

**THE SHELBY COUNTY COMMISSION
SPECIFICATIONS - CONTRACTUAL DOCUMENTS
NORTH-SOUTH CONNECTOR
CONTROL VALVE STATION**



07-15-26

**PREPARED BY
MUNICIPAL CONSULTANTS, INC.
200 CENTURY PARK SOUTH, SUITE 212
BIRMINGHAM, ALABAMA**

JULY 2026

**THE SHELBY COUNTY COMMISSION
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TABLE OF CONTENTS

<u>GENERAL</u>	
Advertisement for Bids	i
<u>BID DOCUMENTS</u>	
General Information For Bidders	2
Bid Bond	8
Insurance Requirements Certification	10
List of Substitute Material Suppliers and Equipment Manufacturers	11
List of Subcontractors	13
Basis of Payment	15
Bid Proposal and Items of Work	20
Accounting of Sales and Use Tax Savings	23
Alabama Immigration Law Compliance	24
Boycott Certificate	26
Economic Boycott Certificate	27
E-Verify, State Contractor's License, and W-9	29
<u>CONTRACTING DOCUMENTS</u>	
Notice Of Award	31
Notice To Proceed	32
Performance Bond	33
Payment Bond	35
Certificate of Insurance and Insurance Endorsements	37
Public Works Contract	38
<u>SPECIAL PROVISIONS</u>	
Section I - Starting and Completion Time and Liquidated Damages	49
Section II - Standard of Quality and Manufactured Articles	51
Section III - Insurance Requirements	52
Section IV - Utility Power and Building Permit	66
Section V - Contractor Personnel	67
Section VI – General Contractor's Roofing Guarantee	68

<u>GENERAL SPECIFICATIONS/CONDITIONS</u>	
Section I - Definition of Terms	72
Section II - Standards Regulations and Licenses	75
Section III - Scope of Work	76
Section IV – Control of Work	78
Section V – Plans, Drawings and Documentation Requirements	83
Section VI – Control of Materials	94
Section VII – Legal Relations and Responsibility to Public	96
Section VIII – Prosecution and Progress	101
Section IX – Payment Instructions	105
Section X – Project Completion	108
Section XI – Warranty and Guarantees	113
<u>SUPPLEMENTAL GENERAL CONDITIONS</u>	
Section 01410 – Structural Tests and Special Inspections (Including Forms)	116
<u>STANDARD SPECIFICATIONS</u>	
Sitework, Excavation and Earthwork	126
Concrete (For Concrete Not Covered/Shown on Structural Drawings)	139
Pavement, Gravel and Concrete Surfaces	152
Grassing	156
Fencing	160
Flashing and Sheet Metal	162
Misc Steel and Other Metals (For Steel/Metals Not Covered/Shown in Structural Drawings)	165
Miscellaneous Building Materials	173
Carpentry	175
<u>STANDARD SPECIFICATIONS - ARCHITECTURAL</u>	
Doors and Accessories	178
Roll-Up Aluminum Doors	183
Painting	184
Miscellaneous Items	195
<u>STANDARD SPECIFICATIONS – PIPING, VALVES AND GATES</u>	
Pipe Materials	197
Installation of Pressure Pipe	210
Mechanical Couplings	216
Manual Valve Actuators	217
<u>STANDARD SPECIFICATIONS – STRUCTURAL</u>	
Structural Engineer’s Index and Seal	220
Concrete (For all concrete shown/covered in the Structural Drawings)(03 00 00)	221
Strip-Type Waterstops (03 15 14)	233
Grout (03 60 00)	236

<u>STANDARD SPECIFICATIONS – STRUCTURAL CONTINUED</u>	
Mortar and Masonry Grout	244
Masonry Accessories	248
Unit Masonry Assemblies	250
Structural Steel	265
Shop Fabricated Wood Trusses	271
<u>STANDARD SPECIFICATIONS - ELECTRICAL</u>	
Electrical Engineer's Index and Seal	282
All Equipment (26 00 01)	283
Electrical General (26 00 10)	289
Electrical Utility Service (26 05 10)	299
Electrical Submittals (26 05 12)	301
Coordination (26 05 16)	305
Conductors (26 05 19)	307
Grounding Electrical Systems (26 05 26)	310
Grounding System (Site Grid) (26 05 27)	313
Hangers and Supports for Electrical Systems (26 05 29)	316
Raceways (26 05 33)	321
Outlet Boxes and Junction Boxes (26 05 34)	327
Raceways Exterior Duct Banks (26 05 43)	330
Electrical Identification (Low Voltage) (26 05 53)	332
Panel Boards (26 24 16)	336
Wiring Devices (26 27 26)	339
Fuses (26 28 13)	342
Enclosed Switches (26 28 16)	345
Manufactured Control Panels (26 29 00)	348
Surge Protective Device for AC System (26 43 13)	364
Surge Protective Devices for Instrumentation, Control and Data Lines (26 43 14)	374
Lighting (26 51 00)	382
<u>EQUIPMENT SPECIFICATIONS</u>	
All Equipment	387
Magnetic Flow Meters	393
Control/Display Panels & SCADA System Modifications/Additions	397

NOTES: 1. The "All Equipment" Specification applies to ALL EQUIPMENT including, but not limited to, Electrical, SCADA, and Control Equipment provided on this project.

2. Additional Items are Specified on the Contract Drawings

GENERAL

ADVERTISEMENT FOR BIDS

Sealed proposals for the construction of the **North-South Connector Control Valve Station** will be received by the Shelby County Commission at the Office of the Chief Financial Officer at the Shelby County Administration Building located at 200 West College Street, Room 125, Columbiana, AL, until **10:00 AM**, the prevailing time, **Thursday, August 6th, 2026**, and at that time publicly opened and read. Description of the proposed work is as follows:

Potable Water Control Valve Station:

- Building (Reinforced Concrete and Masonry Construction)
- Interior Piping and Valves – Large Diameter Ductile Iron (12” through 24”)
- Yard Piping and Valves – Large Diameter Ductile Iron (16” through 24”)
- Electrical System
- Sitework
- Miscellaneous Appurtenances and Work

There will be no pre-bid meeting for this project.

At the time that this Invitation is issued, all informal communications with the County and associated agents regarding this solicitation shall cease. If you have any questions concerning bid specifications, please submit all questions to the Project Manager, Chris DeWeese at cldeeweese@municipalconsultants.org by no later than **12:00 PM Wednesday, July 29th, 2026**. Responses to these questions, if appropriate, will be posted on the eBid Portal by close of business **Monday August 3rd, 2026**. Bidders may only rely upon written guidance or responses. Failure to comply with this provision will be considered an improper communication and will be grounds to disqualify bidder.

Plans and Specifications may be inspected at the Shelby County Water Services office at 10927 US Highway 280, Sterrett, AL (8 AM – 4 PM, Mon-Fri), Shelby County’s E-Bid portal (<https://ebid.shelbyal.com>) beginning **10 AM Wednesday, July 15th, 2026** and at Municipal Consultants, Inc. in Birmingham, Alabama. They may also be obtained from the office of Municipal Consultants, Inc., 200 Century Park South, Suite 212, Birmingham, Alabama 35226, upon payment of **\$125**. Cost of plans and specifications is non-refundable.

All Bidders must be responsible, meeting the criteria and requirements set forth in the specification documents. Prequalification of Bidders is not required.

This project is considered a “Public Works” project and is governed by competitive bid laws as contained in Title 39 of the Alabama Code. Bidders, subcontractors, suppliers, and Bond Agents should be familiar with this code.

The Owner reserves the right to reject any or all proposals and to waive technicalities. No Bidder may withdraw his bid within sixty days from the date set for receiving of the same.

This project is governed by the applicable bid laws and practices of the State of Alabama.

By: Chad Scroggins

Title: County Manager

MUNICIPAL CONSULTANTS, INC.
Consulting Engineers
200 Century Park South, Suite 212
Birmingham, AL 35226

BID DOCUMENTS

GENERAL INFORMATION FOR BIDDERS

BIDS will be received by the Shelby County Commission (herein called the "OWNER"), at the Office of the Chief Financial Officer at the Shelby County Administration Building at 200 West College Street, Room 125, Columbiana, Alabama, until **10:00 AM**, the prevailing time, on **Thursday August 6th, 2026** and then at said office publicly opened and read aloud.

Project

The OWNER is seeking BIDS from qualified, responsible bidders to perform the following PROJECT: Construction of a Potable Water Control Valve Station, including, Reinforced Concrete Vaults, Vault Piping and Valves – Large Diameter Ductile Iron (12” through 24”), Yard Piping and Valves – Large Diameter Ductile Iron (16” through 24”), Electrical System, Sitework, and Miscellaneous Appurtenances and Work. Work shall be performed in a professional, workmanlike manner by qualified, licensed contractors meeting the requirements of these Bid Documents. The scope of work shall be as included in the detailed Plans, General Specifications, and Standard Specifications.

Where certain items are called for or described, it is to establish a “standard” of quality. The BID shall be based upon furnishing the items as specified, called for, or described. BIDDER may submit for approval of substitute equipment/material by including same and following instructions as provided on the “List of Substitute Material Suppliers and Equipment Manufacturers.” All such substitutions are subject to further investigation by the OWNER’s Engineer and approval by the OWNER.

Bid Conference

A Pre-bid conference for BIDDERS will **not** be held.

Questions and Clarifications

At the time that the Advertisement for Bids was issued, all informal communications with the County and associated agents regarding this solicitation shall have ceased. If you have any questions concerning bid specifications, please submit all questions to the Project Manager, Chris DeWeese at cldeweese@municipalconsultants.org by no later than **12:00 PM Wednesday, July 29th, 2026**. Responses to these questions, if appropriate, will be posted on the Shelby County eBid Portal by close of business Monday August 3rd, 2026. Bidders may only rely upon written guidance or responses. Failure to comply with this provision will be considered an improper communication and will be grounds to disqualify bidder.

Available Information

No Geotechnical Report, boring logs or other subsurface information is available from the Owner or Engineer for this project.

Pre-Bid Due Diligence

BIDDER is responsible for thoroughly inspecting the site and for reading and being thoroughly familiar with all the CONTRACT DOCUMENTS. The submission of the Bid shall be evidence that BIDDER has made such thorough examination and that the BID includes all necessary components to provide the OWNER with a fully functional facility that is complete in all respects. The failure or omission of any BIDDER to do any of the foregoing shall in no way whatsoever relieve any BIDDER from any obligation in respect to his BID. BIDDERS must satisfy themselves of the accuracy of the estimated quantities in the BID Schedule by examination of the site and a review of the Drawings and Specifications including ADDENDA. After BIDS have been submitted, the BIDDER shall not assert that there was a misunderstanding concerning the quantities of WORK or of the nature of the WORK to be done. No compensation will be allowed for losses caused by failure to comply with this requirement.

Bid Submission Requirements

Each BID must be submitted in a sealed envelope, addressed to the Shelby County Commission, Attn: Mary Horton, 200 West College Street, Rm. 125, Columbiana, Alabama 35051. Each sealed envelope containing a BID must be plainly marked on the outside as BID for **North-South Connector Control Valve Station** and the envelope should bear on the outside the name of the BIDDER, his address, his general contractor's license number, and the name of the Project for which the BID is submitted. If forwarded by mail, the sealed envelope containing the BID must be enclosed in another envelope addressed to the OWNER at the Chief Financial Officer's Office, 200 West College Street, Rm. 125 Columbiana, Alabama 35051. **Any BID received after the time and date specified shall not be considered. BIDS that are prematurely opened for failure of BIDDER to properly mark the envelope will not be considered.**

All BIDS must be made on the required BID forms provided in this Section, and all information required by the BID DOCUMENTS must be included with the BID. As indicated, all forms must be signed by the BIDDER. All blank spaces for BID prices must be filled in, in ink or typewritten, and the BID form must be fully completed and executed when submitted. Only one copy of the BID form is required. A copy of the BIDDER'S State Contractor's License for the state in which the work will be performed must be attached to the BID DOCUMENTS.

A conditional or qualified BID will not be accepted.

BID DOCUMENTS shall be enclosed in an envelope, sealed and addressed to the Owner with the Bidder's name and address inscribed on the outside and a warning not to be opened until the bid date. Proposals may be submitted to the Owner in person, by mail, or by agent, at any time prior to the day and time set for the opening of bids. Proposals will be opened at the designated office at the time set forth in "Advertisement for Bids." Only bids submitted

by Contractors licensed by the state laws in which the work is to be done will be considered. Proposals shall be submitted in the specification and contractual documents form in the proper order. No Proposal will be received after the time specified in the "Advertisement for Bids". A Bidder may withdraw, personally or by telegraphic or written request, any time prior to the closing time for receipt of bids.

Notice Regarding Application for Tax Certificate of Exemption

Under Alabama law (Alabama Act 2018-234), the Owner is tax exempt from the payment of all State, County, and Municipal Sales and Use Taxes for *purchases that qualify for an exemption* pursuant to Alabama Department of Revenue (ADOR) Rule No. 810-6-3-.77. Bidders shall not include Sales and Use Taxes in their bid for *purchases that qualify for exemption* under ADOR rules. However, Bidders shall account for the Sales and Use Tax savings (i.e., the Sales and Use Taxes not included in the Contractor's bid) in the designated section of the bid form (included in the Bid Documents) in accordance with Alabama law. All Bidders shall reference Alabama Act 2018-234 and the ADOR - Sales and Use Tax Rules (specifically Rule No. 810-6-3-.77) prior to bidding. Bidders shall include all Sales and Use Taxes for purchases of non-exempt materials and items, etc., as well as all other applicable taxes. It shall be the responsibility solely of the Bidder to determine which purchases for this project are exempt from Sales and Use Tax and which purchases are not exempt.

Withdrawal of Bids

BIDDER may withdraw a bid at any time prior to the bid opening included in the Advertisement for Bids by submitting a request to do so in writing to the single point of contact indicated above. Following the bid opening, BIDS must remain firm and unaltered for 60 days after the Notice of Award is transmitted to the BIDDER, provided the Award is made within the 60 days herein described. Should there be reasons why the Contract cannot be awarded within the specified period, the time may be extended by mutual agreement between the OWNER and the BIDDER.

Bond Requirements

Each BID must be accompanied by a BID BOND in the amount of 5% of the bid price or \$10,000, whichever is less payable to the OWNER in the amount described in the General Specifications. As soon as the BID prices have been compared, the OWNER will return the BONDS of all except the three lowest responsible BIDDERS. When the Agreement is executed, the BONDS of the two remaining unsuccessful BIDDERS will be returned. The BID BOND of the successful BIDDER will be retained until the payment BOND and performance BOND have been executed and approved, after which it will be returned. A cashier's check may be used in lieu of a BID BOND.

Successful BIDDER must provide a performance BOND in the amount of 100 percent of the CONTRACT PRICE and a payment BOND in the amount of 50 percent of the CONTRACT PRICE, with a corporate surety approved by the OWNER.

Attorneys-in-fact who sign BID BONDS or payment BONDS and performance BONDS must file with each BOND a certified and effective dated copy of their power of

attorney.

Insurance Requirements

BIDDER shall have its insurance provider thoroughly review all insurance requirements as provided in the Special Provisions prior to Bid opening to ensure the BIDDER includes sufficient monies to meet all insurance requirements. This review by the insurance provider shall be detailed and complete. The review shall determine pricing and availability of all specific insurance requirements including specific endorsements. This review shall determine all additional and special insurance that the successful BIDDER must acquire to be in full and complete compliance with all insurance requirements. Successful BIDDER shall provide a copy of all necessary insurance requirements within fifteen (15) days of the Award by the OWNER.

OWNER Due Diligence

The OWNER may make such investigations as he deems necessary to determine the ability of the BIDDER to perform the WORK, and the BIDDER shall furnish to the OWNER all such information and data for this purpose as the OWNER may request. The OWNER reserves the right to reject any BID if the evidence submitted by, or investigation of, such BIDDER fails to satisfy the OWNER that such BIDDER is properly qualified to carry out the obligations of the Agreement and to complete the WORK contemplated therein. The OWNER may waive any informalities or minor defects or reject any or all BIDS.

As it relates to requested substitutions of materials or equipment, the OWNER may request, and BIDDER shall promptly furnish, such additional information as may be required by the OWNER to clearly indicate full compliance with the Plans and Specifications. This includes, but is not limited to, lists of installations of the same equipment of similar size and complexity (including contact persons and phone numbers), testing and performance data (including both independent laboratory testing and full scale). The OWNER shall, in its sole discretion, approve or disapprove any such substitutes, to be recorded in the Special Provisions of the Contract.

The OWNER reserves the right to reject any BID that is submitted by a BIDDER that is determined by the OWNER to not be a responsible BIDDER or whose BID proposal is not responsive. In determining whether a BIDDER or BID is responsible and/or responsive, the OWNER reserves the right to also request and consider the following factors:

- 1) That BIDDER possesses all licenses and permits required by applicable law, rule, or regulation for the performance of the work prior to bidding;
- 2) That BIDDER has the necessary capital and financial resources to undertake and complete the project;
- 3) That BIDDER has equipment, in good working order, adequate for the performance of the WORK within the time specified;
- 4) That BIDDER has currently within BIDDER's organization the construction management and experienced supervisory personnel available for assignment to the PROJECT;
- 5) Whether BIDDER can provide positive references for successfully completed projects of similar size, magnitude and cost; and
- 6) Whether BIDDER or BIDDER's employees have performed or completed previous work for the OWNER in an unsatisfactory or unprofessional manner.

Disqualification of Bidders

Bidders may be disqualified, in the discretion of the OWNER, for the following reasons:

- 1) If BIDDER uses the same or different names for submitting more than one BID. BIDDER may submit a BID as a Subcontractor to other principals and not be disqualified provided he does not withdraw BID after bid opening.
- 2) If there is a reason for believing that collusion exists among BIDDERS, any or all Proposals may be rejected. Those participating in collusion may be barred from submitting bids on the same or other work with the OWNER, and may, as circumstances warrant, be forwarded to the Attorney General's Office.
- 3) If BIDDER does not comply with the requirements of the Contract Documents, or is not considered a responsible or responsive bidder.
- 4) If BIDDER attempts to influence the bid by communicating about this BID with any employee of the OWNER, the Engineer, or any thereof, other than formal requests for clarifications as set forth herein.

Award

The contract will be awarded to the lowest responsible and responsive Bidder, unless the Owner determines that all the bids are unreasonable or that it is not in the best interest of the Owner to accept any of the bids. Award of the contract will be made on the basis of the lowest base bid. The Contractor's base bid shall be defined as the sum of all totals listed under Items of Work Bid Schedule – Base Bid minus requested and accepted Alternate Deducts to Base Bid. The Owner shall reserve the right to include or exclude any listed Alternate Deducts to Base Bid in calculating the low bid. These deductive alternates will be established by the Owner in the Bid Schedule and Basis of Payment sections of the Bid Documents. Any other suggested and/or proposed alternates by the Contractor/Bidder will not be considered in calculation of the low bid price.

In submitting his Base Bid and Alternate Deducts in the Bid Schedule, the BIDDER thereby certifies that all his prices are based upon providing the base equipment and materials established throughout the Plans and Specifications. Substitute material suppliers and equipment manufacturers listed/provided by the BIDDER in the List of Substitute Material Suppliers and Equipment Manufacturers shall have no basis in determining the lowest bid.

The OWNER further reserves all rights to negotiate a contract and/or pricing in accordance with special circumstances as set forth in Code of Alabama § 39-2-6 (1975).

The OWNER reserves the right to cancel the award of the Contract before fully executed by both parties without any liability against the OWNER or its designees.

Contract Documents

The CONTRACT DOCUMENTS contain the provisions required for the construction of the PROJECT. Information obtained from an officer, agent, or employee of the OWNER or any other person shall not affect the risks or obligations assumed by the CONTRACTOR or relieve him from fulfilling any of the conditions of the Contract.

The party to whom the Contract is awarded will be required to execute the

Agreement, in substantially the same format included in the CONTRACT DOCUMENTS section herein, and obtain the performance BOND and payment BOND within fifteen (15) calendar days from the date when NOTICE OF AWARD is delivered to the BIDDER. The NOTICE OF AWARD shall be accompanied by the necessary Agreement and BOND forms. In case of failure of the BIDDER to execute the Agreement, the OWNER may at his option consider the BIDDER in default, in which case the OWNER may call the BID BOND consistent with Ala. Code § 39-2-11.

The OWNER within fifteen (15) days of receipt of acceptable performance BOND, payment BOND, and Agreement signed by the party to whom the Agreement was awarded will sign the Agreement and return to such party an executed duplicate of the Agreement, unless such time is mutually extended by the parties. Failure of Should the OWNER not execute the Agreement within such period, the BIDDER may by WRITTEN NOTICE withdraw his signed Agreement. Such notice of withdrawal shall be effective upon receipt. The NOTICE TO PROCEED shall be issued within a reasonable time frame of the execution of the Agreement by the OWNER.

Legal Requirements

All applicable federal, state, and local laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the PROJECT shall apply to the Contract throughout. This includes, but is not limited to, the legal requirements set forth in the form contract provided herein.

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____
_____ as Principal, and _____ as
Surety, are hereby held and firmly bound unto Shelby County Commission 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, successors and
assigns. Signed, this _____ day of _____, 20_____. The Condition of the above
obligation is such that whereas the Principal has submitted to the Owner a certain BID,
attached hereto and hereby made a part hereof to enter into a contract in writing, for the
North-South Connector Control Valve Station.

NOW, THEREFORE,

- (a) If said BID shall be rejected, or
- (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 amount that is allowed by Title 39 of the Code of Alabama (1975) for Public
Works projects.

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.

Principal (L.S.)

Surety

By: _____

IMPORTANT - Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the Project is located.

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SPECIFICATIONS - BID DOCUMENTS
NORTH-SOUTH CONNECTOR
CONTROL VALVE STATION**

INSURANCE REQUIREMENTS CERTIFICATION

The Contractor selected for the Project will be required to provide insurance in full accordance with all the requirements of the Contract Documents. Bidders shall ensure that if awarded the Project, the insurance provided will be in full accordance with all these requirements. This includes the exact endorsements and coverages as listed. No exceptions will be allowed.

The Bidder hereby certifies that he has provided all insurance requirements to his insurance provider for their careful review and pricing, and has verified that if his bid is accepted, all the insurance required by the Specifications, including the exact endorsements and coverages, will be provided. The Contractor also certifies that if the Contractor's current insurance provider will not provide the insurance required by the Contract Documents, then the Bidder has located another insurance provider for the Project that will issue insurance for the Project in full accordance with all requirements of the Contract Documents.

Finally, the Contractor certifies that he has included all costs necessary in his Bid to provide all insurance in full accordance with the Contract Documents.

Contractor _____

By _____

Date _____

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SPECIFICATIONS – BID DOCUMENTS
NORTH-SOUTH CONNECTOR
CONTROL VALVE STATION**

LIST OF SUBSTITUTE MATERIAL SUPPLIERS AND EQUIPMENT MANUFACTURERS

The standard of base quality and performance for materials and equipment are identified throughout the Plans and Specifications. The Owner has also approved some material suppliers and equipment manufacturers as listed in the Special Provisions, see the Special Provisions for “Standard of Quality for Base Bid”). The form below provides an opportunity for the Contractor, after careful review of the Plans and Specifications, to offer substitute materials/equipment for the Owner’s consideration that meet the requirements of the Plans and Specifications. The bidding contractor must specifically describe the proposed substitute material/equipment, name the substitute supplier/manufacturer, and write the deduct offered for the Owner’s consideration. The deduct offered shall represent the difference between the cost of the base material/equipment and the less expensive substitute material/equipment. The bidding contractor is not required to offer any substitutions in the form below. If substitutions are offered, Bidder must provide evidence of equal to or superior quality with the Bid. If substitutions require a redesign or alteration of construction drawings, Bidder will be responsible for any additional costs from the Engineer.

Item #	Detailed Description of Material or Equipment	Name of Supplier or Manufacturer	Deduct Offered
1.			
2.			
3.			
4.			
5.			
6.			

Accordingly, the bidding contractor certifies that the deductive substitutes listed in this form meet the requirements of the Plans and Specifications and are therefore offered at the deduct listed for the Owner's consideration.

Contractor _____

Signature _____

Date _____

**THE SHELBY COUNTY COMMISSION
SPECIFICATIONS - BID DOCUMENTS**

**NORTH-SOUTH CONNECTOR
CONTROL VALVE STATION**

LIST OF SUBCONTRACTORS

Contractors submitting a bid are required to list in the spaces provided the name of each of the subcontractors they will use if awarded the Contract. No substitutions will be allowed without approval of the Owner. The Bidder shall list the names of major subcontractors. If all the information is not provided with the bid, this will be grounds for the Owner to disqualify the Bidder for not being responsive.

ITEM OF WORK

SUBCONTRACTOR NAMES

Electrical	
Concrete	
Roofing	
Masonry	
Painting	
Indoor Piping	
Yard Piping	
Asphalt Paving	
Fencing	

The Owner reserves the right to reject a subcontractor at the Owner's sole discretion.

Note: If the Contractor will not use a subcontractor for an Item of Work, he shall write "None" in the blank for the Subcontractor for that Item of Work.

If the Bidder does not write in the name of a Subcontractor, he shall submit with his bid detailed evidence satisfactory to the Engineer that he has sufficient personnel experienced in that trade on his full-time staff to perform that item of work on this project. Failure to submit such satisfactory evidence with the Bid, or the submission of inaccurate, misleading, or incorrect information, will be grounds for the Owner to disqualify the Bidder for not being responsive.

The Bidder certifies that if his bid is accepted, the above subcontracting firms or businesses will be awarded subcontracts for the above portions of the work.

Contractor _____

By _____

Date _____

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STATION**

BASIS OF PAYMENT

BASE BID

The estimates of work listed in the Bid Proposal Form (including Basis of Payment and Items of Work) are to be considered only approximate quantities of items and are to be used as a basis for comparing bids. The Owner does not by any means guarantee that the approximate quantities given will hold in the construction of the work. Final installed quantities may vary significantly from the estimates shown. **Final Payment will be made for actual quantities of the work performed as approved by the Engineer, at the contract prices bid. Should the quantities of the pay items be more or less than the quantities estimated, the contract unit prices bid in the Proposal will prevail.**

For unit price items, the quantities shown in the “Items of Work” reflect estimates. The actual quantities will be adjusted during construction to reflect the conditions encountered, or other changes, or Owner preferences. Inasmuch as the actual quantities may vary considerably from the quantities listed in the schedule or shown on the drawings, the bidders shall insert prices that represent his actual costs. The Contractor shall not be paid an amount higher than he bids.

The cost of all work required for the project shall be included in the “Items of Work” listed for the project.

The Contract Unit or Lump Sum Bid Amounts shall be payment in full for furnishing all resources (materials, labor, equipment, etc.) necessary to install and complete each portion of the project in complete accordance with the requirements of the Plans and Specifications- Contractual Documents. The Contract Bid Amounts shall include the cost of completing all work described under each bid item description and all necessary incidental work not included or listed as a separate bid item. Incidental work may include, but not be limited to, all necessary excavation (earth or rock), backfilling (earth or stone), demolition, sheeting, shoring, piling, bracing, bypass pumping, dewatering, well pointing, clearing, grubbing, erosion control, locating all utilities and existing piping, repairing or replacing damaged facilities, restoration, grassing, disposal of excess materials, traffic/pedestrian control in accordance with the regulations of all authorities or agencies having jurisdiction over the work areas, permit compliance, and all other miscellaneous tasks necessary to fully complete the projects, etc. The quantities actually required may be significantly more or less than the quantities shown. **The Contractor will be paid for only the quantities actually and properly installed and approved for payment. The Contractor shall be paid only the price he bids for each item regardless of the conditions encountered, the quantity actually required, or the unit price.**

ITEMS 1 AND 2 - IMPORTED STONE FOR FOUNDATION CONSTRUCTION AND MISCELLANEOUS USES (EXTRA)

The Contract Unit Price per cubic yard shall be payment in full for the furnishing of all labor, materials, equipment, and all incidentals necessary to construct a foundation from stone or to install stone for other uses determined by the Engineer. This includes, but is not limited to, excavation and handling of unsuitable material beneath the bottom elevation of the crushed stone cushion under structures, dewatering, providing and handling the material, and installing and compacting the foundation material in accordance with the Contract requirements. If such excavated material is determined unacceptable for spoiling on-site (e.g., for final grading in areas to be grassed), it shall be disposed of off-site by the Contractor. There shall be no payment under this item for over-excavation or undercut not requested by the Engineer. This item shall be used only when unsuitable native soil foundation material must be removed. However, no payments will be made to correct subgrades that were suitable (e.g., the in-situ native soil subgrade was suitable, the prepared moisture conditioned subgrade was suitable, etc.) but were later made unstable/unsuitable by construction activities or the lack thereof. It shall not be used to pay for the crushed stone cushion required beneath all paving, structures, or other areas already specifically shown/identified in the Contract Drawings. The quantity shall be calculated based on cross-sections of the final in-place material after specified compaction requirements are met within the limits defined in the Specifications, as shown on the plans or re-established by actual field conditions.

ITEM 3 – POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPING

The Contract Unit Price Bid per linear feet shall be payment in full for the furnishing of all labor, equipment, machinery, materials, and all incidentals necessary to encase ductile iron pipe with polyethylene per the pipe manufacturer's standard at locations determined by the Engineer during construction and in accordance with the manufacturer's instruction. Payment shall be based on length of pipe encased.

ITEM 4 - YARD PIPING

The Contract Lump Sum Price shall be payment in full for the furnishing of all labor, materials, and equipment for the complete installation of the yard piping beginning 5 feet outside the structure, earth excavation, headwalls, all concrete poured at headwalls, concrete encasement, piping supports, thrust restraint, miscellaneous metals, cleanouts, concrete pads around cleanouts and valves, concrete encasement of piping where shown, wrapping and backfilling with compacted, crushed stone where shown or noted, piping, valves, fittings, compaction of bedding and backfill, all appurtenances, incidentals, and miscellaneous equipment shown or specified for this facility or as reasonably inferred or required for a complete and operable facility, clean up, and other services as required for a complete facility in full compliance with the Contract.

This item includes all payment associated with yard piping except for extra bedding required to replace unsuitable bedding material excavated per the request of the engineer. Such extra bedding replacing unsuitable material shall be paid for as Foundation Construction under the corresponding Pay Item for the type bedding/foundation material selected by the Engineer. Payment for piping inside The Control Valve Station or within 5 feet of the outside wall of The Control Valve Station shall be included

with the structure.

ITEM 5 – DUCTILE IRON FITTINGS - ALL SIZES (EXTRA)

The Contract Unit Price Bid per ton shall be payment in full for the furnishing of all labor, machinery, equipment, and materials to furnish and install complete ductile iron fitting assemblies (all sizes) that are required at specific, engineer-approved locations, but could not be reasonably inferred from the Contract Drawings. Fittings that are shown and/or called-out on the Contract Drawings will not be paid for. If a fitting assembly is not shown or specifically called out, but it is implied by the Contract Drawings then no payment will be made for the fitting assembly. This pay item is intended to reimburse the Contractor only for fittings that are required to complete the project but could not be reasonably inferred from the Contract Drawings. Fittings requested by the Contractor to avoid certain soil conditions (e.g., rock) will not be considered for payment unless approved by the Engineer. Unauthorized fittings will not be paid for. Fittings are mechanical joints with glands as specified in the Plans and Specifications. Payment will be made on invoice weight of the base fitting excluding the weight of all accessories (glands, bolts, gaskets, etc.). Quotes/invoices for weight and cost of each fitting shall be provided to Engineer when requested and prior to authorization of any extra fittings. This item shall include all incidentals associated with this work.

ITEM 6 - ELECTRICAL

The Contract Lump Sum Price shall be payment in full for the furnishing of all labor, materials, and equipment for the complete installation of the Electrical System. This item shall include but not be limited to: coordination of incoming power utilities to the Plant; motor control centers; switchgear; power panels; lighting panels; transformers; other electrical panels; surge protection; yard and interior lighting (including concrete foundations for yard lights); all power, control, signal, and instrument wiring and conduit (including but not limited to that between manufacturer or separately provided control panels and external instruments, sensors, and equipment); building and yard wiring; pull/junction boxes; installation and attachment hardware; concrete for conduit encasement; and all appurtenances, incidentals, and miscellaneous equipment shown or specified for this facility or as reasonably inferred or required for a complete and operable facility; clean up; testing; and other services as required for a complete facility in full compliance with the Contract Documents.

ITEM 7 - CONSTRUCTION OF CONTROL VALVE STATION

The Contract Lump Sum Price Bid shall include the furnishing of all labor, materials, equipment, and incidentals to complete the construction of the Control Valve Station per the Plans and Specifications. The lump sum price bid shall include, but not be limited to: the construction of Control Valve Station; all excavation including any rock removal, transporting, placing, and compacting fill; removal of excess materials; all electrical, instrumentation, and control work indicated in the Plans and Specifications; all SCADA/telemetry work and associated coordination requirements; complete control valve assemblies; all valves (and valve boxes), Control Valve Station piping and fittings within building and to five feet beyond the building perimeter; all drainage materials and work; asphalt paving with dense grade base course, as indicated in plans; all concrete work, as indicated in the Plans; fencing; shoring; painting; surveying and staking as required; FINAL grading; topsoil spreading and preparation, and all other work and incidentals

necessary and required to construct a complete and properly functioning Control Valve Station in accordance with the Plans and Specifications and to the satisfaction of the Owner and Engineer. This pay item shall include all work not specifically paid for under another pay item.

ITEM 8 - ALLOWANCE FOR FINAL GRADING AND GRASSING

The Contract Unit Price Allowance shall be payment in full for the furnishing of all labor, materials, and equipment required to complete final raking for finish grading and final grassing of disturbed areas for an acceptable growth of grass as specified. This Item shall include final grassing, fertilization, and finish mowing. The cost to develop the site to its final grade shall be included in Pay Item 7 (Construction of Control Valve Station). Temporary grassing for BMP or other purposes shall be included in other items. Any Contractor costs above this allowance to complete the work shall be included in other Items. The amount of money written in this item will be paid the Contractor when final grading is complete, and an acceptable growth of grass is established. Partial payment will not be allowed for this item.

ITEM 9 – ALLOWANCE FOR MOBILIZATION

The Contract Unit Price allowance shall be the cost allowed by the Owner for mobilization of Contractor's forces. The cost includes portions of all the Contractor's cost for bonds, insurance, set up of Contractor's forces and all field offices (if required), acceptance by Engineer and Owner of schedule of payment values, and equipment and personnel movement. The price established by the Owner is an allowance for the Contractor and will be paid upon completion of mobilization. Any costs the Contractor may have above this allowance to complete this item shall be included in other bid items.

ITEM 10 – ALLOWANCE FOR START-UP AND USE OF THE CONTROL VALVE STATION AND ITS COMPONENTS

The Contract Lump Sum Allowance shall be paid for furnishing the Owner the operable and completed Control Valve Station which has successfully passed tests as specified and been approved by all authorities for use by the Owner as intended and is put in service. This pay item includes, but is not limited to, equipment and valve testing, adjustment, coordination of all controls including SCADA controls and monitoring, startup, operator training, demonstration that the equipment and all valves comply with all specifications and other related services as required to demonstrate that the project is ready for operation by the Owner. The price in this item represents an allowance that is established by the Owner and used by all Contractors bidding the project. The amount of money written in this item will be paid the Contractor when the entire project is in satisfactory service since the station's components are an integral part of the Owner's entire water system. Partial payment will not be allowed on this item. Any costs the Contractor may have above this allowance to complete this item shall be included in other bid items. In order to receive payment for this Bid Item, all Control Valve Station components must be in proper operation, however work elements deemed as true punch list items by the Engineer, (generally cosmetic items and clean-up not necessary or desirable for station operation), do not have to be completed.

ALTERNATE DEDUCTS

ITEM 7A – DEDUCT FOR DELETING THE ASPHALT PAVING (BINDER AND WEARING SURFACE)

The Contract Lump Sum Price shall represent a deduct to the Lump Sum Bid Price for Bid Item 7 – Construction of Control Valve Station. The deduct shall include the deletion of all proposed asphalt paving (binder and wearing surface-total thickness equals 4”) shown and detailed on the site plan drawing for the Control Valve Station.

ITEM 7B – DEDUCT FOR DELETING THE DENSE GRADE BASE COURSE UNDER THE ASPHALT PAVING

The Contract Lump Sum Price shall represent a deduct to the Lump Sum Bid Price for Bid Item 7 – Construction of Control Valve Station. The deduct shall include the deletion of the dense grade base course (8” total thickness) required under all asphalt paving as shown and detailed on the site plan drawing for the Control Valve Station.

ITEM 7C – DEDUCT FOR DELETING THE FENCING SURROUNDING THE CONTROL VALVE STATION

The Contract Lump Sum Price shall represent a deduct to the Lump Sum Bid Price for Bid Item 7 – Construction of Control Valve Station. The deduct shall include the deletion of all of the chain-link fencing (including the double access gate) shown on the site plan drawing for the Control Valve Station.

BID

Proposal of _____ (hereinafter called "BIDDER"),
organized and existing under the laws of the State of _____ doing
business as _____.*

To the **Shelby County Commission** (hereinafter called "OWNER").

In compliance with your Advertisement for Bids, BIDDER hereby proposes to perform all
WORK for the construction of **North-South Connector Control Valve Station** in strict
accordance with the CONTRACT DOCUMENTS, within the time set forth therein, at the prices
stated below, and in accordance with the "Basis of Payment" herein.

By submission of this BID, each BIDDER certifies, and in the case of a joint BID, each
party thereto certifies as to his own organization, that this BID has been arrived at independently,
without consultation, communication, or agreement as to any matter relating to this BID with any
other BIDDER or with any competitor.

No BIDDER may withdraw a BID within 60 days after the actual date of the opening
thereof or after the Notice of Award is transmitted to the BIDDER, provided the Award is made
within the 60 days herein described. Should there be reasons why the Contract cannot be awarded
within the specified period, the time may be extended by mutual agreement between the OWNER
and the BIDDER.

Upon receipt of written notice of the acceptance of this bid, BIDDER will execute the
formal contract attached within fifteen (15) days and deliver a Performance or Payment Bonds and
Certificates of Insurance as required by the state law and the Contract Documents. The bid security
attached is to become the property of the OWNER in the event the contract and bond are not
executed within the time set forth, as liquidated damages for the delay and additional expenses to
the OWNER caused there.

BIDDER hereby agrees to commence WORK under this Contract on or before a date to be
specified in the NOTICE TO PROCEED and to fully complete the PROJECT within the calendar
days as specified in Section 1 of the Special Provisions. Bidder further agrees to pay as liquidated
damages, the sum as specified in Section 1 of the Special Provisions for each consecutive calendar
day thereafter.

* Insert "a corporation", "a partnership", or "an individual" as applicable.

BIDDER acknowledges receipt of the following ADDENDUM:

BIDDER agrees to perform all the work described in the Contract Documents for the following unit prices or lump sum:

Note: The Owner has Sales and Use Tax Exemption status under Alabama law. BIDS shall include only those taxes which are applicable based on this tax exemption status. See Special Provisions for “Application For Tax Certificate of Exemption”.

ITEMS OF WORK
BID SCHEDULE

BASE BID

ITEM	QUAN.	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
1	30	Cubic Yard	Imported Crushed Limestone (ALDOT Specification 825 Type B Moist Pug Mix) For Foundation Construction and Miscellaneous Uses (Extra)	\$ _____	\$ _____
2	30	Cubic Yard	Imported #57 Stone or Surge Stone (ALDOT #2 Stone) for Foundation Construction and Miscellaneous Uses (Extra)	\$ _____	\$ _____
3	250	Linear Foot	Polyethylene Encasement for D.I. Piping (Sizes 16” through 24”)	\$ _____	\$ _____
4	1	Lump Sum	Yard Piping	\$ _____	\$ _____
5	2	Tons	Ductile Iron Fittings – All Sizes (Extra)	\$ _____	\$ _____
6	1	Lump Sum	Electrical	\$ _____	\$ _____
7	1	Lump Sum	Construction of Control Valve Station	\$ _____	\$ _____

ITEM	QUAN.	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
8	1	Lump Sum	Allowance for Final Grading and Grassing	\$ <u>5,000.00</u>	\$ <u>5,000.00</u>
9	1	Lump Sum	Allowance for Mobilization	\$ <u>18,000.00</u>	\$ <u>18,000.00</u>
10	1	Lump Sum	Allowance for Start-up and use of Control Valve Station and its Components	\$ <u>40,000.00</u>	\$ <u>40,000.00</u>

TOTAL OF BASE BID \$ _____

ALTERNATE DEDUCTS TO BASE BID

Note: Only the difference in costs from the Base Bid shall be written in below.

ITEM	QUANT	UNIT	DESCRIPTION	UNIT PRICE	TOTAL
7A	1	Lump Sum	Deduct for Deleting the Asphalt Paving (Binder and Wearing Surface)	<\$ _____>	<\$ _____>
7B	1	Lump Sum	Deduct for Deleting the Dense Grade Base Course Under the Asphalt Paving	<\$ _____>	<\$ _____>
7C	1	Lump Sum	Deduct for Deleting the Fencing Surrounding the Control Valve Station	<\$ _____>	<\$ _____>

ACCOUNTING OF SALES AND USE TAX SAVINGS

Pursuant to Alabama Law, (Alabama Act 2018-234), BIDDER accounts for the Sales and Use Tax savings which are NOT included in the Items of Work - Bid Schedule as follows:

Bidder shall write in the estimated Sales and Use Tax savings which are NOT included in:

1. BASE BID: \$ _____

Failure to provide an accounting of Sales and Use Tax savings in the blank(s) above shall be grounds for the Owner to render the bid non-responsive. Other than determining responsiveness, the estimated Sales and Use Tax savings shall not affect the bid pricing nor be considered in the determination of the lowest responsible and responsive bidder.

Accordingly, the Contractor will not be paid for the Sales and Use Tax savings written in the blank(s) above. Bidder shall reference the Special Provisions for "Application for Tax Certificate of Exemption".

Respectfully submitted by: _____
Bidder

Signature

Address

Print Name and Title

Alabama License Number

Date

(SEAL - if BID is by a Corporation)

Attest _____

Instructions: This Bid shall be signed by the Bidder. Name and address must be shown; if a firm or partnership, the name and address of each member of the firm, or partnership must be shown; if a corporation, the president, vice-president or secretary shall sign and affix the corporate seal. If the person signing the Proposal is an agent, the agent must attach written authorization from the corporation. The Proposal must show the name of the corporation, the state under which the corporation is chartered and the name, title and address of the officer executing the bid.

**CERTIFICATE OF COMPLIANCE WITH THE BEASON-HAMMON
ALABAMA TAXPAYER AND CITIZEN PROTECTION ACT
(Act 2011-535, as amended by Act 2012-491)**

STATE OF ALABAMA §
 §
COUNTY OF _____ §

The undersigned, as a duly authorized representative of _____, (the "Contractor") hereby certifies as follows:

1. The undersigned holds the position of _____ with Contractor and is authorized to provide the representations set out in this Certificate as the official and binding act of Contractor and has knowledge of the provisions of THE BEASON-HAMMON ALABAMA TAXPAYER AND CITIZEN PROTECTION ACT, Act 2011-535 of the Alabama Legislature, as amended by Act 2012-491 (hereinafter "the Act").
2. Using the following definitions from Section 3 of the Act, Contractor has selected the appropriate description of its business structure and indicated the same by initialing its choice below:

BUSINESS ENTITY. Any person or group of persons employing one or more persons performing or engaging in any activity, enterprise, profession, or occupation for gain, benefit, advantage, or livelihood, whether for profit or not for profit. "Business entity" shall include, but not be limited to the following:

- a. Self-employed individuals, business entities filing articles of incorporation, partnerships, limited partnerships, limited liability companies, foreign corporations, foreign limited partnerships, foreign limited liability companies authorized to transact business in this state, business trusts, and any business entity that registers with the Secretary of State.
- b. Any business entity that possesses a business license, permit, certificate, approval, registration, charter, or similar form of authorization issued by the state, any business entity that is exempt by law from obtaining such a business license, and any business entity that is operating unlawfully without a business license.

EMPLOYER. Any person, firm, corporation, partnership, joint stock association, agent, manager, representative, foreman, or other person having control or custody of any employment, place of employment, or of any employee, including any person or entity employing any person for hire within the State of Alabama, including a public employer. This term shall not include the occupant of a household contracting with another person to perform casual domestic labor within the household.

_____ (a) Contractor is a business entity or employer as those terms are defined in Section 3 of the Act.

_____ (b) Contractor is **NOT** a business entity or employer as those terms are defined in Section 3 of the Act.

3. By signing this contract, the contracting parties affirm, for the duration of the agreement, 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.
4. The Contractor is enrolled in E-Verify unless it is not eligible to enroll because of the rules of that program or other factors beyond its control.

Certified this _____ day of _____, 20_____.

CONTRACTOR NAME: _____

By:

Signature: _____

Printed Name: _____

Its: _____

The above Certification was signed in my presence by the person whose name appears above on this _____ day of _____, 20_____.

WITNESSED BY:

Signature: _____

Printed Name: _____

**CERTIFICATE OF COMPLIANCE WITH ACT 2016-312
(BOYCOTT CERTIFICATE)**

The undersigned, as a duly authorized representative of _____, (the "Contractor") hereby certifies as follows:

1. The undersigned holds the position of _____ with the Contractor and is authorized to provide the representations set out in this Certificate as the official and binding act of Contractor and has knowledge of the provisions of Alabama Act 2016-312.
2. In compliance with said Act, the Contractor hereby certifies that it is not currently engaged in, and will not engage in, the boycott of a person or an entity based in or doing business with a jurisdiction with which this state can enjoy open trade.

Certified this _____ day of _____, 20_____.

CONTRACTOR NAME: _____

By:

Signature: _____

Printed Name: _____

Its: _____

The above Certification was signed in my presence by the person whose name appears above on this _____ day of _____, 20_____.

WITNESSED BY:

Signature: _____

Printed Name: _____

**CERTIFICATE OF COMPLIANCE WITH ACT 2023-409
(ECONOMIC BOYCOTT CERTIFICATE)**

The undersigned, as a duly authorized representative of _____,
(the "Contractor") hereby certifies as follows:

1. The undersigned holds the position of _____ with the Contractor named above, is authorized to provide representations set out in this Certificate as the official and binding act of that entity, and has knowledge of Act 2023-409 of the Alabama Legislature.
2. The Contractor is a for-profit entity, organization, association, corporation, partnership, joint venture, limited partnership, limited liability partnership, or limited liability company with 10 or more full-time employees.
3. The Contractor, without violating controlling law or regulation, does not and will not, during the term of the contract, engage in economic boycotts. Without an ordinary business purpose, the Contractor does not and will not refuse to deal with, terminate business activities with, or otherwise take any commercial action that is intended to penalize or inflict economic harm on a company solely because the company, without violating controlling law or regulation, does any of the following:
 - a. Engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy, timber, mining, or agriculture.
 - b. Engages in, facilitates, or supports the manufacture, import, distribution, marketing or advertising, sale, or lawful use of firearms, ammunition, or component parts and accessories of firearms or ammunition.
 - c. Does not meet, is not expected to meet, or does not commit to meet environmental standards or disclosure criteria, in particular to eliminate, reduce, offset, or disclose greenhouse gas emissions.
 - d. Does not meet, is not expected to meet, or does not commit to meet corporate employment or board composition, compensation, or disclosure criteria.
 - e. Does not facilitate, is not expected to facilitate, or does not commit to facilitate access to abortion or sex or gender change surgery, medications, treatment, or therapies.

Certified this _____ day of _____, 20_____.

CONTRACTOR NAME: _____

By:

Signature: _____

Printed Name: _____

Its: _____

The above Certification was signed in my presence by the person whose name appears above on this _____ day of _____, 20_____.

WITNESSED BY:

Signature: _____

Printed Name: _____

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E-VERIFY DOCUMENTATION,
STATE CONTRACTORS LICENSE,
AND W-9 TO BE INSERTED HERE

CONTRACT DOCUMENTS

NOTICE OF AWARD

To: _____

PROJECT Description: North-South Connector Control Valve Station

The OWNER has considered the BID submitted by you on (Bid Date) for the above-described WORK in response to its Advertisement for Bids and General Information for Bidders. You are hereby notified that your BID has been accepted for items in the amount of \$ _____.

You are required by the Information for Bidders to execute the Agreement and furnish the required CONTRACTOR'S Performance BOND, Payment BOND and certificates of insurance within fifteen (15) calendar days from the date of this Notice to you.

If you fail to execute said Agreement and to furnish said BONDS within fifteen (15) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this _____ day of _____, 20_____.

The Shelby County Commission

By _____

Name Chad Scroggins

Title County Manager

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged

By _____

this the _____ day of _____, 20_____.

By _____

Title _____

NOTICE TO PROCEED

To: _____ Date: _____

_____ **NORTH-SOUTH CONNECTOR**
_____ **Control Valve Station**

You are hereby notified to commence WORK in accordance with the Agreement dated _____, 20____ on or before _____, 20____ and you are to complete the WORK within _____ consecutive calendar days thereafter. The date of completion of all WORK is therefore _____, 20____.

The Shelby County Commission

By _____
Name Chad Scroggins
Title County Manager

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged

By _____
this the _____ day of _____, 20____.
By _____
Title _____

Bond Number

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that

(Name of Contractor)

(Address of Contractor)

a _____, hereinafter called Principal, and
(Corporation, Partnership, or Individual)

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto _____

The Shelby County Commission

(Name of Owner)

County Manager's Office, 200 West College Street, Columbiana, AL 35051

(Address of Owner)

hereinafter called OWNER, in the penal sum of _____

Dollars,

(\$ _____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain Contract with the OWNER, dated the _____ day of _____, 20____, a copy of which is hereto attached and made a part hereof for the construction of:

North-South Connector Control Valve Station

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said Contract during the original term thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the Surety and during the one-year guaranty period, and if he shall satisfy all claims and demands incurred under such Contract, and shall fully indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to 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 WORK to be performed thereunder or the SPECIFICATIONS accompanying the same shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS, WHEREOF, this instrument is executed in 4 counterparts, each one
(Number)

of which shall be deemed an original, this the ____ day of _____, 20____

ATTEST:

(Principal)

(Principal) Secretary By _____(s)

(SEAL)

(Witness as to Principal) _____
(Address)

(Address) _____

Surety

ATTEST:

(Surety) Secretary
(SEAL)

Witness as to Surety By _____
Attorney in Fact

(Address) _____
(Address)

NOTE: Date of BOND must not be prior to date of Contract.
If CONTRACTOR is Partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the PROJECT is located.

