.

END OF SECTION 33 39 13

SECTION 44 25 80 - SUBMERSIBLE PUMPS AND CONTROL PANEL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section covers the Work necessary to furnish and install, complete, the Submersible Pump systems specified herein and indicated on the project drawings. Contact the Engineer if any discrepancies are found between the two.

1.02 SCOPE

A. The Contractor shall furnish and install two (2) submersible non-clog wastewater pumps. Each pump shall be equipped with an 4 HP submersible electric motor, connected for operation on 460 volts, 3 phase, 60 hertz, 4 wire service, with 50 feet of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval. The pump shall be supplied with a mating cast iron 4 inch discharge connection and be capable of delivering 180 GPM at 41' TDH. Shut off head shall be 100 feet (minimum).

PART 2 - PRODUCTS

2.01 REQUIREMENTS

A. Pumps shall be as manufactured by Flygt Corporation or engineer pre-approved equal.
   1. Primary Design Point 180 GPM @ 41' TDH
   2. Model NP 3069 SH 3 – 272
   3. Horsepower (minimum) 3.8 HP

2.02 PUMP DESIGN CONFIGURATION

A. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with 20 feet of stainless steel lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight. The working load of the lifting system shall be 50% greater than the pump unit weight.

2.03 PUMP CONSTRUCTION

A. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be AISI type 316 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

B. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or optional Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the

requirement of a specific torque limit.

C. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

2.04 COOLING SYSTEM

A. Each unit shall be provided with an integral motor cooling system. A stainless steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C.). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

2.05 CABLE ENTRY SEAL

A. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

2.06 MOTOR DESIGN

A. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

B. The junction chamber shall be sealed off from the stator housing and shall contain a

terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

C. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

D. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet
or greater.

2.07 BEARINGS

A. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a two row angular contact ball bearing. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

2.08 MECHANICAL SEAL

A. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

B. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

C. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal

due to centrifugal action.

D. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

2.09 PUMP SHAFT

A. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

2.10 IMPELLER

A. The impeller shall be of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

2.11 VOLUTE/SUCTION COVER

A. The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-Iron™ (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

2.12 PROTECTION

A. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

B. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

2.13 CONTROL PANEL

A. General

1. Refer to Specification Section 26 29 00 (“Manufactured Control Panels”) for

additional control panel requirements.

2. The control system shall be designed to operate the required number of pumps specified on the drawing at the power characteristics shown on the plans.
3. The control function shall provide for the operation of the pumps under normal conditions, and shall alternate the pumps on each pump down cycle to equalize the run time. In the event the incoming flow exceeds the pumping capacity of the lead pump, subsequent pumps shall automatically start to handle the increased flow. As the flow decreases, the pumps shall cut off at the elevations as shown on the plans.
4. The control shall function as described below. The equipment listed below is a guide and does not relieve the supplier from supplying a system that will function as required.

B. Mechanical:

1. The enclosure shall be a NEMA 4X Stainless steel enclosure. The enclosure shall be a wall mount type with a minimum depth of 10" sized to adequately house all the components. Enclosures larger than 60” high x 36” wide shall be provided with 12” high leg stands. The enclosure door gaskets shall be rubber composition with a retainer or seamless foamed in place to assure a positive weatherproof seal. The gasket material shall not retain memory. The door shall open a minimum of 180 degrees.
2. A polished aluminum dead front inner door shall be mounted on a continuous aircraft type hinge and shall contain cutouts for mounted equipment and provide protection of personnel from live internal wiring. Cutouts for breaker handles shall be provided to allow operation of breakers without entering the compartment. All control switches, indicator pilot lights, elapsed time meters, and other operational devices shall be mounted on the external surface of the dead front. The dead front shall open a minimum of 150 degrees to allow access to equipment for maintenance. A 3/4" break shall be formed around the perimeter of the dead front to provide rigidity.
3. The back plate shall be manufactured of 12 gauge sheet steel and be finished with a primer coat and two [2] coats of baked on white enamel. All hardware mounted to the subpanel shall be accomplished with machine thread tapped holes. Sheet metal screws are not acceptable. All devices shall be permanently identified using engraved name plates. Use of DYMO type labels is not acceptable