Bond Number

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that

(Name of Contractor)

(Address of Contractor)

a _____, hereinafter called Principal, and
(Corporation, Partnership, or Individual)

(Name of Surety)

(Address of Surety)

hereinafter called Surety, are held and firmly bound unto _____
The Shelby County Commission

(Name of Owner)

County Manager's Office, 200 West College Street, Columbiana, AL 35051

(Address of Owner)

hereinafter called OWNER, in the penal sum of _____

Dollars,

(\$ _____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain Contract with the OWNER, dated the _____ day of _____, 20____, a copy of which is hereto attached and made a part hereof for the construction of:

North-South Connector Control Valve Station

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said Contract during the original term thereof, and any extensions thereof which may be granted by the OWNER, with or without notice to the Surety and during the one-year guaranty period, and if he shall satisfy all claims and demands incurred under such Contract, and shall fully indemnify and save harmless the OWNER from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all outlay and expense which the OWNER may incur in making good any default, then this obligation shall be void; otherwise to 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 WORK to be performed thereunder or the SPECIFICATIONS accompanying the same shall in any way affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS, WHEREOF, this instrument is executed in 4 counterparts, each one
(Number)

of which shall be deemed an original, this the _____ day of _____, 20_____.

ATTEST:

(Principal) Secretary

By _____(s)
(Principal)

(SEAL)

(Witness as to Principal)

(Address)

(Address)

Surety

ATTEST:

(Surety) Secretary

(SEAL)

By _____
Witness as to Surety Attorney in Fact

(Address)

(Address)

NOTE: Date of BOND must not be prior to date of Contract.
If CONTRACTOR is Partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the PROJECT is located.

**CERTIFICATE OF INSURANCE
AND
INSURANCE ENDORSEMENTS**

SHELBY COUNTY, ALABAMA
PUBLIC WORKS CONTRACT

THIS AGREEMENT, entered into as of this _____ day of _____, 20____, is by and between SHELBY COUNTY, ALABAMA, a political subdivision of the State of Alabama (hereinafter called the COUNTY) and _____ (hereinafter called the CONTRACTOR). This agreement concerns the North-South Connector Control Valve Station project issued addenda(s) _____, and the contractor's bid (herein called the PROJECT).

WITNESSETH THAT:

WHEREAS, the COUNTY is currently involved in the planned construction of the PROJECT as specified in design and bid specifications dated July, 2026, which said design and bid specifications are incorporated into this Contract by reference and made part and parcel hereof as fully as if set out herein; and

WHEREAS, CONTRACTOR submitted the lowest responsive and responsible bid for the construction of the PROJECT; and

WHEREAS, the COUNTY desires to engage and contract with the CONTRACTOR to provide technical, professional, and construction services and to construct and complete the PROJECT herein described; and

WHEREAS, the CONTRACTOR desires to contract to provide technical, professional, and construction services and to complete the construction of the PROJECT herein describe.

NOW, THEREFORE, in consideration of the mutual covenants and agreements contained herein, the COUNTY and the CONTRACTOR do hereby mutually agree, covenant, and contract as follows:

Section 1. CONTRACTOR

The COUNTY agrees to engage the CONTRACTOR, and the CONTRACTOR hereby agrees, to perform the construction services hereinabove and hereinafter set forth, and to construct the PROJECT described within this Contract in accord with the accompanying plans and specifications in a good, competent, and workmanlike manner as requested and determined by the COUNTY and in strict compliance with the design and bid specifications for such PROJECT as referenced in other portions of this Contract.

The CONTRACTOR will supply to the COUNTY prior to the commencing of work the following documents, together with any other documents as are required by Alabama law:

A) Certificate of Insurance (with unconditional cancellation clause), said insurance in the amounts as specified in the contract documents and as approved by the COUNTY;

B) Section 84 Business License, Applicable City Business License and all other licenses required by law to complete this project;

C) The CONTRACTOR will furnish to the COUNTY a performance bond equaling the total bid amount of the PROJECT payable to the COUNTY, which said bond shall be in form and substance as approved by the COUNTY. The CONTRACTOR shall also execute and furnish to the COUNTY a payment bond securing the CONTRACTOR'S obligation to pay for all labor, materials, or supplies for work done pursuant to this contract, which said payment bond shall be in an amount equal to fifty percent (50%) of the total contract price and shall be in form and substance as approved by the COUNTY. Said payment bond shall also provide bonded coverage to cover and to compensate for reasonable attorney fees incurred by a successful party in civil actions brought on the bond and ordered to be paid by a court of competent jurisdiction;

D) The CONTRACTOR shall comply with all applicable laws, ordinances, and codes of the U. S. Government, the State of Alabama, any relevant municipality, and the COUNTY, and, specifically and without limitation, shall comply with all provisions of the following:

Public Works. This project is considered a "Public Works" project and is governed by all applicable laws as contained in Title 39 of the Alabama Code (1975). Bidders, subcontractors, suppliers, and Bond Agents should be familiar with this code. Consistent with Ala. Code §§ 39-3-1 and 39-3-4, the bidder must contract materials, supplies, and products manufactured, mined, processed, or otherwise produced in the United States or its territories, if the same are available at reasonable and competitive prices shall use iron or steel produced within the United States when specifications in the construction contract require the use of iron or steel, provided that nothing herein shall require any material that would qualify as a sole source under Ala. Code § 39-2-2(f).

Immigration Law. As required by Ala. Code § 31-13-9, by signing this contract, grant, or other agreement, the contracting parties affirm, for the duration of the agreement, 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.

Open Trade. Consistent with Ala. Code § 41-16-5, contractor represents and agrees that it is not currently engaged in, nor will it engage in, any boycott of a person or entity based in or doing business with a jurisdiction with which the State of Alabama can enjoy open trade.

Economic Boycott. Contractor verifies that the company, without violating controlling law or regulation, does not and will not, during the term of the contract, engage in economic boycotts as defined by Ala. Code § 41-16-160.

Section 2. Scope of Services

The CONTRACTOR shall provide all construction services, work and labor, and other professional and technical services to complete the PROJECT herein described, which shall include, but not necessarily be limited to, the activities, plans, and specifications described in the construction drawings, GENERAL AND STANDARD specifications, bid, and related documents.

Section 3. Time of Performance

The CONTRACTOR shall begin work on the PROJECT upon the execution of this Contract and will continue, uninterrupted, for a period of time not to exceed Three Hundred (300) working days beginning after receiving Notice to Proceed from the COUNTY. Said work to be completed in a good and workmanlike manner by the CONTRACTOR within the period of time specified. See also Special Provisions included as Attachment A.

Section 4. General Provisions

Personnel. The CONTRACTOR warrants that it has the expertise, professional personnel, and adequate work force capable of performing this Contract, as called for herein, in a satisfactory and proper manner, in accord with highest industry standards, or will secure the services of such personnel as may be required to perform such services, construct said PROJECT, and perform its obligations pursuant to this Contract.

Office Space. The CONTRACTOR agrees to provide and maintain the office space and facilities required to perform all services as called for under this Contract, at no expense to the COUNTY.

Subcontracts. Work or services covered by this contract may be subcontracted provided that all subcontractors meet the qualifications as set forth in the Bid Documents and Specifications and have been approved by the COUNTY. Any work or services subcontracted hereunder shall be specified by written contract or agreement and shall be subject to each provision of the Contract Documents including, without limitation, all applicable insurance requirements.

Access to Materials. The COUNTY agrees to make available to the CONTRACTOR, upon request, any maps, documents, and planning materials or any other information in its possession or otherwise readily available, which has a direct bearing on the PROJECT, at no expense to the CONTRACTOR.

Communications. The representatives of the COUNTY and the CONTRACTOR to whom communications regarding the PROJECT which is the subject of this contract should be directed are as follows:

COUNTY: Phillip Crunk, Manager
Shelby County Water Services
10927 US HWY 280
Sterrett, AL 35147
Email: pcrunck@shelbyal.com

CONTRACTOR: _____

Work will be performed by the CONTRACTOR under the direct supervision of the representative of the COUNTY, who will have sole authority of deciding if work conditions, such as weather, temperature, and other details of construction are complied with by the CONTRACTOR. At the discretion of the COUNTY, work may be stopped or delayed at any time until conditions are appropriate, in the opinion of the COUNTY, in order that optimum results and work quality may be obtained from the PROJECT in the

best interest of the COUNTY. The decision of the COUNTY upon any questions connected with the performance of this Contract or any failure or delay in the prosecution of the work by the CONTRACTOR shall be final and conclusive.

Attachment A - Special Provisions is hereby incorporated as part of this contract.

Section 5. Compensation and Method of Payment

(a) For services satisfactorily rendered under this Contract and approved by COUNTY, the COUNTY agrees to pay the CONTRACTOR for fulfillment of the terms and conditions of this Contract as specified in the specifications and bid documents. The total amount to be paid under this section for services shall not exceed _____ dollars and _____ cents (\$_____). Such payment shall, if due, be made monthly at the end of each calendar month, but in no case later than forty-five (45) days after the acceptance by COUNTY that the estimate and terms of the contract providing for partial payment have been fulfilled. In preparing estimates, the material delivered on the site, materials suitably store, and insured off-site, and preparatory work done may be taken into consideration by COUNTY. If the amount due by COUNTY is not in dispute and the amount payable is not paid within the forty-five (45) day period, the CONTRACTOR shall be entitled to interest from COUNTY at the rate assessed for underpayment of taxes under Section 40-1-44(a), Code of Alabama 1975, on the unpaid balance due. Interest payments shall not be due on payments made after the forty-five (45) day period because of administrative or processing delays at the close of the fiscal year. In making the partial payments, there shall be retained not more than five percent (5%) of the estimated amount of work done and the value of materials stored on the site or suitably stored and insured off-site, and after fifty percent (50%) completion has been accomplished and approved by COUNTY, no further retainage shall be withheld. The retainage as set out herein shall be held until final completion and acceptance of all work covered by the contract. Retainage shall be held until all work has been completed to COUNTY's satisfaction. The CONTRACTOR immediately after the completion of the contract shall give notice in writing to the COUNTY. The COUNTY, upon completion and acceptance by COUNTY of the work, shall give notice of completion of the PROJECT by advertising and publishing on the COUNTY website. The publication and advertisement shall be posted for three consecutive weeks. Final settlement shall not be made upon the contract until the expiration of 30 days after the completion of the notice. Additional instruction as to the process for submitting invoices for payment and completion of the project shall be as set forth in the General Specifications.

(b) PROVISIONS OUTLINING THE SOURCE OF SUFFICIENT FUNDS TO BE UTILIZED BY COUNTY TO FULFILL COUNTY'S OBLIGATIONS UNDER THIS CONTRACT (indicate which applies by entering an appropriate mark opposite the following):

X The funds to be utilized by COUNTY to fulfill its obligation under this contract are funds which are held by COUNTY at the time of the execution of this contract or will become available at a date following the execution of the contract.

_____ The source of funds to be utilized by COUNTY in fulfilling its obligation under this contract is a grant, award, or direct reimbursement from the State, federal government, or other source which will not become available until after the execution of this contract, and the provision of this contract requiring prompt payment shall not apply until COUNTY is in receipt of the funds as provided in the contract.

Upon receipt of such funds, the forty-five (45) day requirement specified in this contract shall commence and shall be enforceable as provided herein.

Section 6. Terms and Conditions

(a) Termination of Contract for Cause/Breach of Contract. If through any cause the CONTRACTOR shall fail to fulfill in a timely and proper manner its obligations under this Contract, or if the CONTRACTOR shall violate any of the covenants, agreements, or stipulations of this Contract, the COUNTY shall thereupon have the right to terminate this Contract by giving written notice to the CONTRACTOR of such termination and specifying the effective date of such termination. In such event, all finished or unfinished documents, data, studies, surveys, drawings, maps, models, photographs, and reports, or other materials prepared by the CONTRACTOR under this Contract or during the construction performance, shall, at the option of the COUNTY, become its property.

Notwithstanding the above, the CONTRACTOR shall not be relieved of liability to the COUNTY for damages sustained by the COUNTY by virtue of any breach of the Contract by the CONTRACTOR, and the COUNTY may withhold any payments to the CONTRACTOR for the purpose of set-off until such time as the exact amount of damages due the COUNTY from the CONTRACTOR is determined.

(b) Termination for Convenience of the COUNTY. The COUNTY may terminate this Contract at any time, with or without just cause, by giving written notice to the CONTRACTOR of such termination and specifying the effective date thereof, at least thirty (30) days prior to the effective date of such termination. In such event, all finished or unfinished documents and other materials, as described in the above clause, shall, at the option of the COUNTY, become its property. If the Contract is terminated by the COUNTY as provided in this subparagraph (b), the CONTRACTOR shall be entitled to receive just and equitable compensation for any work satisfactorily completed on said PROJECT.

(c) Changes. The COUNTY may, from time to time, request changes of the CONTRACTOR in the scope of services to be performed hereunder. Such changes, or renegotiation, including any increase or decrease in the amount of the CONTRACTOR's compensation, which is mutually agreed upon by and between the COUNTY and the CONTRACTOR, shall be incorporated in written Change Orders to this Contract. The process for Change Orders shall be as set forth in the General Specifications.

(d) Assignability. The CONTRACTOR shall not assign any interest in this Contract, and shall not transfer any interest in the same whether by assignment or novation, without the prior written consent of the COUNTY provided, however, that claims for money by the CONTRACTOR from the COUNTY under this Contract may be assigned to a bank, trust company, or other financial institution without such approval. Written notice of any such assignment or transfer shall be promptly furnished to the COUNTY.

This Contract shall be binding upon and inure to the benefit of any successor to the COUNTY and such successor shall be deemed substituted for the COUNTY under the terms of this Contract. As used in this Contract, the term "successor" shall include any person, firm, employer, or other business entity which at any time, whether by merger, purchase, or otherwise, which assumes or is assigned responsibility of the COUNTY for the covered PROJECT. This Contract shall also be binding upon and inure to the benefit of the CONTRACTOR, his successors, executors, and administrators.

(e) Reports, Documentation, and Certifications. The CONTRACTOR, at such times and in such forms as the COUNTY, by and through its Engineer, may require, shall furnish to the COUNTY such periodic submissions and certifications as it may request pertaining to the work or services undertaken pursuant to this Contract, the costs and obligations incurred or to be incurred in connection therewith, and any other matters covered by this Contract. Specific requirements relating to documents include, but are not limited to, the Shop Drawings, Submittals, and O&M Manuals sections of the General Specification, the "All Equipment" Specification. CONTRACTOR is responsible for identifying the necessary certifications, requesting the prescribed forms individually prior to the need for them, and promptly submitting such certifications in a timely manner concurrently with the occurrence being certified. Additionally, at the completion of the project, the Contractor shall submit copies of all certifications (except submittal certification forms) collectively in a single three-ring binder with a Table of Contents listing each certification contained in the binder, as well as any required Warranty certifications.

(f) Waiver of Trial by Jury. The parties to this Contract desire to avoid the additional time and expense related to a jury trial of any disputes arising hereunder. Therefore, it is mutually agreed by and between the parties hereto, and for their successors and assigns, that they shall and hereby waive trial by jury of any claim, counterclaim, or third-party claim, including any and all claims of injury or damages, brought by either party against the other arising out of or in any way connected with this Contract and the relationship which arises herefrom. The parties acknowledge and agree that this waiver is knowingly, freely, and voluntarily given, is desired by both parties, and is in the best interest of both parties.

(g) Audits and Inspection/Access to Records/Record Retention. At any time during normal business hours, with prior arrangement and as often as the COUNTY may deem necessary, the CONTRACTOR shall make available to the COUNTY for examination all of its records with respect to matters covered by this Contract and will permit the COUNTY to audit, examine, and make excerpts or transcripts from such records, and to make audits of all contracts, invoices, materials, payrolls, records of personnel, conditions of employment, and other data relating to all matters covered by this Contract.

The CONTRACTOR shall retain all books, documents, papers, and records which are directly pertinent to this contract for a period of six (6) years following completion of the contracted work and expiration of the Contract, unless written permission to destroy them is granted by the COUNTY.

(h) Interest of Members of the COUNTY and Other Local Public Officials. No officer, member, or employee of the COUNTY and no member of its governing body, and no other public official of the governing body of the locality or localities in which the PROJECT is situated or being carried out, who exercises any functions or responsibilities in the review or approval of the undertaking or carrying out of this PROJECT, shall participate in any decision relating to this Contract which affects his personal interest or the interest of any corporation, partnership, or association in which he is directly or indirectly interested or has any personal or pecuniary interest, direct or indirect, in this Contract or the proceeds thereof. The CONTRACTOR shall take appropriate steps to assure compliance.

(i) Interest of the CONTRACTOR. The CONTRACTOR covenants that it presently has no interest and shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of services required to be performed under this Contract. The CONTRACTOR further covenants that, in the performance of this Contract, no person having any such interest shall be employed.

Section 7. Additional Services of CONTRACTOR

If authorized in writing by the COUNTY, the CONTRACTOR shall furnish additional services that are not considered as an integral part of the PROJECT plans and specifications. Under this Contract, all costs for additional services will be negotiated as to activities and compensation by way of a Change Order. The process to create a Change Order shall be as set forth in the Special Provisions. Upon mutual written agreement between the COUNTY and the CONTRACTOR, and written authorization from the COUNTY to proceed, the CONTRACTOR will provide the additional service.

Section 8. Tax Responsibilities of CONTRACTOR

The parties to this Contract agree that the CONTRACTOR is an independent firm or person and that the relationship created by this Contract is that of an independent contractor. Further, the parties agree that the CONTRACTOR is not an employee of the COUNTY, and will not be treated as such for federal income tax purposes. In this regard, the CONTRACTOR acknowledges and accepts all tax responsibilities imposed by federal income tax laws, and any applicable state income tax laws, on self-employed persons, including, but not limited to, the responsibility of withholding from income the required amounts for federal income taxes, Social Security taxes, federal unemployment tax, and applicable state and local income taxes.

Following execution of the Contract and in accordance with the Alabama Department of Revenue (“ADOR”) Rule No. 810-6-3-.77, the CONTRACTOR and any subcontractors shall submit an Application for Sales and Use Tax Certificate of Exemption (ADOR Form ST: EXC-01) to the ADOR that is specifically for this tax-exempt project. The CONTRACTOR and any subcontractors shall comply with all requirements of the ADOR and shall obtain the Certificates of Exemption (ADOR Form STC- 1) prior to ordering any materials for the project that qualify for exemption of Sales and Use Taxes. The OWNER will make available any information that is requested by the Contractor and is required by the ADOR for the CONTRACTOR and any subcontractors to obtain their Certificates of Exemption. In accordance with ADOR Rule No. 810-6-3-.77, the OWNER will also fulfill its obligation to submit its Application for Sales and Use Tax Certificate of Exemption specifically for this tax-exempt project.

Section 9. Independent CONTRACTOR Relationship

In the performance of the work, duties, and obligations evolving under this Contract, it is mutually understood and agreed that the CONTRACTOR is at all times serving as an independent contractor providing the COUNTY with services as a contractor and/or independent contractor. Amounts paid to the CONTRACTOR by the COUNTY as compensation for providing said services and for the performance of this Contract are for services purchased, and amounts paid to the CONTRACTOR shall be deemed to be compensation to an independent contractor and shall not be subject to any tax withholding. It is expressly understood that the COUNTY is interested only in the results to be achieved, and the conduct and control of the work will be the sole responsibility of the CONTRACTOR. The CONTRACTOR is not considered to be an agent or employee of the COUNTY for any purpose, and the CONTRACTOR will not be eligible to participate in any benefits the COUNTY provides for its own employees. It is further understood and agreed that the COUNTY does not agree to use the CONTRACTOR exclusively.

It is further understood and agreed that, except as provided herein, the CONTRACTOR is free to contract for similar services to be performed for others during the term of this Contract.

Section 10. Indemnification and Liability

The COUNTY shall not be liable for any injury to the person or property of any person, firm, or corporation resulting directly or indirectly from CONTRACTOR's performance of this Contract, and the CONTRACTOR assumes full and complete responsibility therefore. The CONTRACTOR shall remain insured under terms of a public liability insurance policy as described in the Special Provisions during the entire term of this Contract and for the performance of all work herein provided. The CONTRACTOR shall further indemnify the COUNTY and hold the COUNTY safe and harmless from any and all liability, lawsuits, judgments, attorney fees, and other costs incurred by the COUNTY in defending any claim or lawsuit made against the COUNTY by any person, firm, or corporation, including any claim made by an employee, agent, subcontractor, or vendor of the CONTRACTOR, arising directly or indirectly out of any work performed by the CONTRACTOR pursuant hereto or any breach or alleged breach of duty or responsibility of the CONTRACTOR related thereto.

The CONTRACTOR and his Surety shall indemnify and save harmless the COUNTY and the Engineer and all of their representatives or agents against any claim or liability arising from or based on the violation of any law, regulation, or permit requirement, whether by himself, his employees, or his subcontractors. The CONTRACTOR agrees to indemnify and/or reimburse the Owner for any fines, violations, charges, suits, or sums of money imposed by the Alabama Department of Environmental Management (ADEM), Environmental Protection Agency (EPA), or any agency overseeing and/or issuing regulation, law or permit for any violation arising out of the work by the CONTRACTOR pursuant to this agreement. The CONTRACTOR agrees to reimburse the COUNTY for all costs the COUNTY incurs due to the CONTRACTOR'S non-compliance or alleged non-compliance with laws, regulations, and permits.

If the CONTRACTOR uses any design, device, material, or process covered by letters, patent or copyright, the CONTRACTOR and the Surety shall indemnify and save harmless the COUNTY and the Engineer and all their authorized representatives from any suits or claims for infringement.

The indemnification obligation under this Section shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the CONTRACTOR, any subcontractor, or equipment or material supplier or manufacturer under workmen's compensation acts, disability benefit acts, or other employee benefit acts.

The obligations of the Contractor under this Section shall not extend to the liability arising out of active negligence, sole negligence, willful misconduct of, or for defects in design furnished by, the COUNTY and Engineer, their agents, consultants, and/or employees provided that such negligence or defect are the primary cause of the injury or damage. Except as provided in this paragraph, no individual official, employee, or agent of the COUNTY or Engineer shall be held personally liable for official actions taken with respect to this Contract.

The COUNTY may retain money due for actions or claims for injuries or damages until settled. The COUNTY and/or the Engineer, or their representatives shall not be liable to the CONTRACTOR for

damages or delays resulting from work by third parties or by injunctions or other restraining orders obtained by third parties.

Section 11. Nonwaiver of Rights

The COUNTY shall not be precluded from recovering from the CONTRACTOR and his surety damages for the CONTRACTOR'S failure to comply with the terms of the Contract. Neither the inspection by the COUNTY or the Engineer or any of their officers, employees, agents, or subconsultants; nor any order by the COUNTY for payment of money; nor any payment for, or acceptance of, the whole or any part of the Project by the COUNTY or Engineer; nor any extension of time or change order; nor any possession taken by the Owner or its employees shall operate as a waiver of any provision of this Contract or any power herein reserved to the COUNTY, or any right to damages. nor shall any waiver of any breach in this Contract be held to be waiver of any other or subsequent breach. Acceptance or final payment shall not be final and conclusive with regards to rejected Work at any time before or during the warranty period; to latent defects; fraud or such gross mistakes as may amount to fraud; or as regards to the COUNTY'S rights under any warranty.

Section 12. Entire Agreement

This Agreement, and the attached Contract Documents set forth herein, constitute the entire agreement of the parties and shall supersede any oral or written agreement of the parties. Any and all changes or modifications must be in writing and signed by the Parties, including Change Orders. For the avoidance of doubt, this Agreement shall consist of the following documents:

This Contract;
Special Provisions;
Invitation to Bid, inclusive of Addendums _____;
Applicable Professional Standards or Regulations;
Plans and Approved Drawings;
Standard Specifications;
General Specifications; and
CONTRACTOR'S bid.

Further, the documents identified above are interrelated, and their intent is to prescribe a complete improvement. In the event of conflicting terms, the order of precedence shall be as identified above.

IN WITNESS WHEREOF, the COUNTY and the CONTRACTOR have caused this Contract to be executed by their duly authorized officers on the day and year first above written.

ATTEST:

SHELBY COUNTY

By: Chad Scroggins
County Manager

Date

ATTEST:

CONTRACTOR

By (print): _____

Title: _____

Date: _____

SPECIAL PROVISIONS

**SPECIAL PROVISIONS
FOR
STARTING AND COMPLETION TIME
AND LIQUIDATING DAMAGES**

SECTION I

1.0 STARTING AND COMPLETION TIME

Work specified under this contract shall begin on the date specified in the Notice to Proceed. The completion of work shall be counted from the specified start date in the Notice to Proceed and will be as follows:

300 calendar days

Requests for extension of time will be submitted to the Engineer along with the Contractor's periodic estimate. The Engineer shall ascertain the facts and the extent of the delay and shall recommend to the Owner whether it should extend the time for completing the Project. The Contractor shall provide all documentation requested by the Engineer. Extensions of time, if any, will be made by the Owner only if in accordance with the Contract Documents.

For change orders requesting extensions of time due to rain, wind, flood or other natural phenomenon, the Contractor's written request must be accompanied, at the Owner's request, by a detailed report of weather at this site for the last ten (10) years with averages showing means and statistical deviations from mean averages to support request for extension. No extension shall be made for delays due to rain, wind, flood or other natural phenomenon of normal intensity for the locality.

In the event any material changes, alterations, or additions are made as herein specified, which in the opinion of the Engineer will require additional time for execution of any work under the contract, then in that case, the time of the completion of the Project may be extended through change order. No extensions of time shall be given for any minor changes, alterations or additions. The Contractor shall not be entitled to any reparation or compensation on account of such additional time or extensions of time.

2.0 NO DAMAGE FOR DELAY

If the Contractor is delayed, hindered, or impeded at any time in the progress of the Work for any reason or by any alleged act or neglect of the Owner, or the Engineer, or by an employee of any of them or by a separate vendor, manufacturer or Contractor employed by the Owner, or by changes ordered in the scope of the Work, or by other causes beyond the Contractor's control, then the Contract Time may be extended at the sole discretion of the Owner by Change Order for such reasonable time as is agreed to by the Owner. However, notwithstanding any other provisions in the Contract Documents, and whether contemplated or not, and whether or not arising by active interference; the Owner, Engineer, and their respective agents and employees shall not be liable for any damages for delay whether for direct or indirect costs, extended home office overhead, idle or inefficient labor or equipment, cost escalations, or monetary claims of any nature arising from or attributable to delay by any cause whatsoever. The Contractor's sole and exclusive right and remedy for delay by any cause whatsoever is an extension of the Contract Time but no increase in

the Contract Sum.

3.0 LIQUIDATING DAMAGE CHARGE

Beginning with the first periodic estimate after the contract completion date, liquidating damage charges may be assessed by the Owner against the Contractor for each calendar day past the contract completion date, plus approved time extensions. The liquidating damage charges shall be deducted from the Contractor's periodic payment by the Owner. The Contractor shall be notified of the liquidating damage charge and shall have ten (10) days in which to file an appeal of the charges with the Owner. The Owner shall review the appeal and render a decision of approval or disapproval. The liquidated damages shall be as follows beginning from the stated or extended date of completion and continuing for so long as the Project remains incomplete.

\$ 900 per calendar day

Should the Owner not deduct liquidated damages when it is first entitled to, this shall in no way limit the Owner's right to deduct or claim the entire liquidated damages at whatsoever time the Owner may desire. It is understood and agreed that the above deduction is not a penalty, but money due to reimburse the Owner for inconvenience and damage to the general public, due to the delay in the completion of the Project and is reasonable. The collection of liquidated damages by the Owner shall not constitute an election or waiver by the Owner of recovery of additional delay or non-delay related damages from the Contractor, and the Owner expressly reserves the right to recover actual damages for other harms resulting from delay. The provisions of the liquidated damage clause shall apply and continue to apply even if the Contractor terminates or abandons the Project prior to the scheduled completion dates.

The amounts of such liquidated damages and actual damages incurred by reason of failure to complete the work stipulated in the Contract are hereby agreed upon as reasonable estimates of the costs which may be accrued by the Owner. It is expressly understood and agreed that these amounts are not to be considered in the nature of penalties, but as damages which have accrued against the Contractor. The Owner shall have the right to deduct such damages from any amount due, or that may become due the Contractor, or the amount of such damages shall be due and collectible from the Contractor or Surety.

**SPECIAL PROVISIONS
FOR
STANDARD OF QUALITY
AND MANUFACTURED
ARTICLES**

SECTION II

1.0 MANUFACTURED ARTICLES

Contractor shall provide all materials or equipment as specified in the Drawings and Specifications. The below Material or Equipment Manufacturer's listed are allowed choices the Contractor may use for the specific material/equipment listed. The Contractor may only use one supplier/manufacturer of each item below. When the Contractor supplies the Engineer a submittal for an item, the supplier/manufacturer for the item will be established. Note that not all items are listed on this page but only select items. Some items are identified by standards of quality in the Specifications and/or Drawings, and some items are specifically listed in the Specification and/or Drawings.

<i>ITEM – MATERIAL OR EQUIPMENT</i>	<i>NAME OF SUPPLIER OR MANUFACTURER</i>
Ductile Iron Pipe	U.S. Pipe, American, McWane
Restrained Joint	Flex Ring or TR Flex

2.0 SUBSTITUTE EQUIPMENT/MATERIALS

Contractor _____ has _____ has not submitted substitute equipment/material in the "List of Substitute Material Suppliers and Equipment Manufacturers" provided in the Bid Documents. After consideration of the request, the Owner accepts the following substitutions: _____

The reduction in cost is reflected in the Compensation section of the Agreement. No extra compensation will be paid to the Contractor for any changes required to adapt the substitute equipment or material and the Contractor shall pay the Owner for any necessary redesign and/or construction drawings. All redesign and drawing will be prepared by the Engineer.

SPECIAL PROVISIONS FOR INSURANCE REQUIREMENTS

SECTION III

(a) General: The Contractor shall purchase and maintain such insurance as will protect him from claims set forth below which may arise from the Contractor's execution of the work, whether execution be by the Contractor, any Subcontractor, any one directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. The Contractor and/or any subcontractors waive subrogation as to the Owner, its officers, agents, employees, consultants, and Engineer (Municipal Consultants, Inc.). This waiver of subrogation shall apply to all policies, including but not limited to, General Liability, Automobile, All-Risk (Builder's Risk), Worker's Compensation, and Umbrella Insurance. This shall be stated as such in all policies and on all certificates. The full aggregate limits shall apply per job or contract. This shall be stated as such in all policies and on all certificates. Insurance for Contractor or any of its agents, employees or subcontractors shall cover both on- site and off-site operations under this Contract and insurance coverage shall extend to any motor vehicles or other related equipment, irrespective of whether the same is owned, non- owned or hired. Coverages shall include, but not be limited to:

- (1) Claims under worker's compensation, disability benefit and other similar employee benefit acts;
- (2) Claims for damages because of bodily injury, occupational sickness or disease, or death of employees;
- (3) Claims for damages because of bodily injury, sickness or disease, or death of any person other than employees;
- (4) Claims for damages insured by usual personal injury liability coverage which are sustained (i) by any person as a result of an offense directly or indirectly related to the employment of such person by the Contractor, or (ii) by any other person;
- (5) Claims for damages because of injury, destruction, or loss of use of tangible property; and
- (6) Where work under this Contract includes any exposure to navigable waterways and/or adjoining water areas, the Contractor shall obtain insurance coverage to include Federal Longshoreman's and Harborworker's Act (USL & H) and Federal Jones Act or other insurance required by other applicable law or regulation.

The Contractor's insurance shall cover both On-going Operations and Completed Operations related to the project. Coverage for Ongoing Operations shall be in effect from the beginning date of the Contract until final payment is made to the Contractor by the Owner. Coverage for Completed Operations shall be in effect for a minimum period of one (1) year after final payment is made to the Contractor by the Owner and/or any time the Contractor is working on the project after final payment has been made to the Contractor by the Owner. There shall be no interruption of insurance coverage during the transition from On-going Operations to

Completed Operations.

Maintenance of proper insurance coverage is a material element of the Contract. Failure to maintain, renew and/or provide evidence of renewal may be treated by the Owner as a material breach of Contract. The lack of insurance does not negate the Contractor's obligations under this Contract including, but not limited to, indemnification of the Owner and Engineer from any damages resulting from the Contractor's failure to obtain, maintain or renew the minimum insurance policies and endorsements required herein.

(b) Certificate of Insurance: Original Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to the Owner's execution of the Contract. These Certificates shall contain the following:

- (1) Unconditional provision that coverage afforded under the policies will not be canceled unless at least thirty (30) days prior Written Notice has been given to the Owner and Engineer.
- (2) The Contractor's and any subcontractor's general liability, automobile liability insurance, and umbrella (and/or excess) insurance shall endorse the Owner, its officers, agents, employees, consultants, Municipal Consultants, Inc., as additional insureds for any claims arising out of work performed under this Contract. Umbrella (and/or excess) liability shall follow form to the underlying insurance. All insurance shall be primary without contribution from any insurance or deductibles available to the additional insureds.
- (3) There shall be a statement for all policies that the Contractor and any subcontractor waive subrogation as to the Owner, its officers, agents, employees, consultants and Municipal Consultants, Inc.
- (4) There shall be a statement that full aggregate limits apply per job or contract.
- (5) Confirmation of coverage of x, c, and u.

(c) Policy Endorsements: Copies of the Contractor's automatic policy endorsements or original policy endorsements acceptable to the Owner shall be filed with the Owner prior to the Owner's execution of the Contract. All policy endorsements shall endorse the Owner, its officers, agents, employees, consultants, Municipal Consultants, Inc., , and these parties/organizations shall be listed as such in the Endorsement Schedule included on the endorsements. The policy number shall be listed in all Schedules. Policy endorsements for additional insureds and waivers of subrogation shall be for both Ongoing and Completed Operations as defined above. Automatic and/or original endorsements for additional insureds and waivers of subrogation for ALL policies (i.e. General Liability, Automobile Liability, All Risk (Builder's risk), Umbrella Insurance, Workman's Compensation, etc.) shall be as broad as (i.e. similarly worded to) the following General Liability endorsements and be acceptable to the Owner:

- (1) Additional Insured Endorsements - ISO's CG 20 10 11/85 or the combination of CG 20 10 10/01 and CG 20 37 10/01.
- (2) Waivers of Subrogation Endorsements - ISO's CG 24 04 10 93 or CG 24 04 05 09.

(d) Liability Insurance: The Contractor shall procure and maintain at the Contractor's

expense, during the work, liability insurance as hereinafter specified:

- (1) Contractor's General Public Liability and Property Damage Insurance including vehicle coverage issued to the Contractor and protecting the Contractor from all claims for personal injury, including death, and all claims for destruction of or damage to property, arising in connection with any operations under the Contract Documents, whether such operations be by the Contractor or by any Subcontractor employed by the Contractor. Insurance shall be written with a limit of liability of not less than \$1,000,000 for all damages arising out of bodily injury, including death, at any time resulting therefrom, sustained by any one person in any one accident, and a limit of liability of not less than \$2,000,000 aggregate for any such damages sustained by two or more persons in any one accident. Insurance shall be written with a limit of liability of not less than \$1,000,000 for all property damage sustained by any one person in any one accident and a limit of liability of not less than \$2,000,000 aggregate for property damage sustained by two or more persons in any one accident. The insurance shall provide full coverage for x, c, and u.
- (2) The Contractor shall acquire and maintain, if applicable, Fire and Extended Coverage Insurance upon the Project to the full insurable value thereof for the benefit of the Owner, the Contractor, and Subcontractors as their interest may appear. This provision shall in no way release the Contractor or Contractor's surety from obligations under the Contract Documents to fully complete the Project.

(e) Worker's Compensation Insurance: The Contractor shall procure and maintain, at the Contractor's own expense, during the Contract Time, in accordance with the provisions of the laws of the state of Alabama, Workman's Compensation Insurance, including occupational disease provisions, for all of the Contractor's employees at the site of the Project and in case any Work is sublet, the Contractor shall require such Subcontractor similarly to provide Workmen's Compensation Insurance, including occupational disease provisions for all of the latter's employees 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 at the site of the project is not protected under Workmen's Compensation statute, the Contractor shall provide, and shall cause each Subcontractor to provide, adequate and suitable Insurance for the protection of its employees not otherwise protected.

(f) "All Risk" Insurance: The Contractor shall secure, if applicable, "All Risk" type Builder's Risk Insurance for Work to be performed. Unless specifically authorized by the Owner, the amount of such insurance shall not be less than 100% of the insurable value. The policy shall cover not less than the losses due to fire, explosion, hail, lightning, vandalism, earthquake, malicious mischief, wind, collapse, riot, aircraft, water damage (other than caused by flood) and smoke during the Contract Time, and until the Work is accepted by the Owner and final payment has been made. The "All Risk" policy shall include testing and start-up and allow for utilization of the Work by the Owner. The policy shall name as additional insured the Owner, its officers, agents, employees, consultants, and Engineer (Municipal Consultants, Inc.). Flood insurance and

all Additional Insured and Waiver of Subrogation Endorsements must be carried in “All Risk Policy” or by separate policy.

(g) Consistent with the requirement for all insurance coverages provided by the Contractor, the Contractor shall notify the Owner and Engineer in writing 30 days prior to the expiration of the Contractor’s Builder’s Risk Insurance and Flood Insurance. The Contractor shall maintain the specified Builder’s Risk Insurance and Flood Insurance continuously for the duration of the project and until the Work has been accepted by the Owner. In no case, shall the Contractor anticipate acceptance by the Owner when planning for discontinuance of the required Builder’s Risk Insurance or Flood Insurance.

(h) Umbrella Excess Liability Over Primary Insurance: The Contractor shall take out and maintain during the term of this Contract, and any extensions thereof, Umbrella Excess Liability Insurance. The minimum limits of coverage shall be \$5,000,000 aggregate. The coverage shall be over the required general liability insurance and automobile liability insurance as a minimum. There shall be no gaps or sublimit deductibles, etc. The Owner, its officers, agents, employees, consultants, Engineer (Municipal Consultants, Inc.), shall be named as additional insureds in all umbrella policies.

(i) Protection of the Owner and Engineers: The Owner, its officers, agents, employees, consultants, Engineer (Municipal Consultants, Inc.), shall be named as additional insureds in all insurance policies carried by the Contractor or that of his subcontractors for this Contract. If the Contractor or his Surety cannot name the Owner, its officers, agents, employees, consultants, Engineer (Municipal Consultants, Inc.), as additional insureds in any policies providing the coverage above, the Contractor shall purchase and maintain Owner's Protective Liability Insurance (OCP Policy) in the amount of not less than \$5,000,000 and the named insured shall be the Owner, its officers, agents, employees, consultants, Engineer (Municipal Consultants, Inc.), during the life of this agreement. The coverage shall remain in full effect for both Ongoing Operations and Completed Operations. The insurance shall protect the Owner, its officers,

agents, employees, consultants, Engineer (Municipal Consultants, Inc.), from any claim or loss arising from any act or failure to act on the part of the Contractor or his Subcontractors. All insurance shall be primary without contribution from any insurance or deductibles available to the additional insureds and OCP policy holders.

(j) Miscellaneous Insurance: Provide all insurance required by railroads, other utilities, etc. Provide, on the behalf of the Owner, all such insurance required of the Owner by railroad, other utilities, etc.

(k) Neither the setting of insurance limits or requirements nor the acceptance or approval of the same by the Owner imply or represent that the limits or the insurance carrier is sufficient or that such insurance actually has been obtained, that being the responsibility of the Contractor. These insurance requirements shall be considered as a minimum. The Contractor shall consult with his insurance agent to determine whatever greater levels of insurance may be desired. The provision of insurance shall in no way limit the Contractor's responsibility under the Contract nor limit his responsibility to indemnify and hold harmless the Owner and Engineer.

1. Automatic and/or original policy endorsements for additional insureds and waivers of subrogation for ALL policies shall be as broad as (i.e., similarly worded to) the following General Liability endorsements:

- a. Endorsements for the Additional Insured - ISO's CG 20 10 11/85 or the combination of CG 20 10 10/01 and CG 20 37 10/01
- b. Endorsements for Waivers of Subrogation - ISO's CG 24 04 10 93 or CG 24 04 05 09.

Samples of acceptable ISO forms are provided on the following pages. Although these sample endorsements are for General Liability, ALL endorsements for ALL policies shall be similarly worded and acceptable to the Owner.

POLICY NUMBER:

COMMERCIAL GENERAL LIABILITY

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

ADDITIONAL INSURED - OWNERS, LESSEES OR CONTRACTORS - (FORM B)

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART.

SCHEDULE

Name of Person or Organization:

(If no entry appears above, information required to complete this endorsement will be shown in the Declarations as applicable to this endorsement.)

WHO IS AN INSURED (Section II) is amended to include as an insured the person or organization shown in the Schedule, but only with respect to liability arising out of "your work" for that insured by or for you.

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**ADDITIONAL INSURED - OWNERS, LESSEES OR
CONTRACTORS - SCHEDULED PERSON OR
ORGANIZATION**

SCHEDULE

(If no entry appears above, information required to complete this endorsement will be shown in the Declarations as applicable to this endorsement.)

- (1) All work, including materials, parts or equipment furnished in connection with such work, on the project (other than service, maintenance or repairs) to be performed by or on behalf of the additional insured(s) at the site of the covered operations has been completed; or
- (2) That portion of "your work" out of which the injury or damage arises has been put to its intended use by any person or organization other than another contractor or subcontractor engaged in performing operations for a principal as a part of the same project.

This insurance does not apply to "bodily injury" or "property damage" occurring after:

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POLICY NUMBER:

COMMERCIAL GENERAL LIABILITY
CG 20 37 10 01

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

**ADDITIONAL INSURED - OWNERS, LESSEES OR
CONTRACTORS - COMPLETED OPERATIONS**

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Name of Person or Organization:
Location And Description of Completed Operations:
Additional Premium:

(If no entry appears above, information required to complete this endorsement will be shown in the Declarations as applicable to this endorsement.)

Section II - Who Is An Insured is amended to include as an insured the person or organization shown in the Schedule, but only with respect to liability arising out of "your work" at the location designated and described in the schedule of this endorsement performed for that insured and included in the "products-completed operations hazard".

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POLICY NUMBER:

COMMERCIAL GENERAL LIABILITY
CG 24 0410 93

THIS ENDORSEMENT CHANGES THE POLICY. PLEASE READ IT CAREFULLY.

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART

SCHEDULE

Name of Person or Organization:

(If no entry appears above, information required to complete this endorsement will be shown in the Declarations as applicable to this endorsement.)

The TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US Condition (Section IV - COMMERCIAL GENERAL LIABILITY CONDITIONS) is amended by the addition of the following:

We waive any right of recovery we may have against the person or organization shown in the Schedule above because of payments we make for injury or damage arising out of your ongoing operations or "your work" done under a contract with that person or organization and included in the "products-completed operations hazard". This waiver applies only to the person or organization shown in the Schedule above.

POLICY NUMBER:

COMMERCIAL GENERAL LIABILITY
CG24 0405 09

WAIVER OF TRANSFER OF RIGHTS OF RECOVERY AGAINST OTHERS TO US

This endorsement modifies insurance provided under the following:

COMMERCIAL GENERAL LIABILITY COVERAGE PART
PRODUCTS/COMPLETED OPERATIONS LIABILITY COVERAGE PART

SCHEDULE

Name Of Person Or Organization:
--

<i>Information reQuired to complete this Schedule, if not shown above, will be shown in the Declarations.</i>

The following is added to Paragraph 8. Transfer Of Rights Of Recovery Against Others To Us of Section IV - Conditions:

We waive any right of recovery we may have against the person or organization shown in the Schedule above because of payments we make for injury or damage arising out of your ongoing operations or "your work" done under a contract with that person or organization and included in the "products-completed operations hazard". This waiver applies only to the person or organization shown in the Schedule above.

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**SPECIAL PROVISIONS
FOR
UTILITY POWER AND BUILDING PERMIT**

SECTION IV

The Owner has already obtained and paid for the Building Permit and driveway permit for this project. The Owner shall provide the necessary documentation to the Contractor at the beginning of construction.

The Owner has already coordinated with Alabama Power Co. to obtain permanent power to the project site and will be responsible for paying for any costs associated with obtaining permanent power to the location of the meter pole shown in the Plans. Also, see notes in Plans. The Contractor shall be responsible for coordinating and scheduling with Alabama Power Co. during bid time and construction to determine when permanent power (and temporary power if needed) can be provided to the site, and the Contractor shall account for this in his construction schedule as required.

**SPECIAL PROVISIONS
FOR
CONTRACTOR PERSONNEL**

SECTION V

Contractor shall submit, when required by the Owner, the resumes of the project manager and project superintendent who will be assigned to this job. Resumes should include recent references from jobs where the manager and superintendent performed in a similar capacity. Up to two resumes may be submitted for each position.

The Owner reserves the right to condition the Award and Execution of the project on selected personnel being assigned to this project for the duration of the project.

Contractor shall also submit when required by the Owner, the resumes and qualifications of the electrical subcontractor. Electrical subcontractor personnel shall be experienced in the construction of water/wastewater facilities. Submission should include job references and resumes of project manager and superintendent who will be assigned to this project.

The Owner reserves the right to reject a subcontractor at the Owner's sole discretion and to condition the Award and Execution of the project on selected personnel being assigned to the project for the duration of the project.

**SPECIAL
PROVISIONS
FOR
GENERAL CONTRACTOR'S ROOFING
GUARANTEE**

SECTION VI

The Contractor for this Project will be required to provide the Owner with the following General Contractor's Roofing Guarantee. The Guarantee shall be on the included form and shall be in addition to any other warranties or guarantees required by the Project Plans and Specifications.

GENERAL CONTRACTOR'S ROOFING GUARANTEE		
Project Name and Address:		Project Owner(s) and Address:
General Contractor's Name, Address and Telephone Number		EFFECTIVE DATES OF GUARANTEE
		Date of Acceptance:
		Date of Expiration:

1. This Guarantee is in addition to other warranties and guarantees required by the Project Plans and Specifications. In the event of a conflict between this General Contractor's Roofing Guarantee and other warranties and guarantees, the more stringent shall apply.
2. The General Contractor does hereby certify that the roofing work included in this contract was installed in strict accordance with all requirements of the plans and specifications and in accordance with approved roofing manufacturer's recommendations.
3. The General Contractor does hereby guarantee the roofing and associated work including but not limited to all flashing and counter flashing both composition and metal, roof decking and/or sheathing; all materials used as a roof substrate or insulation over which roof is applied; promenade decks or any other work on the surface of the roof; metal work; gravel stops and roof expansion joints to be absolutely watertight and free from all leaks, due to faulty or defective materials and workmanship for a period of five (5) years, starting on the date of substantial completion of the project. This guarantee does not include liability for damage to interior contents of building due to roof leaks, nor does it extend to any deficiency which was caused by the failure of work which the General Contractor did not damage or did not accomplish and was not charged to accomplish.
4. Subject to the terms and conditions listed below, the General Contractor also guarantees that during the Guarantee Period he will, at his own cost and expense, make or cause to be made such repairs to, or replacements of said work, in accordance with the roofing manufacturers standards as are necessary to correct faulty and defective work and/or materials which may develop in the work including, but not limited to: blisters, delamination, exposed felts, ridges, wrinkles, splits, warped insulation and/or loose flashings, etc. in a manner pursuant to the total anticipated life of the roofing system and the best standards applicable to the particular roof type in value and in accordance with construction documents as are necessary to maintain said work in satisfactory condition, and further, to respond on or within three (3) calendar days upon proper notification of leaks or defects by the Owner or Engineer.

- A. Specifically excluded from this Guarantee are damages to the work, other parts of the building and building contents caused by: 1) lightning, windstorm, hailstorm and other unusual phenomena of the elements; and 2) fire. When the work has been damaged by any of the foregoing causes, the Guarantee shall be null and void until such damage has been repaired by the General Contractor, and until the cost and expense thereof has been paid by the Owner or by the responsible party so designated.
- B. During the Guarantee Period, if the Owner allows alteration of the work by anyone other than the General Contractor, including cutting, patching and maintenance in connection with penetrations, and positioning of anything on the roof, this Guarantee shall become null and void upon the date of said alterations. If the Owner engages the General Contractor to perform said alterations, the Guarantee shall not become null and void, unless the General Contractor, prior to proceeding with the said work, shall have notified the Owner in writing showing reasonable cause for claim that said alterations would likely damage or deteriorate the work, thereby reasonably justifying a termination of this Guarantee.
- C. Future building additions will not void this guarantee, except for that portion of the future addition that might affect the work under this contract at the point of connection of the roof areas, and any damage caused by such addition. If this contract is for roofing of an addition to an existing building, this guarantee covers the work involved at the point of connection with the existing roof.
- D. During the Guarantee period, if the original use of the roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray cooled surface, flooded basin, or other use of service more severe than originally specified, this Guarantee shall become null and void upon the date of said change.
- E. The Owner shall promptly notify the General Contractor of observed, known or suspected leaks, defects or deterioration, and shall afford reasonable opportunity for the General Contractor to inspect the work and to examine the evidence of such leaks, defects or deterioration.

IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, 20____.

General Contractor's Authorized Signature

Typed Name and Title

GENERAL
SPECIFICATIONS/
CONDITIONS

GENERAL SPECIFICATIONS

SECTION I DEFINITION OF TERMS

In these Specifications, or in any Documents or Instruments in construction operations where these Specifications govern, the following terms, or pronouns in place of them, shall be interpreted as follows:

I.1 ADDENDA

Written or graphic instruments, issued prior to the execution of the agreement which modify or interpret the Contract, Plans, and Specifications by additions, deletions clarifications, or corrections.

I.2 A.S.T.M.

The American Society for Testing Materials.

I.3 BIDDER

A person, firm or corporation submitting a written Proposal in answer to an advertisement or request for Bids for the construction of the improvement.

I.4 CHANGE ORDER

A written instrument prepared by the Engineer and signed by the Owner, Contractor and Engineer stating their agreement upon a change in the Work, the amount of the adjustment in the Contract Sum, if any, and the extent of the adjustment in the Contract Time, if any.

I.5 CONTRACT

The written, executed "Agreement" between the Owner and the Contractor, covering the performance of the work and the furnishing of the labor, equipment and materials necessary to complete the work in accordance with the Contract Documents. The Contract Documents shall be as defined in the "Agreement".

I.6 CONTRACT BID PRICE

The total of the products of the estimated quantities of the items of the work listed in the Proposal and the unit prices bid.

I.7 CONTRACT BONDS

The approved indemnity bonds furnished by the Contractor and his Surety to guarantee completion of the Contract.

I.8 CONTRACT COMPLETION TIME

The period in calendar days from the time specified for the commencement of work to the time specified for its total completion.

I.9 CONTRACTOR

The individual, firm or corporation, the Party of the Second part to the Contract, who has entered into a Contract awarded him by the Owner, acting directly or through his agents or employees.

I.10 ENGINEER

The Engineer employed by the Owner, or his representative.

I.11 EQUIPMENT

Machinery, tools, and supplies for the construction of the work.

I.12 EXTRA WORK

Work authorized in writing by Change Order and performed by the Contractor, for which there is no basis of payment in the Contract Documents.

I.13 EXTRA WORK ORDERS

Written orders by Change Order to the Contractor authorizing work or furnishing of materials for EXTRA WORK, as defined in these Specifications.

I.14 INSPECTOR

A person employed by the Owner or Engineer to make inspection of materials and work.

I.15 ITEM

A specified class of work for which bid prices are in the Bid Documents.

I.16 MATERIAL

Any substance to be used in connection with the improvements.

I.17 NOTICE TO PROCEED (WORK ORDER)

Written notice from the Owner to the Contractor allowing work to start.

I.18 OWNER

The Party of the First Part to the Contract.

I.19 PLANS

All approved drawings which are on file at the office of the Owner or Engineer, or their reproductions showing the details of the work covered by the Contract.

I.20 PROPOSAL

The formal signed Bid Form with prices provided by the Bidder.

I.21 PROPOSAL FORM

All prepared forms on which Bids are submitted in the Bid Documents and all items in the Specification - Contractual Documents.

I.22 PROPOSAL GUARANTY

The Bid Bond or cashier's check to be furnished by the Bidder as a guarantee that he will enter into a Contract for the work as bid.

I.23 RESPONSIBLE BIDDER

Responsible Bidder shall mean a Bidder who, among other qualities determined necessary for performance, is competent, experienced, and financially able to perform the Contract.

I.24 RESPONSIVE BIDDER

Responsive Bidder shall mean a Bidder who submits a bid that complies with the terms and conditions of the invitation for bids, including plans, drawings, specifications and other provisions of the Contract Documents.

I.25 RETAINAGE

Retainage shall mean that money which has been held or retained by the awarding authority from Contractor's pay requests conditioned upon final completion and acceptance of all work in connection with the Project. Payment of retainage to the Contractor may be reduced by other contract considerations.

I.26 RIGHT-OF-WAY

The area acquired for use in constructing, operation and maintaining the work.

I.27 SPECIAL PROVISION

Clauses or memoranda, applying to the Contract of which these Specifications are a part, and/or amending these Specifications.

I.28 SPECIFICATIONS

The requirements, including Supplemental and Special Provisions applying to the Contract, establishing the type and kind of materials, applicable standards of quality and care, and equipment to be furnished and incorporated in the work.

I.29 STREET

Any or all portions of any dedicated street, avenue, alley, road, or other public highway.

I.30 SUBCONTRACTOR

Any individual, firm or corporation undertaking work under the Contract with an Agreement between himself and the Contractor and approved by the Surety with the Owner

reserving the right to disapprove the subcontractor. The Contractor shall be fully responsible for all his subcontractors including but not limited to safety.

I.31 SUPERINTENDENT

The representative of the Contractor who is present at the work at all times and authorized to interact with the Engineer and who is capable of efficiently superintending the work. The superintendent shall act as a manager which excludes him from operating equipment or performing any construction labor.

I.32 SUPPLEMENTAL AGREEMENT

A Written Agreement between the Contractor and the Owner with the consent of the Surety, modifying the original Contract.

I.33 SUPPLEMENTAL SPECIFICATIONS

Specifications supplemental to or superseding specified portions of the Specifications.

I.34 SURETY

The corporate body, licensed under the laws of the state in which the work is to be performed and bound with the Contractor for the performance of the Contract and payment of all claims recoverable under the Contract Bonds.

I.35 WORK

All performance required of the Contractor under the terms of the Contract to complete and provide the Owner the final project as described in the plans and contract.

**SECTION II
STANDARDS, REGULATIONS AND LICENSES**

II.1 APPLICABLE STANDARDS AND REGULATIONS

All work performed hereunder shall comply with all applicable standards and regulations concerning protection of public and employee safety and health, environmental protection, the protection of natural resources, fire protection, burning and non-burning requirements, permits, fees and similar subjects. All work will be subject to compliance with all applicable building and technical codes and will be subject, in addition to all other inspections, to inspection by a representative of the City's and/or County's building inspection department which has jurisdiction over the project, if any. Bidders shall be subject to all provisions of the Alabama Public Works Law, codified as Title 39 of the Code of Alabama including, specifically, any standards relating to products and materials, including iron and steel, made in the United States. No adjustments or compensation will be allowed for losses caused by failure to comply with such requirements.

II.2 GENERAL CONTRACTOR'S PERMITS OR LICENSES

The attention of all Contractor is called to the provisions of the State law governing general contractors as set forth in ALA.CODE §34-8-1 et seq. (1975), particularly in regard to the need for and evidence of a State general contractor's license. ALA.CODE §34-8-1, et seq. (1975) provides that no one is entitled to bid and no contract may be awarded to anyone who does not possess a valid general contractor's permit or license, including specialty classifications for the work, as provided by the foregoing sections of the State Code, and rules and regulations promulgated pursuant thereto and that said bid may not be considered without evidence being produced that he is so qualified. Trade contractors must be duly licensed in accordance with applicable law. The Owner may not enter into a contract with a nonresident corporation that is not qualified under the State law to do business in Alabama.

II.3 PERMITS

Contractor shall be responsible for obtaining any applicable building permits.

SECTION III SCOPE OF WORK

III.1 INTENT OF PLANS AND SPECIFICATIONS

The Contractor shall furnish, unless provided otherwise, all material, machinery, equipment, supplies, transportation and labor for the completion of the project, and shall fully and satisfactorily complete all work, facilities, and improvements, ready for use, occupancy and operation by the Owner in a timely manner. To avoid delaying the schedule, the Contractor shall always spot check by exposing, measuring, etc. the existing facilities early in the project to coordinate the changes as shown or implied by the Contract Documents to existing facilities i.e., piping, equipment, etc.

The Contractor shall, for the price bid, perform all work shown on the Plans, required by the Specifications, or as reasonably inferred, requested, or as required for a complete and workable project. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results. Not all details are shown, particularly for architectural, equipment, and building details. Where details are not shown, the Contractor shall submit proposed details to Engineer for review and shall perform the work in accordance with details accepted by the Engineer.

The Contractor shall not take advantage of errors or omissions in the Plans or discrepancies between the Plans and Specifications. It shall be his responsibility to notify the Engineer of any errors or discrepancies found and ask for a clarification. The Engineer will make the corrections or clarifications. After discovery of such inconsistencies or ambiguities by the Contractor, any work done by the Contractor on any part of the project affected by such inconsistencies or ambiguities before receipt of written corrections from the Engineer shall be at the Contractor's risk.

III.2 SITE ENGINEERING

The Plans show the lines and grades for the prosecution of the work. The Contractor shall be fully responsible for construction to the alignment, elevations and dimensions and shall provide the stake-out of the project off of existing benchmarks and stations. The Contractor shall be held responsible for the preservation of all stakes and benchmarks. If, in the opinion of the Engineer, any of the construction stakes or benchmarks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost to the Owner of replacing them shall be charged against the Contractor.

The Contractor shall set the elevation of all structures, tanks, pipes, and gates, etc. The Contractor shall be solely responsible for verifying all such elevations prior to pouring concrete, etc. The Contractor shall be solely responsible for the satisfactory removal and replacement of any structure, tank, pipe, or gate, etc. that is later determined not to be in full compliance with contract requirements.

The Contractor shall furnish all materials for marking and maintaining points and lines and shall furnish such labor as may be required. When required by the Contract Documents, the Contractor shall provide independent and adequate building facilities to perform field laboratory and/or office for inspection. The Plans and Standard Specifications will indicate the requirements for any required facilities.

III.3 MAINTENANCE OF THE WORK

The Contractor will be required to continuously maintain the work under the Contract from the date of Notice to Proceed until the work is completed and accepted. The work shall be maintained in a manner which maximizes the safety and convenience of all persons in the vicinity of the work. Maintenance work, until finally accepted, shall be included in the Contract Prices. The Contractor shall restore without compensation, all damages to the Work before its acceptance. During suspension of Work, the Contractor shall be responsible for all materials and construction.

The failure of the Contractor to comply with maintenance of the Work may result in notification by the Engineer to the Contractor's superintendent or his employee in charge to comply with the required maintenance. If the Contractor fails to remedy unsatisfactory maintenance within three (3) days after the date of issuance of this notice, the Owner may proceed to maintain the work. However, regardless of whether or not the Contractor is notified of his failure to maintain the work, and regardless of whether or not the Owner maintains the work, it shall remain the responsibility, solely, of the Contractor to maintain the work. The entire cost of this maintenance will be deducted from monies due the Contractor.

This requirement applies to all aspects of the work. This includes but is not limited to such items as site, materials, equipment, supplies, cleaning, and electrical components and work, etc.

III.4 ALTERATION OF PLANS AND CHARACTER OF WORK

The Engineer may without notice to the Surety and without change in the unit bid prices, make alterations in the Plans or the work and its quantities to complete the proposed construction. Alterations shall not be considered as a waiver of any of the conditions of the Contract or Bonds.

III.5 CHANGE ORDERS

The Engineer may order additional or reduced levels of work or materials. If not listed as a pay item or if not included in the Contract Unit Prices, it will be Extra Work, modified work, or deductive work and the total Contract Price unchanged, increased, or decreased. The Engineer will

ask the Contractor for a proposed cost to complete the Work. If the Owner approves the proposed cost, it shall become a part of the Contract. All Change Orders shall be in writing and signed by the Contractor and Owner prior to the any additional or extra work.

If the Owner considers the price excessive on extra work, the Owner may have the Contractor perform the work on force account. The Contractor shall not, except in an emergency, perform work that he may deem "extra work" without first giving prior written notice to the Engineer. In all circumstances, the Contractor shall take appropriate measures to mitigate extra cost and time. Whenever changes are made, whether they eliminate or deduct work or create extra work or when differing conditions are encountered, credits or payments for a Change Order will be made by use of any one of the following methods:

- (1) Unit prices or combinations of unit prices which formed the basis of the original Contract.
- (2) A lump sum mutually accepted based upon the Contractor's estimate which is properly itemized and supported by sufficient substantiating data to permit evaluation by the Engineer and Owner.
- (3) Actual cost of performing the work (estimated cost for reduced work) plus fifteen (15%) percent of actual cost to cover supervision, overhead, bond, profit, and all other costs. The Contractor shall submit to the Owner itemized cost sheets showing actual cost of performance of the work. Actual costs are defined as Required Labor Costs, Labor Insurance, Workmen's Benefits, and Social Security; Cost of Required Materials; and actual Rental Costs of Required Construction Equipment. When the work is performed under this method, the Contractor shall take appropriate measures to mitigate the costs and time incurred.

The Contractor shall promptly price and provide all other information to the Engineer to allow prompt evaluation and processing of change orders. The Contractor shall devote sufficient attention to Change Orders and provide adequate resources to start and complete change order work in an expeditious manner. The Contractor shall not be entitled to any reparation or compensation on account of such additional time or extension of time. The Contractor shall not be entitled to extra time or extra compensation associated with his failure to always act in a timely manner.

Modification to quantities with contractually established unit prices does not constitute extra work. All Change Orders requiring payment above the amount approved by the Owner's appointing authority, the Shelby County Commission, shall be subject to further approval of the Shelby County Commission as required by Owner's policies and procedures.

SECTION IV CONTROL OF WORK

IV.1 ENGINEER

The Owner has appointed the Engineer, Municipal Consultants, Inc., as its liaison and agent for this project. Project communication is generally through the Engineer and the work shall be accomplished under the inspection of the Engineer. The Engineer shall, with coordination of the Owner, decide questions which arise concerning materials furnished and work performed. The

Engineer shall interpret the Plans and Specifications during the fulfillment of the Contract. The Engineer shall have authority to decide disputes and mutual right between Contractors. The Engineer is not authorized to increase the obligation of the Owner to the Contractor.

The Engineer may inspect the Work at intervals appropriate to the stage of construction to become generally familiar with the progress and quality of the completed Work and to determine in general if the work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Contract Documents. However, the Engineer will not be required to make exhaustive or continuous on-site inspections to check quality or quantity of the Work. On the basis of on-site observations as an engineer, the Engineer will keep the Owner informed of progress of the Work and will endeavor to guard the Owner against defects and deficiencies in the Work.

The Engineer will not have control over or charge of and will not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's responsibility. The Engineer will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Engineer will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or of any other persons performing portions of the Work. The Engineer has no authority to supervise or control the Contractor (or subcontractors) or any of their personnel.

The Engineer shall have no obligation or duty to prepare a list of incomplete work until the Contractor has complied with all the requirements of Project Completion. However, should the Engineer produce any preliminary list of incomplete work and provide it to the Contractor, the Engineer is in no way responsible for listing all incomplete or unacceptable items. Such a list may require more time and personnel than the Engineer could devote and may be totally impractical if significant work remains. Whether or not any preliminary list of work is prepared by the Engineer, the Contractor shall not be entitled to any claim whatsoever in regard to such a list. If such a list is given to the Contractor, it shall be solely for the convenience of the Contractor and shall not in any way be considered to be a complete or semi-complete list of incomplete work. The Contractor shall not in any way assume that the list is in any way representative of all the work remaining or is even representative of the importance or magnitude of the remaining work. It is the responsibility of the Contractor to prepare his own listing of incomplete work.

The Engineer will have authority to reject Work which does not conform to the Contract Documents. However, neither this authority of the Engineer nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Engineer to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons performing portions of the Work.

The Engineer shall review and approve or take other appropriate action on the Contractor submittals, such as shop drawings, product data, samples and other data, which the Contractor is required to submit, but only for the limited purpose of checking for conformance with the design concept and the information shown in the Construction Documents. This review shall not include review of the accuracy or completeness of details, such as quantities, dimensions, weights or gauges, fabrication processes, construction means or methods,

coordination of the work with other trades or construction safety precautions, all of which are the sole responsibility of the Contractor. The Engineer's review shall be conducted in a reasonable time period while allowing sufficient time in the Engineer's judgment to permit adequate review. Review of a specific item shall not indicate that the Engineer has reviewed the entire assembly of which the item is a component. The Engineer shall not be responsible for any deviations from the Construction Documents and in all cases the Contractor shall remain responsible for the deviations. The Engineer shall not be required to review partial submissions, submittals containing significant inaccuracies, submittals not properly and thoroughly coordinated by the Contractor, or those for which submissions of correlated items have not been received.

IV.2 CONTRACTOR

The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Owner. The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Engineer at once.

The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless Contract Documents give other specific instructions concerning these matters.

The Contractor shall be fully responsible to the Owner for all acts and all omissions of the Contractor's employees, Subcontractors and their agents and employees, and all other persons performing portions of the Work for the Contractor. The Contractor shall be solely and fully responsible for all safety associated with all work by his personnel, subcontractors, suppliers, agents, and employees, etc. The Contractor shall be fully responsible for the quality of work of and for supervising all work by his subcontractors, suppliers, agents, and employees, etc. The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Engineer in the Engineer's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor. The Contractor shall be responsible for inspection of portions of Work already performed under this Contract to determine that such portions are in proper condition to receive subsequent Work. The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

The Contractor's superintendent, project manager, assistant project manager, and other key project personnel shall be thoroughly knowledgeable regarding all the types of work required to safely and fully complete the entire project in full accordance with all the Plans and Specifications. They shall have a complete understanding of all the potential dangers that may be encountered in the work required by this project. They shall implement and enforce proper safety procedures throughout the entire duration of the construction. They shall also be very well-experienced in their position in performing similar projects (including water and wastewater projects where the project involves water or wastewater) with the same or greater complexity. All Contractor personnel shall be well-experienced at all tasks they are performing. The full-time project manager shall have acceptable experience being the full-time project manager on at least three prior similar projects of similar type and complexity. For projects where a pump station is to be constructed or modified, the minimum required experience shall be similar pump stations or treatment plants on projects of similar or greater complexity and size. For projects where a treatment plant is to be

constructed or modified, the minimum experience shall be treatment plant experience on projects of similar or greater complexity and size.

The Contractor shall utilize office and field personnel who have a full understanding of all the risks and potential dangers that may be associated with all the different types of work involved in the project.

The Contractor shall be solely responsible for insuring that he is in full compliance with all Contract requirements, all requirements in the specifications, and all requirements in the drawings.

IV.3 COOPERATION OF THE CONTRACTOR

The Contractor will cooperate with the Engineer, Owner and other Contractors.

The Contractor shall have a competent Superintendent with authority to direct the work as required by the Engineer. The Superintendent shall be furnished irrespective of the amount of work sublet and shall have authority over all subcontract work.

It may be necessary that certain items of work be completed, fully tested and placed in service before other facilities can be constructed. This often applies when the project involves work associated with existing treatment plants, pump stations, or lift stations, etc. The plans and specifications may not call out any or all of the work elements where such sequencing is necessary. It is the Contractor's duty to identify any such or similar sequencing and implement such sequencing at no additional cost or time to the Owner. The structures and facilities that the Contractor shall have completed and ready for operation in order to fulfill the above requirement shall be scheduled with the Engineer. After all testing and equipment adjustment has been performed to the satisfaction of the Engineer, the facilities shall be placed in operation with the assistance of the Contractor. The personnel of the Owner shall then perform all operating functions in accordance with instructions previously received from equipment manufacturers. The Contractor shall be required to keep the existing facilities and place new units in operation in a manner to best keep the existing facilities operating. All start-ups shall be scheduled with the Engineer.

IV.4 COOPERATION WITH UTILITIES

The Owners or Operators of Private or Public utilities shall have access to the work for the installation or repair. When taking any utilities out of service for construction purposes, the Contractor shall attain the permission and coordinate and comply with whatever requirements the utility Owner may have to minimize the time the utility must be removed from service. This may include such requirements as performing the work at night, weekends, or early morning hours (midnight and later) as may be designated by the utility Owner. The number of shutdowns shall be minimized. This may require two or more separate, independent crews both working simultaneously. All shutdowns shall be carefully planned by the Contractor to ensure minimal disruption with a written plan submitted by the Contractor. Backup equipment and materials shall be provided by the Contractor as appropriate or required. No compensation shall be allowed because of the delay or interference caused by such work.

IV.5 INSPECTORS, ASSISTANTS, AND REPRESENTATIVES

Inspectors, assistants or representatives shall not be authorized to alter the Plans and Specifications; nor shall they act as foreman for the Contractor or interfere with the management of the work. Any advice which they may give the Contractor shall not be construed as binding the Engineer or the Owner in any way, nor releasing the Contractor from fulfilling all of the terms of the Contracts. Inspectors, assistants, and representatives are not authorized to supervise or control the Contractor or subcontractor personnel or their work.

IV.6 INSPECTION OF THE WORK BY ENGINEER

The Contractor shall furnish the Engineer with facility for ascertaining whether or not the work performed and materials used are in accordance with the requirements and intent of the Contract. At any time before final acceptance of the work, the Contractor shall, if the Engineer requests, remove or uncover such portions of the finished work as the Engineer may direct. After the examination, the Contractor shall restore the work to the standard required by Specifications. If the work is acceptable and if the Engineer had been given ample opportunity to inspect the work prior to its being covered, the uncovering or removing may be paid for as Extra allowed the Contractor, provided that the Owner was made aware and approved any such Extra work prior to incurring any costs. No work shall be done nor materials used without providing the Engineer the opportunity to inspect. Failure to reject any defective work or material shall not prevent later rejection whether or not such Work is fabricated, installed, or completed. Failure to detect or reject defective work shall not relieve the Contractor of his responsibilities nor impose any liability on the Engineer. Inspection is not acceptance and shall not constitute acceptance by the Owner. The Contractor is solely responsible for performing all the work in full accordance with all the requirements of the Contract.

IV.7 DEFECTIVE WORK

Defective work shall be removed and replaced without extra compensation. Should the Contractor fail to remove defective work when so ordered by the Engineer, the Engineer may withhold payment. Any work not in full compliance with the requirements of the plans and specifications shall be considered defective work.

In any case, the amount previously paid to the Contractor for defective work may be reduced at any time the Owner determines it is in his best interest. The Owner may also, at any time, deduct amounts and require the Contractor to reimburse amounts and withhold further payment for all costs associated with the complete correction of the defective work to the full satisfaction of the Owner. These deductions or reimbursements shall include, but not be limited to, the full cost of satisfactorily removing all work not in full compliance with all Contract requirements, as well as any other work that must be removed or modified in order to correct or replace the work in non-compliance.

If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as determined by the Owner to be appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

IV.8 UNAUTHORIZED WORK

Work done in excess of that provided by the lines and grades shown on the Plans or as given by the Engineer, or any extra work done without the written authority of the Engineer and approved by the Owner, will be considered as unauthorized, and shall not be billed to the Owner. If Unauthorized Work is directed to be removed it shall be handled as Defective Work.

SECTION V PLANS, DRAWINGS, AND DOCUMENTATION REQUIREMENTS

V.1 GOVERNING DOCUMENTS

The Contractor will be supplied with three copies of the Plans and Specifications. The Contractor shall have on the Work, at all times, one copy of the Plans and Specifications.

V.2 DRAWINGS

The Plans accompanying these Specifications form a part of the Contract and include the drawings showing the location and details of the work insofar as practicable. No change or alteration shall be made in the plans without the written permission of the Engineer. The figure dimensions on the Plans are assumed to be correct, but the Contractor is warned to check carefully all dimensions before proceeding with the construction. Should any errors be discovered, the Engineer's attention shall be immediately directed to same, and his decision in the matter shall be final. Any changes that may materially affect the scope of the Project shall also be subject to approval of the Owner.

V.3 SHOP DRAWINGS, SUBMITTALS, AND O & M MANUALS

The Contractor shall provide all shop drawings, setting layouts and schedules, pipe layout and installation schedules, piping installation details, and such other drawings as may be necessary for the proper and satisfactory prosecution of the work in accordance with the intent of the Drawings and Specifications and to secure a complete and operable project capable of satisfactory performance of the service intended. Upon the request of the Contractor, the Engineer may waive this requirement in the case of standard manufactured items named in the Specifications. The drawings shall be submitted in accordance with an orderly schedule based upon time required for fabrication or manufacture, delivery, and installation of items presented in shop drawings which is coordinated with the Contractor's construction schedule and allows the Engineer reasonable time to review submittals including re-submittals. The Engineer's review time will be longer for submittals for complex equipment and for submittals where the Contractor has not completely complied with all submittal requirements.

Shop drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the Engineer shall be entitled to rely upon the accuracy and completeness of such calculations and certifications.

The actions required to be taken by the Contractor during the submittal process shall include, but shall not be limited to the following:

(a) The Contractor must thoroughly review and coordinate all submittal data before forwarding such material to the Engineer for his review, shall indicate on the submittal material that he has made such a review, and shall verify such indication or statement by his signature or initials on the Contractor's stamp. The Contractor shall clearly mark all corrections, etc., on the submittals, shop drawings, and O&M Manuals prior to furnishing to the Engineer. If the corrections and markup, etc., are significant, the Contractor shall have the manufacturer or fabricator, etc. prepare a new corrected submittal or shop drawing or O&M Manual prior to furnishing to the Engineer. The new submittal shall also be reviewed by the Contractor in full

accordance with the requirements herein prior to furnishing to the Engineer. Further, all electrical and control submittals shall be thoroughly reviewed and coordinated by the Electrical Subcontractor who shall also stamp and sign or initial those submittals. The requirement for review and coordination by the Electrical Subcontractor of electrical and controls also applies to equipment not being provided by the Electrical Subcontractor. All electrical and control submittals (regardless of the manufacturer or supplier) shall also be thoroughly coordinated by SCADA or instrumentation supplier/manufacturer/system integrator prior to making the first submittal. Any submittals apparently not having been thoroughly reviewed or fully coordinated by the Contractor, and Electrical Subcontractor and system integrator as appropriate, may be returned to him (without review, or with partial review, by the Engineer) for re-submittal. Any comments, questions, corrections, or modifications to the submittal as a result of the review by the Contractor, Electrical Subcontractor and system integrator shall be made to the submittal (by the original producer of the submittal unless approved otherwise by the Engineer) prior to the first submittal to the Engineer. All parties required to review or coordinate the submittals shall utilize personnel who are qualified and experienced at reviewing such submittals.

Each submittal shall be numbered consecutively in order of submission to the Engineer. Resubmittals shall be designated with the original submittal number and the suffixes A, B, C, etc., as required, to indicate consecutive resubmissions.

(b) Submittal items shall be referenced to the applicable Division, Section and page numbers of the Specifications.

(c) Submittal items shall be referenced to sheets (by number) of the Contract Drawings on which such items appear, when applicable.

(d) Any and all particular features of the items submitted that may deviate from those specified and/or shown in the Contract Specifications or Drawings shall be clearly indicated by notations on the submittals and on a separate "Exceptions" sheet submitted by the Contractor.

(e) Submittals shall be legible and should be original information. Copies of facsimiles will not be accepted. The "Exceptions" sheet shall be completed by the Contractor and included with all his submittals. The "Exceptions" sheet shall state "None" if there are no exceptions and shall be included with the submittal. The "Exceptions" sheet must be executed (signed and dated) by the Contractor. The Contractor shall include in the list of exceptions all discrepancies in the submittal. (For example, if an item is shown to have one coating in one part of the submittal but a different coating in another part of the submittal, the Contractor shall list such discrepancies as exceptions.) The Engineer shall not be required to find all discrepancies or exceptions as that is the responsibility solely of the Contractor to list all exceptions and discrepancies. The Engineer shall not be required to evaluate any request for an exception unless it is clearly listed on the "Exceptions" sheet included with the submittal.

(f) Submittals for equipment, materials, etc. from different specification divisions shall not be made under a single letter of transmittal.

(g) Submittals shall be stamped "Submittals" on exterior of their envelope or package.

(h) The submittals shall contain all information required for the Engineer to determine, if he desires, if the item being proposed fully and completely complies with all requirements of the Specifications. Where all such information is not submitted, this shall represent the Contractor's certification that such items are in full compliance with all requirements of the plans and specifications.

(i) The Contractor shall cross out all non-applicable information, models, and options, etc. such that all information remaining pertains specifically to the items being furnished.

(j) The submittal shall show all required information relating to coordination with or connection to other equipment. Properly coordinate the location and orientation of all equipment. Ensure equipment does not conflict with other requirements or structures, etc. All control panels and all wiring, including interface with other signals, alarms, or equipment, shall be clearly shown. Clearly show all field wiring and all connections to other equipment including the terminal numbers in other equipment. The Contractor shall fully coordinate all equipment and connections provided for work as shown in the submittal with Electrical, Control, and Panel Suppliers and/or Subcontractors. All electrical and control functions shall be clearly labeled. Provide supplementary notes and descriptions if needed to avoid any confusion.

(k) Equipment shop drawing submittals shall contain the manufacturer's handling and storage requirements, including all maintenance required during storage, type of storage (indoor, outdoor, etc.), heat source, or storage temperature requirements, short term or long-term requirements, and all other pertinent storage and maintenance requirements for type of job, location, and exposures. This storage information shall be clearly written, easy-to-understand, detailed, and complete. If preprinted storage instructions are provided, cross out all non-applicable information. Storage instructions shall separately state instructions for short-term storage, long-term storage, and storage after equipment is installed but before placed into full-time operation. Where motors are part of the submitted equipment, provide the same type of storage information specific to the motors that are provided. Unless clearly stated otherwise by the manufacturer's storage information, storage in utility trailers, or portable storage units (Conex, etc.) shall not be considered indoor or inside storage. Where the required storage requirements are not clear to the Engineer, the equipment shall be stored indoors and inside a permanent structure with conditioned temperature for cooling by air conditioning and heating.

(l) Show anchor bolts and installation requirements. Specifically list all spare parts that will be provided. Specifically list all installation, startup, and training services that will be provided.

(m) Provide all other information requested by Engineer to assist him in understanding the items being provided, the operation of the equipment and controls, the submittals, and the coordination with other equipment.

(n) Provide manufacturer's certification and Contractor's certification that all submittal requirements are fully complied with except as specifically noted. These certifications shall be on a form prepared by and furnished by the Engineer.

(o) Where product samples are submitted for review, the Contractor shall submit a minimum of three samples (i.e. in triplicate) which will be retained by the Engineer/Owner. The samples shall be clearly labeled by permanent labeling to identify the item, date, submittal number, model and/or color, etc., as applicable. All colors to be utilized on the project shall be submitted at one time to coordinate and facilitate color selection by the

Owner. Where required, color charts or samples shall be included in the color submittal for the following items as a minimum: paints, thorocoat, sealants, caulk, brick, mortar, block, fans, louvers, doors, and windows, and other similar items, etc. Provide color samples for other items as applicable or as required.

(p) All equipment manufacturers shall include in their submittal a Submittal Certification Form prepared by the Engineer and executed by the manufacturer's engineer in responsible charge stating that (1) they have responsible control over the submittal, (2) they have thoroughly reviewed and understand the project requirements and the submittal requirements, (3) the submittal is in full accordance with submittal requirements contained in the General Specifications except as the manufacturer itemizes below, and (4) an acknowledgement that the submittal will not be reviewed by the Engineer if it is not in full accordance with all submittal

requirements.

(q) The equipment manufacturer's Submittal Certification Form prepared by the Engineer shall include a space which shall be executed by the Contractor stating that (1) he has carefully reviewed the submittal, (2) it has been reviewed and coordinated by Electrical Subcontractor and SCADA/system integrator, (3) it has been thoroughly coordinated as required, (4) the paint system proposed in the submittal meets all the project painting specifications including but not limited to preparation, coating system, number of coats, thickness, color, (5) the submittal contains long term and short term storage instructions specific for the project including but not limited to whether or not equipment must be stored in conditioned space, heated space, or only out of the weather, etc. (In the absence of clearly written instructions to the contrary, equipment shall be stored in heated and air conditioned space.), (6) the submittal contains listing of all spare parts and these are in conformance with the specifications, (7) the submittal states the manufacturer's field services being provided, (8) the submittal states that all exceptions are listed on an attached sheet, and (9) an acknowledgement that the submittal will not be reviewed by the Engineer if it is not in full accordance with all submittal requirements.

(r) The equipment manufacturer's Submittal Certification Form prepared by the Engineer shall include a space which shall be executed by the Electrical Subcontractor stating that (1) he has carefully reviewed the submittal, (2) it has been reviewed and coordinated by Electrical Subcontractor and SCADA/system integrator, (3) it has been thoroughly coordinated as required, (4) the submittal clearly shows all connecting wiring (including power, control, instrumentation, and SCADA) including but not limited to voltages, power sources, and (where applicable) signal types. This Electrical Subcontractor certification is not required on items that have no electrical or wiring components.

The Engineer shall not be required to review submittals that are not in full compliance with all the submittal requirements. However, should the Engineer elect to review such submittals, the review time will be longer.

The Engineer does not necessarily review all details of all submittals. For some submittals, the Engineer's review may be very limited. Regardless of the Engineer's review or limited or partial review, the Contractor remains fully responsible for full compliance with all requirements of the plans and specifications.

Unless a greater number is called for in various portions of these Specifications the minimum number of copies of submittal data shall be six (6).

Deviations from the Drawings and Specifications shall be called to the attention of the Engineer by the Contractor at the time when such shop drawings or other drawings are first submitted to the Engineer for his consideration. The Engineer's review of any data shall not release the Contractor from responsibility for such deviations, or any subsequent deviations not noted by the Contractor or the Engineer. Any disclaimers or similar statements in the submittals shall not relieve the Contractor, Subcontractor, manufacturer, or equipment supplier of their responsibility.

The Contractor shall coordinate and verify dimensions, arrangements, configurations, and orientation, etc., to ensure that all items fit properly in the space available and are accessible for maintenance and replacement, etc.

Shop drawings and other drawings submitted for review by the Engineer shall bear the Contractor's certification. The certification shall represent that he has reviewed, checked, and approved such drawings; that they are in harmony with the requirements of the project and with the provisions of the Contract Documents; that he has verified all field measurements, construction criteria, materials, catalog numbers, and similar data; and that the work represented by the shop drawings is recommended by the Contractor and that the Contractor's Guaranty will fully apply. The Contractor shall insure that all markups in the submittal and all comments returned with the

submittal are properly incorporated in all products delivered to the project. Regardless of the Contractor's procedures and by virtue of the Contractor submitting the data to the Engineer, he thereby certifies the above and that he has coordinated the submittal with his work. If the Engineer marks up the shop drawing or submittal, the Contractor shall carefully review, check, and coordinate the Engineer's comments prior to releasing the shop drawings and shall promptly notify the Engineer if he disagrees or doesn't understand the markings. Regardless, the Contractor remains fully and solely responsible for compliance with the plans and specifications.

The finished assemblies represented by the shop drawings and other such drawings are required to be in conformance with the standards of the Occupational Safety and Health Administration, wherever applicable. Manufacturer or contractor shall prepare detailed installation drawings for each assembly.

The Contractor shall submit Operation and Maintenance (O&M) manuals for all equipment of all types provided for the project. This also includes but is not limited to all electrical equipment, monitoring equipment, instrumentation, and controls, etc. O&M Manuals shall be handled the same as other submittals and shall be accompanied by the same Submittal Certification Form executed by the Manufacturer and the General Contractor. The manual shall contain sufficient drawings, with all equipment components clearly labeled and identified, such that maintenance personnel can promptly determine each and every individual component requiring maintenance and its location as discussed in the manual. The drawings shall be detailed and easy to understand. The manual shall address all recommended maintenance as well as all safety precautions and procedures. The manuals shall fully describe all the features of all equipment. The controls and panels, including but not limited to all alarms, lights, and switches, etc., shall be clearly explained. The O&M manuals shall have a table of contents and be tabbed, bound, and arranged as necessary for easy reference and use. The Contractor shall review the O&M manuals to ensure compliance with all submittal requirements prior to submitting them to the Engineer. The manuals shall be revised as

necessary prior to making submittal to the Engineer. Two initial manuals shall be submitted a minimum of 90 days prior to equipment startup for Engineer review. The manuals shall be customized specifically to this project and specific for the equipment actually provided. If the O&M manual contains references to equipment components or parts or material different from that actually furnished, the Contractor shall cross out the inapplicable references or sections. The manual shall not include references to "optional" features or components, etc., without clearly and specifically clarifying whether such an option was actually provided. If an optional feature is provided, delete references to "optional". If an optional feature is not provided, cross out references to the feature. The submitted manual will not be considered acceptable if it contains inapplicable references that are not marked out. Any O&M manuals apparently not having been thoroughly reviewed or fully coordinated by the Contractor, may be returned to him (without review, or with partial review, by the Engineer) for re-submittal. The Contractor shall submit originals or very high-quality copies.

The O&M manual for a piece of equipment shall contain an Equipment Maintenance Summary Form that summarizes all routine maintenance requirements of the equipment provided in a concise, easy to follow format. The form shall also clearly indicate maintenance frequency, required lubricants, and lubricant quantity. The form shall also clearly show any required initial oil changes due to the use of different lubricants for storage or due to shortchange intervals at startup. The form shall be located in its own tabbed division and the tab shall be clearly labeled "Maintenance Summary."

The exact location of every lubrication point or adjustment point, etc., shall be clearly shown and labeled in high quality drawings or photographs. The drawings or photographs

shall be such that maintenance personnel can quickly discern the exact location of all items requiring attention. Provide multiple drawings (both overall system and detailed) or photographs where helpful for immediate understanding.

All O&M manuals shall be organized, arranged, and tabbed to allow operators and maintenance personnel to easily and promptly find all needed information. Provide whatever features, figures, and drawings, etc. may be desirable for a very user-friendly manual. Where the manual pertains to multiple models of non-identical equipment, each separate model shall be in its own tabbed division of the manual and the division shall be clearly labeled and contain all the information, drawings, and maintenance summary for that specific model.

After the O&M manual is accepted by the Engineer, the Contractor shall submit six (6) copies of the final O&M Manual.

V.4 DATA FOR SHOP DRAWINGS

The Contractor shall submit, for review by the Engineer, complete catalog data for materials and every manufactured item of equipment and all components to be used in the work, including: specific performance data, material description, rating, capacity, working pressure, material gauge or thickness, brand name, catalog number, general type, and other pertinent data. Where equipment or material is of a minor nature, the Contractor shall furnish the Engineer a complete list, giving names of manufacturers, catalog numbers, and other applicable data. Submittals shall be compiled by the Contractor and reviewed by the Contractor and Engineer before equipment is ordered. Where details of items of equipment are affected by details of items of other equipment, submittals for such associated items of equipment shall be compiled by the Contractor and reviewed by the Contractor and Engineer before any such associated items of equipment are ordered.

Catalog data for equipment and materials submitted by the Contractor shall not supersede the Contract Documents. The Contractor shall check the equipment, materials, and work described by the catalog data against the requirements set forth in the Contract Documents in order to determine the existence of any errors or deviations. The review by the Engineer shall not relieve the Contractor of the responsibility for correcting and/or remedying such deviations from the Drawings and/or Specifications, either by redesigning or by submitting equipment or materials fully meeting the requirements of the Contract Documents. The Contractor shall, in writing, call the attention of the Engineer to equipment and materials deviations at the time of the submittal. If the equipment or material should be accepted, the Contractor will ensure the proper fit of the equipment in the work and guarantee that the equipment or material is suitable for the service intended and that the performance of the equipment or material, with respect to life and efficiency, will equal or exceed that of the equipment or material specified. The form, extent and specifics of the Contractor's Guaranty shall be subject to the decision of the Engineer. Review by the Engineer of the Contractor's submittals of catalog data shall not relieve the Contractor of responsibility for errors in the submittals.

Engineering concurrence of all data described above is a prerequisite to the ordering of the equipment or materials by the Contractor, and, in the case where shop drawings may be required, the acceptability of the shop drawings is also a prerequisite to the manufacture of the item.

Forms relating to this Sections V.3 and V.4 have been included on the following pages.

SUBMITTAL CERTIFICATION FORM

PROJECT: _____ OWNER: _____

GENERAL CONTRACTOR: _____

EQUIPMENT MANUFACTURER: _____

SUBMITTAL DESCRIPTION: _____

CONTRACTOR'S SUBMITTAL IDENTIFICATION NUMBER: _____

EQUIPMENT MANUFACTURER:

I do hereby certify that I have responsible control over this submittal. This submittal has been thoroughly reviewed and all project requirements, along with submittal requirements are completely understood. The submittal is in full accordance with all submittal requirements contained in the General Specifications, except as clearly itemized in the enclosed submittal documentation. I certify that the submittal clearly shows all connecting wiring (including power controls, instrumentation, and SCADA) including but not limited to voltages, power sources, and (where applicable) signal types. By signing below, I certify to the above and acknowledge that the Engineer is not required to review any submittal that is not in full accordance with all submittal requirements.

By: _____ Equipment Manuf.: _____
(Printed Name)

Signature: _____ Date: _____

Title: _____

GENERAL CONTRACTOR:

I do hereby certify that I have carefully reviewed this submittal. This submittal has been reviewed and coordinated by the Electrical Subcontractor and SCADA/system integrator. This submittal has been thoroughly coordinated as required. I certify that the submittal clearly shows all connecting wiring (including power controls, instrumentation, and SCADA) including but not limited to voltages, power sources, and (where applicable) signal types. I further certify that the paint system proposed in the submittal meets all the project painting specifications including, but not limited to, preparation, coating system, number of coats, thickness and color. This submittal contains long term and short term storage instructions specific for the project including, but not limited to, whether or not equipment must be stored in conditioned space, heated space, or only out of the weather, etc. This submittal contains a listing of all spare parts and these spare parts are in conformance with the Specifications. The submittal states the manufacturer's field services being provided. All exceptions are listed on an attached sheet. I acknowledge that the Engineer is not responsible for determining any exceptions to the project requirements or for reviewing any exceptions unless they are clearly pointed out on a page in the submittal entitled "**EXCEPTIONS**" that is signed and dated by the Contractor. By signing below, I certify to the above and acknowledge that the Engineer is not required to review any submittal that is not in full accordance with all submittal requirements.

By: _____ General Contractor: _____
(Printed Name)

Signature: _____ Date: _____

Title: _____

ELECTRICAL SUBCONTRACTOR: (Only applicable if equipment relates to electrical, controls, instrumentation, or SCADA)

I do hereby certify that I have carefully reviewed this submittal. This submittal has been reviewed and coordinated by the Electrical Subcontractor and SCADA/system integrator. This submittal has been thoroughly coordinated as required. I certify that the submittal clearly shows all connecting wiring (including power controls, instrumentation, and SCADA) including but not limited to voltages, power sources, and (where applicable) signal types.

By: _____ Electrical Subcontractor: _____
(Printed Name)

Signature: _____ Date: _____

Title: _____

SUBMITTAL EXCEPTIONS

Project: _____

Submittal: _____

This sheet shall be included with all submittals. List all exceptions below. If there are no exceptions, write "None" and include this executed sheet.

I certify that all exceptions have been listed above.

By: _____ (Printed Name)

_____ (Signed Name)

Date: _____

V.5 RECORD DOCUMENTS

Engineer shall provide to the Contractor, one complete set of Contract Documents to be used by the Contractor for the purpose of documenting as constructed information for all elements of Work. These as constructed documents generated by the Contractor may then be used by the Engineer in preparing Record Drawings for the Project.

The Contractor shall make legible and accurate notations to the drawings to indicate changes. All changes shall be recorded as construction progresses and within 24 hours of a change being made. Work shall not be covered, concealed, or otherwise made inaccessible until all information has been recorded by the Contractor. Record Documents shall be maintained in a clean, dry, legible, and orderly fashion and shall not be used for construction purposes. Record Documents shall be clearly labeled: "Record Documents, Not for Construction".

Changes shall be recorded in erasable colored pencil. Alternate colors may be used to emphasize different types of changes. Changes shall be "clouded" to draw attention to effected area(s). Changes shall be legibly marked and shall include descriptions when necessary. Changes shall be dated and initialed by the Contractor.

Record Documents shall be made available to the Engineer or the Owner at all times. The Engineer may review and approve, on a monthly basis, the Record Documents. Portions of the Record Documents determined to be incomplete or incorrect by the Engineer, shall be corrected by the Contractor before monthly Pay Requests are approved. Before requesting final payment, Contractor shall provide Engineer with a completed set of clean, fully legible Record Documents. Record Documents may be reviewed by Engineer for clarity and completeness; however, the Contractor has sole responsibility for the correctness, and accuracy of the Record Documents. The Owner may withhold final payment until the Record Documents are complete, accurate, and have met all other requirements specified herein.

Record Documents required by this Section shall be in addition to any other Record/As Built requirements contained elsewhere in the Plans and/or Specifications.

Forms relating to this Section have been included on the following pages.

Certification of Proper Installation for

(Print Name of Equipment)

I hereby certify that I have thoroughly inspected and reviewed the referenced equipment and its installation. It has been checked, adjusted and lubricated as applicable. The electrical and safety features meet the requirements of the manufacturer. This equipment meets all the requirements of the Manufacturer and is ready for normal operation.

Project Name

Date

Name – print

Signature

Company Name - print

Position – print

Phone # of Representative
Signing Certificate

This certification does not relieve the Contractor from any of the requirements of the plans and specifications nor does it indicate acceptance of the equipment by the Owner.

SECTION VI CONTROL OF MATERIALS

VI.1 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS

All materials or equipment used on the Work shall meet the requirements of the Specifications. The source of supply of the materials or equipment shall be approved by the Engineer before delivery is started. If it is found that products from a source are unacceptable, the Contractor shall furnish materials from other sources.

The Contractor shall warrant to the Owner and the Engineer that, unless otherwise specified, all materials and equipment furnished under this Contract shall be new, and both workmanship and materials shall be of good quality, free of faults and defects, and in conformance with the Contract Documents. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials. In selecting and/or approving equipment for installation in the Project, neither the Owner nor Engineer assume responsibility for injury or claims resulting from failure of the equipment to comply with applicable federal, state, and local safety codes or requirements, or the safety requirements of a recognized agency, or failure due to faulty design concepts, or defective workmanship and materials. Material and/or equipment damaged by any cause during the construction period shall be subject to rejection by the Engineer; reconditioning and/or repairing material and/or equipment is not acceptable.

VI.2 SAMPLES, TESTS FOR SPECIFICATION COMPLIANCE

All materials shall be approved by the Engineer. Materials used without prior approval shall be considered unauthorized and will not be paid for. Tests for suspected faulty materials, work, or tests not mentioned in this Section shall be conducted by an independent testing laboratory approved by the Engineer. Such tests shall be paid for by the Contractor. Certified copies in duplicate of each test shall promptly be furnished the Engineer. Laboratory testing common to the project shall be paid by the Owner at a laboratory of his choice, unless specified otherwise. These tests include concrete breaks, inspection, soil tests, and liner tests as defined in these Specifications.

The Contractor shall cooperate, coordinate, and assist the Engineer with all testing the Owner deems appropriate for the project. Make appropriate arrangements with the Engineer and provide safe access, etc., so that all such testing can be preformed. There shall be no extra time or payment associated with this work. If retesting is necessary due to not passing on the first test, all costs associated with retesting shall be the responsibility of the Contractor.

Acceptance of materials by the Engineer shall not relieve the Vendor or the Contractor from repairing or replacing defective materials. Any materials rejected at the site

of the work shall be removed from the premises by the Contractor in accordance with Articles V.12 and V.13.

VI.3 SALVAGE MATERIALS AND UNUSED EQUIPMENT AND MATERIALS

All existing materials and/or equipment removed and not required to be reused or relocated remains the property of the Owner. These materials and equipment will be stored orderly at the job site in accordance with the Owner's instructions. All unusable items as determined by the Owner will be disposed by the Contractor as excess materials.

All unused construction materials or equipment remaining at completion of the project will remain the property of the Contractor unless the Owner has purchased unused property through the Contract and has rightful ownership or agrees to purchase or accept ownership of materials or equipment. Making payment of stored materials throughout the job does not constitute the Owner's willingness to purchase unused materials or equipment at the end of the Work.

VI.4 STORAGE OF MATERIALS AND/OR EQUIPMENT

Materials and/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. Where considered necessary to secure proper protection, the materials shall be placed on racks, platforms, or hard clean surfaces not subject to surface drainage. Factory finished items shall be stored above ground, covered, individually sealed, or housed indoors as required. Equipment shall as a minimum be stored and maintained in accordance with the manufacturer's recommendations, or in accordance with the Plans and Specifications if those storage requirements are more stringent. Equipment that has been installed but not being operated by the Owner shall be stored and protected by the Contractor in accordance with the recommendations of the manufacturer and plans and specifications. The Contractor shall be aware of the potential difficulties involved in the storage of equipment fitted with bearings which may suffer damage from a long period of idleness and shall take such precautionary measures as may be required to preserve the life expectancy of the bearings. Materials not properly stored, housed and maintained in condition for service as intended will be deducted from the stored materials and will not be incorporated in the work. Full instructions on storage should be provided with the shop drawings (See Section V.3). The Contractor shall be solely responsible for equipment that is damaged due to flooding or improper storage.

No equipment (including but not limited to process equipment, electrical equipment, HVAC equipment, or mechanical equipment, etc.) shall be stored in a location where it may be flooded or otherwise unintentionally submerged, etc.

Stored materials and equipment shall be located and arranged so as to facilitate observation. 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 Owner, store such material and/or equipment in an insured and bonded warehouse within a 60-mile radius of the project site. 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. A certificate of insurance shall be furnished. The storage facility shall be climate-controlled, if appropriate. 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.

The Contractor shall develop an inventory of stored equipment showing the maintenance required during storage and containing a place for the Contractor to sign off when the maintenance is performed. The maintenance provided shall be stated, dated, and signed by the person performing the work. The Contractor shall notify the Engineer's representative sufficiently prior to performing the work to allow the representative to accompany the Contractor during the maintenance. The Stored Equipment Maintenance Inventory shall be submitted to the Engineer with each monthly pay request. If there is no pay request during a month, the Contractor shall submit the updated inventory monthly until project acceptable.

VI.5 U.S. PRODUCTS PREFERENCE

The successful Bidder (Contractor) shall comply with ALA. CODE §39-3-1 (1975), shall agree to utilize in the execution of the Project, materials, supplies and products manufactured, mined, processed or otherwise produced in the United States or its territories, if the same are available at reasonable and competitive prices and not contrary to any sole source specifications. It is further stipulated that a breach of the foregoing provision of this agreement by the Contractor in failing to utilize domestic products shall result in a downward adjustment in the Contract price equal to any realized savings or benefit to the Contractor.

VI.6 USE OF DOMESTIC STEEL

The attention of all Bidders and that of the successful Bidder (Contractor) is drawn to ALA.CODE §39-3-4 (1975), requiring the use of steel produced within the United States for municipal construction projects when specifications in the construction contract require the use of steel and do not limit its supply to a sole source. This provision is subject to waiver if the procurement of domestic steel products becomes impractical as a result of national emergency, national strike or other causes. Violations of the use of domestic steel requirements shall result in a downward adjustment in the Contact price to equal any savings or benefit to the Contractor.

SECTION VII LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

VII.1 PERMITS AND LICENSES

The Owner will procure general and permits such as those required by highway departments or other utilities to allow the proposed facilities to be installed on public rights of way or privately owned rights of way; however, the Contractor shall procure all other required permits and licenses, pay all royalties and fees, and give all notices necessary. Blasting will not be permitted on this project.

Requirements from permits acquired by the Owner for construction will be strictly adhered to by the Contractor with all stipulations within the Contractor's control being fulfilled. The Contractor shall be solely responsible for satisfying all requirements and costs of all permits and licenses acquired by the Owner regardless of whether such requirements are imposed on the Owner or are imposed directly on the Contractor. This includes, but is not limited to, any permit issued

by utilities, railroad, streets or highways, governmental agencies, or regulatory agencies, etc. This shall include, but by no means be limited to, such requirements as bonds, insurance, indemnification, flagmen, and traffic control, etc. The Contractor shall obtain special or supplemental permits required by agencies to complete the work.