C. Electrical:

1. The panel power distribution shall include all necessary components and be completely wired with tinned, stranded copper conductors rated at 90 degrees c. All conductor terminations shall be as recommended by the device manufacturer.
2. All circuit breakers shall be heavy duty thermal magnetic or motor circuit protectors similar and equal to SQUARE D type FAL. Each motor breaker shall be adequately sized to meet the pump motor operating characteristics and shall have a minimum of 22,000 amps at 480 VAC. The control circuit shall individually be controlled by a heavy-duty breaker.
    a. Circuit breakers shall be indicating type, providing "on-off-trip" positions of the operating handle. When the breaker is tripped automatically, the handle shall assume a middle position indicating "trip".
    b. Thermal magnetic motor breakers shall be quick-make and quick-break

on manual and automatic operation and have inverse time characteristics secured through the use of bimetallic tripping elements supplemented by a magnetic trip.

c. Breakers shall be designed so that an overload on one pole automatically trips and opens all legs. Field installed handle ties shall not be acceptable.

3. Motor starters shall be open frame, across the line NEMA rated with individual overload protection in each leg. Motor starter contact and coil shall be replaceable from the front of the starter without removing from its mounted position. Overload heaters shall be block type, utilizing melting alloy spindles, and shall have visual trip indication. Overload shall be sized for the full load amperage draw of the pumps. Definite purpose contactors, fractional size starters and IEC contactor relays shall not be acceptable.

4. Control transformers shall be provided to provide the 120 VAC and/or 24 VAC for control circuits when required. Transformers shall be fused on the primary and secondary circuits. The secondary windings shall be grounded.

5. A lightning-transient protector with tell-tale warning lights on each phase to indicate loss of protection on the individual phases shall be provided. The device shall be solid state with a response time of less then 5 nanoseconds with withstanding surge capacity of 6500 amperes. Unit shall be instant recovery, long life and have no holdover currents.

6. The Phase Monitor shall be a 12 pin, plug in style unit. The Phase Monitor shall monitor Under Voltage, Phase Reversal, Loss of Power and Phase Imbalance. The motor starter circuits shall be de-energized upon sensing of any of the faults and shall automatically restore service upon return to normal power. The Phase Monitor shall be available to monitor Over Voltage as an option. The output relay shall be DPDT rated at 10A at 240 VAC. The Phase Monitor shall be model 001-230-1212, or model 001-480-1212 as manufactured by Motor Protection Electronics, Apopka, Florida, (407) 299-3825.

7. The control panel shall be suitable for 277/480V-3Phase-4Wire input service voltage.

D. Alarm System:

1. The alarm light shall be a weatherproof, shatterproof, red light fixture with a 40 watt bulb to indicate alarm conditions. The alarm light shall be turned on by the high level alarm and flash until the condition has been corrected. An open contact shall be provided for remote monitoring.

2. The alarm horn shall be mounted on the exterior of the cabinet. The alarm horn shall provide a signal of not less than 90db at 10 feet. The alarm horn shall not degrade the listing of the enclosure. An alarm horn off and silence switch shall deactivate the alarm horn; however, the alarm light will flash until the alarm condition ceases to exist. At that time the alarm reset function will reset for normal operation.

E. Level Control System (SC100 Controller):

1. A controller shall be provided to control up to three pumps. The controller shall be capable of alternating the pumps, and must provide lag pump delays and high and low level alarms.

2. The controller shall be standard “off the shelf” equipment with published literature and fully tested hardware and operating program. The controller must be field configurable from the front of the unit, and require no special tools or

software to set-up or operate.