VII.2 PUBLIC CONVENIENCE AND SAFETY

The Contractor is required to conduct his work as to ensure the least possible obstruction to traffic, to ensure the least possible inconvenience to the general public, businesses, and the residents in the vicinity of the work, and to ensure the protection of persons and property. Contractor shall maintain continuous access to businesses (during and near to hours of operation) and hospitals, etc. No disturbing noise will be allowed particularly in residential areas between the hours of 9:00 p.m. until 7:30 a.m. unless an emergency occurs. Permission of the proper authority is required before any road or street is closed to the public. The maintenance of continuous 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 or 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 responsibility of the Contractor. Respond promptly and appropriately to all complaints. Coordinate and cooperate with affected property Owners and keep them advised of work schedules and activities.

No road, sidewalk or vehicle path shall be closed by the Contractor except by permission of the Engineer, and while closed the Contractor shall maintain traffic through or around the Work. The Contractor shall notify emergency agencies and the Engineer before the starting of construction of any situations that might inconvenience or endanger traffic. All right-of-ways shall be kept continuously open and maintained in passable and safe condition. The Contractor shall clean-up and place streets back in service as soon as possible. Paving shall be patched as soon as possible. Use cold-mix asphalt as temporary patch if required by plans or specifications, or if helpful in continuously maintaining public safety or convenience.

The convenience of the general public and of residents along the road or other travelways shall be provided for in a satisfactory manner. Where roads or streets are not available for use as detours, traffic shall be permitted to pass through the Work. The traveling public shall have precedence over Contractor's vehicles and shall not be delayed for the convenience of the Contractor. The Contractor shall provide flagmen whose sole duties shall consist of controlling the movement of public traffic. No additional charges will be paid for traffic routing or control.

The Contractor shall provide and maintain temporary roads to provide access to the Work, driveways, houses or buildings affected by the work. Temporary bridges for pedestrians shall be provided over surfacing, pavement, sidewalks or muddy areas.

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; the State "Manual on Uniform Traffic Control Devices for Streets and Highways"; and other authorities having jurisdiction in the areas and traffic control. The Contractor is solely responsible for satisfying all safety and traffic control requirements of authorities concerned with or affected

by this work. The Contractor shall provide, install, and continuously maintain all traffic control and other safety features, etc. as may be desirable for the protection, safety, and convenience of the public. The Contractor is solely and fully responsible for protecting the public. This responsibility applies both during working hours and non-working hours, 7 days per week, for the entire duration of the project.

VII.3 PROTECTION AND RESTORATION OF PROPERTY, STREETS AND LANDSCAPE

The Contractor shall not enter upon private property without obtaining permission from the owners and lessees. The Contractor shall be responsible for the preservation of all public and private property. The Contractor will obtain necessary information of existing utilities and shall give notice to the owners or authorities at least forty- eight (48) hours before his operations will affect such property. The Contractor shall not interfere with the operation of utilities. The Contractor shall at his own expense, take necessary precautions to avoid interruption of service or damage.

Work under this Contract shall include the restoration of all paved areas and macadamized roadways to their original condition at his own expense. If the Contractor fails to restore disturbed areas promptly, the Owner, after giving three (3) days' written notice, may have the pavement restored and deduct cost from the payment due the Contractor. However, any such action or lack of action, by the Owner shall not relieve the Contractor of any of his obligations under this Contract, including but not limited to safety. The Contractor must conform to the prevailing State Highway Code and Railroad Company requirements at his own expense. The Contractor shall maintain roads, streets, and highways affected by his work in a safe condition at all times.

When damage or injury is done to public or private property by the Contractor, he shall repair such damage or injury so that it is equal or better condition to the property before damage.

VII.4 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES

The Contractor shall fully cooperate with private and public utilities. Where the Contractor's operations are adjacent to properties or utilities, work shall not be started until arrangements for their protection have been made. The Contractor shall be solely responsible to the Owners and Operators of properties or utilities for injuries or damages. The Contractor shall co-operate with the owners of utilities if any of their facilities are removed or rearranged. The Contractor shall be responsible for costs associated with this item.

In the event of interruption to utility services or potential damage to the utility caused by the Contractor, the Contractor shall promptly notify the proper authority. He shall cooperate in the restoration of service promptly. The Contractor shall be responsible for all costs associated with this item.

VII.5 SAFETY AND CONSTRUCTION METHODS

The Contractor at his own expense, shall maintain project and public safety. The Contractor agrees to hold the Owner and Engineers harmless and indemnify them from all claims for damages resulting from construction of the project by the Contractor or Subcontractors, his agents or employees. The Owner and/or Engineers are not responsible for providing the Contractor a safe place to work nor for the safety of any equipment, procedure or material used on construction or incorporated into the work. The Contractor shall be solely responsible for the means and methods of construction and for safety.

The Contractor or Owner may sometimes impose limitations or other requirements on the Contractor's sequence of construction. Such limitations or requirements do not constitute control of the Contractor's means or methods, nor relieve the Contractor's responsibility for safety.

The Contractor, in the prosecution of his 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.

Under the terms and conditions of this Contract, the Engineer shall not act as Safety Engineer or Safety Supervisor, 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 and his methods of construction.

The Contractor is solely and completely responsible for conditions of the job site, including safety of all persons and property affected directly or indirectly by his 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 acceptance of the work by the Owner, and thereafter shall be subject to the terms and conditions of the Guaranty.

The duty of the Engineer is to review the work in order to determine its acceptability in accordance with the Specifications and to conduct construction review of the Contractor's performance for the benefit of the Owner. This shall not be construed as a duty to review the adequacy of the Contractor's safety measures or construction methods 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.

VII.6 SANITARY PROVISIONS

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

VII.7 CLEANUP

During construction, the Contractor shall continuously keep all dirt, mud, and dust, etc., cleaned from all roads, streets, highways and parking lots, etc. that may be affected by his work. The Contractor shall take whatever measures are necessary to maintain such roads, streets, and highways in a clean and safe condition at all times.

The Contractor shall clear and remove debris from the project sites as a result of construction. He shall maintain and restore in an acceptable manner all property, both public and private, and leave the Right-of-Way, adjacent property, and sites of the improvements in a neat condition.

He shall thoroughly clean all discoloration, mud, dirt, rust, paint, markings, concrete splatter, ink or other lettering, and stains of any nature, etc. from all structures and surfaces, etc.

The Contractor shall take appropriate measures during and throughout construction to prevent discoloration and staining, etc., of all surfaces during construction. He shall provide cleaning of all mud, concrete splatter, oil, and stain-producing materials, etc. during construction as required to facilitate final cleaning. Regardless, all discoloration and staining, etc., shall be totally removed at the completion of construction. The Contractor shall use pressure washing, steam cleaning, chemical cleaning, and whatever additional measures may be necessary to totally remove all traces of all discoloration and all stains of all types, etc. The cleaning shall be conducted in a manner that the final surface appearance is uniform and attractive.

When facilities are cleaned prior to the completion of all work, and then startup, operation, or other activities by the Owner or Contractor result in the need for additional cleaning, such cleaning shall be performed by the Contractor.

These cleaning requirements apply to the entire project including but not limited to all, floors, walls, ceilings, structures, buildings, roofs, windows, enclosures, equipment, walks, sidewalks, steps, stairs, metal surfaces, fiberglass surfaces, plastic surfaces, masonry, paving, concrete, asphalt, and all other surfaces, etc.

These cleaning requirements also apply to all electrical facilities, including but not limited to, inside and outside of electrical panels, conduits, pull boxes, and lights, etc. Protect electrical facilities from concrete splatter when concrete is being placed. Clean all dust and debris, etc. from the inside of all electrical and control panels, etc.

VII.8 EXISTING CONSTRUCTION AND FACILITIES

Where construction 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 furnish such bond (cash or surety as required), insurance agreement or satisfy any other permit conditions as may be required before executing such construction work. A copy of the bond or insurance agreement (when required) must be filed with the Owner before any work is done. The Contractor

is responsible for his means and methods of construction to satisfy the permitting authority and to obtain the desired result as shown within the Contract Documents.

SECTION VIII PROSECUTION AND PROGRESS

VIII.1 PROSECUTION OF WORK

The Contractor shall begin the Work under the Contract within ten (10) calendar days after issuance of the Notice to Proceed. He shall give the Engineers notice to start work at least seventy-two (72) hours before beginning work. The Contractor shall notify the Engineers twenty-four (24) hours before he expects to undertake particular construction or testing.

Time limits stated in the Contract Documents are of the essence of the Contract. By submitting a Bid and executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work. The Contractor shall employ an ample force and provide adequate construction equipment to insure its completion within the Contract time. The Contractor shall properly plan, coordinate, and schedule all work to insure completion within the Contract Time.

All work shall receive the personal attention of the Contractor or of a competent superintendent who shall have authority to act for him. The Contractor shall notify the Engineers of the person authorized to act as superintendent. The Contractor shall have his superintendent on site at all times when work is being performed. The superintendent shall be a full time employee of the general contractor and not of a subcontractor. Any employee of the Contractor or Subcontractor found by the Owner to be incompetent, shall be dismissed from the work.

The Contractor shall utilize the same suppliers, equipment manufacturers, and subcontractors as he listed in the bidding documents that he submitted with his bid. The Contractor shall be fully responsible for all work and safety practices of all his subcontractors.

To coordinate work to be accomplished with affected entities, a progress meeting will be held periodically at the project site. The progress meeting will be held on Fridays and will be attended by the Engineer's inspector, Owner's representative, Contractor's superintendent, Contractor's project manager from his home office, affected subcontractor(s), and other parties who may be invited. The Owner reserves the right to establish the time of the meeting, change frequency of meetings, change meeting days, or to cancel the meeting.

Prior to starting up any equipment, the Contractor shall insure that all tanks, piping, and equipment, etc., are thoroughly cleaned of any debris or substances that may cause damage. The Contractor shall be fully responsible for all startups. He shall ensure that all operations are in accordance with the manufacturer's recommendations. If certain equipment is not to be operated or is to operate only under special procedures, the Contractor shall be fully responsible for insuring that such procedures are carefully followed. The Contractor shall lock out (with his own locks) and tag out breakers, controls, equipment, valves, and gates, etc., where needed to prevent unintended operation by others. The Contractor shall clearly communicate any special operating instructions to the Owner and Engineer in writing.

Color Selection Conference: Prior to the selection by the Owner of any colors (including but not limited to colors of paint, block, brick, mortar, louvers, soffit, gutters, roofing, doors, windows, furniture, counters, cabinets, molding, lighting, and all other materials or equipment to be provided by the Contractor), the Contractor shall furnish triplicate samples of all colors to be selected. After review of the colors by the Owner and Engineer, a conference shall be held to be attended by the Contractor, Owner, and Engineer for the Owner to make his selections. One of the samples shall be retained by the Owner, one by the Engineer, and the third by the Contractor.

The Contractor shall cooperate with the Engineer and keep him informed regarding all planned short-term and long-term activities. This includes but is not limited to all startup and testing, etc., issues. The Contractor shall notify the Engineer in advance of all such activities so that the Engineer may observe these if he desires. The Contractor shall provide the Engineer with copies of all manufacturer startup and testing reports, etc.

If changes are made on the project to accommodate the Contractor's requests, the Contractor shall be solely responsible for all associated changes, including but not limited to electrical, control, instrumentation, and SCADA changes. He shall make all such changes at his own expense to maintain the same functionality, flexibility, expandability, and redundancy etc. as provided by the original design. There shall be no extra time awarded due to agreeing to the Contractor's request.

Provide copies of all manufacturer or manufacturer representative, etc. site visit reports, startup reports, test reports, and all other manufacturer or installer reports (including but not limited to troubleshooting or service reports) to the Engineer promptly after the action occurs. If problems occur after startup or during the warranty period, and a service visit or repair, etc., is needed, the Contractor shall promptly provide to both the Engineer and Owner a written report from the service provider describing the problem and the corrective actions taken.

The Contractor shall provide temporary power and temporary utilities as needed to construct the project. All power costs and utility costs, including those for testing, shall be the responsibility of the Contractor until the Owner accepts the project or, at the Owner's discretion, begins beneficial use of the project. Regardless, the Contractor shall be responsible for extra utility costs incurred by or billed to the Owner due to the Contractor's activities or non-compliance with the Contract, or late completion.

It shall be the responsibility solely of the Contractor to properly prosecute all works in a safe manner that fully and continuously protects all people at the site(s) as well as the public. Neither the Owner or the Engineer are responsible for safety. Only the Contractor has the authority to control his work and to implement safe work practices.

VIII.2 TEMPORARY SUSPENSION OF WORK

The Owner shall have the authority to suspend the Work or parts for periods due to unsuitable weather or conditions which he considers unfavorable for satisfactory prosecution of Work, or for failure of the Contractor to perform any provisions of the Contract. No additional compensation shall be paid the Contractor for suspension. Upon suspension, the Work shall be properly protected. The Contractor shall not suspend the Work without the approval of the Owner. The Engineer will be notified twenty-four (24) hours before work is to be resumed.

Should the Work be stopped by an injunction, court restraining order, process or judgment directed to either of the parties hereto, then such delay shall not be charged against the Contract time. The Owner will not be liable to the Contractor for such delay or termination of the Work. If it should become necessary to stop work, the Contractor shall properly store materials and equipment and properly protect the Work.

VIII.3 SATURDAY, SUNDAY, HOLIDAY, AND NIGHT WORK

Work on Saturdays, Sundays, Holidays, or at night 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 Owner must be notified prior to beginning work. The work should be scheduled well in advance and arrangements made for prosecution of the work with minimum inconvenience to the public. All work required on Saturdays, Sundays, Holidays, or at night shall be so performed without additional expense to the Owner. Maintenance work normally required for protection of persons, or for protection of the work or property, will be permitted at any time. No equipment or system where controls or any other complicated processes are involved shall be placed in service on Friday, Saturday, Sunday, observed Holidays, or any day before observed Holidays without the consent of the Owner.

VIII.4 CONSTRUCTION SCHEDULE

The Contractor is instructed to submit to the Engineer, prior to initiating the work but not later

than ten (10) 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 Proposal and 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 may employ such reasonable and proper measures, subject to other conditions of these 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. The Contractor shall not be allowed additional compensation for employment of such measures.

The Contractor shall show in the schedule the proposed dates of commencement, completion, and cost (if cost was not delineated in Basis of Payment) of the various subdivisions of work comprising the project, and also shall 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.

VIII.5 AVOIDANCE OF POLLUTION CONTRIBUTION DURING CONSTRUCTION OPERATIONS

The employment of all safeguards and all precautions necessary to minimize contributions of pollution to water courses during the construction operations is the responsibility of the Contractor. The proper performance of excavating and backfilling operations, the interception and diversion of surface drainage around excavated areas or areas having the soil cover disturbed, the construction of temporary terraces or dikes, and the use of silt fences or other silt retaining means will be necessary to prevent concentration of run-off over freshly excavated or backfilled areas and to minimize stream pollution resulting from soil transported in run-off from the construction site. At the conclusion of the work, and after all temporary facilities have been removed, all areas disturbed by construction operations shall be restored to as good a condition as when found, or to condition as may be specified for the particular area. The Contractor shall comply with all ADEM and EPA laws, regulations, guidelines, and permits, etc.

VIII.6 USE OF CHEMICALS

All chemicals used during construction of the project or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reagent, or of other classification, must show approval of EPA, USDA, or FDA, according to the purposes for

which the particular chemical is to be used. Application of all such chemicals and disposal of residues therefrom are dependent upon the instructions and recommendations of the manufacturer's of the respective chemicals.

SECTION IX PAYMENT INSTRUCTIONS

IX.1 PAYMENTS ON ACCOUNT/PAYMENTS WITHHELD/RETAINAGE

Provide a complete and detailed schedule of values to the Engineer in a timely manner prior to the 1st payment request. The schedule of values shall be patterned after the bid items in the Contract but much more detailed. This schedule shall be in a format with breakdowns and amounts, etc., acceptable to the Owner. The schedule of values shall be revised until it is satisfactory to the Owner. The Owner shall not be required to make or continue payments until the Schedule of Values is acceptable to the Owner. The submittal of this schedule of values by the Contractor shall act as a certification by the Contractor that the

values reflect the total cost such that the cost associated with unperformed work items is sufficient to fully complete the work. Provide an explanation with the schedule of values explaining what work is included in each item. The schedule of values and pay request shall be revised whenever it appears that the monies remaining to be paid may not be sufficient to cover the entire cost (including overhead and profit, etc.) of the remaining work. This may result in deduction being made from items previously paid for.

Upon presentation of a verified application for payment, as the Work progresses, the Owner shall make partial payments (generally monthly) to the Contractor for the billable work performed less payments already made and less deductions for any incomplete, unacceptable, or defective work. The Contractor shall include neatly organized backup data and detailed calculations fully supporting all the items in his pay request. All such information shall be arranged in a manner required by the Engineer. The required format may vary as the project progresses. Also include totals and percentages for both total work performed to date and work remaining after the current pay request. On relocation projects reimbursable by the Alabama Department of Transportation, application for payment will be submitted by the Owner to the Alabama Department of Transportation. When reimbursement funds are received by the Owner from the State, payment will be made to the Contractor. In making partial payments to the Contractor, there shall be retained five (5%) percent of the estimated amount of work done and value of materials suitably stored on the site or suitably stored and insured offsite (offsite storage must be approved). Provided, however, after fifty (50%) percent of the project has been satisfactorily completed, no further retainage will be withheld. The calculation of percent completed shall be based on the value of work actually in place and agreed upon by the Engineer. The value of stored materials shall not be considered in the calculation of percent completed. Submittals must be approved and all comments addressed to the satisfaction of the Engineer before any payment is made on the items the submittal addresses.

The Contractor will be paid only for items listed in the "Items of Work". The Contractor shall include the cost of any and all work required, but not specifically listed, in the cost of the items listed. The Contractor shall include in the Contract Sum all allowances stated in the Contractor Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, or the Contractor chooses. Unless otherwise provided in the Contract Documents, allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts. The Contractor's costs

for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum and not in the allowances. Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order.

The Contractor's submittal of an Application for Payment (that is, a request for payment) shall be a certification by the Contractor that he is familiar with the work performed, has inspected the work performed, certifies that all work billed for on the current and previous applications has been completed in accordance with all the requirements of the Contract, and certifies that the status of completion indicated is accurate and that the amounts requested for payment are accurate. The Application for Payment shall be the Contractor's certification (1) that all work billed for has been properly completed to the percentage or amount shown, and (2) that all work billed for complies fully with all requirements of the plans and specifications.

The Contractor further warrants that upon submittal of an Application for Payment, all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work. Such applications shall not include requests for payment of amounts the Contractor does not intend to pay or has not paid, where applicable to a Subcontractor or material supplier because of a dispute or for any other reason. When requested, the Contractor shall promptly provide the Engineer proof of payments made. The proof shall be a certified statement from the subcontractor or material supplier showing the invoice amounts and the amount actually received for the project. Retainage or other amounts to be paid later shall not be included in the amounts paid. The proof of payment shall be clearly stated and acceptable to the Engineer.

The issuance of a Certificate for Payment will constitute a representation by the Engineer to the Owner, based on the Engineer's observations at the site and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Engineer's knowledge, information and belief, quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon completion; to results of subsequent tests and inspections; to minor deviations from the Contract Documents correctable prior to completion; and to specific qualifications expressed by the Engineer. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Engineer has (1) made exhaustive or continuous inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

The Engineer may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Engineer's opinions the representations to the Owner required above cannot be made. If the Engineer is unable to certify payment in the amount of the Application, the Engineer will notify the Contractor and Owner. If the Contractor and Engineer cannot agree on a revised amount, the Engineer will issue a Certificate for Payment for the amount for which the Engineer is able to make such representations to the Owner. If the Contractor feels that he is entitled to be paid more, he shall

promptly provide to the Engineer detailed and complete documentation demonstrating that he has earned the amounts he requested and that sufficient monies remain to be paid to fully complete all the requirements of the plans and specifications.

Retainage may be held by the Owner until final completion and acceptance of all work covered by the Contract Documents. No other escrow or deposit arrangements are acceptable to the Owner. When maintenance periods are included in the Contract Documents, such period shall be considered a component part of the Contract and retainage will be held until the expiration of such periods.

Unless specified otherwise in the Basis of Payment, separate structures or buildings, public work, or other separately identifiable divisions of the Contract in regard to which a separate price has been stated in the Contract Documents or can be separately ascertained, are integral parts of the complete project, and the Owner will not release retainage or make payment in full or separate divisions even though that part of the project may be complete, accepted, and in full service until the entire project and all components thereof have been completed, tested, accepted, and are in satisfactory service.

All materials and work covered by partial payments as provided for herein shall become the sole property of the Owner; provided, however, the Contractor shall not be relieved from the sole responsibility for the care and protection of materials, equipment, and work upon which payments have been made and for the restoration of any damaged work.

When work has been determined to be unacceptable, the Owner may at any time deduct the full cost, as estimated by the Engineer, of removing the unacceptable work and replacing it with work fully meeting the requirements of the Contract. The Owner may at any time refuse to pay for any work that will be affected by the removal and replacement of unacceptable work. The Owner shall not be required to pay for, or may at any time, deduct the full cost of removal and replacement, of all affected work that is dependent on or supported by or connected to, etc., unacceptable work or work not demonstrated to be in full compliance with all Contract requirements.

When requested, the Contractor shall promptly provide full support and detailed documentation clearly showing (1) that the amounts previously paid and currently being requested are justified, and (2) that sufficient monies remain for fully completing all work items of concern. There shall be no obligation for the Engineer to approve a payment amount requested if the Contractor does not acceptably demonstrate that the item (including any associated remedial work) can be totally completed per all Contract requirements for the amount remaining. In addition to retainage, additional amounts will be withheld for start-up, testing, cleanup, grassing, price adjustments, etc., and any and all other required work until all such work is totally complete in all respects. The Contractor shall not receive full payment for a work item until it is totally complete in all respects. Payment for an item shall not preclude later withholding for that item if it is determined that the payment should not have been made or if a problem develops with the work previously paid for. In addition, the Owner may also withhold payment of the whole or any part of a verified or approved application for payment from the Contractor to such an extent as may be necessary to protect itself from loss on account of any of the following causes discovered subsequent to its verification or approvals:

- 1) Defective work.
- 2) Evidence indicating probable filing of claims by other parties against the Contractor.
- 3) Failure of the Contractor or subcontractor to promptly make payments to subcontractors or for materials, labor, food stuffs and supplies.

- 4) Damage to another contractor under separate contract with the Owner.
- 5) Assessment of liquidated damages or fines, fees, etc.
- 6) Overestimated quantities or percent completion from previous estimates.
- 7) Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum.
- 8) Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay.
- 9) Persistent failure to carry out the Work in accordance with the Contract Documents.

When the above grounds are removed, applications for payment will then be verified and/or approved for amounts not previously verified and approved because of them.

IX.2 USE OF COMPLETED PORTIONS OF THE WORK

The Owner shall have the right to take possession of and use any completed or partially completed portion of the work, 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 or substantial completion of any work not completed in accordance with the Plans, Specifications, and other Contract Documents.

SECTION X PROJECT COMPLETION

X.1 SUBSTANTIAL COMPLETION

“Substantial completion” shall be that degree of completion of the entire Project, unless otherwise provided for, as evidenced by the Engineer’s written notice of substantial completion, sufficient to provide the Owner, at its discretion, the full-time use of the work or defined portion of the work for the purposes for which it was intended. “Substantial completion” of a Project shall be that degree of completion that has provided a minimum of 7 continuous days of successful, trouble-free operation of the entire project facilities in a “fully automatic” manner acceptable to the Owner and Engineer and with all redundant and alternative systems fully operational. The Contractor shall demonstrate that all features of the project function properly and reliably in the intended mode during this seven- day period in order for the project to be considered eligible for substantial completion. All alternative modes of operation and flexibility must be demonstrated during this period. All equipment contained in the Project, plus all other components required by the Contract

Documents to enable the Owner to operate the project facilities in the manner that was intended, shall be complete on the substantial completion date. The Project herein described is a complete Project in its entirety and shall include clean-up and other aesthetically pleasing requirements of the project. Completion of individual components of the Project cannot be considered for substantial completion until the sum total of these components are complete and thus, the components when operating properly will provide the Owner with a complete Project.

When the Contractor considers that the Project is substantially complete, the Contractor shall carefully review all requirements of the plans and specifications, carefully compare the work completed to the work required, and prepare and submit to the Engineer a detailed, complete list of all items to be completed or corrected and request an inspection for

substantial completion. The Contractor shall not misrepresent the work as substantially complete when a limited investigation indicates that the work is not substantially complete. The failure by the Contractor to include any items on such list does not alter the responsibility of the Contractor to complete all work in accordance with the Contract Documents. After inspection and/or if an operating facility, after a minimum of seven continuous days of successful, trouble-free operation has been achieved during startup, the Engineer may, at his sole discretion, issue a written notice of substantial completion for the purpose of establishing the starting date for specific equipment guarantees or warranties, and to establish the date the Owner will assume the responsibility for the cost of operating such equipment.

Said notice shall not be considered as final acceptance of any portion of the Project or relieve the Contractor from completing the remaining work, including any remaining performance or acceptance testing, within the specified time and in full compliance with the Contract Documents. Specifically, the issuance of a written notice of substantial completion shall not relieve the Contractor of his obligation to promptly remedy any omissions and latent or unnoticed defects in the Project covered by the written notice of substantial completion.

X.2 FINAL INSPECTION

After the Contractor properly completes all work on his detailed list of items to be completed or corrected, he shall again carefully review all requirements of the plans and specifications and carefully compare the work completed to the work required by the plans and specifications. He shall complete any work not completed in accordance with the plans and specifications, as well as any other required work that may be brought to his attention by others. When all work is complete, the Contractor shall notify the Engineer and Owner that his work is complete. The Contractor shall not misrepresent the work as complete when a limited investigation indicates that the work is not complete.

Upon notice from the Contractor that its work is complete, the Engineer and/or other representatives of the Owner shall make a final inspection of the Work or Project and conduct test or tests, if applicable. The Engineer shall notify the Contractor of all apparent and/or visible instances where the Project fails to comply with the Contract Documents, as well as any defects he may discover (punch list). The Contractor shall immediately make such alterations as are necessary to make the Project comply with the Plans and Specifications and to the satisfaction of the Engineer.

Verification, approval, inspection, final inspection, issuance of final acceptance, issuance of final certificate of payment, action or approval by the Owner upon the final certificate of payment or final acceptance shall not in any way relieve the Contractor of responsibility for faulty materials or workmanship.

X.3 FINAL PAYMENT

When the Contractor shall have completed all of the work in accordance with the terms of the Contract Documents, he shall certify to the Owner that he has completed all of the work. 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. The Contractor shall give "Notice" of the completion of the work by an advertisement in a newspaper of general circulation published within the City or County in which the work has been done, for a period of four successive weeks. A final payment shall not be made upon the Contract until the expiration of 30 days after the completion of the "Notice". Proof of publication of the "Notice" shall be made by the Contractor to the authority by whom the Contract was made by affidavit of the publisher and a printed copy

of the "Notice" published. If no newspaper is published in the County in which the work is done, the "Notice" may be given by posting at the courthouse for 30 days, a proof of same shall be made by the judge of probate, sheriff, and the Contractor.

When the Owner and the Engineer have completed a review of the Work and of the request for final payment and accepted all work, final payment of the amount determined to be due under the Contract will be made to the Contractor, provided that:

(1) Any deficiencies in the Work noted during the review shall have been satisfactorily corrected.

(2) The Contractor shall have submitted certified evidence that all payrolls, all amounts due for labor and materials, and all other indebtedness connected with the work have been fully paid and satisfied, and that there are no outstanding claims or demands against the Contractor in any manner connected with the work.

(3) Proof of publication of "Notice" of completion in newspaper in manner described by law.

(4) A properly executed and duly certified voucher for payment, verified by Engineer or other representative.

(5) A release of all claims and claims of lien against the Owner and its agents and Engineer from the Contractor and all major subcontractors (the Owner may waive the requirement for subcontractor releases) arising under and by virtue of the Contract, on form provided by the Owner, duly executed by the Contractor and with the consent of the Surety. The Contractor may specifically exclude claims of the Contractor from the operation of the release if specifically excluded therefrom in stated amounts and the reason therefore. The Contractor may with the consent of the Owner representative, if any subcontractor refuses to furnish such a release, furnish a bond with surety satisfactory to the Owner representative to indemnify against such claims. Forms documenting the release of claims pursuant to this subsection are included on the pages following this Section.

(6) In accordance with ALA.CODE §39-2-12(c), a non-resident Contractor shall satisfy the Owner that he or she has paid all taxes due and payable to the State, the Owner and all applicable political subdivisions.

Upon Project completion and acceptance by the Owner's representatives, but not before the expiration of thirty (30) days after completion of the "Notice", the amount due the Contractor pursuant to the Contract Documents shall be paid. On relocation projects reimbursable by the Alabama Department of Transportation, application for payment may be submitted by the Owner to the Alabama Department of Transportation. When reimbursement funds are received by the Owner from the State, payment will be made to the Contractor.

X.4 ACCEPTANCE OF FINAL PAYMENT CONSTITUTES RELEASE

The acceptance by the Contractor of the final payment shall release the Owner, the Engineer, as representatives of the Owner, and their officers, employees, agents, and subconsultants from all claims and all liability to the Contractor for all things done or furnished in connection with the Project, and every act of the Owner and others relating to or arising out of the work. No payment, however, final or otherwise, shall operate to release the Contractor or his Sureties from obligations under this Contract and the Performance Bond, Payment Bond, and other bonds, warranties and guarantees as herein provided.

CONTRACTOR'S AFFIDAVIT OF RELEASE OF LIENS AND PAYMENT OF DEBTS AND CLAIMS

PROJECT:

(project name)

CONTRACT DATE:

TO OWNER:

(name and address of Owner)

STATE OF:

COUNTY OF:

I CERTIFY to the best of my knowledge and belief that all work has been performed and materials supplied in strict accordance with the terms and conditions of the corresponding contract documents between the _____, hereinafter called the OWNER, and _____, hereinafter called the CONTRACTOR, for the above referenced project.

I further certify and declare that all bills for materials, supplies, utilities and for all other things furnished or caused to be furnished by the CONTRACTOR and used in the execution of the contract are fully paid and that there are no unpaid obligations, liens, claims, security interests, encumbrances, liabilities and/or demands of agencies, subcontractors, materialmen, mechanics, laborers or any others resulting from or arising out of any work done, caused to be done or ordered to be done by the CONTRACTOR under the contract, except as listed below.

I further certify and declare that, except as listed below, the CONTRACTOR (including but not limited to the Contractor, Subcontractors, all suppliers of material and equipment, and all performers of work, labor, or services) releases and forever discharges as well as indemnifies and holds harmless the OWNER and ENGINEER (Municipal Consultants, Inc.) from any and all obligations, liens, claims, security interests, encumbrances and/or liabilities arising by virtue of the contract and authorized changes between the contracting parties, and any and all claims and demands of every kind and character whatsoever against the OWNER and ENGINEER (Municipal Consultants, Inc.), arising out of or in any way relating to the contract and authorized changes.

EXCEPTIONS:

CONTRACTOR:

(name and address of Contractor)

BY: _____

(signature of authorized representative)

(printed name and title)

Subscribed and sworn to before me on this _____ day of _____, 20____.

Notary Public

My commission expires: _____

CONSENT OF SURETY TO FINAL PAYMENT

PROJECT:

(project name)

CONTRACT DATE:

TO OWNER:

(name and address of Owner)

In accordance with the provisions of the Contract between the OWNER and the CONTRACTOR as indicated above, the

(name and address of Surety Company)

, SURETY COMPANY,

on bond of

(name and address of Contractor)

, CONTRACTOR,

hereby approves of the final payment to the CONTRACTOR, and agrees that the final payment to the CONTRACTOR shall not relieve the SURETY COMPANY of any of its obligations to

(name and address of Owner)

, OWNER,

IN WITNESS WHEREOF, the SURETY COMPANY has hereunto set its hand
on this _____ day of _____, 20____.

Surety Company

Signature of authorized representative

Printed name and title

SECTION XI WARRANTY AND GUARANTEES

XI.1 WARRANTY AND GUARANTEE

The Contractor warrants to the Owner and the Engineer that all materials, work, and equipment furnished under this Contract will be new unless otherwise specified and that all work, materials and equipment will be of good quality, free from fault and defects in conformance with the Contract Documents. All work, materials, and equipment not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The warranty shall be for one year from the date of the Final Acceptance or the date of Substantial Completion of the full Project completed in its entirety, whichever is first. If within one (1) year from the beginning date of the warranty period, any of the work, materials or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so. This warranty includes all equipment even if the specific equipment warranty from the equipment manufacturer has expired. This obligation shall survive termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

If the Project involves a roof on a building or other structure, then the Contractor shall execute and provide the Roofing Guarantee. The guarantee shall be delivered to the Owner and Engineer prior to final payment. If the Project involves termite treatment, the Contractor shall furnish to the Owner a written warranty certifying that the applied soil poisoning treatment will prevent the infestation of subterranean termites and that if subterranean termite activity is discovered during the warranty period, Contractor shall re-treat the soil and repair or replace any damage caused by termite infestation. The warranty shall be for a period of five (5) years from the date of treatment signed by Applicator and Contractor.

XI.2 CORRECTION OF DEFECTIVE WORK DURING WARRANTY/ GUARANTEE PERIOD

The Contractor hereby agrees to make, at his own expense, all repairs or replacements necessitated by defects in materials or workmanship, provided under the terms of this Contract, and pay for any damage to other works resulting from such defects, which become evident within 1 year after the beginning date of the warranty period by the terms of any applicable special guarantee required by the Contract Documents unless the Owner has previously given the Contractor a written acceptance of such defects. The Contractor shall promptly correct such defects upon receipt of a written notice from the Owner to do so. This obligation shall survive the termination of the Contract.

Unremedied defects identified for correction during the warranty period described herein before, but remaining after its expiration, shall be considered as part of the obligations of the warranty. Defects in material, workmanship, or equipment which are remedied as a result of obligations of the warranty shall subject the remedied portion of the Project to an extended warranty period of 1 year after the defect has been remedied. Repetitive malfunction of equipment shall be cause for equipment replacement and an extension of the guarantee period for the equipment to a date 1 year following acceptable replacement. The Contractor further assumes

responsibility for a similar guarantee for all work and materials provided by subcontractors or manufacturers of packaged equipment components.

The Contractor also agrees to hold the Owner and the Engineer and employees harmless from liability or damages, including the Engineer and attorneys' fees, and cost and expenses of litigation of any kind arising from damage due to said defects. The Contractor shall make all repairs and replacements promptly upon receipt of written order for same from the Owner or its agent. If the Contractor fails to make the repairs and replacements promptly, or in an emergency where delay would cause serious risk, or loss, or damage, the Owner may have the defective work corrected or the rejected work removed and replaced, and the Contractor and his Surety shall be liable for the cost thereof. The Contractor during the warranty period shall repair/replace as rapidly as possible any and all equipment, materials, etc., which are found to be defective. Should any items not be repaired/replaced within thirty

(30) days from the time it is reported to the Contractor by the Owner, then the warranty period shall be extended on that item for a period equal to the time that the item has remained defective, incomplete, or inoperable as determined by the Owner. The Contractor must certify that the item has been corrected. The Owner's rights under this Article shall be in addition to, and not a limitation of, any other rights and remedies available by law.

Nothing contained in this Section shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the time period of one year as described in this Section relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

SUPPLEMENTAL GENERAL CONDITIONS

SECTION 01410 – STRUCTURAL TESTS AND SPECIAL INSPECTIONS

PART 1 - GENERAL

1.0 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.

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements required for compliance with the International Building Code, Chapter 17, Structural Tests and Special Inspections.
- B. Structural testing and special inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve contractor of responsibility for compliance with other construction document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the construction document requirements.
 - 3. Requirements for contractor to provide quality-assurance and -control services required by architect, owner, or authorities having jurisdiction are not limited by provisions of this section.
- C. The owner will engage one or more qualified special inspectors and / or testing agencies to conduct structural tests and special inspections specified in this section and related sections and as maybe specified in other divisions of these specifications.
- D. Related Sections include but are not limited to the following:
 - 1. 030000 CONCRETE.

1.2 DEFINITIONS

- A. Approved Agency: An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the building official.
- B. Construction Documents: Written, graphic and pictorial documents prepared or assembled for describing the design, location and physical characteristics of the elements of a project necessary for obtaining a building permit. Construction Documents include all supplemental

instructions, sketches, addenda, and revisions to the drawings and specifications issued by the registered design professional beyond those issued for a building permit.

- C. Shop Drawings / Submittal Data: Written, graphic and pictorial documents prepared and / or assembled by the contractor based on the Construction Documents.
- D. Structural Observation: Visual observation of the structural system by a representative of the registered design professional's office for general conformance to the approved construction documents. Structural observations are not considered part of the structural tests and special inspections and do not replace inspections and testing by the testing agency or special inspector.
- E. Special Inspector: A qualified person who demonstrating competence, to the satisfaction of the code enforcement official and registered design professional in responsible charge, for inspection of the particular type of construction or operation requiring special inspection. The special inspector shall be a licensed professional engineer or engineering intern or a qualified representative from the testing agency.
- F. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.
- G. Special Inspection, Periodic: The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.
- H. Testing Agency: A qualified materials testing laboratory under the responsible charge of a licensed professional engineer, approved by the code enforcement official and the registered design professional in responsible charge, to measure, examine, test, calibrate, or otherwise determine the characteristics or performance of construction materials and verify confirmation with construction documents.

1.3 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Minimum qualifications of inspection and testing agencies and their personnel shall comply with ASTM E329-03 Standard Specification for Agencies in the Testing and / or Inspection of Materials Used in Construction.
 - a. Inspectors and individuals performing tests shall be certified for the work being performed as outlined in the appendix of the ASTM E329. Certification by organizations other than those listed must be submitted to the building official for consideration before proceeding with work.
 - 2. In addition to these requirements, local jurisdiction may have additional requirements. It is the responsibility of the testing and inspection agencies to meet local requirements and comply with local procedures.

1.4 CONFLICTING REQUIREMENTS, REPORTS, AND TEST RESULTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but

apparently equal, to the registered design professional in responsible charge for a decision before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the registered design profession in responsible charge for a decision before proceeding.
- C. The special inspector's reports and testing agencies results shall have precedence over reports and test results provided by the contractor.
- D. Where a conflict exists between the construction documents and approved shop drawings / submittal data, the construction documents shall govern unless the shop drawings / submittal data are more restrictive. All conflicts shall be brought to the attention of the registered design professional in responsible charge.

1.5 SUBMITTALS BY SPECIAL INSPECTOR AND / OR TESTING AGENCY

- A. Special inspectors shall keep and distribute records of inspections. The special inspector shall furnish inspection reports to the building official, and to the registered design professional in responsible charge, contractor, architect, and owner. Reports shall indicate that work inspected was done in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the building official and to the registered design professional in responsible charge prior to the completion of that phase of the work. A final report documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted at a point in time agreed upon by the permit applicant and the building official prior to the start of work.
 - 1. Special inspection reports and test results shall include, but not be limited to, the following:
 - a. Date of inspection.
 - b. Description of inspections or tests performed including location (reference grid lines, floors, elevations, etc.).
 - c. Statement noting that the work, material, and / or product conforms or does not conform to the construction document requirements.
 - 1) Name and signature of contractor's representative who was notified of work, material, and / or products that do not meet the construction document requirements.
 - d. Name and signature of special inspector and / or testing agency representative performing the work.
- B. Schedule of Non-Compliant Work: Each agent shall maintain a log of work that does not meet the requirements of the construction documents. Include reference to original inspection / test report and subsequent dates of re-inspection / retesting.
- C. Reports and tests shall be submitted within 1 week of inspection or test. Schedule of Non-Compliant Work shall be updated daily and submitted at monthly intervals.

- D. Final Report of Special Inspections. Submitted by each agent listed in the schedule of Structural Testing and Special Inspections.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S RESPONSIBILITY

- A. The contractor shall coordinate the inspection and testing services with the progress of the work. The contractor shall provide sufficient notice to allow proper scheduling of all personnel. The contractor shall provide safe access for performing inspection and on site testing.
- B. The contractor shall submit schedules to the owner, registered design professionals and testing and inspecting agencies. Schedules will note milestones and durations of time for materials requiring structural tests and special inspections.
- C. The contractor shall repair and / or replace work that does not meet the requirements of the construction documents.
 - 1. Contractor shall engage an engineer / architect to prepare repair and / or replacement procedures.
 - 2. Engineer / architect shall be registered in the state in which the project is located. Engineer shall be acceptable to the registered design professional in responsible charge, code enforcement official, and owner.
 - 3. Procedures shall be submitted for review and acceptance by the registered design professional in responsible charge, code enforcement official, and owner before proceeding with corrective action.
- D. The contractor shall be responsible for costs of:
 - 1. Re-testing and re-inspection of materials, work, and / or products that do not meet the requirements of the construction documents and shop drawings / submittal data.
 - 2. Review of proposed repair and / or replacement procedures by the registered design professional in responsible charge and the inspectors and testing agencies.
 - 3. Repair or replacement of work that does not meet the requirements of the construction documents.

3.2 STRUCTURAL OBSERVATIONS

- A. Structural observations may be made periodically as determined by the registered design professional in responsible charge.

3.3 TESTING AND INSPECTION

- A. Testing and inspection shall be in accordance with the attached Schedule of Special Inspections.

- B. Reference related specifications for the minimum level of inspections and testing. Provide additional inspections and testing as necessary to determine compliance with the construction drawings.

PART 4 - SCHEDULES AND FORMS (ATTACHED)

- 4.1 STATEMENT OF SPECIAL INSPECTIONS.
- 4.2 SCHEDULE OF SPECIAL INSPECTIONS.
- 4.3 FINAL REPORT OF SPECIAL INSPECTIONS.

END OF SECTION 01410

STATEMENT OF SPECIAL INSPECTIONS

Project: Shelby County Control Valve Station (NORTH-SOUTH CONNECTOR)

Project Address:

Permit Applicant:

Applicant Address:

Owner: Shelby County Commission

Owner Address:

Registered Design Professionals (RDP):

Lead Engineer: Municipal Consultants

Geotechnical Engineer:

Structural Engineer: MBA Engineers, Inc.

Mechanical Engineer:

Electrical Engineer:

This statement of special inspections is submitted as a condition for permit issuance in accordance with Chapter 17 of the International Building Code. It includes a *Schedule of Special Inspections* applicable to the above referenced project as well as the identity of the individuals, agencies, or firms intended to be retained for conducting these inspections.

The Special Inspector(s) shall keep records of all inspections and shall furnish interim inspection reports to the building official and to the registered design professional in responsible charge at a frequency agreed upon by the permit applicant and building official prior to the start of work. Discrepancies shall be brought to the immediate attention of the contractor for correction. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the building official and the registered design professional in responsible charge prior to completion of that phase of work. A *Final Report of Special Inspections* documenting required special inspections and correction of any discrepancies noted in the inspections shall be submitted by each agent at the completion of that phase of work.

Maximum frequency of interim report submittals shall not be less than one week.

The Special Inspection program does not relieve the contractor of the responsibility to comply with the Contract Documents. Jobsite safety and means and methods of construction are solely the responsibility of the Contractor.

Owner's Acknowledgement:

Signature

Date

Building Official's Acceptance:

Signature

Date

Permit No.

Frequency of interim report submittals to building official:

☐ Monthly

☐ Bi-Monthly

☐ Upon Completion

☐ Per Attached Schedule

RDP in Responsible Charge



Project Name: Shelby County Control Valve Station (NORTH-SOUTH CONNECTOR)

Project Address _____

During construction of the referenced project, it is intended that special inspection as outlined in Chapter 17 of the 2021 International Building Code be provided for by the owner. The following areas of work will require special inspection:

MATERIAL / ACTIVITY	FREQUENCY OF INSPECTION	INSPECTOR
A. Inspection of Steel per 1705.2 (in accordance with quality assurance inspection requirements of AISC 360).		
1. Inspection of welding:		
a. Prior to welding:		
1. Welding procedure specifications available	Continuous	Testing Agent
2. Manufacturer certifications for welding consumables available	Continuous	Testing Agent
3. Material identification (type/grade)	Periodic	Testing Agent
4. Welder identification system	Periodic	Testing Agent
5. Fit-up of groove welds (including joint geometry)	Periodic	Testing Agent
6. Configuration and finish of access holes	Periodic	Testing Agent
7. Fit-up of fillet welds	Periodic	Testing Agent
b. During welding:		
1. Use of qualified welders	Periodic	Testing Agent
2. Control and handling of welding consumables	Periodic	Testing Agent
3. No welding over cracked welds	Periodic	Testing Agent
4. Environmental conditions	Periodic	Testing Agent
5. Welding specification procedure followed	Periodic	Testing Agent
6. Welding Techniques	Periodic	Testing Agent
c. After welding:		
1. Welds cleaned	Periodic	Testing Agent
2. Size, length, and location of welds	Continuous	Testing Agent
3. Welds meet visual acceptance criteria	Continuous	Testing Agent
4. Arc strikes	Continuous	Testing Agent
5. K-area	Continuous	Testing Agent
6. Backing removed and weld tabs removed	Continuous	Testing Agent
7. Repair activities	Continuous	Testing Agent
8. Document acceptance or rejection of welded joint or member	Continuous	Testing Agent
2. Inspection of high-strength bolting:		
a. Prior to bolting:		
1. Manufacturer's certifications available	Continuous	Testing Agent
2. Fasteners marked in accordance with ASTM requirements	Periodic	Testing Agent
3. Proper fasteners selected for the joint detail	Periodic	Testing Agent
4. Proper bolting procedure for the joint detail	Periodic	Testing Agent
5. Connecting elements meet applicable requirements	Periodic	Testing Agent
6. Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used	Periodic	Testing Agent
7. Proper storage provided for bolts, nuts, washers, and other fastener components	Periodic	Testing Agent
b. During bolting:		
1. Fastener assemblies placed in all holes and washers (if required) are positioned as required	Periodic	Testing Agent

2. Joint brought to the snug-tight condition prior to the pretensioning operation	Periodic	Testing Agent
3. Fastener component not turned by the wrench prevented from rotating	Periodic	Testing Agent
4. Fasteners are pretensioned in accordance with the RCSC specification progressing systematically from the most rigid point toward the free edges	Periodic	Testing Agent
c. After bolting:		
1. Document acceptance or rejection of bolted connections	Continuous	Testing Agent
MATERIAL / ACTIVITY	FREQUENCY OF INSPECTION	INSPECTOR
B. Inspection of Concrete per 1705.3 – 1705.3.1 & Table 1705.3		
1. Inspection of reinforcing steel and placement.	Periodic	Testing Agent
2. Inspection of anchors cast in concrete where allowable loads have been increased, or where strength design has been used.	Periodic	Testing Agent
3. Inspection of anchors post-installed in hardened concrete members.	Periodic	Testing Agent
4. Verifying use of required design mix.	Periodic	Testing Agent
5. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	Continuous	Testing Agent
6. Inspection of concrete and shotcrete placement for proper application techniques.	Continuous	Testing Agent
7. Inspection for maintenance of specified curing temperature and techniques.	Periodic	Testing Agent
8. Inspect formwork for shape, location, and dimensions of the concrete member being formed.	Periodic	Testing Agent
C. Inspection of Soil Conditions per 1705.6		
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	Periodic	Testing Agent
2. Verify excavations are extended to proper depth and have reached proper material.	Periodic	Testing Agent
3. Perform classification and testing of compacted fill materials.	Periodic	Testing Agent
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	Continuous	Testing Agent
5. Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly.	Periodic	Testing Agent

FINAL REPORT OF SPECIAL INSPECTIONS

Project: Shelby County Control Valve Station (NORTH-SOUTH CONNECTOR)

Project Address:

Testing / Inspection Agent:

Testing / Inspection Agent Address:

Scope of Testing / Inspections:

To the best of my information, knowledge, and belief, the special inspections or testing required for this project, and designated for this Agent in the *Schedule of Special Inspections* submitted for permit, have been completed in accordance with the contract documents.

Interim reports submitted prior to this final report and numbered to , form a basis for, and are to be considered an integral part of this final report.

Special Inspector's Seal

Prepared By:

Type or print name

Signature

Date

(Licensed Professional Engineer)

STANDARD SPECIFICATIONS

**STANDARD SPECIFICATION
FOR
SITEWORK, EXCAVATION, AND EARTHWORK**

SECTION 1-1

1.0 PREPARATION OF SITE

Preparation of the site shall consist of the relocating, maintaining and/or removal of all fences, railings, poles, pipelines, culverts, structures, walkways, etc., located within the areas to be graded or to be occupied by new structures, pipelines, or other components of the project. Such relocations, maintenance, and/or removal may be required when the permanent use of such facilities will be required during construction or after construction, or when the temporary use of such facilities will be required. Site preparation work shall also include the provision of such drainage ditches, banks, travelways, etc., as may be required for proper prosecution and protection of the work.

Topsoil shall be stripped to a depth of not less than 12 inches from areas to be affected by the work, excavated or filled, and stockpiled for final distribution. If stored onsite for reuse, topsoil shall be placed on the site at locations acceptable to the Owner and Engineer. The Contractor shall consult with the Engineer regarding use of the site for fill areas, material storage areas, and spoil areas. The Contractor shall conserve the maximum amount of topsoil for use in final grading; avoid rendering any part of the work site unfit for future use; and maintain maximum access to the construction work, existing facilities, or new facilities. Soils testing and compaction testing shall be paid for by the Owner.

2.0 CLEARING AND GRUBBING

Clearing and grubbing shall consist of cutting, removing, burning and disposal of all trees, brush, stumps, grass, woods, roots, etc., within areas indicated to be graded, cut, filled, or occupied by structures, pipelines, or other facilities. All roots projecting from walls of excavation shall be either cut or removed so that minimum clearances of three feet from outside line of all structures, pipelines, etc., will be secured. No vegetation or other perishable material shall be left within areas of fill.

It shall be the responsibility of the Contractor to dispose of all debris resulting from clearing and grubbing operations. No materials resulting from the clearing and grubbing operations shall be left on the site unless required otherwise. Materials temporarily used to form silt barriers for erosion control shall be removed from the site after permanent erosion prevention cover is established by the Contractor.

All holes and/or depressions caused by the removal of stumps, roots, snags, etc., shall be backfilled, finish graded, and grassed. Disposal of debris shall be accomplished in such a manner as to fully comply with all applicable laws, codes, ordinances, etc.

All burning of material on the work site, when permitted, 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 local authority or County Department of Health having jurisdiction over the construction site.

The burning of stumps, timber, logs, trimmings, brush, or other combustible materials where allowed shall be accomplished in such a manner that there will be no smoke or flyash nuisance. Burning shall not be initiated when atmospheric conditions are such as would cause a static cover in the area. Burning shall be strictly controlled. Quantities of materials being burned shall be limited so as to prevent damage to trees and/or growth adjacent to the cleared area, or to facilities or structures located in the surrounding area.

Trees, undergrowth, and ground cover outside of the construction areas or limits shall not be damaged or disturbed. Any tree scarred by equipment shall be immediately repaired and painted with approved asphaltic coating material. All damaged limbs shall be pruned by a clean cut and cut shall be painted with approved asphaltic coating material. Damaged undergrowth shall be pruned and treated. All areas disturbed or damaged by the Contractor's operations shall be restored to their original condition or as a minimum as specified.

3.0 SITE GRADING

All excess material or material which is unacceptable for use as fill or backfill shall be removed from the site and disposed of at the Contractor's expense. Final grading on the site, except over areas to be occupied by structures, walks, roadways, paved areas, etc., shall be of such material as will support vegetation. The entire area disturbed by the construction operations shall be finish graded, restored, and grassed. All fill material, not specified to be crushed stone, placed in areas to be occupied by roadways, walks, embankments, dikes, or other earth structures shall be compacted to 98 percent of maximum density unless otherwise indicated on the Drawings.

4.0 EROSION AND SILTING

The Contractor shall plan his site work and construction operations in such a manner as to effectively control soil erosion and runoff. The Contractor shall prevent pollution of streams and/or storm drains as would result from silt or soil runoff, or as would result from any material used in the construction operations such as oil, grease, paints, chemicals, fuels, solvents, or any construction debris. The Contractor shall obtain and comply with any permits and regulations required by ADEM or other agencies.

The Contractor shall intercept and block drainage from the construction site by means of silt fences, silt barriers, and sedimentation pools as required. Silt fences, wherever used on the site, shall consist of hay bales securely fastened in place or of suitable permeable barrier fabric designed to filter water and retain silt. Fabric shall be securely set in the ground and firmly held in place.

The Contractor shall be responsible for obtaining necessary NPDES Permits 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. All costs associated with making the

application for the permit and for meeting the requirements of the Permit shall be borne by the Contractor.

5.0 CLEANING UP AND RESTORATION OF SURFACE FOR GRASSING

The Contractor shall maintain the construction and disturbed areas. All disturbed areas shall be restored to their original condition. Traveled areas shall be maintained in a passable condition by crushed stone or temporary paving as required at the Contractor's expense. All construction work shall be performed within reasonable limits around the areas of the work. All ground surface areas within the project construction limits shall be finished graded and grassed. All cut banks, slopes, or other areas outside of the construction limit that have been disturbed by the Contractor's construction operations shall also be graded and grassed.

The Contractor shall dispose of excess material as specified herein, and shall remove all rubbish, trash, and surplus construction materials from the site. Areas, sections, or portions of the work site within which construction work has been completed prior to beginning of final grading and grassing, shall be protected from erosion by employment of temporary control measures such as seeding and mulching or seeding and netting. All temporary erosion control and pollution control features installed by the Contractor shall be maintained by the Contractor prior to and following final grading and grassing.

Where trenches are excavated across raw land, undeveloped areas, pastureland, grassed areas, etc., the material placed in the top foot of backfill for such trenches shall be selected so as to be suitable for support of vegetation as found or as hereinafter specified. Where trenches are cut through finished lawns of bermuda, zoysia, centipede, or other types of lawn grasses, the top soil shall be dressed and fertilized, and the top of the trench adequately prepared for placement of sod matching the type grass removed.

Before placement of topsoil, the subsoil shall be loosened to a depth of not less than four inches but not greater than eight inches, the surfaces shall be cleared of all rock one inch or larger in size, all construction debris, or other objectionable material. The topsoil, previously removed and stored, shall then be placed over the prepared subsoil. The depth of the topsoil shall be sufficient to allow for natural settlement, so that after such settlement has taken place the surface of the topsoil layer will conform to the finished elevations and contours shown on the Drawings.

Should the stockpile of topsoil accumulated from the trenching operations not be adequate for supplying the quantities of topsoil required for preparation of the areas described hereinabove, the Contractor shall furnish, at his expense, topsoil from other sources to meet any deficiencies. Topsoil preparation shall consist of loosening the soil by discing, harrowing, or other approved methods. On areas having a slope of 3:1 or flatter, the soil shall be loosened to a depth of approximately three inches; and on slopes steeper than 3:1, the soil shall be merely roughened to a depth of approximately one inch. All clods, loose stones, and other foreign materials which are larger than one inch in any dimensions shall be removed. All gullies and washes that develop in the loosened soil prior to seeding shall be repaired. Seeding shall immediately follow soil preparation so as to avoid both compaction and/or wash by heavy

rainfall and crust formation by sunbaking. Seeding will not be permitted on hard or crusted soil surfaces.

After preparation of topsoil, the Contractor shall immediately proceed with the grassing work. All materials used shall conform to the requirements in these Specifications under "Grassing".

If the construction work in any areas or portions of the work site should have been completed prior to completion of other construction work on the site, and the surface of the ground over and around such completed construction work will not be disturbed by the continued prosecution of other construction work within the project site, the Contractor may elect to perform the finish grading, ground preparation, and permanent grassing over such areas. The Contractor shall understand, however, that all permanent grassing work done prior to the undertaking of the final grading, ground preparation, and permanent grassing of the project site after all construction work has been completed shall be at this own risk. The Contractor shall be responsible for maintenance of temporary grassing or any permanent grassing installed prior to the undertaking of final grading and permanent grassing.

6.0 RIP RAP

Rip rap shall be placed in the locations shown on the Drawings. The areas, widths, and lengths shown for rip rap coverage are the minimums required. Field conditions or changes in field conditions may dictate that the coverage at a particular location be decreased or increased.

Rip rap shall be stone conforming to the requirements of AHD Specifications Section 814.01, Class 2 rip rap. Rip rap material shall consist of reasonably well-graded stones ranging in weight from approximately 10 pounds to approximately 200 pounds, with not over 10 percent weighing over 200 pounds, at least 50 percent over 80 pounds, and not more than 10 percent weighing less than 10 pounds. Rip rap bedding, where shown to be required, shall consist of gravel or crushed stone AHD Size #467. Thickness of bedding shall be as shown on the Drawings.

Rip rap shall be placed in accordance with AHD Specifications Section 610 for placement of Class 2 rip rap. Rip rap shall be placed in such a manner as to produce a reasonably well-graded mass of rock having the minimum practical percentage of voids. Rip rap shall be placed to its full course thickness in one operation in a manner that avoids displacement of the bedding material. The finished rip rap shall be free from objectionable pockets of small stones and clusters of large stones. Dumping of rip rap will be allowed provided mechanical equipment is used to dress the stones to a reasonably uniform slope.

No extra payment for rip rap deposited contrary to the locations shown on the Drawings will be made unless requested in writing by the Owner and/or Engineer. The Contractor shall maintain the rip rap 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.

If shown on the drawings, the Contractor shall furnish and install a geotextile fabric in the locations shown on the Drawings prior to the placement of the rip rap. The geotextile shall be of nonwoven construction. The fabric shall be mildew, insect, and rodent

resistant and shall be inert to chemicals commonly found in soil. 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.

The embankment stabilization fabric shall be placed in the manner described and in accordance with the manufacturer's recommendations. The surface to receive the geotextile shall be prepared to a smooth condition free of obstructions, depressions, and debris. The fabric shall be placed loosely, not in a stretched condition. The rip rap shall be placed so that the geotextile is not punctured. The rip rap shall completely cover the fabric.

The fabric shall be placed on the slopes so as to provide a minimum overlap of 18 inches. The geotextile shall be placed either parallel or vertical to the direction of the flow. If placed parallel, the upstream or higher panel shall overlap the downstream or lower panel. At the top of the embankment the fabric shall be keyed into the ground a minimum of 18 inches. If a cushion layer is placed, the bottom toe shall be finished by lapping the fabric back onto the cushion layer and securing with rip rap. The cost of furnishing and installing the geotextile fabric in accordance with the Plans and Specifications shall be included with the rip rap.

7.0 EXCAVATION - GENERAL

Excavated materials which are suitable for incorporation in the embankment and berms or other fills or ditches shall be placed directly therein, or stockpiled and subsequently used in the embankment, or other fills. The Contractor shall conduct grading operations in such a manner as to allow ample quantities of "Selected Soils" to be held in reserve or stockpiled, as necessary, to provide the required materials for backfilling or filling where allowed. No direct payment will be made for such necessary manipulation as doubled handling or hauling. Excess or unsuitable material which is not needed or inadequate for construction shall be disposed of as approved by the Engineer. All costs associated with the removal and disposal of materials and all costs associated with the restoration of surfaces of disposal areas shall be included in the unit prices and/or lump sum prices bid for the work under the Contract. There shall be no extra cost to the Owner for such removal, disposal and surface restoration work. There is no pay item for backfill and the Contractor shall include the cost of backfill in the cost of the structure.

All excavated materials shall be stored in a manner that will not cause damage to adjacent properties or environment nor obstruct access to any new or existing facilities. Drainage lines shall not be obstructed nor shall natural drainage of the surrounding ground be altered or obstructed.

8.0 EARTH EXCAVATION - DEFINITION AND GENERAL REQUIREMENTS

"Earth Excavation" shall include the removal, reuse and/or disposal of all materials, excluding those specified under "Clearing and Grubbing" and "Rock Excavation - Definition and General Requirements." Rocks and boulders one cubic yard or less in volume shall be classified as earth. Excavated materials which are suitable for incorporation in fills,

embankments, backfills, berms, etc., shall be placed directly therein, or stockpiled and subsequently used. Excess or unsuitable materials shall be disposed of by the Contractor.

Earth excavation for structures shall be completed such that all footings, foundations, floor slabs, etc., bear on firm undisturbed soil, rock, or engineered/compacted fill. If, at the elevations shown on the Drawings, soil over the area to be occupied by a structure is found to be unsuitable for supporting the design load, the Contractor shall remove such soil and replace it with material placed and compacted in accordance with the Plans and these Specifications.

Earth excavation in trenches for pipe shall be open cut, unless otherwise shown in the Plans. Trenches shall be excavated to the depths shown in the Plans or as required to secure the specified minimum cover over the pipe. Boulders, large stones, rock or shale meeting the definition of "Earth," shall be removed from around all pipe to provide bedding, backfill, and compaction clearances indicated in the Plans and these Specifications.

9.0 ROCK EXCAVATION - DEFINITION AND GENERAL REQUIREMENTS

Rock excavation shall consist of the loosening, removing, and disposing of all rock, solid limestone or sandstone in original bed, in well-defined ledges, or in boulder form. It shall include all solid rock which cannot be removed until loosened by blasting or use of a track excavator mounted ram hoe. Boulders having a volume of more than one cubic yard shall 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. Unless identified in the Plans for use in the work or disposal on the site, all excavated rock shall be disposed of by the Contractor.

Where rock is the supporting material for structures, the Contractor shall expose and clean all foundation areas as required for inspection and evaluation of bearing conditions. All rock seams, voids, or fissures in the exposed areas shall be filled with crushed stone of suitable gradation.

Rock excavations in trenches for pipe shall be open cut unless otherwise shown in the Plans. Trenches shall be excavated to the depths shown in the Plans or as required to secure the specified minimum cover over the pipe. Rock shall be removed from around all pipe to provide bedding and compaction clearances indicated in the Plans and these Specifications.

10.0 BACKFILL FOR STRUCTURES

Lumber, rubbish, debris, braces, etc., shall be removed from all excavations prior to backfilling. Suitable backfill shall be free of topsoil and organics, reasonably dry (within limits necessary for compaction), and free of large stones or rocks. Backfilling shall not begin without prior approval of the Engineer. Backfill containing rock larger than three inches in any dimension shall not be used within three feet of structures. Backfill containing rock too large to be placed in eight inch lifts, shall not be used for backfill or embankments except upon approval of the Engineer. If materials excavated onsite are unsuitable at the time

they are required for backfilling, or the quantity of material is insufficient, the Contractor shall provide suitable backfill materials.

Contractor shall, when necessary, provide adjustments to the natural moisture of soils before compacting. In general, backfill soils should be aerated or moisture conditioned to maintain the moisture content within two percent of the optimum moisture content. Backfill shall be placed in thin loose lifts and mechanically compacted to prevent settlement to a minimum of 95% standard proctor (ASTM D-698, latest revision) 100% compaction shall be required under structures or when shown on Drawings. For compacted material that does not pass required testing, the Contractor shall remove the fill or backfill to the last layer which passed compaction test.

The need for aeration and drying of some of the soils may be required before they can be placed and satisfactorily compacted. The Contractor will be required to have adequate equipment to manipulate and aerate soils with excessive moisture so that placement and compaction can be expedited. No direct or separate payment will be allowed for special handling of these soils.

The Contractor shall be responsible for maintenance of backfill. The Contractor shall promptly refill areas where settlement of backfill has occurred. Backfill shall be placed with the approval of the Engineer and only after all adjacent structures have gained sufficient strength to support the backfill loads.

11.0 BACKFILL FOR TRENCHES

Backfill for pipe trenches shall be as described in the Gravity Sewer Installation specification, Installation of Pressure Pipe specification, details in the Plans and as generally specified herein. Backfilling shall not begin without prior approval of the Engineer. Lumber, rubbish, debris, braces, etc. shall be removed from all trenches prior to backfilling. Suitable backfill shall be free of topsoil and organics, reasonably dry (within limits necessary for compaction), and free of large stones or rock. Backfill containing rock larger than one cubic foot shall not be used for backfill except upon approval of the Engineer. If materials excavated onsite are unsuitable at the time they are required for backfilling, or the quantity of suitable materials is insufficient, the Contractor shall provide backfill materials. Backfill shall be placed in thin loose lifts and mechanically compacted to prevent settlement to a minimum of 95 percent standard proctor (ASTM D-698, latest revision). Provide greater compaction where required elsewhere or called for by the Drawings.

The Contractor shall be responsible for maintenance of backfill. The Contractor shall promptly refill and restore areas where settlement of backfill has occurred. Backfill shall be placed with the approval of the Engineer and only after all adjacent structures have gained sufficient strength to support the backfill loads.

12.0 EMBANKMENT AND FILL WORK

Embankments and fills shall not be started without the concurrence of the Engineer. The material used in embankments and fills shall be free from frost, stumps, trees, roots, sod, muck, or debris of any kind. Only materials as specified herein shall be used. Fill

and embankment material shall not be placed on frozen ground. Wet ground to be covered by fill shall be drained. 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 bond with the new material.

Compacted fills shall be constructed by depositing fill materials in successive, uniform layers of not more than eight inches in depth, loose measurement. Lifts shall be placed over the entire fill area keeping the surface of each layer parallel to the elevation of finished grade by use of blade graders. In close proximity to existing structures, leveling shall be accomplished by use of small spreaders, bulldozers, or hand methods. Each layer shall be rolled and compacted by tamping, rolling, or other suitable equipment depending upon character of material to the specified density before the succeeding layer is placed. The final layer shall be brought to elevation of finished compacted fill before topsoil is placed to conform to finished contours, cross sections or details shown on the Drawings.

Contractor shall, when necessary, provide adjustments to the natural moisture of soils before compacting. In general, backfill soils should be aerated or moisture conditioned to maintain the moisture content within two percent of the optimum moisture content. Backfill shall be placed in thin loose lifts and mechanically compacted to prevent settlement as follows:

(1) areas beneath future slabs, sidewalks, structures, roads, pipelines, embankments etc. - minimum of 98% standard proctor (ASTM D-698, latest revision) (2) all areas denoted as "Spoil Areas" shall be compacted to 85% Standard Proctor Density minimum unless called to be higher elsewhere. Compacted material that does not pass required testing, the Contractor shall remove the fill or backfill to the last layer which passed compaction tests.

The need for aeration and drying of some of the soils may be required before they can be placed and satisfactorily compacted. The Contractor will be required to have adequate equipment to manipulate and aerate soils with excessive moisture so that placement and compaction can be expedited. No direct or separate payment will be allowed for special handling of these soils.

Rock large enough to prevent fill work from proceeding in eight inch lifts shall not be placed in compacted fills in areas to be occupied by structures, bearing slabs, footings, roadways, walks, etc. Rock of permissible size deposited in such fills shall be dispersed and well separated in all directions by acceptable fill material.

All sampling and testing work shall be performed by an independent testing laboratory selected by the Owner. The cost of initial sampling and testing shall be borne by the Owner. Subsequent re-testing of any samples or locations failing the initial test shall be performed at the expense of the Contractor.

13.0 UNAUTHORIZED EXCAVATION AND BACKFILLING

Whenever unauthorized excavation is beyond the lines and grades established, the Contractor shall, at his own expense, refill with suitable material, tamped and settled, to ensure the stability of the structure. The area of over excavation shall be replaced at the Contractor's expense with select material as described in the Undercut and Foundation Construction subsection. Unauthorized excavation beneath structures shall be refilled with concrete at the Contractor's expense, if this is necessary in the opinion of the Engineer to protect the structure.

14.0 SHORING

The Contractor shall provide all necessary sheeting, shoring and bracing when soil conditions, rock conditions, or the Plans require them. Damage to existing and/or proposed structures, pipelines, utilities, etc., due to water, earth pressures, or other causes shall be repaired or replaced promptly by the Contractor at his own expense.

The Contractor is reminded that all excavation for structures, trench excavation, rock excavation and sheeting, and shoring shall be prosecuted in accordance with the protective guidelines and requirements of OSHA "Safety and Health Regulations for Construction," as set forth in the Federal Register, latest revision, and that the employment of all protective measures is at the Contractor's expense. Sheeting, shoring, bracing and sloping are methods of accomplishing the work, and such methods may vary according to the Contractor's methods of dewatering, excavating, and installing the work. All such methods of accomplishing the work are the sole responsibility of the Contractor, in accordance with the OSHA guidelines.

Should the plans or specifications require the Contractor to submit a shoring plan or equivalent, it will not be reviewed by the Engineer. Submittal of such documents is solely for record purposes that the plan was prepared by others. The Contractor is solely responsible for the safety of all shoring and excavation.

15.0 UNDERCUT AND FOUNDATION CONSTRUCTION (SELECT MATERIAL)

Where the Engineer required the earth to be undercut to a depth below the bottom of the crushed stone cushion immediately beneath structures, the undercut material shall be replaced by a foundation constructed from select material. This material will consist of (1) previously excavated earth that was selected by the Engineer and stored separately by the Contractor until used for foundation construction, and/or (2) select materials imported from off site. The Engineer shall select which of these materials will be utilized. The select material shall be adjusted, if necessary, by the Contractor to achieve a moisture content within -2 to -3 percentage points of the optimum moisture content determined from compaction tests. The foundation material shall be placed in six inch or less lifts which each lift compacted to a minimum of 100 percent or as shown on Drawings of its maximum dry density as determined by ASTM D698 (Standard Proctor). The foundation will be constructed up to the elevation of the crushed stone cushion beneath the structure.

16.0 REMOVAL OF WATER

The Contractor shall, at all times during construction, provide and maintain ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work. The Contractor shall keep excavations and work dry until the structures or facilities to be constructed are completed and the Engineers are in agreement with the Contractor to discontinue dewatering operations. No claims for an amount of money in excess of the bid prices for the work will be entertained or allowed on

account of the character of the ground in which the trench or other excavations are made, dewatering requirements or water management.

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.

17.0 DISPOSAL OF EXCESS MATERIALS

The Contractor shall, unless required otherwise by the Plans, Specifications, and/or the Engineer, remove from the construction site all materials and debris resulting from the construction operations, and all material unsuitable for use as backfill or for use in restoration of the surface of the construction.

The Contractor shall make all necessary arrangements for disposal of the materials and debris described hereinabove. It shall be the Contractor's responsibility to fully satisfy the requirements of the landowners whose property he has used as disposal sites for materials and debris removed from the project site. Should such properties or disposal locations be adjacent to the project site and not of remote location, the surfaces of such adjacent lands shall be restored in accordance with the provisions of these Specifications as well as in accordance with requirements of the owner of such adjacent lands.

The provisions of these Specifications may be waived in the event that the Contractor should elect to dispose of materials and debris removed from the project site at a landfill meeting the requirements of the Alabama Department of Environmental Management and/or the local Authority having jurisdiction. In such case, it shall be the responsibility of the Contractor to dispose of the materials at the landfill in accordance with the Rules and Regulations established by the Authorities and/or Agencies mentioned hereinabove for operation of the landfill.

18.0 EXPLOSIVES

It shall be the sole responsibility of the Contractor to observe all laws, regulations, ordinances, etc., relating to explosives, including but not limited to all Federal, OSHA, State, and Local. The Contractor's attention is further directed to the General Specifications sections relating to safety, explosives, and the Contractor's responsibilities. Heavy blasting in rock which is to form a foundation shall not be permitted.

The Contractor shall ensure all persons supervising, participating, observing, or near the area of blasting operations are informed of proper procedures and properly trained. Contractor's responsible personnel shall be present and supervise all blast design, loading, and shot firing. The Contractor shall be solely responsible for following all laws, regulations, local ordinances, etc., pertaining to blasting. If more stringent than specified, these requirements shall become the minimum standards. The Contractor shall be solely responsible for all damages to properties or persons resulting from his blasting operations.

The Contractor shall be solely responsible for all safety associated with blasting. This responsibility of the Contractor shall also include but not be limited to, all work by subcontractors, suppliers, agents, and employees, etc.

19.0 PAYMENT

The costs of all necessary, Sitework, Excavation, and Earthwork shall be included in the appropriate lump sum and/or unit prices set forth in the Items of Work - Bid Schedule.

When any individual tasks of Sitework, Earth Excavation, and/or Earthwork are listed separately in the Items of Work - Bid Schedule, they shall be bid, defined and paid as outlined below and/or described in the Basis of Payment. The Basis of Payment and plans will prevail over any discrepancies herein. All other required Sitework, Excavation, and Earthwork not listed as separate bid items shall be included in the remaining lump sum and/or unit prices set forth in the Items of Work - Bid Schedule. No payments for double hauling or handling will be made.

Unless rock excavation is clearly and specifically listed as a separate pay item in the Items of Work – Bid Schedule, it shall be considered as unclassified excavation and included in the cost of other work items. No additional payment shall be made.

Earth Excavation

When earth excavation is to be paid for on the basis of unit price bid, the limits of pay excavation shall be as follows:

Structures - Established by unit price (per cubic yard) measured having vertical sides extending one foot beyond the outside of the structure's footings with depths measured from the surface of natural grade following clearing and grubbing to the grade lines as established by elevations shown on the Drawings for underside of structures, stone cushions, foundations, footings, bearing slabs, etc. No payments will be made for earth excavations beyond these limits unless authorized by the Engineer.

Trenches - Earth excavation in trenches shall be included in the price bid on pipe, manholes, inlets or headwalls, etc. or included in other prices if the "Bid Schedule - Items of Work" form does not contain specific unit prices for the same.

Others - Established by unit price (per cubic yard) measured by survey cross-section methods (following clearing and grubbing if necessary). All measurements for payment of excavation will be based on the said cross-sections or original grades regardless of any subsequent changes occurring during the work.

These same limits shall apply for estimating all earth excavation quantities whether included in the original Contract Documents or negotiated as additional work. They shall also apply for estimating quantities for Undercut and Foundation Construction when it appears as a separate bid item(s) in the Items of Work - Bid Schedule.

Rock Excavation

When rock excavations are to be paid for on the basis of unit price bid, actual rock measurements shall be made and the limits of pay excavation shall be as follows:

- Structures - Established by unit price (per cubic yard) measured having vertical sides extending one foot beyond the outside of the structure's footings with depths measured from the top surfaces of the uncovered rock to the bottom of the rock or grade lines as established by elevations shown on the Drawings for underside of structures, stone cushions, foundations, footings, bearing slabs, etc., as applicable. No payments will be made for rock excavations beyond these limits.
- Trenches - Established by unit price (per cubic yard) calculated as follows; per linear foot of pipe installed, measured with a width of the pipe outside diameter plus 12 inches each side of pipe (i.e. pipe outside diameter plus 24 inches), and depths measured from the top of the uncovered rock to the bottom of the rock if above pipe or minimum required bedding depth of 6 inches or as required by the engineer or drawings as applicable. No payments will be made for rock excavations beyond these limits. Trench section not less than 50 feet shall be stripped for measurement.
- Others - Established by unit price (per cubic yard) measured by survey cross-section methods. Contractor shall be responsible for uncovering areas of rock for survey. All measurements for payment of excavation will be based on the said cross-sections regardless of any subsequent changes occurring during the work.

Unit prices bid shall include, but not limited to, drilling, blasting, removal and disposal. There shall be no extra payments for removal of rock with no overburden or "high rock". These same limits shall apply for estimating all rock excavation quantities whether included in the original Contract Documents or negotiated as additional work. When unusual conditions are discovered during excavation, typically indicated by the presence of seams, fissures or voids, additional excavations will be required in order that proper inspection of the foundation conditions may be made.

Undercut and Foundation Construction

Foundation Construction will be measured from the final surface required by the Engineer up to the crushed stone cushion below the footing of the structure. The measurement will extend to 1.0 foot outside the footing. Where a "Foundation Construction from Select Material" bid item is included in the Bid Schedule - Items of Work, the Contractor shall include all cost of the work described in this section in that item. Where no separate bid item is included, the cost of this work shall be included elsewhere in this bid.

20.0 GENERAL

The Contractor shall be solely and fully responsible for safety associated with

blasting, excavation, and all other aspects of the construction. This responsibility of the Contractor shall also include but not be limited to, all work by Contractor, subcontractors, suppliers, agents, and employees, etc.

**STANDARD SPECIFICATION
FOR
CONCRETE
(For Concrete Not Covered/Shown in the Structural Drawings)**

SECTION 1-2

1.0 DESCRIPTION

Concrete shall be comprised of cement, fine aggregates, coarse aggregate, and water, and shall be so proportioned and mixed as to produce a plastic, workable mixture. The relative stiffness of the mix may be varied within the limits hereinafter specified so as to secure the mix most suitable for the particular location and/or condition of placement. Concrete shall be Class "A" or Class "B" as defined below and required under Composition:

(a) Class "A". All reinforced concrete shall be Class "A". If the structure is to contain liquid, the concrete shall be watertight.

(b) Class "B". Concrete not requiring reinforcing. In general, the use of Class "B" concrete shall be limited to plain underground, unreinforced concrete for pipe bracing, skin coats, and concrete fill.

2.0 COMPOSITION

Concrete shall be "ready mixed" apportioned by the approved design mix. Concrete shall contain not less than 6-1/2 bags of approved cement per cubic yard. The slump shall indicate "the mix" is workable and not be less than 3-1/2 inches nor greater than 5. The Engineer may require additives to provide a workable mix. Concrete shall be inspected by a laboratory designated by the Engineer who will test the mix and make test cylinders. Method of measuring the materials shall be approved by the Engineer.

3.0 MATERIALS

(a) Cement. Cement used shall be Portland Cement of an approved brand. The cement shall meet Type II requirements. The Engineer shall designate a retarder, if required. Certificate of test showing the cement meets the Standard Specification of A.S.T.M. Designation C-150 with latest revisions will be required. In order to ensure uniformity of color and appearance, the same brand of cement shall be used in the mixes for all concrete on the project. Portland Cement shall be of color acceptable to the Engineer.

(b) Fine Aggregates. Fine aggregates used shall be clean, sharp and conform to the Standard Specification of A.S.T.M. Designation C-33. No screening or crushed slag will

be permitted as substitute for sand in concrete or mortar work. Fine aggregate shall be graded to the following limits:

Passing 3/8" Sieve	100%
Passing #4	95 to 100%
Passing #6	45 to 80%
Passing #50	10 to 30%
Passing #100	2 to 10%

(c) Coarse Aggregates. Coarse aggregate shall consist of either crushed stone, or gravel, and the aggregate shall be clean, hard, durable, and free from foreign matter. The aggregate shall conform to the Standard Specification A.S.T.M. Designation C-33. Coarse aggregate shall be graded as indicated below. The design mix shall set the gradations of the coarse aggregate for the particular project. Unless stated differently, the gradation shall be 1- inch maximum except where smaller gradation may be needed, such as in beams with congested steel.

Percentages Passing Square Openings

Designated Size	2-1/2 Inch	2 Inch	1-1/2 Inch	1 Inch
2" to #4	100	95 to 100	---	35 to 70
1-1/2" to #4	---	100	95 to 100	---
1" to #4	---	---	100	90 to 100
3/4" to #4	---	---	---	100
1/2" to #4	---	---	---	---

Designated Size	3/4 Inch	1/2 Inch	3/8 Inch	#4
2" to #4	---	10 to 30	---	0 to 5
1-1/2" to #3	35 to 70	---	10 to 30	0 to 5
1" to #4	---	25 to 60	---	0 to 10
3/4" to #4	90 to 100	---	20 to 25	0 to 10
1/2" to #4	100	90 to 100	---	0 to 15

(d) Water. Water used shall be clean, potable and free from harmful amounts of acids, alkalies or organic materials. No water shall be added at the job site unless approved by the Engineer.

4.0 AIR ENTRAINED CONCRETE

Concrete used shall be air entrained. When required or directed by the Engineer, concrete shall contain an admixture for controlling the setting rate. The addition of air will be

by approved admixtures or by approved Portland Cement containing admixture, conforming to A.S.T.M. C-260 or latest revision. Testing shall be in accordance with A.S.T.M. Standards.

In general, the air content shall conform to the following except when changed by the Engineer or the Testing Laboratory responsible for the design mix and plant inspection.

<u>Coarse Aggregate in Inches</u>	<u>Air Content Percent by Volume</u>
1-1/2, 2 or 2-1/2	5% +/- 1%
3/4 or 1	6% +/- 1%
3/8 or 1/2	7-1/2% +/- 1%

If the air content is not satisfactory, the Contractor may be required to remove and replace the concrete without extra compensation or the concrete may be refused to be poured. Concrete refused at the site cannot be used and must be permanently removed from the job site.

5.0 MIXING AND PLACING

Ready mixed concrete shall be in accordance with ASTM Specification C-94. Concrete will be conveyed to the place of deposit by methods which prevent the separation of materials. Concreting shall be carried on as a continuous operation until a section is completed. No dry to set joints will be allowed.

Concrete will be compacted during placing and shall be thoroughly worked around reinforcement, embedded fixtures, and into the corners of the forms. The number and types of the tools or equipment utilized in the compaction process shall be such that compaction can keep pace with the pouring and that compaction can be completed while the concrete is still fresh and plastic. Before beginning any pour, the Contractor shall have on hand and readily available at the location of the pour, spare tools and equipment, in good working condition that can be immediately utilized in case of the malfunction of any tools or equipment being used. Mechanical vibrators will be required with backup vibrators onsite.

Before placing concrete, debris, ice, frost, and water shall be removed from the reinforcement and forms. Forms shall be thoroughly wetted immediately prior to placing concrete, except when freezing. Concrete shall not be poured when the temperature is below 40°F or 45°F and falling unless measures and facilities for protection of the concrete have been provided. Such measures and facilities shall be subject to concurrence of the Engineer and may include insulation of the poured structure, protective covers, and heat source capable of maintaining temperature of the poured structure (forms and rebar) at 50°F or above. Concrete, at the time when deposited in forms or slabs when protection is required, shall not have a temperature lower than 65°F. At no time shall concrete reach a temperature lower than 50°F. The maximum temperature of concrete, at any time during its production, transportation, and placement, shall not exceed 90°F. During cold weather the finished concrete shall be protected for an adequate length of time following the pouring by maintaining the temperature at a level not lower than 50°F.

After concrete has been placed, it shall be protected against loss of moisture and against damage from succeeding construction operations. Water curing methods shall be

employed for all concrete unless other methods are specified herein, shown on the drawings, or concurred with in writing by the Engineer. Water used for curing shall be potable water meeting the requirement of ASTM C 94 with no properties that would stain concrete. Concrete curing methods shall be in accordance with ACI 308. Curing shall be achieved through immersion, ponding, or continuous sprinkling through soaker hoses or lawn sprinklers as required by the type of structure. Concrete surfaces shall be kept continuously wet throughout the curing period. Alternate wetting and drying of concrete surfaces shall not be allowed. Curing shall be continuous for a minimum of 7 days.

Concrete poured in beams, columns, and walls shall be kept wet by continuously sprinkling concrete with water until forms have been removed. After forms have been removed, concrete shall be wetted continuously by one of the above methods for a minimum of 7 additional days. Additional water curing time may be required by the Engineer when environmental conditions are adverse or when daytime temperatures exceed 95°. Concrete for slabs and footings shall be kept continuously wet through sprinkling, ponding, or immersion for a minimum of 7 days. Additional water curing time may be required by the Engineer when environmental conditions are adverse or when daytime temperatures exceed 95°.

In locations where concrete surfaces are specified to be rubbed, concrete shall be kept wet by continuous sprinkling until rubbing has been completed and then shall be covered after rubbing has been completed. Covering shall be by the application of polyethylene sheeting. In addition to walls and other surfaces to be rubbed, the above shall also apply to exposed beams and columns.

Liquid membrane-forming curing compounds may be used in some cases after completion of the above-stated periods of wet curing, if concurred with in writing by the Engineer. Curing compounds are not permitted on surfaces receiving surface treatments or coatings or on any surface in contact with potable water treatment structures. Curing compounds shall conform to the requirements of ASTM C309, Type 2. The compound should be applied at a uniform rate as specifically recommended by the manufacturer. The method of application shall be as recommended by the manufacturer. Application of the curing compound shall follow the recommendations of the manufacturer and ACI 308. The use of curing compounds, if allowed, shall not be a substitute for the wet curing described above.

Liquid "Cure and Seal" compounds shall be used on all floor slabs in operations buildings, pump rooms, chemical rooms, maintenance buildings, filter galleries (both upstairs and downstairs), electrical buildings or rooms, valve rooms, control rooms, laboratories, offices, and other buildings, except such compounds shall not be used on slabs or portions of slabs that will receive carpet, tile, or other type of surface treatment. All slabs, whether receiving the "Cure and Seal" or not, shall be water cured. Apply compounds in accordance with manufactures recommendations and ACI 308. "Cure and Seal" compounds shall be Diamond Clear VOX by Euclid Chemical Company, or equal.

When placing concrete in walls, the concrete shall be deposited in tremies or by other approved methods to prevent segregation and the accumulation of hardened concrete on the reinforcement above the level of the concrete. The lower end of the tremie or spout shall be not more than six feet above the surface of the concrete.

All concrete shall be placed in continuous horizontal layers of such depth that no dry to set (cold) joints are formed, however not more than 30 minutes shall elapse between

placing of successive layers. The depth of any layer shall not exceed two feet.

The concrete mix shall be so placed (without segregation) and compacted (without excessive vibration) that there will be no water on the surface of the finished layer or on the surface of the finished pour. Should water appear on the surface of any layer the pour shall be stopped, the water shall be removed, and the pour shall not be continued until corrective measures satisfactory to the Engineer are employed.

5.1 MIXING AND PLACING – SIDEWALKS, DRIVEWAYS AND PATHWAYS

For sidewalks, driveways and other miscellaneous pathways, concrete mix design and placement will conform to ALDOT Standard Specifications 501 and 618. Drawings may contain special requirements, for reinforcements, finishes, etc.

6.0 TEST

Certification of mill test from the manufacturer of cement and steel will be required. The Contractor shall submit a representative sample of aggregate to a laboratory approved by the Engineer for a design mix as follows:

100 Pounds Fine Aggregate
150 Pounds Course Aggregate
50 Pounds of Cement
3 Ounces of Additive

All concrete shall be designed to test a minimum of 4000 psi in 28 days, and shall break at or above 4000 psi in 28 days, but in no case will a mix of less than 6½ bags of cement be acceptable regardless of test break results. Cylinder testing as required by A.S.T.M. C-39 will be used for testing and be at the expense of the Owner. All concrete placed on the project, unless specifically otherwise noted, shall have all the cylinders represented by the pour break at a 28-day minimum strength of 4,000 psi in order for the pours to be considered acceptable. Provide higher strength concrete or grout where required by specifications or plans or by equipment manufacturers.

The specimens (cylinders) shall be carefully prepared, stored, and protected at the project site in a manner satisfactory to the Engineer until they are ready for transportation to the Testing Laboratory. The cylinders shall be stored on a level bed in a moist environment, and shall be protected against movement, surface water, ground water, rainfall, and cold weather. The furnishing of slump cones, screeds (knife edges), and containers for the specimens shall be the responsibility of the Contractor.

7.0 WATERTIGHT CONCRETE AND TESTING

Basins, tanks, or any structure built to contain liquid shall be watertight. As soon as possible, the Contractor shall fill structure with water and if leakage should develop, the

contractor shall correct leakage in a manner acceptable to the Engineer. Duration of leakage test shall be not less than 72 hours with no leakage allowed for this period for approval. The tests shall be repeated until leakage has been stopped with the work not being accepted by the Engineer until it is watertight. Before testing watertight structures, the structure roof or other bracing shall first be poured and cured and all concrete must achieve its full strength. No backfill shall be added until structure has been accepted as watertight.

Minor concrete repairs for leaking walls shall be fixed by means to stop all leakage. Major concrete cracks in walls shall be repaired by flexible pressure injected sealant or material by a specialty contractor such as Barton Southern Company who has experience in such repairs. All exposed concrete shall be re-rubbed and finished such that the entire wall has a uniform pleasing appearance.

8.0 REINFORCING STEEL

Reinforcing steel used shall be Billet Steel, Grade 60. Steel shall comply with the latest revisions for the following:

<u>Type</u>	<u>ASTM Designation</u>
Billet Steel Bars	A-615, Grade 60
Welded Steel Wire Fabric	A-185, Grade 65
Dowels Across Expansion Joints	A-675, Grade 80

Reinforcing shall be properly bent and free from rust, mill scale, and other foreign substance. Reinforcing bars should not be bent or straightened in a manner that will injure the materials. Bars with kinks or improper bends should not be used. Bars shall not be bent in the field except for realignment of #7 through #18 rebar up to about a 30° bend and #3 through #6 rebar up to about a 45° bend. No bars partially embedded in concrete shall be field bent. Exposed reinforcement bars for future extensions shall be protected from corrosion and concrete splatter.

Reinforcing shall be in accordance with the Plans and approved Shop Drawings. The Contractor shall furnish reinforcing bar details and marking or erection diagrams to the Engineer for review. These shall be on the same size drawings as the Engineers' Plans, and shall be clear and legible. Any splicing, other than that shown in the Plans or Shop Drawings, shall be approved by the Engineer.

When it is necessary to splice reinforcement at points other than shown on the Drawings, the character and location of the splices shall be detailed through the submittal process for review by the Engineer. In such places the bars shall be placed in contact and securely wired. Wherever possible splices in adjacent bars shall be staggered. Lengths of splices or laps shall be a minimum 30 bar diameters unless indicated otherwise in the Drawings. In no case shall length of lap be less than that required by ACI 318 or the *CRSI Manual of Standard Practice*, latest edition.

Mechanical connections should be installed in accordance with the manufacturers' recommendations. A full mechanical connection is one in which the bars are connected to develop in tension or compression at least 125 percent of the specified yield strength of the bar.

For welded splice, when required, the bars shall be butted and welded to develop in tension at least 125 percent of the specified yield strength of the bar. Welding shall conform to the current edition of "Structural Welding Code - Reinforcing Steel" (ANSI/AWS D1.4).

The clear distance between parallel reinforcing bars in a layer should not be less than the nominal diameter of the bars, 1 inch or 1-1/3 times the nominal maximum size of the coarse aggregate, whichever is greatest. Where parallel reinforcement is placed in two or more layers, the bars in the upper layers should be placed directly above those in the bottom layer with the clear distance between layers not less than one inch. All reinforcements shall be protected by a thickness of concrete as follows:

- A. For concrete deposited against the ground without the use of forms, the steel shall have 3 inches cover, except a 4 inch slab shall have 2 inches of cover.
- B. For concrete exposed to the weather or to the ground or to water or to the inside of wet wells, clearwells, etc., with the use of forms, the concrete cover over the steel shall be 2 inches.
- C. For slabs and walls not exposed to the ground or to the weather or to the ground or to water or to the inside of wet wells, clearwells, etc., the steel concrete cover shall not be less than 3/4 inch for #11 bars and smaller or 1-1/2 inch for #14 and #18 bars. Underside of slabs exposed to sewer and other harsh affects shall have 1 inch of cover for 6 inch slabs and 1-1/2 inches for 8 inch and greater slabs.
- D. For beams, girders, and columns not exposed to the ground or to the weather, the steel concrete cover shall not be less than 1-1/2 inches.

The steel supplier shall provide bent spacers of #3 bars. Provide larger bars where needed for proper support. The Contractor shall coordinate the dimension and details, etc., with the method in which the rebars will be arranged and supported to insure proper clearance. These spacers shall be used in walls and slabs to ensure that the steel from the concrete surfaces has proper clearance as outlined above. Reinforcing shall be maintained at the required clearance from the forms during the pouring and hardening of the concrete. Chairs shall be used to maintain clearance on slabs. Concrete supports poured on jobsite may be acceptable for slabs poured against ground if the proposed method of producing and utilizing the supports is acceptable to the Owner. The use of stakes, stones, or brick to support reinforcing shall not be acceptable. Except as modified herein, or in the Plans, bar supports and spacing of same shall be per recommendations set forth in the *CRSI Manual of Standard Practice*, latest edition. Steel wire bar supports in concrete areas where soffits, slabs, or ceilings are exposed to view or are painted shall be Class 1 or Class 2, Types A or B; Class 3 shall be acceptable in other areas.

Pre-tying of steel mats shall generally not be allowed. Where allowed, it shall be the responsibility solely of the contractor to coordinate all openings through the steel and all other details. Vertical and horizontal bars of pre-tied mats shall align exactly with adjoining steel and dowels, etc. If extra bars must be cut for openings through mats due to the pre-tie

operation, the Contractor shall field install full length bars to replace those extra bars cut. This shall be in addition to all other bars required by other details.

9.0 FORM WORK

The Contractor shall furnish, maintain, erect, and remove all forms, molds, centers, and bulkheads, templates or profiles, and shall furnish and maintain all screeds and bonding grooves, keyway materials or other forms necessary for construction of the concrete included in this Contract. Except as hereinafter specified otherwise, forms shall be of wood or metal, and of type and condition as approved by the Engineer. Only joints indicated in the Plans or approved in the Submittals will be permitted.

The Contractor shall be responsible for the design, erection, bracing, sealing, and finishing of the form work in such a manner as to contain and support the concrete during placement. All form work is to be well built, substantially unyielding, tight, properly spaced, set true to line and elevation, properly braced, and anchored. Forms shall be held by means of wall clamp ties. Wire ties will not be permitted. No tie shall be used which are removable and leaves a hole through the concrete section, or which leaves metal within one inch of the surface of the concrete. Form ties shall be equipped with integral waterstops.

Bevel strips shall be placed at all corners of walls, at all points where angles occur in walls and at all tops (both edges) of exposed walls. All such corners, angles, or intersections exposed to view shall be chamfered.

The inside contact surfaces of forms shall be coated with non-staining mineral oil before being set in place. For potable water structures, oils shall be approved for use in potable water applications. Oil shall not be allowed to contact reinforcing steel or surfaces to which the concrete is to be bonded. Contact surfaces of forms shall have tight, flush, watertight joints, packed and taped where required so as to prevent loss of water or paste. Bottom edges of forms shall be set true and tight against footings or other receiving concrete surfaces, and shall be sealed to prevent loss of water or paste. Forms shall be wet before pouring concrete.

Temporary openings shall be provided at the base of wall forms, beam forms, and column forms to facilitate cleaning. All forms shall be thoroughly cleaned and washed immediately before beginning a pour, and all temporary openings shall be closed. In case of wall pours starting at the base slab or other levels below ground affected by the water tables, the Contractor shall provide pump sumps and pumps to completely remove all wash down water and any water containing silt or debris.

When forms have been erected for some time prior to a pour or have been exposed to changes in weather, the Contractor shall recheck all forms immediately before the pour, and shall make any adjustments necessary to bring the contact surfaces to true horizontal, vertical, or circular lines.

The Contractor shall provide special forms where required for openings in walls and floors for the installation of pipes, gates, flanges, and similar items. Where pipes are already in place, all pipe openings shall be securely blocked or bulkheaded to prevent entrance of concrete, paste, or laitance into the pipes. Where gates, such as flat frame sluice gates or other flat frame gates are to be installed, the wall plate in the area to be occupied by the gate shall be

true and even, both horizontally and vertically in order that the gate may be installed watertight and not be warped by uneven drawdown on the gate anchor bolts.

10.0 REMOVAL OF FORMS

The removal of forms shall not be started until the concrete has attained sufficient strength to withstand any live loads that may be imposed by succeeding steps in the construction process. The length of time required between placement of concrete and removal of forms may vary with weather conditions, loading conditions, and particular construction activity in the vicinity of the recently poured concrete elements. In no case, however, shall forms be removed earlier than the following unless the concurrence of the Engineer is first secured.

Beams and Elevated Slabs	14 - 21 Days
Footings and Slabs	1 - 7 Days
Columns and Walls	3 - 7 Days

11.0 FINISHING

All concrete surfaces shall be finished to the elevation shown on the Drawings. Where surfaces of concrete pours are specified and/or indicated to have final finish other than the monolithic concrete, the monolithic pour shall be terminated at such level below the final finish elevation as is correct or suitable for the particular final finish. Those surfaces over which grout is to be placed for setting or grouting-in of machinery, equipment, bed plate, foot plates, bearing plates, etc., shall be "green-cut" and cleaned prior to the placement of grout. Surfaces specified to receive special finishes shall be prepared as hereinafter specified, or required by the Plans.

Where surfaces to be finished are covered by forms, the forms shall be removed as soon as possible (following specified minimums) to permit finishing work. Immediately following removal of forms all imperfections in the surfaces of the concrete (such as form marks, projections, fins, rough areas, honeycombed areas, pits, mismatched joint marks, tie holes, etc.) shall be corrected by use of cutting tools, grinding tools, patching, plugging, and rubbing. Plastering shall not be permitted. Form tie holes and form bolt holes shall be immediately plugged. Where form ties or form bolts are left in the concrete, such accessories shall be equipped with integral waterstops, and the ends of such accessories shall not be closer than one inch to the surface of the concrete. The holes left in each face shall then be primed with a tack coat of grout mixed with an approved accelerator, a stiff mix of mortar with an approved accelerator tamped in the holes, and the surfaces finished flush with the concrete surfaces.

All interior and exterior concrete surfaces of walls, columns, beams, ceilings, etc., permanently exposed to view above ground, in galleries, rooms, tanks, basins, etc. (from 1'-0" below grade or the low water line upward), structures covered with grating shall have the walls rubbed to 1' below the minimum water level, and the ceiling of structures where the walls require rubbing, shall be rubbed while "green" with a carborundum stone to a smooth, consistent, and uniform even surface showing no marks, joints, pits, pockets, or form grain. All imperfections shall be corrected immediately after removal of forms. Rubbing of surfaces shall begin after imperfections have been corrected and shall be completed within five days after the

removal of forms from such surfaces. All rubbing will leave concrete uniform, consistent, and pleasing appearance. If concrete is stained, etc., from subsequent operations such as repair or leaks, the entire area will be rerubbed to accomplish satisfactory results.

All interior floors shall be given a “steel trowel”, monolithic cement top finish unless otherwise shown in the Plans or specified. Enough cement finishers shall be employed to complete the finishing work before the cement has taken its initial set. Where such floors are shown to be equipped with floor drains, the surfaces of the floors shall slope evenly to the floor drains. No water shall stand on the finished floors. Floors finished before completion of the work shall be protected from damage by boards, sisal kraft building paper, or other adequate means.

Floors of basins, except those where final grout finish is specified to be swept in by the operating mechanism, shall be screeded to a reasonably smooth and uniform finish with even slopes as indicated on the Drawings. The screeding work shall continue until sufficient paste is brought up to secure a uniform cement/sand (grout) appearance, free from any exposed aggregate. Grout shall be added if necessary to secure the desired appearance. Where floors of basins are indicated to be sloped to floor drains, no standing water shall remain. Floors shall be uniformly sloped as indicated on the Drawings.

Surface of exterior concrete walkways, suspended slabs, and other exterior concrete surfaces subject to foot-traffic, shall be wood float finished and then lightly crossed- broomed. Where these surfaces are indicated to be sloped for drainage, no standing water shall remain.

The Contractor shall construct all curbs, bases, and foundations required for setting equipment called for in these Specifications or shown on the Drawings. Curbs, bases, and foundation pads shown on the Drawings are for equipment of a particular manufacturer. Should equipment of other manufacturers be furnished, the Contractor shall prepare drawings showing details of curbs, bases, and foundation pads to receive the equipment furnished. These drawings shall be submitted to the Engineer for review. No extra compensation will be allowed by reason of such changes in design of such concrete items.

The treads of all concrete steps and stairs shall be finished by trowel with 3/4 inch thickness, non-slip concrete, applied as dry as practicable at the time that steps are poured, and as an integral part of same. The aggregate for this concrete finish shall contain 33-1/3 percent abrasive aggregate (3/32 inch maximum size) manufactured by the compression and vibration process and 66-2/3 percent crushed stone (3/8 inch maximum size). This top finish shall cover the entire tread back of the non-skid nosing elsewhere specified, and shall be troweled to a smooth, even, level surface. Proportions: 2 cement, 1 sand, 3 aggregate by volume.

12.0 CONSTRUCTION JOINTS, EXPANSION JOINTS, AND WATERSTOPS

Construction joints, expansion joints, waterstops, and joint seals shall be provided at locations indicated or approved in advance by the Engineer. Changes shall be subject to the Engineer’s approval. Before concrete is placed against previously poured concrete, the contact surfaces shall be cleaned until completely free of laitance, dirt, and debris. Contact surfaces shall be kept continuously moist between successive pours of concrete and shall be thoroughly wetted immediately before placement of fresh concrete.

Waterstops shall be placed at concrete joints in all structures built to contain water. Waterstops shall be PVC material, dumbbell configuration, 9 inches wide and not less than 3/8 inch thick, ribbed pattern unless shown otherwise in the drawings. Splices of waterstops will be by vulcanizing. All watertight joints, whether waterstop is required or not, will be sealed on the inside face by approved sealants similar and equal to these products: Duoflex by the Sika Corporation, Synthacalk GC2+ by Pecora Corporation or equal. The joint shall be prepared (e.g., chamfered, grooved, primed, etc.) in accordance with the sealant manufacturer's recommendations. No nail or wires holes or any type of penetration will be allowed in waterstops.