3. The controller shall be a microprocessor-based device and not require a battery to maintain the operating program. All set-up values shall be stored in non-volatile memory. The controller shall be UL listed as Industrial Control Equipment, UL 508.
4. A numerical 3 digit, 7 segment LED level display shall be provided on the front of the unit showing levels in feet and tenths of feet.
5. The controller shall not require an external power supply or any external I/O modules to be a fully functioning unit. An analog input (4-20mA) with zero and span adjustments, shall be provided. Relays with 10 amps rated contacts shall be provided as standard for control functions.
6. All electrical connections, for power or I/O, shall be by quick disconnect phoenix style connectors.
7. The controller shall have 12 discrete inputs. The inputs shall be optically isolated, transient protected and be programmable for the following functions.
    a. Pump disable with HOA in OFF, or pump fault
    b. External Alternator Selector Switch
    c. All pump disable – for connection to Phase Monitor
    d. Limit number of pumps, called to run, while on emergency power
    e. Alternation by External Time Clock
    f. Freeze wet well level during a bubbler tube purge
    g. Pump disable upon low level – for connection to low level float switch
    h. Float switch backup
8. Troubleshooting features shall include a fault indicator on the front of the unit and retrievable fault codes that aid in diagnosing most common problems. Status of the discrete inputs shall also be viewable from the front of the unit. A level simulation feature shall be available from the front of the unit. The controller shall automatically return to monitoring wet well level after sixty seconds, if left in simulation mode.
9. Menu selectable First-On/First-Off or First-On/Last-Off alternation sequences shall be available. Menu selectable alternation modes shall include:
    a. Standard Alternation
    b. Jockey pump (Pump 1 stays on when other pumps turn on)
    c. Jockey Pump (Pump 1 turns off when other pumps turn on)
    d. Split alternation (Pumps 1&2, Pump 3)
    e. Fixed sequence (Pump 1 always lead)
    f. Stepped on/off (Only one pump runs at a time)
10. Pump disable discrete inputs shall cause the alternator to skip over disabled pumps. The controller shall remember which pump was in the lead position during a power outage.
11. An RS232 serial port with the Modbus protocol shall be provided for SCADA. Modbus RTU or ASCII modes shall be menu selectable. RTS and CTS hardware connections along with all necessary programming shall be in place to fully interface with commonly used radio or telephone modems. Programming shall be in place to collect and transmit the station status, and to allow for the remote control of the pumps.
12. The pump On/Off levels, high level alarm, and low level alarm setup values shall be viewable and changeable from a remote location. Pump elapsed time meters

shall be viewable and resettable from a remote location, and shall be stored in non-volatile memory during a power outage

13. The controller shall contain a discrete input for connection to an external time clock to force pump alternation. The controller shall have a parameter setting to allow the analog input level to be a 4-20ma signal from a transducer, or an input from a conductance level probe with ten sensor points or both using probe as a back up. The controller shall have a parameter to select the level probe type by the distance between the electrodes, impedance settings and shall have a level offset parameter to enable the transducer or conductance level probe to be placed off the bottom of the wet well, while maintaining an accurate representation of the wet well depth. The controller shall be able to perform floatback-up with two to six floats.
14. The controller shall be model SC100 as manufactured by MPE Electronics, Apopka, Florida.

F. Backup Float Controls:

1. A three float backup option shall be provided. This option will allow the system to run both pumps in the event of a primary controller failure. In the event that the high level float is tipped, the controls will call the lead pump to run and after the lag float is tipped, call the lag pump to run. Both pumps will run until the off float is reached. This will continue until the failure of the primary controller is addressed. This backup float option shall utilize hardwired relays and a separate pump alternator as described below (rather than the primary controller) to control the pumps in the event of failure of the primary controller or level transducer. Provide intrinsically-safe relaying/barriers/separating for all wetwell float switch connections. Float switches shall be self-weighted Anchor Scientific "Roto-Float" type(s) as required by application, supported by ¼" type 304 stainless steel cable support with PVC-coated 15-pound anchor, installed per manufacturer's recommendations.