All expansion joints shall be sealed with backer-rod, primer, and polyurethane sealant. In the case of slabs on grade, the complete sealing process shall be applied only to top surface of joint; in the case of vertical walls the complete sealing process shall apply to joints on both faces of the wall and joints over tops of walls; and in the case of elevated slabs and beams, the complete sealing process shall apply to joints on top surfaces, on edges, and on all exposed undersides. Backer-rod shall be of premium grade polyethylene foam or Rescor type filler material, unless specifically shown otherwise in the drawings. Primer shall be an underwater type primer suitable for the surface conditions to which the joint will be subjected. Primer will be allowed to dry thoroughly if required by the manufacturer's instructions prior to application of sealants.

All PVC waterstop shipped to the project shall be new and shall not have had a shelf-life (storage after date of manufacture) of greater than eight months. All PVC waterstop received on the job shall be used (closed in concrete on both sides of a joint) within eight months after date of manufacture. The waterstop shall be stored at the job site in an indoor location and shall be protected against direct sunlight. After the waterstop is set in a concrete pour the exposed half of the waterstop shall be protected against damage resulting from the construction operations and against sunlight. The Contractor shall so schedule his pours that the joint material (waterstop) will be completely enclosed in concrete within eight months after date of manufacture.

Expansion joints for sidewalk or paving slabs abutting structures, for floor slabs meeting columns where columns pass through floor and for concrete aprons meeting ground floor slabs shall, unless indicated otherwise in the Plans, be filled with material meeting the requirements of ASTM Specification D 1751-73, and shall consist of preformed strips of cellular fibers saturated with asphalt.

13.0 GROUT AND CONCRETE ANCHORS

Grout to be swept in as topping for floors of structures equipped with collecting equipment shall be a cement/sand mix in proportion 1:3 and having slump not exceeding 6 inches. Slump may vary according to practice of the representative of the particular equipment manufacturer. Construction grout used for closing in box-outs, filling holes in concrete, patching walls and similar applications shall be non-shrink, expanding type, and shall have a compressive strength of not less than 4500 psi. Machinery grout shall be used for setting all plates, pumps, compressors, engines, generators, and other machinery and equipment. It shall be non-shrink type, and shall have high flow at low water content, high density, and compressive strength not

less than 7500 psi. All concrete anchors shall be stainless steel.

All anchors not placed in concrete before a pour will be chemically anchored or mechanically anchored in cured concrete and withstand 15,000 pound pull. The chemical adhesive anchors shall be C6+ By ITW/Red Head or equal. Mechanical anchors shall be Ramset or equal. Chemical anchors must be utilized when the anchored equipment is subject to vibration or if the anchor is subject to moisture.

14.0 FLOTATION

The Contractor shall prevent the flotation of concrete structures during construction.

15.0 FERRULES, OPENINGS, AND RECESSES IN CONCRETE

Suitable alloy-steel sleeves or wall pipe assemblies shall be set in concrete for all small piping of every kind where such piping passes through concrete walls or floors. Such sleeves or ferrules shall be set with reference to their position in the final finish. Where it is found impossible to exactly locate the position of small pipes, openings of sufficient size shall be left in the concrete to allow the necessary latitude for later locating the sleeves and pipes, and after insertion of sleeves and pipes, the holes shall be properly filled with concrete. Annular spaces between sleeves and piping in exterior walls shall be caulked with Link-Seal (or equal) assemblies.

16.0 SETTING FITTINGS, FLANGES, ANCHOR BOLTS, EQUIPMENT ETC.

Where necessary to set flanges for gates or valves, pipes, manhole frames or castings, sleeves, pipe hanger rod inserts, frames, etc., in concrete walls, floors or slabs, particular care shall be taken by the Contractor to insure that all these fittings etc. are properly set in forms, level, plumb, lined up, and properly oriented, etc., the Contractor shall use submittals and other Contractors' or special drawings. The Contractor shall set all anchors, bolts, or other steel work in the concrete forms for motors, or other machinery or equipment in accordance with installation drawings by the supplier of the equipment, or as indicated by the Engineer. Paint all aluminum such as gates, handrails, conduit where placed against concrete or dissimilar metals with approved coating for intended service to protect from corrosion.

A watertight installation shall be secured where piping passes through tank or basin walls. Wall sleeves, wall pieces, and pipe to be placed in concrete walls shall first have tar coating on outside of the pipe or fitting burned off before the pipe is grouted or monolithically cast in place. Such pipe pieces may be furnished with outside "bare".

17.0 SETTING ELECTRIC CONDUIT AND DEVICE BODIES

Electrical conduit shall be installed in the concrete work as indicated, and provision shall be made for their protection during the pouring of the concrete. Outlet boxes shall be located with reference to the final floor, wall, or ceiling finish. Device bodies shall be

so secured to the forms before the concrete is poured. Any galvanized conduit in potentially wet areas require Roboy PVC coating. Aluminum conduit entering concrete shall receive a bitumastic coating.

Prior to placing conduit, the Contractor shall use approved manufacturer shop drawings to accurately determine the correct locations and dimension for all conduit stubups, electrical gear, control panels, and all other facilities requiring power, etc.

**STANDARD SPECIFICATION
FOR
PAVEMENT, GRAVEL, AND CONCRETE SURFACES**

SECTION 1-3

**1.0 REMOVING AND REPLACING EXISTING PAVEMENT AND
CONCRETE**

No hard surface (pavement, concrete, etc.) shall be cut unless authorized. These surfaces shall be cut to a neat continuous line and replaced with same type material and thickness. Base course to be of same type material removed. Removal and replacing surfaced areas shall meet the requirements of the governing body. Should requirements not be in effect, the Contractor will replace these areas as indicated on the Plans or as required by the Engineer or the Owner. These surfaces shall not be replaced until authorized. All damaged hard surfaces shall be restored to its original condition and shall be replaced as soon as possible. If any inconvenience or potential inconvenience to the public is noted, the hard surfaces will be replaced immediately. Any repair after completion of the project or settlement under the replaced sections of hard surfaces will be at the expense of the Contractor. Unless otherwise noted, pavement replaced shall be included in the Unit Price Bid of Items except for repairs.

2.0 PAVEMENT

Construction and types of finished paving for roads, parking areas, and service areas shall be as shown on the Drawings or as specified below. All subgrade and base courses shall be in accordance with AHD Specification Section 301. The subgrade shall be prepared using materials in place. All depressions shall be filled with approved material compacted to same density as the remainder of the subgrade. Soft places in the subgrade shall be excavated and refilled with approved material or crushed stone so as to achieve the density specified for compacted fill. The base shall have a compacted thickness of base course under pavement of not less than 6 inches, and materials for base course shall be in accordance with AHD Specifications Sections, 823.02(d) and 826.02(d), or compacted pug mix. Subgrade and base shall be compacted to a minimum of 98% SPD. Surface of crushed stone finish shall be 2" of No. 4 gradation, compacted. Asphalt paving shall be pre-mixed bituminous pavement meeting the requirements of AHD Specifications Section 424. Base course shall be primed and pavement constructed in accordance with the provisions of AHD Specifications Section 410 except asphalt will be compacted. The pavement shall consist of binder course and wearing course. Binder course shall be Mix B (AHD Section 424) placed at the rate of 150 pounds per square yard, and wearing course shall be Mix A (AHD Section 424) placed at the rate of 110 pounds per square yard. Apply binder and wearing course at higher rates if called out on Plans. Pavement shall be installed smooth and level. Sufficient time shall lapse before the wearing course is installed on the binder course. The wearing course will be the last work on the job after all "punch" list items are completed. All dirt, mud, and other undesirable

material shall be completely cleaned from the binder prior to placing the wearing course. Unless specifically requested by the Owner, the wearing course shall not be installed until after all site work is complete and after all activities that potentially damaged the asphalt are complete.

When asphaltting in cold, an ADOT Certified Testing Lab will be made available by the Owner to measure surface temperature on which asphalt is to be placed as well as air and asphalt temperatures. As a minimum, air temperature shall be 40E and rising as well as the surface the asphalt is to be placed. The contractor will bear the cost of the laboratory testing for this situation.

If any settlement occurs under roadway, the entire roadway shall be resurfaced for at least 50 feet on both sides (100 feet total) of the settled trench. Where resurfaced segments approach within 50 feet of each other, the segment between resurfaced segments shall also be resurfaced, even though outside the 50 feet segment.

Prior to placing curb, gutter, concrete, or asphalt, etc., use survey equipment to check that all paving will properly drain to prevent puddle formation. Coordinate with Engineer and adjust grades as required to prevent ponding during rain or washdown.

3.0 CONCRETE WALKS AND OTHER SURFACES

All concrete walks shall be constructed on firm compacted subgrade or a crushed stone base of compacted thickness not less than 4 inches. The subgrade shall be damp when concrete is placed. Expansion joints shall be located where the walk changes direction, abuts a structure, top and bottom of steps, and not farther apart than 30 feet on a straight run. The expansion joint and filler shall be 3/8-inch-thick asphaltic fiberboard with edges of the concrete rounded. Contraction joints 1 inch deep shall be cut across the walk not farther than 6 feet apart. Final finish will be lightly cross broomed.

Concrete parking areas and drives will be finished as described above with #5 rebar @ 10" o.c., e.w. added for reinforcing or as shown on the plans.

4.0 CURB, GUTTER, AND COMBINATION CURB AND GUTTER

This Sub-section shall cover the work of constructing Portland cement concrete gutter, curb, or combination curb and gutter, constructed with or without metal reinforcement. Curb and gutter shall be constructed in accordance with the plan details and these specifications at the locations shown on the plans or established in conformity with the lines, grades, dimensions, and cross sections shown on the plans or designated.

All materials shall conform to the requirements of Concrete Standard Specifications herein. The foundation shall be constructed or excavated to the required depth below the finished surface in accordance with the cross section shown on the plans or as designated. All soft or other unsuitable material shall be removed and replaced with suitable material, in layers not to exceed 4 inches compacted. The foundation shall be compacted as provided for the applicable types of material involved.

The Contractor shall use standard type metal forms or wood forms or if requested in writing and approved by the Engineer, an approved automatic extrusion type curb

and/or gutter machine. These forms shall be straight except for radial sections, and free from warps and of sufficient strength, when staked, to hold the concrete true to line and grade without distortion. They shall provide the approved typical section and depth of the section shown on the plans. Radial or curved forms may be of flexible metal or a wood form of approved design. Bent or damaged forms shall not be used. All forms shall be securely staked, braced, and held together to the exact lines and grades established and shall be kept sufficiently tight to prevent leakage of mortar. All forms shall be cleaned and oiled with a suitable form oil immediately before concrete is placed against them.

Any automatic extrusion type curb and/or gutter machine considered for approval must be demonstrated to produce a section conforming to the dimensions, cross-section, lines, and grades shown on the plans. Failure to consistently produce an acceptable product shall be cause to withdraw approval of the machine and order the use of standard forms. All types of curbs, gutter, and combinations shall be placed in one operation, to the depth of cross section specified on the plans. The use of a two-stage operation will not be permitted.

Gutter, curb, and combination curb and gutter shall be constructed in sections of the lengths shown on the plans. The length of section may be reduced where necessary to form closure. The handling, storage, proportioning, and mixing of concrete shall conform to the Concrete Standard Specification herein.

All expansion, contraction, and construction joints shall be constructed as shown on the plans. If not shown on the plans, joints shall be placed as follows:

1. Expansion joints shall be placed in curb and/or gutter to match those in concrete pavement where the two are adjacent.

2. Expansion joints shall be 3/4 of an inch wide. They shall be placed where curb, gutter or combined curb and gutter terminate against concrete driveways and other concrete structures except inlets. The joints shall be placed at least 20 feet from the location of the termination of the curb, gutter or combined curb and gutter at inlets.

3. Expansion joint filler and sealer shall be one of the materials provided by AASHTO M 153 or AASHTO M 213 with the latter being modified to allow a maximum of 25% water absorption. Expansion joint filler shall extend from the bottom of the curb and/or gutter to within 1 inch of the top; the sealer shall be 3/4 of an inch thick and shall be recessed 1/4 of an inch from the top. Hot Applied Joint and Crack Sealant shall meet the requirements of AASHTO M 324 (ASTM D 6690) for Type I Sealant or Type II Sealant. Cold Applied Joint and Crack Sealant shall be a resilient adhesive compound capable of effectively sealing joints from infiltration of incompressible materials and water throughout repeated contraction and expansion cycles. The sealant shall be a homogeneous blend of materials, which may or may not require a primer. The sealant shall meet the requirements given in ASTM D 5893.

4. Contraction joints shall be placed in curb and/or gutter to match those in concrete pavement where the two are adjacent, but in no instance more than 20 feet between joints. The contraction joints shall be sawed or otherwise cut 2 inches deep by 1/8 of an inch wide and shall extend 2 inches below the pavement surface.

The subgrade and forms shall be checked and approved just prior to placing concrete against them. All debris or other foreign material shall have been removed from the space to be occupied by the concrete. The subgrade shall be moist but not wet or muddy. After mixing, the concrete shall be placed in the forms and shall be tamped, spaded, or vibrated sufficiently to produce a dense homogeneous mass and to bring the mortar to the surface. Particular attention shall be given to spading the concrete along and against the surface of the forms to prevent honeycombing and secure a smooth, uniform surface.

When the forms are filled, the concrete shall be struck off with a template, cut to the curb edge design. The exposed concrete surface shall then be finished smooth with a wooden float in a manner that will compact the mass and produce a true, even top surface. Plastering with mortar to build up or finish will not be permitted. The surface of the gutter and the face and top of the curb shall be checked with a 10-foot straightedge and any irregularities more than 1/4 of an inch in 10 feet corrected. The alignment and grade shall not at any point vary more than 1/2 of an inch from that established by the elevation control stakes. Excessive troweling with a steel trowel will not be permitted. A textured finish shall be provided on the exposed surface just before the concrete becomes nonplastic by the use of a burlap or cotton fabric drag, brush, or broom which will produce a uniform gritty texture along the length of the curb, gutter, or combination curb and gutter. The upper edges of curb and gutter shall be rounded with an approved edging tool to the radius shown on the plans. The joint templates shall be set during the placing of the concrete and allowed to remain in place until the concrete has set sufficiently to hold its shape but shall be removed while the forms are still in place.

The forms shall be left in place until the concrete has set sufficiently so that they can be removed without damage to the work, but, unless otherwise directed, they shall be removed within 24 hours after the concrete has been placed. Immediately after the removal of the forms, the repair of any minor defective areas shall be accomplished.

Immediately after the finishing operation is completed, the concrete shall be cured. If mats are used, they shall be kept continuously moist for a period of at least 72 hours. During this period, and until completion and acceptance of the work, it shall be protected from damage by the elements or other cause. After the concrete has set sufficiently, spaces along the front and back sides of the gutter, curb, or combination curb and gutter, shall be backfilled to the required elevation with suitable material which shall be compacted.

**STANDARD SPECIFICATION
FOR
GRASSING**

SECTION 1-4

1.0 GENERAL

This work shall consist of furnishing, planting and establishing an acceptable stand of grass or other vegetative cover for use and protection of the project. Work includes, but is not limited to temporary seeding as required, furnishing and placement of fertilizers and soil treatments, furnishing, inoculation, and planting of seeds, and the covering, compaction and maintenance of seeded areas. On all work on and adjacent to private property, the Contractor shall replace the disturbed materials with materials identical to those on the site. Sod shall be provided and installed wherever needed to match existing grass. In sensitive areas and when required by Owner during construction, grass and landscaping will be replaced immediately after primary construction (i.e. pipeline installation, etc.) is complete with Contractor accepting the risk of further disturbance due to testing, other clean-up, etc.

2.0 MATERIALS

Sodding and Seeding. The sod shall be native to the area with well matted roots. Sod containing weeds, other grasses, or fire ants shall not be accepted. The seed mixture, fertilizer, lime and rates of application of all these items shall be as specified herein as a minimum and as required to achieve full coverage. Topsoil shall be placed over the area to be seeded or sodded to a depth of 4 inches. Topsoil will be obtained from the original excavation stockpile. If sufficient topsoil is unavailable, the Contractor will obtain and deliver topsoil from another site at his expense. Topsoil shall be free from all rock or gravel.

2.1 SEED MIXTURES

Seeds and seed mixtures shall conform to the Alabama Department of Transportation Standard Specifications for Highway Construction, Section 860.01, latest edition. Permanent seed mixtures in areas subject to frequent mowing for planting zones 1 and 2 shall be 1A or 2A with mix adjusted as required for the season. All areas at treatment plants, pump stations, wells, and tanks, as well as all areas inside fencing, shall be considered frequently mowed areas. Seasonal temporary mixes shall be as specified for their respective permanent mix. Temporary grassing may be modified by the contractor as required for erosion control or to comply with his BMP plan. In areas not subject to frequent mowing, mix shall be 1E or 2E depending on the planting zone. Seed mixtures shall be modified when required to match adjacent grassing. No Bahia grass shall be seeded.

3.0 PROCURING AND HANDLING SOD

Sod shall be kept moist and planted within three (3) days. Sod will not be allowed to dry out or freeze. Sod shall be machine-stripped at a uniform soil thickness with a minimum of two (2) inches of soil adhering to the roots when placed. Sod shall be live, fresh, uninjured, and growing grass at the time of planting. Sod shall be handled in a manner that will prevent tearing, breaking, drying, or other damage. Sod shall be healthy when placed.

4.0 GROUND PREPARATION

The ground shall be plowed to a depth of not less than four (4) inches but not greater than eight (8) inches. The ground shall be cleared of all rock 3/4 inch (.75") or larger in size of any dimension, all construction debris, or other objectionable material by hand raking. After plowing and clearing, the ground shall be pulverized. Then, rock and debris-free topsoil shall be placed over the prepared area to a depth of four (4) inches, and mixed with the fertilizer and lime. After placement of topsoil, the ground shall be cleared of clods, all stones, rocks brush, roots, construction debris, or other objectionable material. In areas subject to frequent mowing, the ground shall be fine raked and hand picked to remove all gravel and rocks. Remove all other objects that may cause damage to mower blades. The Contractor shall supply water, and additional fertilizer if needed, for planting and growth without additional expense to the Owner.

5.0 PLANTING

Sod shall be placed on level, prepared soil at any time when ground is not wet or frozen. Sod shall be placed by butting edges of sod block and with alternating joints. Sod shall be used to fill in all voids after the sod has been laid. Roll sodded areas with hand-held roller to bond sod to soil and to smooth out rough spots. Completed sod shall be smooth, and free from irregularities. The Contractor shall maintain the planting until the final approval of the project which includes watering when necessary. Water shall be applied by the use of hose sprinklers, soaker hose, water truck with irrigation attachments or other watering equipment that will apply water in such as fashion as to avoid damaging areas. Seeded areas will have mulch applied at approximately two tons per acre to lessen the impact of erosion. All gullies and washes created shall be repaired and reseeded.

6.0 FERTILIZER AND SEED

When area is to be seeded, apply fertilizer in accordance with manufacturer's instructions at 500 lbs. per acre of 8-8-8 fertilizer or 300 lbs per acre of 13-13-13 fertilizer. Apply fertilizer after smooth raking of topsoil and prior to roller compaction. Do not apply fertilizer at same time or with same machine as will be used to apply seed. Mix thoroughly into upper 2 inches of topsoil. When growth has emerged and is growing normally, a second application of an approved nitrogen fertilizer shall be applied. Fertilizer shall be applied

uniformly at a rate of 67 pounds of nitrogen per acre unless a higher rate is desired to enhance growth.

Apply seed at rates specified evenly into intersecting directions and rake in lightly. Exercise care in covering to preserve the grade so that areas adjacent to pavement are not left higher than paved surface. After sowing, seed bed shall be compacted immediately with a cultipacker, roller or approved drag. Compacting of seeding is not required when seed has been applied hydraulically or mulched.

Do not seed areas in excess of that which can be mulched on same day. Mulching material shall be oat or wheat straw, free from weeds, foreign matter detrimental to plant life. It shall be spread over all seeded areas at a minimum rate of approximately 2 tons per acre and shall be applied to a uniform depth in such a manner that not more than 10 percent of the soil surface is exposed. The use of wet hay or straw will not be permitted. Baling twine shall be removed from mulch prior to placement.

Where temporary grass has been planted, the contractor shall establish the permanent grassing specified when weather and soil conditions are within the agronomic practice limits for the intended permanent species. Existing temporary vegetation shall be mowed to a height of approximately 3 inches or sprayed with an approved herbicide to retard future growth. The area shall be lightly scarified to prepare a suitable seed bed for permanent vegetation. Fertilize and permanent species shall be applied in the manner specified. Seed shall be covered by a second scarification followed by rolling. Scarification and rolling may be omitted when seed is spread by hydraulic equipment provided existing growth is 3 inches to 6 inches in height.

Erosion fabric shall be used when shown on the drawings, on all slopes greater than 3:1 and/or when the terrain requires use of erosion fabric. Fabric shall be woven jute fabric; open mesh construction smolder-resistant treated fabric shall be used and equal to Belton Anti-Wash/Geojute. Install fabric according to manufacturer's instruction.

Hydroseeding, when indicated in the plans to be provided, shall be accomplished with approved equipment, and all mixtures shall be constantly agitated from the time that they are mixed until they are finally applied to the seed bed. All such mixtures shall be used within eight hours from time of mixing. Nozzles or sprays shall not be directed toward the ground in such a manner as to cause erosion or runoff.

7.0 ACCEPTANCE

Acceptance of the planting shall be the satisfactory placement and growing of the material as determined by the Engineer. As a minimum, satisfactory stand for seeded grass must be a growing complete cover of grass, uniform in height, color, and density, in which gaps do not exceed the following:

1. Bare areas shall be scattered and not comprise more than 1/100 of any given area.
2. For frequently mowed areas, bare spots shall not exceed 4 square inches.
3. For infrequently mowed areas, bare spots shall not exceed 6 square inches.

Provide, at no additional cost to the Owner, watering, additional seed, additional fertilizer, and/or lime, etc., as required to achieve acceptance. It shall be the responsibility of the Contractor to secure a stand of grass such as will minimize loss of soil by erosion; to maintain all seeded areas until final acceptance of the work; and to restore or replace any portion of the grassing work that is found to be defective, or which results in an unsatisfactory stand of grass, or which becomes damaged prior to acceptance of the work. However, all grassing and coverage (whether seeded or sodded) through developed areas or in easements must match that existing prior to construction. Sod shall be level, well knitted and growing, covering the entire designated area.

If a satisfactory stand of grass or sod is not established then the area shall be re-seeded or re-sodded without any additional cost to the Owner. The responsibility of the Contractor shall continue to the following extent; should all other work at the site have been completed and accepted and should the Contractor have removed all forces and equipment from the plant site, he shall nevertheless, in the event of failure or partial failure of the grassing work, be obliged under the terms of the Bond given to the Owner to return such forces and equipment to the plant site as are necessary to ensure the satisfactory completion of this portion of work under the Contract.

The Contractor shall mow all sites a minimum of two (2) times, a minimum of two weeks apart after the permanent species has been established, with a finish type mower to demonstrate that the site can be readily maintained by the Owner without difficulty and without damaging equipment. Repeat the mowings a minimum of two additional times if portions of the site are disturbed, regraded, or any work is performed or equipment moved off the site, or any other activity is performed that may affect the acceptance of the grassing. The mowings shall be at a close setting (i.e., low grass height) that will reveal any deficiencies from these Specifications and any debris or potentially damaging items.

The Owner shall not be obligated to make any payment for grassing until an acceptable stand of grass meeting all the requirements of these specifications is achieved.

**STANDARD SPECIFICATION
FOR
FENCING**

SECTION 1-5

1.0 TYPE “A”

Fencing shall be similar and equal to that manufactured by Merchants Metals in Atlanta, GA or Stephens Pipe & Steel, LLC in Russell Springs, KY. The Fencing Specifications herein shall be considered minimum requirements for Type “A” fencing. See Contract Drawings for any project specific requirements (e.g. specific height, gauge, etc.). The height will be 7 feet, including 3 strands of barbed wire. Wire fabric will be 9 gauge with 6-gauge finish, 2-inch mesh. Line post shall be a maximum 10-foot centers and be 2-1/4-inch beam weighing 4.1 pounds per foot or 2-1/2-inch O.D. pipe weighing 3.65 pounds per foot. Terminal posts shall be 2-1/2-inch square and weigh 5.79 pounds per foot or 3-inch O.D. pipe weighing 5.79 pounds per foot. Top rails shall be 1-5/8 inch weighing 2.28 pounds per foot. Post shall be set in concrete. Drive anchors may be used. Tension wires shall be provided. Entrance gates, unless otherwise indicated, shall be double 6 foot wide. Single entrance gates shall be 4 foot wide. When gates greater than double 6 foot up to double 12-foot wide are specified, terminal posts of 4-inch O.D. pipe weighing 9.11 pounds per foot with braced gates and trusses to be used. Gates shall have latching devices, padlocks (to match existing locks), plunger rod, and recess barrel for rod. Double gates shall have retaining devices to hold gates in fully open position. All gates will have chain and handhole. All materials shall be hot-dipped galvanized after fabrication. Where indicated on the drawings, all fencing and components shall be PVC coated, color to be selected by Owner from manufacturers standard colors. Chain link fabric shall conform to ASTM F-668, Class 2b. Fabric shall have a minimum PVC coating thickness of 0.010 inches. All posts, rails, and fittings shall have a minimum 10 mil coating.

Where indicated on the drawings, fencing (including gates, etc.) shall be furnished with plastic vertical tubing (PVT slats) with colors selected by Owner.

Where indicated on the drawings, fencing shall be furnished with bottom bars (bottom rails) spanning between all posts. The bottom rails shall match the top rail. Install in a manner to provide maximum security

2.0 TYPE “B”

Fencing will be galvanized hog wire, 47 inches high with three strands of barbed wire one foot above the hog wire. Barbed wire will be double twisted, 4 point, and 12- 1/2 gauge. The fencing will be vertical wire of 10 gauge spaced at 6 inches and horizontal wire of 12- 1/2 gauge spaced at 3 inches at the bottom and 8 inches at the top. Line post will be buried 30 inches at 10-foot centers and crossed braced at not more than 200-foot intervals. Corner and gate post shall be braced and be buried 36 inches in 12-inch diameter concrete. Double gates shall be welded of 1-3/8-inch O.D. tubular galvanized steel pipe with central

support and a diagonal tension rod and turnbuckle. Double gates will be fitted with galvanized hinges and foot latches with lock clasp. Signs not to exceed 200-foot intervals and on each gate shall be aluminum enameled reading “DANGER – NO TRESPASSING” for wastewater lagoons. Materials to be used are specified below and on the Plans.

<u>POST</u>	<u>WOOD</u>	<u>METAL</u>
Line Post	4" diameter SYP treated with creosote oil at 16 pounds	“T” section steel, hot galvanized 1.33 pounds per foot
Braces	same as line post	2" steel, hot galvanized
Corner and Gate	6" diameter SYP treated with creosote oil at 16 pounds	2" angle or 2" i.d. pipe, hot galvanized

3.0 GENERAL

All signs attached to fences and gates will be attached with stainless steel wire or bolts.

All fencing, gates, and appurtenances shall be installed in a manner that fully protects the security of the site.

Where fencing work includes modifications or connections to existing fencing, maintain the security provided by the existing fencing at all times throughout construction.

**STANDARD SPECIFICATION
FOR
FLASHING AND SHEET METAL**

SECTION 1-6

1.0 SHEET METAL GENERAL

The gauges for sheet metal shall be as specified or as indicated on the Drawings, but in no case less than gauge No. 22 for aluminum. Sheet lead shall weight 4 lbs. per square foot. All exposed edges shall be soldered, beaded or returned for strength and appearance. The Contractor shall provide all necessary ribs, cleats, stiffeners and reinforcement required to make all sections rigid and substantial with allowances made for expansion and contraction.

2.0 MEMBRANE FLASHINGS FOR SILLS AND THROUGH WALLS

Under shower rooms, sills, through walls and like moisture-vulnerable openings provide built-in membrane flashing or 5 ounce cooper saturated fabric or PVC membrane. Flashing for single wythe block walls shall be solid metal copper flashing. PVC membrane shall not be less than 30 mils thickness, have zero water absorption, be resistant to ozone, have a tensile strength of 2,200 psi and shall be suitable for use under temperature range of -20E F to +212E F. Exposed surfaces and lines of moisture entrance to walls shall be coated and caulked with an approved polysulfide sealant.

3.0 FLASHING

Counterflashing shall be provided at the intersections of roofs with parapet walls, coping, curbs or other vertical surfaces. Unless noted otherwise, counterflashing shall be laid in overlapping strips with not less than 6" lap joints, and top ends shall be broken for insertion in sealing grooves or reglet grooves. Top ends of counterflashing shall be anchored in grooves by caulked lead wool, and tops of grooves shall be sealed with silicone sealant. Lap joints shall be press sealed on a full bed of flashing cement over the entire area of lap. Counterflashing shall be securely anchored to vertical walls by means of case-hardened concrete nails equipped with lead washers. Counterflashing shall be fabricated from aluminum of not less than 0.050" thickness.

Flashing collars shall be provided for all roofing penetrations. Base flanges shall have 4" projection from vertical sleeves and shall be fully imbedded in flashing cement on top of built-up roofing layers. Base flanges shall be covered with two plies of 15 lb. felt sealed to flange and between plies with roofing cement. Lower ply shall extend out 6" from flashing sleeve and upper ply 9" from flashing sleeve. After flood coat is in place, a bead of flashing cement shall be run around intersection of flood coat. Where vent stacks or pipes are not fitted with a flashing cap, vertical flashing sleeve shall extend to top of pipe and shall be turned down 2" inside of pipe. Sleeve shall be lead. Where the pipe stacks are fitted with

stack hoods, stack collars shall be an integral part of the stack. The vertical sleeves of the flashing collars shall be brought up under the stack collars.

4.0 THRU-WALL FLASHING

The work required consists of providing all labor, materials and equipment necessary to furnish and install all thru-wall flashing. The Contractor shall submit for approval all materials proposed for use. Thru-wall flashing shall be 0.020" thick non-reinforced, homogeneous waterproof, impermeable sheeting composed of elastomeric substances which have been reduced to a thermoplastic state and extruded into a continuous sheet. The flashing shall not physically deform when under tension at 70° F and shall be suitably stabilized to resist exposure without physical deterioration when subjected to weatherometer testing in accordance with ASTM D-822 for a period of not less than 400 hours. The flashing shall show no signs of cracking or flaking when bent thru 180° over a 0.032" mandrel and over the same mandrel in the opposite direction thru 360° all at a temperature of minus 20° F. Flashing shall be marked with manufacturers brand name embossed at frequent intervals and shall be Vi-Seal Type 20 manufactured by Afco Products, Inc.; Nervastral HD manufactured by Rubber and Plastics Compound Co., Inc.; 20 Mil Nu-Flex manufactured by Sandell Manufacturing Company, Inc.; Wascoseal Type 20 manufactured by Wasco Products, Inc. Adhesive for bonding and splicing shall be synthetic rubber base cold setting cement of specific type as recommended by the manufacturer of the thru-wall flashing.

Wall flashing shall generally be installed at bottom of all air spaces in exterior walls, over all exterior wall lintels, under sills, at spandrel beams, under copings and at other locations as required for a complete installation. All surfaces to receive the flashing shall be reasonably smooth, clean, dry and free from irregularities. On all horizontal surfaces, the flashing shall be laid either in a fresh bed of mortar above and below or a coat of adhesive. Vertical surfaces shall be spotted with adhesive to hold flashing in place. Thru-wall flashing shall start 1/2" from the outside face of the wall and shall be carried through the wall, turning up where possible to facilitate flow through weep holes to outside. Thru-wall flashing shall turn up on back of wall not less than 2" or shall be carried upward across cavity as shown or a minimum of 8" and secured in interior wythe mortar joint. Flashing for heads and sills shall start 1/2" from outside face of wall, carry through the wall, and be turned up at the inside as detailed or not less than 2". Head flashing for steel lintels shall be carried 8" beyond both ends. Both head and sill flashing shall be turned up past the sides to form a pan. Flashing shall be spliced at joints by splitting the two plies lapping four inches and coating the contacting surfaces with adhesive.

5.0 ROOFING ACCESSORIES

Gutters shall be of approved design and formed of 22-gauge aluminum. Gutter flashing flange shall extend under roof not less than 6 inches. The gutter and downspout assemblies shall be securely anchored by means of straps, anchor bolts and fasteners. Straps shall be rods or flats not less than 1/4" in diameter or not less than 1/8" x 1/2", respectively. Wire or perforated metal shall not be used for straps. Scuppers, collection boxes, and leaders

shall be fabricated from the same metal as the gutter and downspout assemblies. For membrane roofs, scuppers by membrane manufacturer Fascia and roofing stops shall be continuous shapes of minimum 16-gauge aluminum and formed to details shown, high or low to suit conditions, with sufficient aprons for securing to deck. Unless specified otherwise, all lumber used for nailers, blocking, or supports shall be pressure treated with water-based salt in accordance with the requirements of the American Wood Preservers Association. Insulation stops around roofing penetrations shall be of the same material. All wood used to provide a satisfactory roof will be provided by the Contractor without extra compensation. Walkway pads shall be provided for access to all roof mounted mechanical equipment as required and/or indicated on the Drawings. Walkway pads shall be granule surfaced, 1/2" thick Celotex "Carey Tread", Meadows "Whitewalk", or equivalent.

**STANDARD SPECIFICATION
FOR
MISCELLANEOUS STEEL AND OTHER METALS
(FOR STEEL/METALS NOT COVERED/SHOWN IN STRUCTURAL DRAWINGS)**

SECTION 1-7

1.0 MATERIALS

All materials shall be furnished complete with all accessories required for final erection and setting. All steel items shall be furnished with shop coat of rust-inhibitive primer unless specified to be hot-dipped galvanized or to receive protective coating requiring surface preparation by sandblasting on the site immediately prior to application of final coating. Aluminum shall be Alloy 6061-T6 except where specified or shown otherwise. Structural steel shall be new and conform to ASTM Specification A36. Cast Iron shall be cast from high strength, fine grain cast iron conforming to the requirements of ASTM Specification A48. All irregularities shall be ground smooth to secure uniform surface. All materials, except cast iron, shall be stored in such a manner as to prevent contact with the ground. All shop connections shall be welded. All welding shall be shielded arc welding meeting latest standards of the American Welding Society (AWS). All welding work shall be performed by welders qualified by procedures, tests and documentation as prescribed in AWS D1.1, AWS B2.1 and the AWS Certified Welder Program.

2.0 SHOP DRAWINGS

For dimensions and general arrangement of structural steel and miscellaneous metals, reference shall be made to the Drawings. The Contractor, before commencing work, shall check all governing measurements at the site and the elevations of all structures on which work is to be set. If any inconsistencies in measurement are found, they shall be referred to the Engineer. The Contractor will be held responsible for the working out of details, and no extras will be allowed because of his failure to inform himself in regard to site conditions. Where no details are indicated, the Contractor shall submit details prepared in a workmanlike manner from measurements taken at the site in order to insure proper fit. Measurement taken for the fabrication and installation of grating, plates, railings and stairways shall be taken at the site subsequent to the placing of piping, valves, machinery and other items that may affect the details of construction. The Contractor shall carefully coordinate all aspects of the work prior to making the submittal. The Contractor shall submit to the Engineer before beginning the work the necessary Shop Drawings. The checking of the Drawings by the Engineer does not relieve the Contractor of any responsibility regarding measurements and correct amount of material.

3.0 HANDRAILS

All handrails and posts shall be aluminum Alloy 6063-T6, nominal 1-1/2 inch diameter, Schedule 40. Post extensions below floor concrete surfaces shall be grouted in ferrules provided in concrete. All aluminum shall have a clear anodized finish. Flanges and stainless steel anchor bolts shall be provided for anchoring railings to walls. All railings installed shall fully comply with OSHA requirements.

Handrails shall be designed to withstand a 200# concentrated load applied in any direction to the top rail. The handrail shall be made of pipes joined together with component fittings. Samples of all components, bases, toe plate and pipe must be submitted for approval. Components that are glued or pop riveted at the joints will not be acceptable. All components must be mechanically fastened with stainless steel hardware. Aluminum surfaces in contact with concrete, grout or dissimilar metals will be protected with a coat of bituminous paint, mylar isolators or other approved material.

Posts shall not interrupt the continuation of the top rail at any point along the railing including corners and the end terminations (OSHA 1910.23). The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings. Toe plate shall conform to OSHA standards. Toe plate shall be a minimum of 4" high and shall be an extrusion that attaches to the posts with clamps which allow for expansion and contraction between posts. Toe plates shall be set 1/4" above the walking surface. Toe plates shall be provided on handrails as required by OSHA and/or as shown on drawings. Toe plates shall be shipped loose in stock lengths with pre-manufactured corners for field installation. After installation, railings shall be checked for final alignment, using a tightly drawn wire for reference. The maximum misalignment tolerance for railings shall be 1/8 inch in 12 feet. Bent, deformed, or otherwise damaged railings shall be replaced.

All removable handrails and posts, etc., shall have drain holes to remove water in the receiver bracket or pipe sleeve port or concrete in which removable posts or handrails are inserted. Where the handrail must be interrupted (such as at slide or sluice gate frames or operators, etc.) carefully coordinate the handrail with the equipment necessitating the interruption such that the opening (and guard chain if appropriate) is as short as practical.

4.0 BRACKETS, SUPPORTS, AND HANGERS

The Contractor shall furnish and install hangers, brackets, supports, stem guides, and items as required for pipe installation. Brackets shall be fabricated steel or cast iron. Steel brackets and supports shall be hot-dipped galvanized after fabrication or primed according to the Specifications. Anchor bolts shall be stainless steel.

All piping shall be securely supported when hangers are required and conform to the ANSI Code for Pressure Piping B31.1.0, and MSS Standard Practice SP-58. All rigid hangers shall provide a means of vertical adjustment after erection. Maximum spacing between pipe supports shall be in accordance with the following with a minimum of 1 hanger per adjacent pipe joint.

<u>Pipe Size (Inches)</u>											
1/2	3/4	1	1-1/2	2	2-1/2	3	3-1/2	4	5	6	8
<u>Maximum Span (Feet)</u>											
5	6	7	9	10	11	12	13	14	16	17	18

For pipe of sizes greater than 8 inches, two hangers or supports shall be provided for each full length section of pipe. Hanger rods shall be hot rolled steel rod meeting the requirements of ASTM Specification A36. Size and spacing of rods shall be such that load carrying capacities of rods based upon root area of thread will not be less than 2.0 times the actual load on the hanger. Structural attachments shall be beam clamps. Where piping is supported from concrete slabs, the Contractor shall install concrete inserts for attachment of hanger rods. Ceiling flanges and anchor bolts may be used for attachment of hanger rods for smaller piping subject to the approval of the Engineer. All pressure piping shall be adequately braced at all points of change in direction of piping runs.

Pipe hangers shall be capable of supporting the pipe under all operating conditions; shall allow free expansion and contraction of the piping, shall prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment; and shall be so designed that they cannot become disengaged by movements of the supported pipe.

5.0 GENERAL – ANCHORS, BRACKETS, AND SUPPORTS

The Contractor and/or manufacturer shall provide size, type, and material for anchors for all equipment and other components used on the project. The Contractor shall properly install all anchors, brackets, supports, etc. and manufacturer's representative shall assure itself that all of these were installed properly. Anchor bolts shall be stainless steel unless noted otherwise. Brackets, supports, etc. shall not protrude into walkways or walkspaces, or any thoroughfare or work area where they may produce a tripping hazard or any bodily injury hazard.

When allowed, galvanized threads, bolts, and nuts are used, spray paint nicked areas with galvanizing paint. Also, all pipe wrench marks and other scratches will be spray painted to prevent rusting. Clean off threading compound rust stains, splatter from whatever sources, lettering, or any source or foreign substance on all exposed metal.

In areas conducive to corrosion, all fasteners, nuts, bolts and washers shall be stainless steel. Equipment in such areas will also use stainless steel fasteners on all appurtenance and components.

Where required to avoid spalling and approved by Engineer, use epoxy anchors (in strict accordance with the epoxy manufacturer's recommendations) to mount handrail or equipment. Epoxy anchors shall be used where there is a potential for vibration or potential for spalling of concrete. Epoxy and anchoring chemicals shall be

carefully selected by the Contractor to handle the conditions and type loading that may be encountered by the anchors. Install all anchor systems in strict accordance with the manufacturer recommendations.

6.0 METAL STAIR ASSEMBLIES

Metal stair assemblies shall be furnished and installed where indicated on the Drawings and at the angles indicated with handrailings and nonslip treads. Handrails shall be welded on job site and reprimed. Steel steps will be primed before shipment in accordance with the Specifications.

Stair assemblies shall be fabricated from aluminum shapes and extrusions in accordance with details shown on the Drawings. Aluminum shall be Alloy 6063-T5 or Alloy 6063-T6. Stair assemblies shall be complete with channel stringers, foot plates or angles, hanger plates or angles, safety treads, carrier angles and handrailing. Handrailing shall be as specified. Stair assemblies shall be anchored to concrete floors (top and bottom landings) by means of stainless steel anchor bolts. Standard stair assemblies shall be similar and equivalent to assemblies as fabricated by Thompson Fabricating Company, Inc.

Stair assemblies (including their supports and attachments, etc.) shall as a minimum be designed by the metal fabricator for the loads required by the Standard Specifications. Design for heavier loading if indicated or required elsewhere.

7.0 SKYLIGHTS

Skylights shall be factory assembled units, self curbing with acrylic plastic translucent domes, aluminum retaining frame, aluminum curb frame with integral condensation and seepage gutter, and closure between curb frame, dome, and retaining frame shall be one piece extruded vinyl gasket. All screws and screw nails shall be stainless steel. Curb frame shall be bedded on mastic seal on top of curb. Where skylights are set on roof curbs, roof flashing shall extend up behind curb frame lip to base of curb frame. Where skylights are set on top slabs, the space between lip of curb frame and outside face of curb shall be closed with approved sealant. Skylights shall be equal to Duro Last.

8.0 FLOOR GRATINGS

Floor gratings shall be furnished as panels and shall be furnished and installed as indicated on the Drawings. All gratings shall be held firmly in place by removable non-corrodible metal clips. Clips shall not project above surface of grating or walkway. Openings cut in floor gratings shall be framed with 1/8" bar stock of same depth as grating. Unless indicated otherwise on the drawings, floor grating shall be fabricated from straight extruded aluminum I-bars laced together by interlocking cross-bridges or spacers, securely fastened to the bearing bars. Ends of spans shall be closed with flat bars to form box panels. Unless indicated otherwise on the drawings, tread surfaces shall be slip resistance with longitudinal grooves performed by the extrusion process. Unless indicated otherwise on the drawings, grating shall be designed by the grating fabricator to safely support 250 psf with a deflection

not exceeding 1/240 of the span or 1/4 inch. Grating shall be two (2) inches deep unless indicated otherwise on the drawings. Grating shall be Borden's I-bar or equal unless indicated otherwise on the drawings.

Where grating spans exceed 5'-0", and at other location where needed, the grating Fabricator shall design and provide aluminum support beams and all appurtenances to carry the maximum load of the grating as stated above. The beams shall be furnished with appropriate adjustable aluminum supporting clips, attachments, and stainless-steel nuts and bolts. The support beam systems are not necessarily shown on the drawings. Provide supports (not shown in drawings) on either side of all valve operators and floorstands, etc., that are supported by or adjacent to grating. Where access to areas beneath grating may be needed, provide narrow sections of grating to facilitate its removal.

All grating, frames, supports, and all appurtenances shall be properly embedded and installed such that no uneven surfaces or potential tripping hazards are created.

The Contractor shall install embedded grating supports, surface mounted grating supports, and any other types of grating supports in a manner such that the grating will be properly, fully, and securely supported. The grating shall be provided by the Contractor in sufficient length and width that it cannot slip off the supports even if no attachment (hold-down) clips are provided when it is installed in the worst possible configuration. Even when one end of the grating is installed such that it occupies the maximum possible amount of bearing surface, there shall be sufficient grating resting on the opposite support to safely carry the full design loading of the grating. With the grating flush against one end, the minimum seat at the opposite end (i.e. the end with the least bearing surface) shall not be less than 1.5 inches.

Grating supports and grating shall be installed such that the top of grating and embedded frames is exactly flush with adjacent concrete or other adjacent surface. The grating must not be installed in a manner that creates any potential tripping hazard such as may occur if the grating and adjacent surface were not at the same elevation.

The Contractor shall take whatever measures are necessary to correct non-conforming grating to the satisfaction of the Owner.

If the grating must be removed during the startup, final inspection, or punch list correction or similar periods, the Contractor shall replace and reinstall all attachment (hold-down) clips such that all clips are secure when all work has been finally completed.

If hinged sections of grating are used, they shall be designed by the Contractor and installed such that the failure of the hinge or its attachment shall not allow the hinged section to fail. If the hinge fails, the grating shall remain supported by beams that span the complete opening covered by the grating or other satisfactory supports.

If removable sections of grating cutouts (within a larger section of grating) are used, they shall be supported by beams that span the complete opening covered by the grating and that are mounted below the stationary grating. It shall not be acceptable to weld supports to the stationary grating or use other methods less dependable than fixed beams.

9.0 FLOOR PLATES

Metal floor plates shall be cast iron, steel or aluminum as indicated on the Drawings, non-slip type of either diamond or checkered pattern, and set in frames so that top of plate is flush with floor. Frames shall match floor plates and be integrally set in monolithic concrete, anchored by means of embedment clips or anchor bolts. Floor plates shall be accurately fitted to frames. Cast iron floor plates and frames shall be machined to provide even bearing. Steel and aluminum floor plates shall be reinforced where necessary because of span so as to meet load requirements of 250 psf.

10.0 FLOOR VAULT ACCESS DOORS

Floor doors or vault doors shall be of aluminum construction and shall be of size and dimensions as shown on the Drawings. Frames shall be fabricated from extruded aluminum channel metal thickness of not less than 1/4" thickness and shall be equipped with anchor flange around perimeter for embedment in monolithic concrete. Drainage coupling; 1- 1/2", shall be located in bottom of channel frame; and drain piping shall be furnished and installed to a location shown in the drawings or, if no location is shown, to a location (sump in structure or gravel bed in ground, etc.) as determined by the Engineer during construction. Doors shall be single-leaf or double-leaf as indicated with diamond patterned plate not less than 1/4" thickness, reinforced to withstand a live load of 300 psf and be watertight construction. Door (each leaf) shall be equipped with heavy forged brass hinges, stainless steel pins, spring operators, automatic hold-open arm with release handle, and snap lock with removable handle. Finish of aluminum shall be "mill finish" with bituminous coating applied to exterior of frame. All hardware shall be stainless steel. Floor doors shall be as manufactured by Thompson Fabricating Company or Bilco.

11.0 GUARD CHAINS

Guard chains shall be furnished and installed for closing between terminations of pipe railing, at ladders, and elsewhere when shown on the Drawings or required by gates or other appurtenances that interrupt handrail. Guard chains shall be welded steel link 3/16" round stock, weighing not less than 43#/100 LF. Each end of each chain length shall be equipped with stainless steel snap hooks to fasten in eyes of 5/16" eye-bolts. Chain and accessories shall be stainless steel. Eye-bolts shall be stainless steel, shouldered type, bolted through terminal posts of railing or anchored at other terminations, with adapter blocks (aluminum) each side of post. Guard chains shall be double drape for 2-level railing system. Terminal posts shall be stiffened by reinforcing bars.

12.0 LADDERS, RUNGS, AND STEPS

The Contractor shall furnish and set all metal ladders, ladder rungs, and steps as shown on the Drawings. Suitable wall plates or legs and anchor bolts shall be provided as anchorage fittings to set the items securely against concrete, masonry walls, or on floors. All anchor bolts shall be stainless steel.

Safety cages and extension side members shall be provided with ladder assemblies where indicated on the Drawings. All ladder/assemblies and accessories shall be aluminum Alloy 6063 unless otherwise noted or indicated on the Drawings. Steel ladders, where indicated, shall be hot-dipped galvanized after fabrication. Ladder rungs shall be flat topped. Single ladder rungs or steps (individually set in concrete) shall be aluminum Alloy 6063, and shall terminate in walls or anchorage with 3" hook (L). Lengths of ladder rung anchors encased in concrete shall be shop coated with coal tar (bitumastic) or zinc chromate primer. Rungs shall be similar and equal to Neenah R-1982-W.

Cast iron manhole steps, where called for or indicated on the Drawings, shall be 17" wide x 13-1/2" deep, 2-bar step, plastic coated, insert depth not less than 7-1/2". Cast iron shall be ASTM A48, not less than Class 30.

Man-assisting grabs shall be furnished and installed at all ladders. Grabs shall be fabricated from 2" aluminum pipe and aluminum bars. Aluminum pipe shall be stiffened by reinforcing bars.

13.0 LINTELS

Lintels of standard rolled structured steel shapes shall be provided for all openings through or in masonry walls. Lintels shall be of sizes and lengths shown below unless otherwise noted in the plans. Miscellaneous loose lintels, such as required over heating and ventilating grilles, electrical panel boxes, and other similar miscellaneous openings not specifically shown on the Drawings, shall be 3-1/2 inches x 4 inches x 5/16 inch angles for each 4 inch thickness of masonry. Lintels shall be shipped primed unless galvanized lintels are called for in the drawings. Where lintels are made up of two or more members, they shall be fabricated in the shop, and bolted or welded together, with separators if required, and plates where required. Masonry bearing at each end of lintels shall not be less than 6 inches.

<i>Clearspan Opening</i>	<i>Lintels - Steel Angles</i>	
	<i>Brick</i>	<i>Block</i>
4' or less	3 1/2" x 4" x 5/16"	2@ 3 1/2" x 4" x 5/16"
5'	3 1/2" x 5" x 5/16"	2@ 3 1/2" x 4" x 5/16"
6'	3 1/2" x 6" x 5/16"	2@ 3 1/2" x 4" x 5/16"
7'	4" x 6" x 3/8"	2@ 5" x 3 1/2" x 5/16"
8'	4" x 8" x 3/8"	2@ 5" x 3 1/2" x 5/16"

Where 12" block is used, each lintel horizontal ledge shall be approximately 4-1/2" such that entire cavity of block is concealed. The height of the lintel in 12" block shall be 6" minimum.

Note: Load bearing cavity walls require 2 lintels to be welded and attached to allow equal defection in both wythes. Block lintels requiring two units shall be welded in shop.

Note: If the clearspan of the opening exceeds that shown in the above table, or if the wall configuration dictates a different lintel, and if no detailed lintel is called for on the drawings, the Contractor shall provide a design consisting of a heavy W-shape structural steel member, reinforced and extended as required, designed to handle the maximum loading (including monorail or crane load if applicable). The design shall be coordinated with the masonry and all other aspects of the opening. The design shall be developed by and stamped by a licensed professional engineer.

14.0 STRUCTURAL AND MISCELLANEOUS ALUMINUM

Unless otherwise noted, all materials and work shall conform to applicable provisions of the Aluminum Association, "Standard for Aluminum Structures". All members shall be Aluminum Association standard structural shapes. Fabrication work shall be in accordance with current industry practice. Connections not specifically detailed on the Drawings shall develop the full strength of the least strength member of the connection. Unless otherwise noted, connections shall be all-bolted, bearing type, utilizing stainless steel bolts and nuts equipped with a helical spring lock washer under the stationary element (bolt head or nut) and a flat washer under the turned element. A sufficient number of bolts shall be provided in each connection to develop the shear strength of the members.

Structural aluminum shall be erected so that individual pieces are plumb, level, and aligned within a tolerance of 1:500. The elevation of horizontal members shall be within 1/16" of the required elevation. Baseplates shall be set level in exact position and grouted in place.

**STANDARD SPECIFICATION
FOR
MISCELLANEOUS BUILDING MATERIALS**

SECTION 1-8

1.0 INSULATION

Insulation will be applied to those areas shown on the drawings, as hereinafter specified. Coordinate with other trades to minimize changes in the insulation installation.

Blanket or Batt insulation shall be glass fiber with a craft or aluminum foil covering conforming to ASTM C665 (latest revision), Type II or Type III with thickness as shown on the drawings. Insulation in the ceiling shall have an "R" value of not less than 30. Insulation in exterior walls and partition walls shall have an "R" value of not less than 11. Sound attenuation batts at walls where indicated on Drawings shall be a run of 3" thick, unfaced batts. Where shown on drawings or where masonry and/or CMU cavity walls are used, install a minimum of 3" of insulation equal to "Dow" Styrofoam or polystyrene unless shown otherwise.

Blankets shall be placed with vapor barrier facing the heated side in all cases. Areas around doors, windows, etc. shall be filled tightly with loose pieces of insulation. Insulation shall be attached securely and fit tight in all locations. Insulation attachments shall be according to the manufacturer's written directions and the Architect's approval. Coordinate air conditioning spaces with other subcontractors. Insulation shall be installed between piping and sheathing.

For split face CMU walls, provide insulation as shown on the drawings and as required by Masonry Specifications.

For Membrane Roofing, provide insulation as shown on the drawings, and as required by Roofing Specifications.

2.0 CAULKING AND SEALANTS

Building joints shall be inspected prior to application and any conditions detrimental to achieving a positive weather tight seal shall be reported to the general contractor and the Engineer. Sealant shall not be applied to joints treated with a water repellent preservative. Follow manufacturer's written directions for surface preparation of different materials prior to application. Submit samples to Engineer for approval and color selection.

Sealant shall be one part Butyl-Rubber based sealant DAP, Inc. and conform to FS TT-S-001657. If joints are deeper than 1/2", joint backing shall be Tremco joint backing or equal. Equal products manufactured by Dow-Corning or Pecora Chemical Corporation will be acceptable.

All openings to be sealed shall be thoroughly cleaned, dry and free from dust, grease or any other loose matter. Joints deeper than 1/2" shall have a polyethylene joint backing packed into joint to within 1/2" of surface. Where joints are 3/4" wide, joint backing

should be placed where depth of joint sealant doesn't exceed 1/4". Sealant should be run applied so that bead of sealant fills joint completely. All beads shall be tooled immediately after application to ensure firm full contact. Excess materials shall be struck off with tooling stick or knife. All excess materials and smears shall be removed immediately as the work progresses. The manufacturer's written directions shall be strictly followed. All joints around windows, doors, and between horizontal siding and trim shall be caulked.

3.0 VAPOR BARRIER

A 15-mil minimum vapor barrier shall be placed under the bottom slab of all buildings. Use a heavier weight barrier where required by the drawings.

STANDARD SPECIFICATIONS FOR CARPENTRY

SECTION 1-9

1.0 GENERAL

The Contractor shall furnish and securely set in place temporary railings, closures, or other protection as may be required at all floor openings, stairwells, edges of ramps or balconies, roof lines, or at other such locations of like nature. The Contractor shall provide temporary ladders or steps until permanent stairs are in place, temporary wood protection for finished corners and for finished floors, temporary closures for door and window openings until permanent closures are in place, temporary doors with hinges or locks where required for protection from elements or unauthorized entry. The Contractor shall provide temporary closures for all openings in outside walls or roof where necessary to protect the work against the weather or to protect against intrusion. The Contractor is reminded that all protective walks, runways, railings and guards are subject to the requirements of "Safety and Health Regulations for Construction" of OSHA, latest revision, as set forth in the Federal Register.

2.0 ROUGH CARPENTRY

The work under this Section consists of all rough carpentry including, but not limited to, sills, plates, studs, headers, girders, blocking, nailers, sheathing, decking, bracing, etc.

All lumber shall meet grading rules of Southern Pine Inspection Bureau (SPIB). All structural/framing lumber shall be kiln-dried to a maximum moisture content of 15% (i.e. KD15). All other miscellaneous non-structural lumber shall have a moisture content that does not exceed 19%. All lumber shall be properly stored and protected to prevent moisture contents from exceeding these moisture values at the time of installation

All pressure treated wood shall be pressure treated according to American Wood Protection Association (AWPA) and be provided by a treatment plant accredited by the American Lumber Standard Committee. Unless noted otherwise on the Plans, the Use Category System established by AWPA Standard U1 shall be used to determine the appropriate level of preservative/treatment and inspection required for each location where treated lumber is to be used. In no case, shall any treated lumber have a level of treatment less than required by AWPA's use category UC-2. All wood required to be installed adjacent to masonry or concrete, or otherwise noted on drawings, shall be pressure treated.

All lumber shall bear the grade stamp of inspecting agency. All structural/framing lumber shall meet SPIB grade "Select Structural" unless indicated otherwise on the Plans. All lumber for blocking, other miscellaneous uses that are interior/unexposed shall be No. 2 common southern yellow pine, S4S, or utility grade Douglas fir S4S. Lumber such as nailers, grounds, fillers, back blocking, spacers, non-structural studs, etc. shall be No. 2 southern yellow pine S4S or stud grade spruce.

Furnish all items of rough hardware such as nails, screws, bolts, anchors, ties, etc. of quality and material required to properly secure the woodwork. Any hardware which has the potential to be exposed to moisture shall be corrosion resistant. Items required to be built into concrete or masonry shall be furnished in ample time. Fastenings into face of masonry shall be made with toggle bolts, lead expansion shields or molly anchors. Wood plugs will not be accepted.

All plywood shall be in accordance with APA – The Engineered Wood Association. Unless indicated otherwise on the Plans, roof decking shall be 3/4" C-D plywood with a 24" O.C. span rating (min.) and an exterior rated glue bond. Plywood subfloor/floor decking shall be 3/4" T&G, C-C, plugged and touch sanded with a 16" O.C. span rating and an exterior rated glue bond unless indicated otherwise. Exterior rated construction adhesive shall be used to adhere roof/floor decking to rafters/joist in addition to mechanically securing in accordance with the fastener size and nail pattern established by the applicable building code unless indicated otherwise in the Plans. Sheathing for exterior wood framed walls at locations allowed by the applicable building code shall be 1/2" Southern Pine asphalt impregnated insulation board (minimum) unless indicated otherwise on the plans. Sheathing at corners for exterior wood frame walls shall be 1/2" C-D (minimum), with a 16" O.C. span rating and an exterior rated glue bond.

Do all miscellaneous wood framing as indicated on drawings, per applicable building codes, and as required by other trades. Framing shall be square cut, closely fitted, rigidly secured, level and plumb. Provide all wood blocks and nailing strips as conditions require to be imbedded in masonry and/or elsewhere, whether mentioned or not. Bridging and bracing for roof trusses shall be as recommended by truss manufacturers.

Sill plates shall be anchored to masonry with 8" x 1/2" diameter bolts with 2" washers embedded not less than 15" into masonry. Fill cones of masonry where anchors occur. Single sole plates may be used if anchored directly to slab. All non-bearing studs shall be 24" o.c. Top plates for non-bearing partitions may be single plates. Provide solid 2 x 4 blocking behind all paper holders and grab bars. Nailing shall be in accordance with the requirements of the applicable edition of the International Building Code unless there are stricter requirements by the local governing code.

STANDARD
SPECIFICATIONS
ARCHITECTURAL

**STANDARD SPECIFICATION
FOR
DOORS AND ACCESSORIES**

SECTION 2-1

1.0 STEEL DOORS

Steel doors shall be flush type, 1-3/4 inch thickness, full swing, complete with steel frames and hardware. Face sheets shall be No. 18 gauge, seamless cold rolled, leveled sheet steel, factory primed. Doors and frames shall be chemically treated to promote good paint adhesion. Interior of pan formed by face sheets and edge closing members shall be completely filled by rigid urethane core and coated with layer of synthetic resin-base sound deadener. Fire doors shall be of steel construction and manufactured under the UL factory inspection program in compliance with UL Procedures R-3791 and R-5493 and shall bear the UL Label for Class "A" 3-Hour Fire Doors. Frames shall comply with UL Procedures R-382/or UL-63. All doors shall be factory prepared for mortised hinges, locks, latches and flush bolts in accordance with applicable ANSI Standards and reinforced for attachments. Doors shall be equal to Fenestra 2000 K Series.

Door frames shall be No. 16 gauge steel, factory primed, and not be less than 5- 3/4 inches deep. Head frames for double doors shall be No. 10 gauge steel reinforced with No. 16 gauge C-section insert sleeves. Frames shall be equipped with jamb and sill anchors suitable for type material in the opening and be Fenestra or equal. Not less than 3 anchors per jamb section for nominal 7'-0" opening are required. Frames shall be reinforced for attachment of hinges, strikes, and components of other door hardware. Frames may be either knocked-down or welded.

2.0 ALUMINUM DOORS

Aluminum doors shall be flush type, 1 3/4" thickness, full swing, complete with aluminum frames and hardware suitable for aluminum doors. Doors and frame shall be suitable for exterior installation. Door core shall be of honeycomb material 80 pounds per 3000 square feet ream, 20% phenolic resin, 7/16" cell size. A 5" x 0.125" wall thickness extruded tube shall be provided on all four sides for hardware backup; extruded tube shall be 6060-T5 aluminum alloy. Door shall be constructed of one piece 0.040" stretcher-leveled aluminum alloy facing, smooth-finished pattern, laminated to 0.125" tempered hardboard with entire door construction consisting of five plys. Entire perimeter of door shall be furnished with special beveled edge design aluminum extrusion 6063-T5 alloys to receive aluminum skin and hardboard the full width of door.

Doors shall receive anodized finish of a color as selected by the Owner. After application of finish, doors shall receive protective "peel-off" coating which shall remain in place until the end of construction. Doors and frames shall be erected plumb and in true alignment; frames shall be rigid and securely anchored in place. All doors shall be factory prepared for mortised hinges, locks, latches, and flush bolts in accordance with applicable ANSI Standards and reinforced for attachments.

Door frames shall be of extruded aluminum 6063-T5 Alloy with a wall thickness of 0.125 inches. Frame depth shall be as required for function and neat appearance generally filling the opening from the inside to the outside of the opening and shall be not less than 2" in height on inside or outside face. Exterior frames shall be cut square at corners and screwed together with stainless steel screws and extruded corner brackets. Head frames for double doors shall be No. 10 gauge with insert sleeves for reinforcement as required. Finish of frames shall be as noted herein for aluminum doors. Aluminum doors shall be as manufactured by Cline.

All hardware, locksets, hinges, etc. on aluminum doors shall be all stainless steel with dull finish.

3.0 WOOD DOORS

Extent and location of each type of wood door is shown on Drawings and in Schedules. Work includes prefitting to frames and pre-machining for hardware and louvers.

Types of wood doors include flush panel, solid core with veneer faces. Doors shall comply with the following:

1. ANSI/NWWDA I.S.1: "Industry Standard for Wood Flush Doors".
2. AWI Quality Standards for Section 1300 "Architectural Doors".

Each wood door shall be marked with NWWDA Wood Flush Door Certification Hallmark certifying compliance with applicable requirements of ANSI/NWWDA I.S.1 Series. For manufacturers not participating in NWWDA Hallmark Program, a certification of compliance may be substituted for marking of individual doors. Fire-rated wood doors and frame assemblies shall be in accordance with ASTM E-152, listed and labeled by UL, Warnock Hersey or other testing and inspection agency acceptable to authorities having jurisdiction. A fire-rated door refers to the entire door assembly and consists of the doorway, door frame, frame anchorage system, glazing and glazing frame, door and necessary hardware. A separate label for each opening assembly is required. All wood doors shall be obtained from a single manufacturer, unless otherwise approved by Engineer.

Submittals shall include the manufacturer's complete and current Product Data for each type of wood door, certifying compliance and including the details of core and edge construction and trim for openings and louvers. Shop Drawings shall show the location and size of each door; elevation of each kind of door; details of construction; location and extent of hardware blocking; fire ratings; and other pertinent data.

Doors shall be protected at all times from damage, soiling and deterioration and delivered to site in manufacturer's standard packaging. Contractor shall comply with specified ANSI standard and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install and Maintain Wood Doors" and follow manufacturer's recommendations. All doors shall be clearly identified with numbers correlating with designations on Shop Drawings by use of removable markings which will not damage doors.

Acceptable manufacturers are Glen-Mar Door Mfg. Co., Weyerhaeuser Company, or approved equal. Interior flush solid core doors with transparent finish shall have faces of natural birch, plain sliced. Grades shall be premium. Construction shall be PC-5 (particle board core, 5 ply). Fire-rated solid core doors shall have faces and AWI grade to

match non-rated doors in same area of building, be manufacturer's standard core construction to provide fire-resistance rating shown, be manufacturer's standard laminated edge construction to provide improved screw-holding capability and split resistance. Pairs of fire-rated doors shall be furnished with formed steel edges and astragals. These doors shall provide 20-minute rating with fire retardant stiles which are labeled and listed for kinds of applications indicated without formed steel edges and astragals.

Factory-cut light openings shall have trim for non-fire-rated doors with solid wood moldings of profile shown. Where called for wood louvers in prepared openings shall be factory installed.

Doors shall be pre-fitted and pre-machined at factory where shown per AWI Quality Standards for hardware. Comply with Finish Hardware schedule, hardware templates, door frame shop drawings and other information required to ensure proper fit of doors and hardware. Take accurate field measurements of hardware mortises in metal frames before pre-machining.

Contractor shall examine installed door frames before doors are hung and verify that frames comply with type, size, location and swing characteristics shown, and have been installed with plumb jambs and level heads. Before hanging, verify that doors are free of defects. Contractor shall submit written report of any unacceptable conditions and not proceed until problems are corrected.

Doors shall be conditioned to average prevailing humidity in installation areas prior to hanging. Manufacturer's written instructions shall be followed during installation. Install doors in compliance with referenced AWI Quality Standard and requirements of NFPA No. 80.

All doors shall be aligned and fitted in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Seal cut surfaces after fitting and machining.

1. For non-rated doors, provide clearances of 1/8" at jambs and heads; 1/16" per leaf at meeting stiles for pairs of doors; and 1/8" from bottom of door to top of decorative floor finish or covering. Where threshold is shown, provide 1/4" clearance from bottom of door to top of threshold.
2. Fire-rated doors: Provide clearances per NFPA 80.
3. Bevel non-rated doors 1/8" in 2" at lock and hinge edges.
4. Bevel fire-rated doors 1/8" in 2" in lock edge.
5. Trim stiles and rails only to extent permitted by labeling agency.

Contractor shall prefit doors to frames and machine for hardware as required for fit and uniform clearance at each edge. Finish doors in accordance with Plans and Specifications for Painting.

Doors shall be adjusted or replaced which do not swing or operate freely, as required by the Engineer. Doors shall be refinished or replaced when damaged during installation, as required by the Engineer. The Contractor shall prevent damage or deterioration until time of Substantial Completion.

4.0

GLAZING, CAULKING AND WEATHERSTRIPPING

All doors, transoms and observation windows shall be glazed with 1/4-inch tempered glass. Glass not otherwise specified or scheduled for windows and doors is to be 26- oz. double strength "A". Putty shall be designed for the use indicated and relate directly to the metal to which it is applied. Doors furnished with glazing stops shall be back-puttied with stops set in white-lead-and-oil.

All exterior openings as required to be completely watersealed shall be caulked to weather seal with elastomeric vinyl or polysulphide permanently elastic caulking compound. All doors separating climate control areas from non-climate-controlled areas shall be weatherstripped around the entire perimeter of the door opening. Weatherstripping shall be aluminum and closed cell neoprene sponge sealer. All weatherstripping shall be installed in accordance with the manufacturer's instructions.

5.0

DOOR HARDWARE AND ATTACHMENTS

All hardware shall be suitable for heavy duty service, and shall be Russwin, Sargent, Schlage or equal. For purpose of identifying quality and style of hardware reference will be made to manufacturer's style number. All finishes shall be U.S. 26D, unless otherwise specified. Aluminum doors shall have all stainless-steel hardware. Locksets for doors - Sargent 7700 Line, OB Design; Russwin "Stilemaner" 300 series, design "Mono"; or Schlage "A" series, design "Asturn", "D" series for exterior. Locksets for rapid exit doors shall be mortise lock type exit device complete with all panic hardware operators, attachments, and trim. Door closers shall be provided on all exterior doors and on other doors as indicated. Head bolts and foot bolts shall be provided for inactive leaves of double doors. Bolts shall be concealed construction actuated by either fliplever or thumbturn. Where rapid exit hardware is specified, head and foot bolts shall be vertical rod type, concealed, and actuated by panic bar. Door stops or wall bumpers shall be provided for all full swing doors not equipped with door closers. For each door leaf knob that would strike adjacent surfaces, provide appropriate wall-mount bumper. T-Astragals shall be provided for inactive leaves of all double doors, except when panic hardware is specified and/or indicated.

Hinges shall be full mortise type, 4 1/2" x 4 1/2", and shall be 2-ball bearing or 4-ball bearing according to the height of door. Each standard door leaf shall be hung on 1 1/2 pairs of 2-ball bearing hinges; and each leaf of doors higher than 7'-0" shall be hung on 2 pairs of 4-ball bearing hinges. Specialty doors shall have the number of hinges as shown on the drawings.

Locksets for Safety Exit Doors shall be mortise lock type exit device conforming to Federal Specification FF H-106a, Series 820, and shall be complete with all panic hardware operators, attachments, and trim. Covers shall be stainless steel; chassis, pressure formed non-ferrous alloy; arms, stainless steel; crossbar, 1" stainless steel tubing, 0.062" thick; crossbar mounting, 36" above floor; door pull, stainless steel; cylinders, outside keyed.

Unless noted otherwise, key all locks alike in each general unit and key all units differently. Provide five keys of each unit and one general masterkey system throughout. For additions to existing structures, doors shall be keyed to match existing building doors. For each internal entry door, one plastic nameplate is required.

Louvers shall be furnished and installed in locations as shown on the Drawings and shall be of sizes and dimensions as indicated. Louvers installed in doors shall be of depth accommodated by door thickness. Dissimilar metals shall be completely isolated by means of neoprene strips. Louvers shall be of quality equal to manufacture of Airolite Company; H. H. Robertson Company; Louvers & Damper, Inc.; or equivalent.

Louvers for exterior doors shall be of aluminum construction, shall be similar and equal to Airolite, adjustable, outside screened with 18x16 mesh bronze screen cloth, and shall be equipped with automatic operator. Finish shall match that of doors. Louvers for interior door shall be of aluminum construction and shall be of depth to match thicknesses of doors. Louvers shall be trimmed both faces with flanges. Finish shall match that of door trim.

Aluminum thresholds shall be used and shall not be less than 0.250 inch thick. The thresholds shall be installed with stainless steel screws. Exterior door thresholds shall be interlocking type for weatherstripping exterior side. Thresholds for interior doors shall be flat saddle type, except when such doors are to be weatherstripped for soundproofing, light-proofing, or air-tightness. Thresholds shall be non-slip fluted type, not less than 1/2 inch nor greater than 7/8 inch in height and shall be cut and notched to fit door openings.

Full weatherstripping shall be provided. The doors shall be watertight when directly exposed to a very intense, wind-driven rain.

6.0 GENERAL

All doors and frames shall be submitted and furnished per the applicable Building Code requirements. Door and frame sizes shall be coordinated by the Contractor with masonry coursing and other aspects of the work. Rough opening sizes and installation, etc., shall be per the manufacturer's written recommendations. After installation, protect from damage.

**STANDARD SPECIFICATION
FOR
ROLL-UP ALUMINUM DOORS**

SECTION 2-2

1.0 DESCRIPTION

Roll-up aluminum doors shall be interior face of wall or between jamb mounted as indicated on the plans. Between jamb mounting shall include a galvanized fascia, as conditions require.

Roll-up doors shall be chain hoist operated.

Curtains shall be aluminum, with a minimum 18-gauge flat exterior and No. 14 (3") slats. Curtain shall have 24-gauge interior slats with anodized finish. The cavity between the exterior and interior slats will be filled with a foamed-in-place polyurethane insulation. The galvanized bottom bar shall be double angle and attached to an insulated slat with neoprene vinyl astragal.

Doors shall be designed to withstand 20 pounds per square foot of windload (88 m.p.h.). Endlocks or windlocks shall be furnished on alternate slats, as standard. Roll-formed galvanized steel channel assemblies shall be designed to guide curtain travel and retain curtain under design wind pressure. Guides shall have vinyl weatherstrip on exterior side only.

Hoods shall be 24-gauge aluminum with anodized finish and neoprene hood baffle.

Bracket plates shall be constructed of primed galvanized steel with a minimum thickness of 3/16". Operating bracket shall be fitted with ball bearing. Pipe shaft shall be constructed of prime steel and of sufficient diameter to prevent deflection greater than 0.03" per foot of door width.

Helical torsion, counterbalance springs shall be grease packed and have a 25 percent safety factor. Springs shall have permanently sealed, lubricated ball bearings and an inner shaft of cold-rolled steel. Chain keeper and a provision for padlocking chain at chain keeper shall be provided on hand operated doors. The hand chain shall be plated 5/0 lock link chain for chain operated doors.

Ferrous metals shall have shop coat of rust inhibitive primer. Guides and bracket plates shall be coated with a flat black prime paint.

STANDARD SPECIFICATION FOR PAINTING

SECTION 2-3

1.0 GENERAL

Paint work shall consist of furnishing all labor, materials, scaffolding, and equipment necessary for the complete finish coating of all equipment, piping and appurtenances, exposed structural work, concrete surfaces, masonry surfaces, woodwork, miscellaneous iron work and similar items except those surfaces specifically excepted. Where items are not specifically mentioned as requiring painting work but not specifically excepted, they shall be finished in the same manner as specified for similar items. It is the intent of these Specifications that the painting work be complete, and that no items of equipment, structural components, or surface normally requiring finish coatings be left unpainted. In general, exterior brick surfaces, concrete walls of basins, factory finished items, aluminum, stainless steel, and galvanized items, shall not be painted, except as hereinafter specified. Gypsum wall board shall be painted as noted on the Drawings or as specified in the Standard Specification for Gypsum Wall Board.

2.0 STANDARD OF QUALITY

Products of Tnemec Company, Inc., North Kansas City, MO is established as a standard of quality. Equal products may be approved by the Engineer. An "or equal" product will not be approved that decreases from that specified hereinafter recommended dry film thickness or the number of coats to be applied, or that changes the generic type of coating, or that fails to equal or exceed the manufacturer's printed performance data of the specified product(s) as specified hereinafter. Tank painting shall comply with AWWA D-102, Steel Structures Painting Council SSPC-PA2 as applicable, approved paint manufacturer's specifications, and as specified herein.

All paint used on surfaces which will be in contact with potable or treatable water shall be guaranteed by the paint manufacturer to be suitable for the intended surface and not to be a hazard to health. Any paint which cannot be so guaranteed, whether or not specified by manufacturer and product designation, shall not be used.

All paint used for intermediate and finish coats at sewage treatment plants and sewage pumping stations where hydrogen sulfide may be present, shall be guaranteed by the paint manufacturer to be fume proof and suitable for sewage plant atmosphere containing hydrogen sulfide. Any paint that cannot be so guaranteed shall not be used.

3.0 PREPARATION OF SURFACES

The Contractor shall properly prepare surfaces prior to proceeding with work and shall be held responsible for any poor work caused by improperly prepared surfaces. The

application of the first coat of paint by the Contractor shall be construed as an acceptance by him of the responsibility for the condition of the base. Preparation of surfaces shall be as generally outlined below unless recommended otherwise by the manufacturer and approved in advance by the Engineer.

All surfaces shall be thoroughly cleaned and free from all dirt, oil, grease, rust, weld slag, projections, and other foreign matter before priming. This cleaning shall be done by the use of sandpaper, steel scrape, wire brush, or sandblasting as required. Where required, metal surfaces shall be cleaned with a liquid solvent to remove dirt or grease before application of paint materials. Metallic surfaces on which fluids have been used shall be thoroughly cleaned before any paint is applied. Where rust or scale is present, the Contractor shall prepare surfaces in accordance with these Specifications. He shall sandblast or thoroughly wire brush surfaces before priming. Primer shall be applied immediately after surface preparation within the same day and before rusting has begun. The Contractor shall repair all items that have been shop primed or finished coated (excluding items to be prepared and coated onsite) that have become damaged.

A. Metal

1. All Metal. Grind smooth and remove rust, scale, and foreign materials.
2. Submerged Metal. SSPC-SP10-63, Near White Blast.
3. Non-submerged Metal. SSPC-SP6-63, Commercial Blast.
4. Machinery and Equipment. SSPC-SP2-63, Hand Tool.
5. Non-ferrous Metal. All non-ferrous metal shall be SSPC-SP1 solvent cleaned followed by abrasive blasting in accordance with SSPC-P 7 Brush Off Blast Cleaning to create a uniform profile of 1.0 – 2.0 mils.
6. Submerged Ductile Iron (OD): NAPF 500-03-04: "External Pipe Surface Condition".

- B. Masonry. Repair damaged areas, brush-off blast, and wash to remove loose materials.
- C. Submerged Concrete Surfaces. Abrasive blast to provide adequate profile for coating system (Reference SSPC-SP 13. ICRI CSP 5).
- D. Wood. Patch damaged areas, sand, dust, and dry before paint application.
- E. Tar-Coated Surfaces. Tar-based coating shall not be allowed.

Steel, ductile iron, cast iron, and other ferrous metal surfaces not to be immersed in liquid shall receive one shop coat of N140 Pota-Pox Plus applied at 7.0 - 9.0 mils DFT. Such surfaces shall be prepared for shop coating in accordance with Steel Structures Painting Council Specification or NAPF Standards referenced herein. Shop coats shall be compatible with primers and finished coats specified herein for subsequent field application. After receipt of such components, and proper repairs are completed if necessary, surfaces of components shall be prepared as follows:

- Shop Primed Steel Surfaces Submerged or in Vapor Zone Service (i.e., within a 10 ft envelope along/around contained process streams/water-levels that are open to

atmosphere and everywhere within an enclosed process structure): All areas damaged during shipping and installation shall be abrasive blast cleaned in accordance with SSPC-SP 10 Near White Blast Cleaning. All areas of intact shop primer shall be abrasive blast cleaned in accordance with SSPC-SP 7 Brush-Off Blast Cleaning to provide a uniform anchor profile. All edgers shall be feathered.

- Ductile Iron Pipe Surfaces Submerged or in Vapor Zone Service: All areas damaged during shipping and installation shall be abrasive blast cleaned in accordance with NAF 500-03-04: "External Pipe Surface Condition". All areas of intact shop primer shall be abrasive blast cleaned in accordance with SSPC-SP 7 Brush-Off Blast Cleaning to provide a uniform anchor profile. All edgers shall be feathered.
- Non-Submerged Steel and Ductile Iron Surfaces: All shop primed surface shall be power washed in accordance with SSPC WJ 4 Light Cleaning (minimum 3,500 psi) to remove all dirt, dust, chalk, loose paint, as well as any other foreign matter. All areas where the shop primer has been damaged shall be cleaned in accordance with SSPC-SP 11 Power Tool Cleaning to Bare Metal or abrasive blast to an SSPC-SP 6 Commercial Blast Cleaned Surface.
- Galvanized Steel: Where galvanized surfaces are specified to be painted or coated, such surfaces shall be abrasive blasted in accordance with ASTM D 6386 to provide a uniform 1.0 – 2.0 mils anchor profile

Where steel, cast iron, ductile iron, or other ferrous metals (such as motor housings, stands and similar items) are received on the job with finish coats already applied, cleaning shall be in accordance with Steel Structures Painting Council Specifications (SSPC- SP1, SSPC-SP2, SSPC-SP7), as required. A tie coat shall be applied in accordance with the painting schedule. Factory applied coatings shall be compatible with field coatings specified. Steel and other ferrous metals surfaces to be immersed in liquid shall be sandblasted in the field in accordance with Steel Structures Painting Council Specification for White Metal Blast Cleaning (SSPC-SP10). Ductile iron surfaces which will be immersed in liquid shall be cleaned in accordance with SSPC-SP6 Commercial Blast Cleaning.

Concrete and masonry surfaces shall be allowed to age for at least 30 days before coatings are applied. Concrete surfaces (walls, floors, beams, columns, ceilings) specified to be painted or coated shall be properly cleaned and etched to secure a granular surface free from glaze (SSPC-SP 13/ICRI CSP 1-2). When etching has been completed, the surface shall be rinsed, tested, and neutralized if required. Concrete surfaces specified to receive epoxy coatings shall be sandblasted or mechanically abraded in accordance with SSPC- SP 13 /ICRI CSP 3-5 (or as recommended by the manufacturer) to remove all laitance and surface film and shall produce a profile suitable for the specified coating. Where it is found that etching of high density precast concrete items (such as hollow core roof slabs) shall not provide adequate grip for standard masonry coatings, the Contractor shall use a coating particularly suitable for application on such surfaces, and such coating shall be applied at no extra cost to the Owner. Concrete block masonry surfaces shall be cleaned and prepared for painting by scraping or wire brushing (SSPC-SP2) or by air blasting. Concrete floors, where specified in the Plans or Specifications to be painted, shall be prepared by mechanical means in accordance with the manufacturer's instructions. All concrete to be coated shall be tested for

moisture vapor transmission in accordance with ASTM F1869. Should readings in excess of 3lb per 1,000 square feet be obtained, the surface shall be treated with Tnemec 208 Epoxoprime MVT in accordance with the manufacturer's instructions.

The Contractor shall clean wood surfaces to be painted of all dirt, soil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. He shall smooth these finished surfaces exposed to view, using sandpaper and shall dust them off. He shall scrape and clean small, dry seasoned knots before application of the priming coat. After priming, he shall fill holes and imperfections in finish surfaces with putty or plastic wood filler. He shall sandpaper smooth the filled holes or imperfections when the putty or wood filler has dried and cured.

4.0 APPLICATION

Unless approved in writing by the manufacturer and agreed upon in advance by the Engineer, no painting will be allowed until the paint manufacturer's representative is on the job. All painting will be accomplished in accordance with the paint manufacturer's specifications. The paint manufacturer's representative shall test all paint mil thickness and holidays in the presence of the Engineer. The Contractor will be required to perform Holiday Testing as soon as the work is sufficiently cured according to the manufacturer's recommendations. All pinholes and deficiencies will be repaired. Any coating not meeting specifications will be reworked. Adequate ventilation which will effectively remove solvents shall be provided for proper drying of paints on interior surfaces.

It shall be the responsibility of the Contractor to ensure the compatibility of the field painting products which will be in contact with each other or which will be applied over shop painted or previously painted surfaces. Paint used in successive field coats shall be produced by the same manufacturer but with varying colors and shades. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint.

No coating or paint shall be applied when (1) the surrounding air temperature or the temperature of the surface to be coated or painted as measured in the shade is below that recommended by the manufacturer and a minimum of 50°F, (2) when the substrate temperature exceeds the maximum temperature recommended by the manufacturer, or (3) when the substrate temperature is less than 5°F above the dew point. Dew point shall be measured by use of an approved instrument in conjunction with the U.S. Department of Commerce Weather Bureau Psychrometric Tables. Paint shall not be applied to wet or damp surfaces and shall not be applied when the relative humidity exceeds 85 percent. The painting contractor is responsible for making himself aware of the weather conditions that would preclude him from painting under the above conditions.

5.0 SURFACES TO BE PAINTED

Except as specifically excluded below or indicated in the Plans. All metal subject to rust, piping, equipment, wood, and concrete masonry, and outdoor exposed (non- insulated) PVC/CPVC piping shall be painted in accordance with the coating systems specified

herein. Unless otherwise specified or indicated in the Plans, the following surfaces shall be left unpainted:

- a. Exposed surfaces of aluminum, except exposed ductwork.
- b. Polished, finished, or unfinished stainless steel, except flashings and counter flashings.
- c. Galvanized surfaces, except piping, exposed interior conduit, and exposed ductwork.
- d. Piping concealed in inaccessible plumbing chases and above suspended ceilings.
- e. Rubber and plastics.
- f. Acoustical panel ceilings.
- g. Face brick.
- h. Exterior concrete more than one foot below finished grade or normal low water level.
- i. Surfaces specified to be factory finished.
- j. Existing surfaces not noted specifically in the Plans or Specifications.

All exposed interior and exterior poured-in-place concrete for walls, beams, columns, and precast concrete members (i.e. double tees, hollow core slabs, etc.) for non-water containing structures shall be painted to one foot below grade on the exterior and to the horizontal slab/surface on the interior with Thorocoat, Fine by BASF, Tex Cote or Tnemec Series 157 Enviro-Crete. For water containing structures, two coats of Thoroseal by BASF shall be used to one foot below grade and one foot below normal low water levels. Underground vaults, wet wells, electrical chases and other similar areas do not require coating unless shown on Drawings. Coating shall be applied per the manufacturer's recommendations as a two-coat acrylic based system achieving a dry film thickness of 12-16 mils. Prepare a 5' by 5' complete a test section to demonstrate the final color prior to application of the coating system. Coating shall not proceed until the test section is approved by the Engineer.

On any single structure, use the same product for all areas to be coated with a specified color. Do not mix colors or products from more than one source.

Curing compound on structural concrete construction that is to receive a protective coating shall be prohibited. The applying contractor shall notify other trades of this requirement. The Engineer may waive this prohibition and allow use of a curing compound meeting the requirements of the coating manufacturer. Where curing compounds are used, Contractor shall assume complete responsibility for removing compound as required to result in an acceptable coating finish. Existing items requiring coating will be set forth in the Plans.

Cementitious crystalline waterproofing shall be applied where called for on the Plans. Crystalline waterproofing shall form non-soluble crystals of dendritic fibers within the pores and capillary tracts of concrete. Crystalline waterproofing shall be the Xypex line of products as manufactured by Xypex Chemical Corporation, or Engineer approved equal. Surfaces receiving waterproofing coating shall be prepared according to manufacturer's recommendations. Coating shall be slurry applied in accordance with the manufacturer's recommendations and consisting of the following:

- A. 1st Coat: Xypex Concentrate at 300 square feet per 60lb pail or 1/16".

B. 2nd Coat: Xypex Modified at 300 square feet per 60lb pail or 1/16"

All painting shall be in accordance with the Engineer/Owner's color scheme selected during construction. Where specific color scheme is not required by Owner/Engineer during construction, the scheme specified herein shall apply. Many different color variations may be required for architectural effect, piping identification, or other reasons required by the Engineer/Owner. The painting contractor shall allow sufficient time during construction and the submittal process for color scheme selection, coordination, and delivery of coatings.

Factory finished surfaces which have become damaged prior to acceptance by the Owner shall be spot primed and repainted with materials equivalent to those used in the original application. If, in the opinion of the Engineer, spot repair of the damaged area is not satisfactory, the entire surface or item shall be repainted as required by the Engineer.

Throughout the work the Contractor shall use drop cloths, masking tape, and other suitable measures to protect all surfaces from cleaning operations, accidental spraying, spattering, or spilling of paint. The Contractor shall be responsible for and shall correct and repair damage resulting from his operations or the operations of those responsible to him. Paint deposited on surfaces which are not being painted at the time shall be immediately removed. Bituminous paints spilled or dropped on any material except metals shall be surface cleaned and spot painted with aluminum paint prior to applying the specified paint. Exposed concrete or masonry not specified to be painted which is damaged by paint shall be either removed and rebuilt or, where authorized by the Owner, painted with two coats of masonry paint.

6.0 MISCELLANEOUS - TANKS AND BASINS

Upon completion, allow the tank to dry at least 7 days or greater if recommended by the paint manufacturer after the finish coat has been applied and before the tank is sterilized and filled with water. During this period, both the door at the bottom and at the top must remain open.

Paint is to be applied by conventional or airless spray on the interior of the tank in accordance with the manufacturer's requirements. Spray coating of the interior surface shall have an approved method for overspray protection at the discharge from the venting fan. The exterior coating shall be applied with roller or brush.

After the tank has been thoroughly cleaned of all dirt, scale, etc., and after the Engineer has approved it, the Contractor shall sterilize the structure in accordance with AWWA requirements. A series of bacteriological samples shall then be taken and delivered to the state laboratories for examination. This procedure shall be repeated until satisfactory bacteriological samples are taken. Upon receipt of satisfactory results and approval of the Engineer, the facility may be turned into the system.

7.0 MATERIALS

All materials required for painting shall be delivered in unbroken packages, bearing the brand and name of the manufacturer, and all materials shall be subject to review by

the Engineer. All materials used shall be safely stored and stored in accordance with manufacturer's requirements. The Contractor shall provide access to storage space for the Engineer.

Paints approved for various surfaces shall be as manufactured as listed below. The manufacturer shall make available to the Contractor the services of a technical representative who shall be consulted with respect to drying times, cure-out times, compatibility of primers and overcoats, and miscellaneous problems that might arise during the progress of the work. No claim of the Contractor concerning the unsuitability of the materials specified or his inability to produce first-class work with the same, will be entertained, unless such claim is made in writing to the Engineer before the Contract is signed.

TNEMEC - PAINTING SYSTEMS

<i>Item</i>	<i>Prime Coat</i>	<i>Finish Coat(s)</i>
Masonry - Interior Non-Submerged	Fill porous surfaces with 130 EnviroFill @ 60-80 sq. ft./gal	1 Coat 113 Tneme-Tuffcoat @ 4.0 – 6.0 mills DFT. 1 Coat 297 Enviro-Glaze @ 2.0 – 3.0 mills DFT
Masonry – Exterior Above Grade	NONE	2 coats 156 Enviro-Crete @ 8.0 – 10.0 mills DFT per coat
Masonry - Exterior Below Grade	NONE	2 coats 46-465 @ 8.0 – 10.0 mills DFT per coat
Masonry - Submerged in Potable Water	218 MortarClad @ 1/16" minimum. Fill all bug holes, voids, and seal surface	22 Epoxoline @ 20 – 25 mills DFT
Masonry – Submerged in Wastewater	218 MortarClad @ 1/16" minimum. Fill all bug holes, voids, and seal surface	1 coat 436 Perma-Shield FR @ 100 – 125 mills DFT
Concrete Floors - Opaque Finish *	208 Epoxoprime MVT @ 6.0 – 8.0 mils DFT	2 Coats 280 Tneme-Glaze @ 6.0 - 8.0 mills DFT per coat
Concrete Floors - Clear Sealer *	NONE	1coat 201 Epoxoprime @ 6.0 - 8.0 mils DFT. 1 coat 295 CRU @ 2.0 – 3.0 mills DFT
Chemical Sumps *	218 MortarClad @ 1/16" minimum. Fill all bug holes, voids, and seal surface	2 coats 239SC Chembloc @ 6.0 – 8.0 mills DFT per coat.
Concrete Floors - Double * Laminate Quartz Floor	222 Deco-Tread @ 20 mills DFT- Broadcast to refusal - Repeat	One grout coat 222 Deco- Tread @ 6.0 – 8.0 mills One finish coat of 248 Everthane;@ 2.0 - 3.0 mills DFT
Wood Interior and Exterior	10-99W Primer @ 1.0 - 2.0 mills DFT	2 coats 1029 Enduratone @ 1.0 - 2.0 DFT per coat
Interior and Exterior Non- Submerged Metal	Prime: Series 91 H2O Hydro-Zinc @ 2.5 – 3.5 mills DFT	1094 @ 2.0 – 3.0 mills DFT

<i>Item</i>	<i>Prime Coat</i>	<i>Finish Coat(s)</i>
	Intermediate: Series 66 Epoxoline @ 2.0 - 3.0 mils DFT	
Submerged Steel and Ductile Iron Pipe - Potable Water	Primer: Series N140-1211 Pota-Pox Plus @ 5.0 – 7.0 mils DFT.	2 coats 21 Epoxoline @ 8.0 – 10.0 mils DFT per coat.
Submerged Steel and Ductile Iron Pipe – Wastewater Open Top Structures	Primer: Series N140-1211 Pota-Pox Plus @ 5.0 – 7.0 mils DFT. Intermediate: N140 Pota-Pox Plus @ 4.0 – 6.0 mils DFT.	142 Epoxoline @ 10.0 – 12.0 mils DFT
Submerged Steel and Ductile Iron – Wastewater Closed Top Structures – Submerged and Vapor Zone	Series N140 Pota-Pox Plus @ 4.0 - 6.0 mils DFT	Finish: Series 435 Perma-Glaze @ 25.0 – 35.0 mils DFT.
Ductile Iron Pipe – Submerged and Vapor Zone Service - Wastewater	Series N140 Pota-Pox Plus @ 6.0 – 8.0 mils DFT	435 Perma-Glaze @ 25.0 – 35.0 mils DFT
Interior and Exterior Non-Submerged Ductile Iron Pipe	Prime: N140 Pota-Pox Plus @ 7.0 – 9.0 mils DFT Intermediate: Series 66 Epoxoline @ 2.0 - 3.0 mils	1094 Endura-Shield @ 2.0 – 3.0 mils DFT
Non-Submerged Ductile Iron – Vaults	Prime: N140 Pota-Pox Plus @ 7.0 – 9.0 mils DFT Intermediate: Series 66 Epoxoline @ 3.0 - 5.0 mils	Finish: 66 Epoxoline @ 4.0 – 6.0 mils
Outdoor, exposed (non-insulated) PVC/CPVC piping**	Series 20 Pota-Pox @ 3.0 – 5.0 mils DFT	Series 1070 Fluoronar @ 2.0 – 3.0 mils DFT

* Where called for on Drawings.

** Surface Preparation: Clean and dry. Sand to provide a uniform, dense, surface profile of at least 1.5 mils

Thinners shall be as recommended by the paint manufacturer. No other products will be used.

8.0 PIPING AND EQUIPMENT IDENTIFICATIONS

All installed process equipment and similar items (i.e. pumps, motors, tanks [process tanks and chemical tanks, etc.] etc.) shall have its equipment number (e.g. “1”, “2”, etc.) prominently painted on the equipment (or on both the inside and outside of the equipment hatch for submersible pumps). The number shall be neatly stenciled in 3" high letters. High impact plastic adhesive strips may be used in lieu of painting if they have permanent adherence.

Exposed piping and piping in accessible areas shall be identified with lettering or tags designating the service of each piping system, shall have flow directional arrows, and shall be color coded as shown below. Colors to be used shall be verified in the submittal process and changed as directed by the Engineer at no additional cost to the Owner.

Piping shall be completely painted with the selected colors, unless approved otherwise by the Engineer. Color coded vinyl snap on markers with flow direction arrows (by Brady or equal) shall also be used on piping to be left unpainted. All other piping specified to be painted shall match adjacent surfaces, unless otherwise directed by the Engineer.

Lettering and flow direction arrows shall be provided near equipment served, adjacent to valves, on both sides of walls, and floors where pipe passes through, at each branch or tee, and at intervals of not more than 30 feet in straight runs of pipe. If, in the opinion of the Engineer, foregoing requirements will result in an excessive number of labels or arrows on a run of pipe, the number required shall be reduced as directed.

Where the outside of the pipe or pipe covering is 5/8 inch or smaller, metal tags shall be provided instead of lettering. Tags shall have the selected identifying lettering stamped in and shall be fastened to the pipe with suitable chains. Metal tags and chains shall be aluminum or stainless steel. Where tags are used, pipe shall be the color selected.

Lettering on piping shall be painted, stenciled, or snap-on markers. Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915" or Seton "Setmark". Letter size shall be as follows:

<u>Outside Diameter of Pipe or Covering</u>	<u>Minimum Height of Letters</u>
5/8 inch and smaller	Metal Tags - 1/4 inch
3/4 inch through 4 inch	3/4 inch
5 inch and larger	2 inches

Aluminum tags shall be provided for all valves and gates. Buried valves with concrete pads shall be tagged as shown on the drawings. For all other valves, provide numbered aluminum tags fasten to valves with aluminum or stainless steel chains. Coordinate numbering with Engineer during submittal process.

8.1 WATER PLANT AND WATER BOOSTER STATION PIPING COLOR CODE:

A. Water Lines:

Raw	110GN Clover
Settled or Clarified	10GN Aqua Sky
Finished or Potable	11SF Safety Blue

B. Chemical Lines:

Alum or Primary Coagulant	04SF Safety Orange
Ammonia	00WH Tnemec White

Carbon Slurry	35GR Black
Caustic	02SF Safety Yellow with 09SF Safety Green Band
Chlorine (Gas and Solution)	02SF Safety Yellow
Fluoride	25BL Fountainbleu with 06SF Safety Red Band
Lime Slurry	37GN Irish Spring
Ozone	02SF Safety Yellow with 04SF Safety Orange Band
Phosphate Compounds	37GN Irish Spring with 06SF Safety Red Band
Polymers or Coagulant Aids	04SF Safety Orange 09SF Safety Green Band
Potassium Permanganate	14SF Safety Purple
Soda Ash	37GN Irish Spring with 04SF Safety Orange Band
Sulfuric Acid	02SF Safety Yellow with 06SF Safety Red Band
Sulfur Dioxide	37GN Irish Spring with 02SF Safety Yellow Band

C. Wastewater:

Backwash Waste	68BR Twin
Sludge	84BR Weathered Bark
Sewer (Sanitary or Other)	34GR Deep Space

D. Other:

Compressed Air	91GN Balsam
Gas	28RD Monterrey Tile
Other Lines	32GR Light Gray

8.2 WASTEWATER PLANT AND LIFT STATION PIPING COLOR CODE:

	<u>Generic Color</u>	<u>Tnemec Color I.D.</u>
<u>Chlorine (Gas and Solution)</u>	Yellow	OSHA Safety Yellow (02SF)
<u>Compressed Air</u>	Dark Green	Balsam (91GN)
<u>Fire Hydrant</u>	Red	OSHA Safety Red (06SF)
<u>Lime</u>	Light Green	Irish Spring (37GN)

<u>Polymers or Coagulant Aids</u>	Purple	OSHA Safety Purple (14SF)
<u>Potable Water</u>	Dark Blue	Safety Blue (11SF)
<u>Sewage Plant Effluent</u> <u>(Non-Potable Water)</u>	Clay	Terra Cotta (07RD)
<u>Sewer (Sanitary or Other)</u>	Dark Gray	Deep Space (34GR)
<u>Sludge (Dark Brown)</u>	Dark Brown	Weathered Bark (84BR)
<u>Primary Sludge</u>	Dark Brown with Yellow Label (Primary)	Weathered Bark (84BR) OSHA Safety Yellow (02SF)
<u>Return Activated Sludge</u>	Dark Brown with Red Label (RAS)	Weathered Bark (84BR) OSHA Safety Red (SC09)
<u>Waste Activated Sludge</u>	Dark Brown with Light Green Label (WAS)	Weathered Bark (84BR) Daiquiri Ice (PA30)
<u>Primary Scum</u>	Dark Brown with Light Gray Label (Scum)	Weathered Bark (84BR) Light Gray (IN01)
<u>All Other Non-Process Lines</u>	Light Gray	Light Gray (32GR)

**STANDARD SPECIFICATION
FOR
MISCELLANEOUS ITEMS**

SECTION 2-4

1.0 GENERAL

All items of MISCELLANEOUS ITEMS shall be furnished and installed in accordance with the requirements of the Drawings and specific manufacturer recommendations.

2.0 SAFETY EQUIPMENT

Safety equipment shall be furnished and installed as hereinafter described and at locations shown on the Drawings.

Fire Extinguishers shall dry powder, pressurized with nitrogen, ABC multi-purpose type, FM approved and U.L. Listed, with 10-pound capacity. Unit shall be surface wall mounted with heavy duty and Type 304 stainless steel anchors and hardware. Fire extinguishers shall be mounted in the locations shown on the drawings.

3.0 WARNING SIGNS

The following signs shall be provided and installed. All signs shall be manufactured from phenolic plastic. They shall be 0.125" thick, 2 ply with holes for mounting with stainless steel screws. The signs shall be permanent and designed for outdoor installation. Unless noted otherwise, the size shall be approximately 18" x 12". Other signs required by plans but not listed below shall be as per these specifications unless noted otherwise.

Warning - Equipment Starts Automatically

2 – Inside Control Valve Station

Danger – Live

Provide on every Electrical Panel and Equipment Control Panel

In addition to those signs called for above, two (2) additional signs shall be provided and installed at locations determined during construction. The language for these signs shall be determined during construction.

STANDARD
SPECIFICATIONS

PIPING, VALVES,
AND GATES

**STANDARD SPECIFICATION
FOR
PIPE MATERIALS**

SECTION 3-1

1.0 GENERAL

All fittings required for horizontal and vertical bends and deflections are not necessarily shown or called out on the drawings. Plan and coordinate pipe installation such that all required fittings and appurtenances will be available when required. When working around existing utilities, or facilities, etc. carefully spot dig for potential conflicts in a timely manner to allow adjustments to be planned and to avoid delay.

2.0 DUCTILE IRON PIPE AND FITTINGS

Ductile iron pipe shall meet AWWA and ANSI Specifications C-150, C-151 and A 21.50, A 21.51 respectively. Pressure class of ductile iron pipe shall be as indicated on Drawings.