G. Ancillary Equipment:

1. The following devices shall be furnished on the inner door of the control enclosure for each pump motor:
   a. For Each Pump:
   i. Overtemperature Light (Amber)
   ii. Leakage Alarm Light (Amber)
   iii. Pump Starter/Overload Alarm Light (Amber)
   iv. Alarm Reset Pushbutton
   v. Hand/Off/Auto Selector Switch
   vi. Running Light (Green)
   vii. Off Light (Red)
   viii. Elapsed Time Meter
   b. Other
   i. High Level Alarm Light (Amber)
   ii. Backup Float System Active Alarm Light (Amber)
   iii. Backup Lag Level Alarm Light (Amber)
   iv. Backup Lead Level Alarm Light (Amber)
   v. Backup Low Level Alarm Light (Amber)
   vi. General Alarm Silence Pushbutton
2. The alternator shall be a plug in, solid state unit with lead-lag-auto selector and

test switches except when provided in a dedicated control device. The unit shall operate on 120 vac and provide DPDT ten amp rated contacts. Two LEDs shall indicate the next position to run as lead pump.

3. A thermal heater and thermostat shall be installed to maintain the internal temperature of the enclosure above the dew point.
4. Control wiring shall be copper, tinned, UL1015, 18ga. Minimum.
5. One Mini-Cas 120 unit shall be supplied for each pump to monitor the pump for over-temp and leakage. The unit shall have an 11pin, round base to mate with a standard 11 pin socket. The unit shall also be flanged in order to allow deadfront door mounting with use of 11 pin reverse socket, Omron part number P3GA-11.
    a. The unit is to be able to be powered by 24VAC, 24VDC, or 120VAC, and to contain LED indication for power on, over-temp, and leakage conditions. The unit shall contain an over-temp reset bush-button to reset the unit after the fault has cleared, as well as a selector switch that that allows the selection of manual or auto reset.
    b. The sensor input circuitry is to contain both hardware and software filters for noise immunity, as well as sensor input short circuit protection. The Mini-Cas 120 unit shall be model 14-407129, as supplied by Flygt Corporation.
6. Load Center
    a. The lift station shall be equipped with a 120/240V-1Phase load center with main primary and secondary breakers and branch circuit breakers as indicated on electrical plans (mounted within control panel) to feed all control and auxiliary equipment at site as required and as indicated on electrical plans. The load center shall be fed from a step down transformer mounted within the pump station enclosure as indicated on electrical plans. An operating mechanism shall penetrate the control panel deadfront door and a padlockable operator handle shall be secured on the exterior surface for each breaker. Interlocks must prevent opening the door until main circuit breaker is in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position. All breakers shall be numbered and labeled (with associated circuit function).
7. SCADA RTU:
    a. Provide Mission Mydro #M150 series SCADA RTU with:
        i. Flatpack enclosure, mounted integrally within the Pump Control Panel
        ii. Option boards as required for the following inputs, internally-wired to relays from level control system or analog signal provisions within control panel (all by panel supplier):
            1. Discrete Inputs:
                a. Pump 1 running/stopped (to be based on auxiliary contacts at the starter, NOT based on load sensors)
                b. Pump 2 running/stopped (to be based on auxiliary contacts at the starter, NOT based on load sensors)

c. Low Wetwell Level Alarm (from backup float system / SC1000)
d. High Wetwell Level Alarm (from backup float system / SC1000)
e. Pump 1 Fail (Overload/Seal Failure/Overtemp)
f. Pump 2 Fail (Overload/Seal Failure/Overtemp)
g. Loss of Input Power/Loss-of-Phase
h. Backup Floats Active Alarm
i. Generator Running status

2. Analog Inputs:
a. Wetwell level
b. Station flow

iii. Cell-based radio and antenna system, with antenna mounted external to panel as recommended by supplier for proper coverage
iv. Power supply as recommended by supplier
v. One year service package
vi. One year manufacturing and material warranty
All in accordance with owner's standards

H. SUBMERSIBLE TRANSDUCER

1. A submersible transducer manufactured from 316 stainless steel, containing a piezo resistive sensor with output signals proportional to applied pressure shall be supplied. The electronics shall be padded in a silicon compound for protection and have 316 stainless or plastic composite device protecting the sensing face of the transducer. The transducer shall operate from a power supply voltage of 10-30 VDC and supply a 4-20ma signal proportional to water level into the controller. The control signal shall be transmitted via a vented, molded polyurethane jacketed cable. The cable shall be gripped by a neoprene grommet and potted in place. The transducer shall be protected by a desiccant and surge arrestor. Surge protection shall be provided for the transducer. The suppressor shall be a dual pair [four wire] module implementing three stage hybrid technology to address over voltage transients and fault currents. The surge suppressor shall be supplied with a female connector and be part number PC642 as manufactured by EDCO.
2. An Intrinsically safe barrier shall be supplied for the transducer as manufactured by Cooper Crouse Hinds or equal. The barrier shall have an LED indicating power with replaceable fuses and dual ground. The barrier socket shall be of plug in design utilizing back plane technology. The barrier shall be UL listed as associated apparatus providing intrinsic circuits for use in Class I, Group A,B,C,D, Class II, Group E,F,G, Class III when used with drawing number SBO3 US1.

I. Manufacturer:

1. A final as built drawing encapsulated in mylar shall be attached to the inside of the front door. Schematics shall be done in ladder logic with wire numbers and line numbers. Real time cross referencing of relay contact to line numbers shall be given as well as written description of component function on each circuit of the drawings. From/ to wire and termination reports shall be shown on the as built drawings. Drawings shall be available in HTML format. Terminal strip layouts shall be provided for ease of

connecting external devices.

2. All component parts in the control panel shall be permanently identified with engraved legend plates as designated on the drawings. A list of all legends shall be available in Excel format and attached with the schematics on the panel door.
3. All equipment shall be tested to the operational requirements. Each control function shall be activated to check for proper indication.
4. All equipment shall be guaranteed for a period of one year from the date of installation. The guarantee is effective against all defects in workmanship and/or defective component. The warranty is limited to replacement of or repair of the defective equipment.
5. The manufacturer shall be a UL508 shop and provide evidence on the end product.

J. Station Flow Transmitter

1. Provide integral transmitter (within the Pump CP) for the station flow meter per owner's standards.

3.01 PUMP TEST

A. The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:
   1. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.
   2. A motor and cable insulation test for moisture content or insulation defects shall be made.
   3. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
   4. The pump shall be run for 30 minutes submerged, a minimum of six (6) feet under water.
   5. After operational test No. 4, the insulation test (No. 2) is to be performed again.
B. A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment upon request.
C. The pump cable end will be sealed with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

3.02 SITE TEST

A. The pump shall be tested at start-up and voltage, current, and other significant parameters recorded. The manufacturer shall provide a formal test procedure and forms for recording data. Only factory certified or authorized service personnel shall perform start-up service.

3.03 PUMP WARRANTY

A. The pump manufacturer shall warrant the units being supplied to the owner against defects in workmanship and material for a period of five (5) years or 10,000 hours under the Municipal Wastewater - Permanent Installation Warranty Policy.

3.04 DOCUMENTATION

A. Manufacturer will supply digital (pdf) or three (3) hard copy sets of detailed standard submittal drawings, Operation and Maintenance instruction manuals and parts list. Standard submittals will consist of:

1. Pump Outline Drawing
2. Control Data
3. Access Frame Data
4. Typical Installation Guides

B. Parts Lists and Technical Manuals shall be supplied after start- up has been completed.

END OF SECTION 44 25 80