In general, ductile iron pipe shall be furnished with push-on (i.e. boltless) joints for buried applications. The principal standard covering push-on joints shall be AWWA C111/ANSI 21.11. Restrained push-on joint pipe shall be per the specification for Restrained Joint Ductile Iron Pipe and Fittings and shall generally be required in critical buried applications such as highway crossings, creek crossings, railroad crossings, and in other locations as identified on the Drawings. The pipe joint shall be rated/certified to meet or exceed the pressure rating of the pipe itself, or a higher-pressure rating as indicated on the Drawings. In no case, shall the pipe joint be rated for less than 250 psi.

In general, ductile iron pipe shall be furnished with flanged joints for exposed, above-grade applications, unless shown otherwise on the Drawings. The principal standard covering ductile iron flanged pipe shall be AWWA C115/ANSI 21.15 and AWWA C110/ANSI A21.10. All pipe flanges shall meet or exceed ductile iron Class 150 or Class 300 per ASME/ANSI B16.42 or cast-iron Class 250 per ASME/ANSI B16.1 as indicated on the Drawings or as required for connections to equipment, valves, fittings, etc. The flanged pipe joint shall be rated/certified to meet the pressure rating of the connecting pipe or a higher- pressure rating as indicated on the Drawings. In no case, shall the flanged pipe joint be rated for less than 250 psi.

All buried ductile iron pipe shall, unless indicated otherwise, be tar coated outside. Pipe and fittings to be installed in buildings, galleries, basins, other locations where such pipe and fittings will be permanently "exposed" shall have an exterior coat of rust inhibitive primer per the Standard Specification for Painting. Wall pipes, sleeves, fittings, etc., to be installed through concrete walls shall be furnished bare or the exterior coatings removed before installing. All ductile iron pipe and fittings shall be furnished with interior cement lining in accordance with ANSI A21.4/AWWA C104, latest revision, standard

thickness, with an asphaltic seal coat unless indicated otherwise in the Drawings or these Specifications.

All ductile iron fittings shall have a body and joint rated/certified to meet or exceed the pressure rating of the connecting pipe or a higher-pressure rating as indicated on the Drawings. In no case, shall the fitting body and joint be rated for less than 250 psi. Unless indicated in the Plans to be push-on joint, buried fittings shall be mechanical joint or restrained joint. Full body mechanical joint fittings shall meet or exceed AWWA C110/ANSI 21.10. Compact mechanical joint fittings and push-on joint fittings shall meet or exceed AWWA C153/ANSI A21.53. The principal standard covering mechanical and push-on joints shall be AWWA C111/ANSI 21.11. Restrained push-on joint fittings when required by the Drawings shall be per the specification for Restrained Joint Ductile Iron Pipe and Fittings.

For exposed, above grade applications, ductile iron fittings shall be furnished with flanged joints unless indicated otherwise on the Drawings. The principal standards covering ductile iron flanged fittings shall be AWWA C110/ANSI 21.10 and ASME/ANSI B16.42. Large fitting sizes including 54", 60" and 64" shall be covered by ASME/ANSI B16.42 and either AWWA C110/ANSI 21.10 or AWWA C153/ANSI A21.53. All fitting flanges shall meet or exceed ductile iron Class 150 or Class 300 per ASME/ANSI B16.42 or cast-iron Class 250 per ASME/ANSI B16.1 as indicated on the Drawings or as required for connections to equipment, valves, fittings, etc. Flanged fitting joints shall be rated/certified to meet or exceed the pressure rating of the connecting pipe or a higher pressure as indicated on the Drawings. In no case, shall the flanged fitting joint be rated for less than 250 psi.

Bolting shall conform to Table 10.14 of ANSI A21.10/AWWA C110 or ANSI A21.15/AWWA C115 as applicable unless required otherwise by pressure rating requirements. Bolts for use with flat ring type gaskets between cast iron flanges shall conform to the requirements of ASTM A307-84, Grade B, hex head; and nuts shall be hex type of same grade and finish as the bolts. Bolts for use with full face type gaskets between cast 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. Bolts shall also conform to the requirements of ANSI B18.2.1, and nuts shall conform to the requirements of ANSI B18.2.2. High strength bolting and nuts when required due to the pressure rating required by the Drawings or any combination of pressure rating, flange material, and/or gasket material required shall meet the requirements of ASTM A 193 Grade B7 and ASTM A 194 Grade 2H respectively.

The bolting requirements stated above shall apply except when specifically indicated otherwise and except in highly corrosive environments such as inside sewer lift stations, submerged applications, sewage valve pits, sewage/sludge tanks, or any other highly corrosive applications. For these highly corrosive applications, all bolting and nuts shall be 316 stainless steel. The bolts shall be UNC rolled thread, stainless steel per ASTM A 193, Grade B&M, (type 316). The nuts shall be heavy hex, stainless steel per ASTM A 194, Grade 8M, type 316, coated to prevent galling.

Couplings for use with grooved end joints, where specifically called for in the Plans, shall be ductile iron in accordance with ASTM 536, Grade 65-45-12. Gaskets shall be the center leg design manufactured of a nitrile compound. Bolts shall be track head design and

manufactured in accordance with ASTM A-183, minimum tensile 110,000 psi. Couplings shall be Vitaulic or equivalent.

Gaskets for flanged joints, mechanical joints, and push-on joints shall meet the requirements of ANSI A21.11/AWWA C111, latest revision as a minimum. Special gaskets required to achieve high certified pressure ratings per the Drawings shall be per the recommendations of the ductile iron pipe and fitting manufacturer and shall comply with ASME/ANSI Specifications. The gasket materials shall provide the required pressure rating and withstand the expected bolt load without injurious crushing and be suitable for the service conditions. Unless indicated otherwise or required due to pressure rating, gasket materials for various service conditions shall be as follows:

- A. Water Service (up to 120° F) - SBR (Synthetic Rubber)
- B. Water Service (above 120° F) - Neoprene
- C. Wastewater Service - SBR (Synthetic Rubber)
- D. Air Piping For Blowers - EPDM

3.0 RESTRAINED JOINT DUCTILE IRON PIPE AND FITTINGS

Where required by the Plans, restrained joint pipe and fittings shall meet Specifications in the Ductile Iron Pipe and Fittings sections and shall be a boltless restrained connection to protect against separation due to thrust. Restrained joint pipe shall be flexible restrained push-on type, unless otherwise indicated. Joints shall 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. Restrained push-on joint to be equal to American “Flex-Ring” or U.S. Pipe “TR Flex”.

Restraining or “Gripper” gaskets to be used to restrain slip joint pipe shall only be allowed when specifically called for in the Plans. 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 or the pressure rating of the pipe, whichever is greater. Gaskets shall be equal to American Fast-Grip or U.S. Pipe Field Lok Gasket.

4.0 RESTRAINT FOR MECHANICAL JOINT VALVES AND FITTINGS

Where required by the Plans, mechanical joint restraint shall be provided for valves and fittings. Joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism, which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and

ANSI/AWWA C153/A21.53, latest revision. Twist-off nuts shall be used to ensure proper actuating of the restraining devices.

The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., MEGALUG, Ford Meter Box Company, Uni-Flange, or equal.

5.0 BOSSES ON DUCTILE IRON PIPE

Bosses shall be ductile iron and welded to the pipe by the pipe company in the foundry. For pipe sizes 6" through 12" in diameter, a minimum of Class 52 pipe shall be used unless the pipe manufacturer recommends a higher-class pipe. For pipe sizes 14" through 54" in diameter, Class 51 pipe shall be used unless a higher-class pipe is recommended by the pipe manufacturer. Bosses shall be drilled and tapped for proper connection in accordance with the Standard Specifications.

6.0 POLYETHYLENE ENCASEMENT

Polyethylene wrap in tube or sheet form for piping encasement shall be manufactured of virgin polyethylene material conforming to the requirements of ASTM Standard Specification A674. The material requirement, if not shown on the Plans, shall be V-Bio Enhanced Polywrap. Material and installation methods shall be in accordance with the requirements of AWWA/ANSI C105/A21.5 and the pipe manufacturer.

7.0 COPPER PIPE

Copper pipe shall be seamless copper water tube meeting the requirements of AWWA Specification 7S-CR for Type K copper water tube, Type K, hard drawn, or of ASTM Specification Designation B88-61 for seamless copper water tube, Type K hard drawn.

Class O tube may be used underground in sizes through 1-1/4". Class O tube is suitable for use with flared or compression fittings, and with solder-type fittings, provided that rounding, sizing, and preparation of tube ends is performed with the proper tools. Fittings for copper water tube, Class O, installed underground, shall be similar and equal to Mueller, Hays, Ford Meter Box Company or Swagelok (up through 1" size).

Copper water tube installed underground in sizes 1-1/2" and larger shall be Class H, furnished in straight lengths. Fittings shall be solder-type as manufactured by Mueller, Hays, or Crane. All branches from underground tube (1-1/2" and larger) shall be made by use of brass unions and copper to L.P.S. adapters. All valves installed at tees and/or crosses in piping runs shall be similarly equipped.

Copper water tube installed in buildings, vaults, galleries, etc. shall be Class H, furnished in straight lengths, and shall be installed in straight runs. An exception to the specification relative to installation of copper water tube in straight runs may be made when short lengths (not greater than 4') of tubing requiring bends and/or offsets are necessary for connection of items of equipment to water supply lines. This exception would apply only to tubing sizes 3/8" and smaller.

Fittings for tube of sizes 1-1/4" and larger shall be solder-joint type as manufactured by Mueller, Hays or Crane, except that all branches from the main run (whether from tees or crosses) shall be equipped with brass unions and copper to I.P.S. adapters. Valves are required on all branches and all valves are required to be equipped with brass unions and copper to I.P.S. adapters. Fittings for tube size 1" and smaller shall be manufactured by Swagelok or Imperial.

8.0 STAINLESS STEEL PIPE

Stainless steel tubing shall meet the requirements of ASTM Specifications Designation A269 for seamless stainless-steel tubing, Type 316. All fittings for use with stainless steel tubing shall be Swagelok or equal.

Two inch and smaller stainless-steel pipe shall meet ASTM A312, TP316L, schedule 40S, seamless. Stainless steel pipe 2-1/2" or larger shall be pickled and passivated by full immersion meeting ASTM A778, TP316L, as welded grade. Fittings 2" and smaller shall be screwed, stainless steel to ASTM A182, type 316 or barstock to ASTM A276, type 316. Fittings 2-1/2" or larger shall meet ASTM A774 type 316L, butt welded type, stainless steel, schedule to match the pipe, as welded grade. All ells shall be long radius unless specifically indicated otherwise. Flanged pipe ends shall be made up of type 316L stainless steel continuously welded slip-on type rolled angle face rings. Flanges and all flange components shall be stainless steel. Flanges shall be drilled to ANSI 16.1 Class 125 standard. Piping sections shall be shop welded to the maximum extent possible for shipping and handling, field connections in addition to those indicated on the Drawings shall be flanged as described above. Bolting shall be stainless steel type 316. Gaskets shall be EPDM. Welding shall be performed using welders and procedures qualified in accordance with ASME Section IX. On exposed pipe clean all markings, stains, paint, concrete, dirt, etc. from pipe.

9.0 PVC PIPE - SMALL DIAMETER

PVC pipe and fittings for small diameter service pipe shall be rigid, polyvinyl chloride pipe and fittings meeting the requirements of ASTM Specification Designation D- 1785, Type I, Schedule 80, and Commercial Standard Specification CS 207-60, Type I, Schedule 80. Pipe shall be furnished with threaded joints or glue joints for connection to fittings, companion flanges and flanged valves. Glue on glued piping and fittings (including on spare lines) shall be fully compatible with and recommended for the chemical being conveyed. Glue for chemical lines shall be weld on 724 or equal.

10.0 POLYVINYL CHLORIDE SEWER PIPE

All pipe and fittings 15" and less shall be slip joint and made from polyvinyl chloride (PVC) components as described in ASTM D-1784. The sewer pipe and fittings shall meet or exceed the requirements of ASTM D-3034 (SDR 26), Type PSM Polyvinyl Chloride Sewer Pipe and Fittings. Laying lengths shall be 13 feet minimum. All pipe 18" and larger shall meet ASTM 679 and be PS115.

The bell shall consist of an integral wall section with joints conforming to ASTM D-3212. Gaskets shall be vulcanized and comply with ASTM F-477 for Elastomeric Seals for Joining Plastic Pipe.

Each Pipe shall be marked as prescribed by ASTM Standard D-3034 of F-679 as follows: Pipe size, manufacturer's name and code, cell classification, standard dimension ratio (SDR), use (sewer pipe) and ASTM standard.

Representative samples, as directed by the Engineer, will be tested with acetone in accordance with ASTM 2152.

11.0 POLYVINYL CHLORIDE PIPE (PRESSURE CLASS)

The pipe shall be made from Polyvinyl Chloride plastic (PVC) as defined in ASTM Specification D-1784. The pipe shall conform to ASTM Specification Bell conforming to ASTM D-3139 and be approved by the National Sanitation Foundation. The pipe shall have water working pressure rating of 200 psi (SDR21) or 250 psi (SDR17) at 23 degrees C. or greater if shown on the plans. Pipe used for sanitary sewer force mains shall be green in color. Fittings shall be ductile iron and mechanical joint. The pipe will be stored away from direct sunlight.

The joints shall be "push-on" or "twin gasketed coupling", meeting ASTM Standards D-3139. Thickened bell pipe shall be provided meeting Section 6.2 of ASTM D- 3139. Pipe lengths shall not exceed 20 feet. Lubricant shall be nontoxic and have no effects on the gasket or pipe material. Gaskets shall meet ASTM F477 requirements. The gasket manufacturer's mark and year of manufacture shall be molded in the rubber. Gaskets shall be vulcanized natural or synthetic rubber. No reclaimed rubber shall be used. The Owner shall be supplied a certified copy of the manufacturer's quality control report.

As a minimum, the pipe shall have the following data applied to each piece every two feet:

1. Nominal Size
2. Type of Material
3. ASTM Standards
4. Manufacturer
5. National Sanitation Foundation Seal of Approval
6. Quality Control Code
7. Working Pressure Rating

All spigot ends shall be marked to indicate the distance the spigot end should be extended into the bell.

12.0 POLYVINYL CHLORIDE PIPE (AWWA C900 OR C905)

PVC water pipe shall be extruded from clean, virgin PVC resin compound in accordance with ASTM D1784, Class 12454-A or 12454-B. PVC pipe shall meet the requirements of AWWA C900 and C905, Class 200 (SDR 14, minimum) unless indicated a higher Class in the drawings, with the same outside diameters for corresponding nominal sizes

of ductile iron pipe meeting the requirements of AWWA C151. PVC pipe shall be capable of making connection with cast iron fittings meeting the requirements of AWWA C111 without the use of adaptors. Pipe shall be fabricated in nominal 20-foot length. Fittings shall be ductile iron, mechanical joint. Marking requirements of every joint include:

- A. Nominal size and outside diameter dimension base (C.I.)
- B. PVC
- C. Dimension ratio
- D. AWWA pressure class
- E. AWWA (900) designation number
- F. Manufacturer's name and production code indicating date of manufacturer and production shift time
- G. Type of service

PVC pipe shall be equipped with bell and spigot joints. Bell shall consist of integral wall section with pipe. Bell section shall have same hydrostatic strength as pipe wall and meet the requirements of AWWA C900. Joints shall have elastomeric gaskets manufactured in conformance with ASTM F477. Gaskets shall be formulated for water service and be supplied separately from the pipe bell and lubricate recommended by the pipe manufacturer.

13.0 TRANSITION COUPLING

Transition coupling for sewer service lines shall be flexible, made of elastomeric plastic, resistant to chemicals and sewer gases and leakproof. Clamps, hardware, and appurtenances shall be stainless steel. Coupling shall be Fernco or equal. Main line coupling, 8" or larger, will be ductile iron or stainless-steel sleeves.

14.0 PIPE NIPPLES

All pipe nipples 3" and less with screwed connections shall be Schedule 40 brass or stainless steel. No galvanized material will be allowed for screwed joints.

15.0 VALVES - GENERAL

Valves shall close clockwise with 3 turns per inch. Unless indicated otherwise, valves shall have mechanical joint or flange ends. Sewer valve operating nuts shall be of a different size and/or shape of water valve nuts as approved by the owners. All valves operators will be extended as required for safe, convenient and easy access for operation.

All valves, operators, floorstands, brackets, and appurtenances, etc., that require painting shall be prepared and painted in accordance with the Painting Specifications for this project. Primer, intermediate coat, and topcoat shall be the coating system required by the Painting Specifications and manufactured by the same paint manufacturer as submitted to

the Engineer and accepted for the remainder of the project. Color shall be as selected by the Owner. Refer to the Painting Specifications for the project.

All exterior materials shall be suitable for underground service. Exterior bolting shall be 304 stainless steel. Valve assemblies installed in typical underground applications shall be rated for underground service and be designed for satisfactory operation under an external hydrostatic head of 10 psi. Valve assemblies installed in submerged applications (e.g., wetwells, basins, wetlands, ponds, lagoons, etc.) shall be rated for continuous submerged services under 25' (min.) of water submergence or as required by the application shown in the Contract Drawings.

16.0 BUTTERFLY VALVES

The butterfly valves shall be of rubber seated tight closing type and shall meet AWWA Standards C504 and be Class 150B unless indicated on the Plans to be Class 250. Where shown or called out for such application, valves shall be suitable for submerged and underground service and/or air service. Valves on blower discharge piping shall be suitable for hot air. The valve operator shall be suitable for underground service with permanent lubrication. The operator shall close clockwise. All valves shall have an epoxy coating in accordance with AWWA C550 on the inside of the body. Valve bearings shall be sleeve type that are corrosion resistant and self-lubricating. Bearing load shall not exceed 1/5 of the compressive strength of the material. Valve actuators shall be fully grease packed and have stops in the open/close position. The actuator shall have a mechanical stop which will withstand an input torque of 450 ft. lbs. against the stop. The traveling nut shall engage alignment grooves in the housing. The actuator shall be a slotted lever type for 4" to 12" valves and a link and lever type for 14" through 48". A means of adjusting the stem and shaft to attain zero leakage on closure of valve vane shall be provided without taking the valve out of service.

Class 150B butterfly valves shall comply with the following details. Valve discs shall be made from cast iron ASTM A-126 Class B for 3" through 20" sizes or ASTM A-48 Class 40 for 24" size. Sizes 30" and larger shall be ductile iron ASTM A-536 Grade 65-45-12. Disc shall be furnished with 316 stainless steel seating edge to mate with the rubber seat on the body. Ductile iron of adequate strength may be substituted for cast iron. Valve shafts shall be stainless steel conforming to ASTM A-276 Type 304. Shaft seals shall be standard self-adjusting chevron "V" type packing. Shaft seals shall be of a design allowing replacement without removing the valve shaft. All valves shall be hydrostatic and leak tested. The leak test shall be performed at a differential pressure of 150 psig with the disc in a closed position. In a slightly open position, internal hydrostatic pressure equal to 300 psig shall be applied to the inside of the valve body for five minutes. Certified test results shall be made available to the Engineer.

Valves rated for 250 psig service shall comply with the following details. Valves discs shall be constructed of cast iron ASTM A-40 Class 40 for 10" through 20" sizes or ductile iron ASTM A-536 Grade 65-14-12 for 6", 8", 24" through 48" sizes. Disc shall be furnished with 316 stainless steel seating edge to mate with the rubber seat. Ductile iron of adequate strength may be substituted for cast iron. Valve shafts shall be stainless steel ASTM

A-564 Type 630 Condition H-1150. Stub shafts or through shafts are acceptable. Shaft seals shall be standard self-adjusting chevron "V" type packing. Shaft seals shall be of a design allowing replacement without removing the valve shaft. All valves shall be hydrostatic and leak tested. The leak test shall be performed at a differential pressure of 250 psig with the disc in a closed position. In a slightly open position, internal hydrostatic pressure equal to 500 psig shall be applied to the inside of the valve body for five minutes. Certified test results shall be made available to the Engineer.

Where used in water plant or filter applications, valve supplier shall provide valves with actuators as shown on the drawings and/or as required by the filter manufacturer. Supplier/manufacturer shall review application and provide valves and actuators specifically suited for the application (pulsing, throttling, etc.) The actuator shall comply with all filter manufacturer recommendations including but not limited to operating frequency and duration and control logic, etc. Completely coordinate valves and actuators with filter manufacturer prior to making the first submittal. Provide written concurrence with the valves and actuators from the water plant/filter manufacturer and filter control panel manufacturer with the first submittal.

All valves shall be assembled, machined, and tested domestically at the manufacturer's facility. All valves shall be equal to Mueller, DeZurick, Val-Matic or approved equal.

See painting requirements under "Valves - General" and in the "Painting Specifications".

17.0 RESILIENT SEATED GATE VALVE

Valves shall be resilient seated wedge type manufactured to meet the requirements of AWWA C515 with ductile iron bodies. Valves shall have a clear, unobstructed water way when fully opened and shall be at least as large as the pipe inside diameter for which it is intended. All internal surfaces shall be coated with epoxy to a minimum thickness of 8 mils. Said coating shall be non-toxic, impart no taste to water and shall conform to AWWA C550. Gate valves 12" and smaller shall be rated for 250 psi cold water working pressure and shall be tested to 500 psi. Valves 14"-24" shall be rated for 200 psi cold water working pressure and shall be tested to 400 psi. Gate valves 18" through 24" shall have gearing. Gate valves in horizontal position shall have bevel gearing and valves in vertical position shall have spur gearing. Allen screws or metric bolting shall not be allowed. Stem shall be sealed by three O-rings. The top two O-rings shall be replaceable with valve fully opened and while subject to fully rated working pressure. O-rings set in cartridge shall **not** be allowed. Valve shall have two thrust washers with one located above and one below the thrust collar to assure trouble-free operation of valve. The area between the O-rings shall be filled with lubricant to provide lubrication to the thrust collar bearing surfaces each time the valve is operated. The sealing mechanism shall provide zero leakage at the water working pressure when installed with the line flow in either direction and shall consist of a cast or ductile iron gate with a resilient seat bonded or mechanically attached. Further, it shall be designed such that no sliding of rubber on the seating surfaces is required to compress the rubber. It shall also be designed such that compression-set of the rubber shall not affect the

ability of the valve to seal when pressure is applied to either side of the gate. The gate shall be provided with a drain in the bottom to flush the internal cavity of foreign material each time the valve is opened. The valve shall be American Flow-Control, Mueller or approved equal.

See painting requirements under "Valves - General" and in the "Painting Specifications".

18.0 TAPPING SLEEVES AND VALVES

Tapping sleeves shall be bolted split type of ductile iron construction meeting ASTM A 536 Grade 65-45-12. Side flange seals shall be of the O-ring type of either round, oval, or rectangular cross-sectional shape to form a watertight joint when bolted in place. Tapping sleeves shall conform to the respective chemical and physical properties specified for ductile iron fittings in ANSI A21.10/AWWA C110. Walls of sleeves shall be extra heavy, and the sleeves shall accommodate gray iron pipe, ductile iron pipe of the various standard thickness classes and C-900 type PVC pipe. Tapping sleeve and valves shall be manufactured by Dresser, Mueller, American, or equal.

Sleeves for use with ductile iron, cast iron, and C-900 PVC shall be equipped with mechanical joint ends. The Contractor shall determine the type sleeve required for accommodating the pipe and pipe outside diameter before ordering the sleeve. All sleeves are to include the end joint accessories and split glands necessary to assemble sleeve to pipe. No special tools shall be required other than a standard socket wrench. Sleeve shall be coated with asphaltic varnish in compliance with NSF-61.

Tapping sleeves for pressure class PVC lines shall be of heavy welded stainless steel per ASTM A240, type 304 and type 304L. Gasket shall be virgin SBR per ASTM D2000 MAA 610, compounded for water and sewer service with broad cross-section to resist rolling and provide dependable seal. Bolts shall be 5/8-inch UNC rolled thread trackhead, stainless steel per ASTM A193, type 304. Nuts shall be heavy hex, stainless steel per ASTM A194, type 304, coated to prevent galling. Flange shall be ductile iron per ASTM 536, Grade 65-45-12 or stainless steel per ASTM A240, type 304 to accommodate tapping valve flanges. Tapping sleeves for pressure class PVC shall be Romac Industries, Inc., style "SST III", Mueller "H-304", or equivalent.

Branch outlets of sleeves shall be equipped with flanges made with female faces to accommodate raised male faces of tapping valves.

Tapping valves shall meet or exceed the requirements of these Specifications for AWWA resilient seat gate valves with bodies and bonnets made of ductile iron for 250 psi working pressure. The tapping side of the valve shall be equipped with flange having raised male face to ensure proper alignment with the sleeve and shall be equipped with a flange having slotted bolt holes for attachment of tapping machine. The outlet end of the valve shall have the desired joint connection for the intended pipe. All interior and exterior ferrous surfaces shall be protected against corrosion by fusion bonded epoxy coating. Valves shall meet requirements of AWWA C509. Coating shall be applied prior to assembly to assure coverage of all exposed areas including bolt holes. Seat rings shall be oversized so as to permit the use of cutters of the full nominal size of the tapping valves.

19.0 VALVE BOXES

The Contractor shall furnish and install valve boxes for all buried valves. Valve boxes shall be cast iron, screw type, with extension pieces as required to make up the length of box required from surface of ground to top of the valve body. Valve box lids shall be marked as to service. Valve boxes shall be equal to Dresser.

See painting requirements under "Valves - General" and in the "Painting Specifications".

20.0 CHECK VALVES

Check valves shall have ductile iron or cast steel bodies, and shall be plug type, with disc mounted on guided stem. Plug, seat, stem, and guide bushing shall be bronze meeting requirements of AWWA C508. Valves shall be gravity swing type, equipped with lever and weights with stainless steel hinge pins. Valves shall be equal to Mueller, Dresser, American.

21.0 FIRE HYDRANTS

Fire hydrants shall conform to the specifications of the American Water Works Association, C502 with a pressure rating sufficient to match test pressure of the line. They shall be compression type traffic model with 5-1/4" valve opening. Hydrants shall have one 4-1/2" or 5" and two 2-1/2" steamer nozzles with sizes to match the local fire department. Larger nozzle shall be fitted with integral Storz connection when shown on drawings. Threads shall match fire department equipment. Hydrants shall have a bury of 3-1/2 feet unless noted otherwise in plans. The fire hydrants shall be installed as shown on the Plans. Fire hydrants shall be M & H, American, Mueller, or equal, and/or as called for in the plans or specifications or required by Owner for matching their standard. All fire hydrants shall be connected to the main with a 6" valve and rodded throughout.

22.0 STORM DRAINAGE PIPE

Reinforced concrete drainage pipe for storm water shall conform to ASTM C-76, or A.A.S.H.O. M41. Pipe shall be fitted with tongue-and-groove type joints with rubber gaskets unless otherwise indicated. Corrugated metal pipe and arches shall conform to the requirements of the A.A.S.H.O. Designation M-36. All pipe arches shall be bituminous coated in accordance with the requirements of A.S.H.D. Specification 525 and/or 526.

23.0 PRECAST CONCRETE MANHOLES

The pre-cast reinforced concrete manholes shall be constructed in accordance with ASTM C-478. Manholes shall consist of circular pre-cast concrete sections not less than 4'-0" in diameter or as shown on the Drawings. The top section shall be suitable for mounting cast iron manhole frames and covers. Risers shall be furnished in suitable increments to an

elevation not more than 12" below the base of the cast iron frame and cover. Maximum elevation of riser shall permit setting top of manhole frame at the finished grade shown on the Drawings. The bottom riser of the manhole shall be provided with openings to accommodate the sewers entering and leaving the manhole. The arrangement of the openings shall permit the construction of sewers in accordance with the alignment, elevations, and grades shown on the Drawings. All pre-cast concrete manholes shall be set on a foundation bed of compacted crushed stone, 8" minimum thickness, and covering the bottom of the excavation.

Steps, frames, and covers shall conform to the requirements of Gray Iron Casting, ASTM A48-60T, Class 20. The manhole cover shall be the solid indented type with bearing surface machined to provide solid bearing and prevent rocking. Vented manholes are not allowed unless specifically called for in the plans. When required, waterproof manhole frames and covers shall have bolted on lid with rubber or neoprene gasket for watertight sealing. Stainless steel anchor bolts will be used. Frames shall be firmly anchored to top section of manhole. Weight of frames and covers shall be 308 pounds or heavier.

Joints between the manhole sections will be made with offset joints with rubber gaskets or preformed butyl sealants. Rubber gaskets shall meet the requirements of ASTM C 443, latest revision. Sealants shall meet federal specifications SS-S-00210 (210-A) and AASHTO M-198B.

Manholes of precast concrete construction shall have flexible openings to accept sewers entering and exiting the manhole. The openings shall comprise a complete joint with insert piece precast in wall of manhole and comprised of cast iron insert ring tapped to receive draw bolts, cast iron compression flange, and rubber O-ring gasket, or a complete joint with seal assembly inserted in a hole cored in the manhole wall and comprised of a rubber or neoprene boot, stainless steel seal band, stainless steel pipe clamp.

4' diameter manholes shall have a minimum base thickness of 6" unless a greater thickness is called for elsewhere. 6' diameter manholes shall have a minimum base thickness of 8" unless a greater thickness is called for elsewhere.

Flexible connectors shall be provided as follows:

Pipes Less than 18 Inches Diameter

Flexible manhole connectors for lines 18 inches in diameter or less shall be Kor-N-Seal, as manufactured by NPC, Inc. Milford, New Hampshire, or equal. Connectors shall conform to the latest revisions of ASTM C923 and ASTM A167. Boots shall be of chemical resistant, resilient EPDM rubber. Assemblies with toggle or wedge-type expanders shall be fabricated of 304 Series non-magnetic stainless steel. Wedge assemblies shall be from reinforced nylon. External take-up clamps shall be Series 304 non-magnetic stainless steel. Bolt assemblies shall be of Series 305 non-magnetic stainless steel. Flexible connectors shall be stored and installed in strict accordance with the manufacturer's recommendations. Pipes shall be centered in the connector opening and supported during installation such that the pipe does not rest on the connector core band.

Pipes Larger than 18 Inches Diameter

For pipes larger than 18 inches diameter, flex connectors shall be the A-Lok Connector, as manufactured by A-Lok Products, Inc. Tullytown, Pennsylvania, or approved equal. Seal shall provide a flexible, positive watertight connection between pipe and manholes. The seal between the connector and the manhole wall shall be made by casting the connector integrally with the manhole wall during the manufacturing process in such a manner that it will not pull-out during coupling. The seal between connector and pipe will be made by pure compression of the resilient material against the outside diameter of the pipe. The connector shall be capable of being cast into a round structure in a curve and remain centrally located in the manhole wall so that there is no loss of compression or deflection in larger pipe due to curvature of the manhole wall. The connector shall be the only component to affect the seal between the pipe and structure. The connector shall be molded or extruded and vulcanized from materials whose physical/chemical properties meet or exceed the physical/chemical resistant properties outlined in ASTM C923. The connector shall meet or exceed the performance requirements prescribed in ASTM C923. The connector shall be of size specifically designed for the pipe material being used and shall be installed in accordance with the recommendations of the manufacturer.

24.0 PRECAST CONCRETE WETWELLS

When allowed in the Plans to be substituted for precast manholes, precast wetwell sections shall conform to the minimum requirements of ASTM C789. Concrete box sections shall be provided for depth of bury load conditions indicated on the Plans. Unless indicated otherwise, all pipe penetrations or connections shall be made with flexible type connectors. Joints shall be watertight subject to both an infiltration and exfiltration test prior to and following backfilling.

When wetwells are used for manholes, precast flat tops may be provided to transition to a standard four-foot diameter manhole if shown to be acceptable in the plans. Manhole steps shall extend continuous through four-foot manhole risers and precast wetwell to the ground invert.

**STANDARD SPECIFICATION
FOR
INSTALLATION OF PRESSURE PIPE**

SECTION 3-2

1.0 GENERAL

All fittings required for horizontal and vertical bends and deflections are not necessarily shown or called out on the drawings. Plan and coordinate pipe installation such that all required fittings and appurtenances will be available when required. When working near existing utilities and facilities, etc., carefully spot dig for potential conflicts in a timely manner to allow adjustments to be planned and to avoid any delay.

The Contractor shall furnish and install all pipe, fittings, valves, operators, extensions, couplings, valve boxes, gaskets, bolts, nuts, supports, hangers, bracing, appurtenances, and accessories as specified or as required; and shall place the entire piping installation in proper operating condition in every respect. 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. Piping materials shall be of the types, classes, and sizes shown on the Plans or, if not indicated on the Plans, as specified herein.

The interior of all pipe, fittings, valves, and accessories shall be kept free from dirt and foreign material. 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. Should dirt, mud, concrete, laitance, paint, or other foreign materials enter the piping or any section of piping, such piping or section of piping shall immediately be cleaned. Each length or section of pipe shall be cleaned immediately before being placed in the trench and joined. Cleaning shall be accomplished by use of a tight swab or other suitable cleaning device. If necessary, a brush pig shall be run through the section of pipe prior to final swabbing. Pipe ends shall be wiped clean before the pipe is joined.

2.0 HANDLING AND STORING PIPE AND ACCESSORIES

The Contractor shall provide the proper equipment, tools, and facilities necessary for the efficient prosecution of the work. Materials damaged in unloading, handling, or installation shall be promptly discarded and removed from the area of the work. 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. No pipe, fittings, valves, etc., shall be unloaded by inserting loader blades, teeth, etc., into the pipe interior.

Pipe shall be stored on racks or timbers in such a manner that pipe ends are above the ground surface. 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. 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 a manner as specified hereinabove.

3.0 PIPE LAYING

The top of the pipe shall be a minimum of 30" below the surface unless specified deeper by a permitting agency or the plans. The pipe shall have a uniform bearing. Bell holes shall be dug so that the bell will clear the ground. The pipe shall be swabbed for cleanliness before lowering to the trench. Whenever pipe is cut, it shall leave a smooth end at right angles to the axis. All plastic pipe, except services, shall have a #14 copper wire, plastic coated and laid continuously beneath the pipe. Locating tape will not be used. The end of the pipe shall be closed when the work is left temporarily. Angles or bends in the line shall be braced against movement by using concrete and/or permanent joint restraints. Rock and boulders shall be removed to a clearance of at least 6 inches from pipe, valves and fittings. If the bottom of the trench is found to be unsuitable, the Contractor will remove the material, backfill and compact with a suitable base. If unsuitable material cannot be removed, the Contractor shall construct a structural foundation, which does not include stone, for the pipe as directed by the Engineer. Additional compensation will be allowed for this structural foundation work. Extend all valve operators as required for safe, convenient and easy access for operation.

4.0 BRACING OF PIPE AND FITTINGS

All pressure piping shall be braced against internal thrust by means of restrained joints and/or poured-in-place concrete bracing where changes in direction occur or where branches from the line are located.

Braced underground pressure piping shall be securely braced against movement with concrete thrust blocks and bearing against solid, undisturbed ground. Where solid or undisturbed ground cannot be obtained for bracing or where indicated on the Drawings, restrained joint pipe and/or fitting shall be required. Fittings shall be wrapped in plastic with no concrete being placed directly on accessories. All concrete used in underground bracing shall be Class "B" concrete in accordance with the requirements of these Specifications unless shown otherwise.

Special bracing for particular locations identified on the Drawings and/or described herein shall be in accordance with details shown on the Drawings for the particular special brace and shall be complete with reinforcing steel and miscellaneous metal work, if required.

Piping installed above ground in buildings, galleries, tunnels, piping trenches, and chases shall be supported and braced as indicated on the Drawings and specified herein. Where pipes are braced or supported above ground piping by means of concrete piers or thrust blocks, the concrete used by construction of such piers or thrust blocks shall be Class "A" as specified in these Specifications; shall be reinforced; shall be anchored to slabs and/or walls by dowels; and shall be finished to match adjacent concrete surfaces or finished surfaces of adjacent walls or floors, whichever is applicable.

All exposed piping shall be installed neatly in straight lines and without sags. Unless a closer spacing is called for elsewhere, the maximum distance between hangers shall be as follows:

<i>Metal Pipe - Maximum Spacing</i>		
<i>Diameter (inch)</i>	<i>Spacing (feet)</i>	<i>Maximum Hanger Diameter (inch)</i>
1-1/4 or smaller	6.5	3/8
1-1/2 to 2	10.0	3/8
2-1/2 to 3	10.0	1/2
4 - 6	10.0	5/8
8 - 12	14.0	7/8
14	20.0	1

<i>Schedule 80 - PVC - Maximum Spacing</i>		
<i>Diameter (inch)</i>	<i>Spacing (feet)</i>	<i>Minimum Hanger Diameter (inch)</i>
1/2	4-1/2	3/8
3/4	4-1/2	3/8
1	5	3/8
1-1/2	5-1/2	3/8
2	6	3/8
3	7	1/2

If thinner wall PVC is allowed and utilized, the maximum spacing shall not exceed 1/2 of that allowed for Schedule 80 PVC.

5.0 TRENCH BACKFILL

Backfill shall be compacted in layers not to exceed 8 inches and to a minimum density of 95 percent of Standard Proctor Compaction Test. Provide greater compaction where required by other specifications or by the plans. Backfill will be selected earth-free of rocks and hard objects, to a point 12" above the pipe with the remainder of the trench to be kept free of large rocks. Any special trench requirement will be shown on the drawings. When utilities cross other utility trenches, compact trench sufficient distance on either side of existing trench.

6.0 GUARANTEE OF PIPE INSTALLATION AND REPAIRS

All work and materials shall be guaranteed for a period of one (1) year after final acceptance. The Contractor shall pay for cost incurred by the Owner for repairs within and during the guarantee period.

7.0 TESTING OF WATER AND SEWER MAINS

The Contractor shall furnish approved equipment. Testing shall be done in the presence of the Engineer. Testing will be 1-1/2 times the normal operating pressure at the lowest point of the test section but not less than 150 pounds per square inch at any point in the test section. The Engineer shall determine the test pressure and test sections which shall be limited to a maximum of one mile. Tests with joints uncovered shall be maintained for a period to inspect the section, but in no case for less than two hours. Where the pipeline is backfilled, the test will be maintained a minimum of two (2) hours with hydrostatic test performed in accordance with AWWA C-600. Make-up water will be added and measured by a calibrated meter and in a method acceptable to the Engineer. Calibrated pressure gauges shall be used and, when requested, verified on-site such that the testing method is suitable to the Engineer. The make-up water is the “testing allowance” or leakage. Leakage shall not exceed the following:

Maximum Leakage per
1,000 Feet of Pipe in Gallons per Hour

<u>Pipe Diameter</u>	<u>at 150 psi</u>	<u>at 200 psi</u>	<u>at 250 psi</u>
3 Inches	0.28 GPH	0.32 GPH	0.36 GPH
4 Inches	0.37 GPH	0.43 GPH	0.47 GPH
6 Inches	0.55 GPH	0.64 GPH	0.71 GPH
8 Inches	0.74 GPH	0.85 GPH	0.95 GPH
10 Inches	0.92 GPH	1.06 GPH	1.19 GPH
12 Inches	1.10 GPH	1.28 GPH	1.42 GPH
14 Inches	1.29 GPH	1.48 GPH	1.66 GPH
16 Inches	1.47 GPH	1.70 GPH	1.90 GPH
18 Inches	1.66 GPH	1.91 GPH	2.14 GPH
20 Inches	1.84 GPH	2.12 GPH	2.37 GPH
24 Inches	2.21 GPH	2.55 GPH	2.85 GPH
30 Inches	2.76 GPH	3.19 GPH	3.56 GPH
36 Inches	3.31 GPH	3.82 GPH	4.27 GPH
42 Inches	3.86 GPH	4.46 GPH	4.99 GPH
48 Inches	4.41 GPH	5.09 GPH	5.70 GPH

Tests shall be made with a pressure recording gauge. The Contractor shall provide all piping for installing the gauge. Projects financed by the Farmer's Home

Administration shall have a maximum leakage of 10 gallons per inch of pipe diameter per mile of pipe in 24 hours.

It is the Contractor's responsibility to remove all air from the line before testing and plug as required each end of the test section at his expense. Valves may be used at the Contractor's discretion. Contractor shall furnish all water for testing and flushing.

This testing applies to all pipelines (except gravity sewers) including but not limited to pipelines not supplied by pumps.

8.0 TESTING OF AIR MAINS

All plant air piping under low pressure shall be tested to 30 psi by 24 hour recording gauge and all joints being subject to a bubble test before any backfill is placed. All leaks shall be promptly repaired and piping retested.

9.0 DISINFECTION OF WATER DISTRIBUTION SYSTEM

All water mains, pipe fittings, valves, and hydrants installed or affected by the project through which water passes must be properly flushed and sterilized as required by ADEM, the State Board of Health, or any other governing state/local health or environmental agency. In general, procedures for flushing and disinfecting shall be in accordance with AWWA C651, latest revision, and as generally outlined in the *Installation Guide for Ductile Iron Pipe* published by the Ductile Iron Pipe Research Association.

Flushing velocities shall be at least 2.5 fps. For large diameter pipe, where it is impractical or impossible to flush the pipe at specified velocity, the Contractor shall clean the pipeline in place from the inside by brushing and sweeping, then flush the line. If required, the Contractor shall flush the pipe through flushing branches and remove branches after flushing is complete. Service connections and hydrants shall be flushed following pipeline flushing. Contractor shall provide temporary connections as required and operate all valves at least twice during flushing to ensure the complete piping system (including short runs and dead-end runs) installed or affected during construction has been thoroughly flushed. Contractor shall provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties.

Chlorine shall be used for disinfection. If adequate disinfection is not achieved with dry chlorine additions, liquid chlorine solution methods shall be employed. The Contractor shall furnish all chlorine, chemical feed pumps, generator sets, temporary valves and connections, materials, labor, and equipment required for proper disinfection of the piping system. The Contractor shall operate valves, hydrants, and appurtenances during disinfection to ensure that disinfecting solution is dispersed into all parts of pipeline, including dead-ends and areas that otherwise may not be treated. In no case shall the Contractor allow disinfecting solution to enter piping systems which are in service.

Samples will be taken to the State Health Department for analysis. If the samples do not meet the standards of the Health Department, the disinfection process shall be repeated until satisfactory test results are obtained. Approval of samples shall be secured before placing piping system in service. After disinfection, the Contractor shall flush water

from pipeline and hydrants until water through the entire piping system is equal chemically and bacteriologically to the water supply. Contractor shall properly dispose of all disinfecting solution and flushing water in accordance with all applicable requirements and regulations. Contractor shall not allow flow into a waterway without adequate dilution or other satisfactory methods to prevent damage to adjacent properties and environment.

10.0 WATER SERVICE CONNECTIONS

Service connections shall be 3/4 inch and shall consist of a mainline tap, using a hinged saddle, installing a corporation stop, 3/4 inch copper pipe and terminating with a curb stop and a swing check valve at the meter box. Service pipe shall be laid with a minimum of 24 inches of cover with fittings to be equal to the Mueller Company. Service pipe depth under paving will be in accordance with existing local or State Highway Department regulations.

**STANDARD SPECIFICATIONS
FOR
MECHANICAL COUPLINGS**

SECTION 3-3

Pipe couplings shall be threaded, push-on mechanical joint, or bolted as specified herein, required for the application, or as indicated on the Drawings. Unless indicated otherwise, mechanical coupling shall be Smith-Blair, or equal, as follows:

<u>Type</u>	<u>Model</u>
Straight	411
Transition	413
Reducing	415
Insulating	416

Harness bolts, where required on lines under pressure where shown on the Drawings shall be joint restraint system as manufactured by Star National Products, or may be equivalent systems of the manufacturers.

Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. Depending upon sleeve length, a space of at least 1/4" and not more than one inch shall be left between the pipe ends. Pipe and coupling surfaces which contact gaskets shall be clean and free from dirt and other foreign matter during assembly. 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. Following installation of the coupling, damage areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of the Engineer.

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. The remaining components shall be cleaned and shop primed with the manufacturer's standard rust-inhibitive primer.

STANDARD SPECIFICATIONS FOR MANUAL VALVE ACTUATORS

SECTION 3-4

Valve actuators shall be provided, installed, and adjusted by the valve manufacturer. Actuator mounting arrangements and handwheel or chainwheel positions shall be as indicated on the drawings, specified herein, or as directed by the Engineer.

1.0 GENERAL

Unless otherwise required by the Owner, the direction of rotation of the wheel or wrench nut to open each valve shall be to the left (counterclockwise). Each valve body or actuator shall have cast thereon the work "Open" and an arrow indicating the direction to open.

The housing of traveling-nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or set screws to prevent rotation of the nut or collar on the reach rod will not be acceptable. The valve and actuator shall be designed so that shaft seal leakage cannot enter the actuator housing.

Comply with painting requirements in Painting Specifications.

2.0 HANDWHEELS

Handwheel diameters shall be at least 8" but not more than 24" for 30" or smaller valves and not more than 30" for 36" and larger valves. The required Force to force the valve from a closed position and to operate the valve shall not be more than 30 foot – pounds. The gearing and handwheels shall be such that the valve is easy to operate.

3.0 CHAINWHEELS

Unless indicated otherwise or specifically required to be equipped with other types of actuators, all valves with center lines more than 7'-6" above the floor shall be provided with chainwheels and operating chains. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable actuator extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized carbon steel and shall be looped to extend to within 4 feet of the floor below the valve.

4.0 FLOOR STANDS

Floor Stands and Extension Stems: When required by the installations, floor stands and extension stems shall be provided for operation of valves. Floor stands shall be of the nonrising stem, indicating type, complete with all necessary steel extension stems, couplings handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Stem guides shall be spaced so that the stem L/R ratio does not exceed 200. Provide all necessary anchor bolts in type 304 stainless steel. Floor stands shall be cast iron base type, Figure F-5515 as manufactured by Clow Corporation, Figure A-26426 as manufactured by Mueller Company, or equal. All handwheels shall turn counterclockwise to open the valves. Where operators for quarter-turn valves are located on floor stand, extension stems shall be torque tube type properly sized for the maximum torque capacity of the valve.

Floor stand stems and extension stems shall be stainless steel where called for elsewhere in the specifications or drawings. Floor stand anchor bolts shall be stainless steel.

STANDARD
SPECIFICATIONS

STRUCTURAL

STRUCTURAL SPECIFICATIONS INDEX AND SEAL

03 00 00	Concrete (for all Concrete shown/covered in the Structural Drawings)
03 15 14	Strip-Type Waterstops
03 60 00	Grout
04 05 17	Mortar and Masonry Grout
04 05 23	Masonry Accessories
04 22 00	Unit Masonry Assemblies
05 12 00	Structural Steel
06 17 53	Shop Fabricated Wood Trusses

NOTE: THESE STRUCTURAL SPECIFICATIONS ARE FOR ALL WORK SHOWN OR IMPLIED IN THE STRUCTURAL DRAWINGS. IF AN ITEM OF WORK IS SHOWN OR IMPLIED IN THE STRUCTURAL DRAWINGS BUT IS NOT COVERED BY THESE STRUCTURAL SPECIFICATIONS, THEN THE APPROPRIATE SPECIFICATION INCLUDED ELSEWHERE IN THIS SPECIFICATIONS BOOKLET SHALL GOVERN.



Structural Engineer Seal

SECTION 03 00 00 – Concrete

1.0 DESCRIPTION

Concrete shall be comprised of cement, fine aggregates, coarse aggregate, and water, and shall be so proportioned and mixed as to produce a plastic, workable mixture. The relative stiffness of the mix may be varied within the limits hereinafter specified so as to secure the mix most suitable for the particular location and/or condition of placement. Concrete shall be Class “A” or Class “B” as defined below and required under Composition:

(a) Class "A". All reinforced concrete shall be Class "A". If the structure is to contain liquid, the concrete shall be watertight.

(b) Class "B". Concrete not requiring reinforcing. In general, the use of Class “B” concrete shall be limited to plain underground, unreinforced concrete for pipe bracing, skin coats, and concrete fill.

2.0 CONCRETE MIXTURES

- (a) Proportion normal-weight concrete mixture as follows for all concrete shown/covered in the Structural Drawings:
1. Minimum Compressive Strength: 4,000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 8-inches Max for concrete with verified slump of 2 to 4-inches before adding high range water-reducing admixture or plasticizing admixture per ACI 301.
 4. Air content: 5 1/2%, $\pm 1.5\%$ at point of delivery.

3.0 MATERIALS

(a) Cement. Cement used shall be Portland Cement of an approved brand. The cement shall meet Type II requirements. The Engineer shall designate a retarder, if required. Certificate of test showing the cement meets the Standard Specification of A.S.T.M. Designation C-150 with latest revisions will be required. To ensure uniformity of color and appearance, the same brand of cement shall be used in the mixes for all concrete on the project. Portland Cement shall be of color acceptable to the Engineer.

(b) Fine Aggregates. Fine aggregates used shall be clean, sharp and conform to the Standard Specification of A.S.T.M. Designation C-33. No screening or crushed slag will be permitted as substitute for sand in concrete or mortar work. Fine aggregate shall be graded to the following limits:

Passing 3/8" Sieve	100%
Passing #4	95 to 100%
Passing #6	45 to 80%

Passing #50	10 to 30%
Passing #100	2 to 10%

(c) Coarse Aggregates. Coarse aggregate shall consist of either crushed stone, or gravel, and the aggregate shall be clean, hard, durable, and free from foreign matter. The aggregate shall conform to the Standard Specification A.S.T.M. Designation C-33. Coarse aggregate shall be graded as indicated below. The design mix shall set the gradations of the coarse aggregate for the project. Unless stated differently, the gradation shall be 1-inch maximum except where smaller gradation may be needed, such as in beams with congested steel.

Percentages Passing Square Openings

Designated Size	2-1/2 Inch	2 Inch	1-1/2 Inch	1 Inch
2" to #4	100	95 to 100	---	35 to 70
1-1/2" to #4	---	100	95 to 100	---
1" to #4	---	---	100	90 to 100
3/4" to #4	---	---	---	100
1/2" to #4	---	---	---	---

Designated Size	3/4 Inch	1/2 Inch	3/8 Inch	#4
2" to #4	---	10 to 30	---	0 to 5
1-1/2" to #3	35 to 70	---	10 to 30	0 to 5
1" to #4	---	25 to 60	---	0 to 10
3/4" to #4	90 to 100	---	20 to 25	0 to 10
1/2" to #4	100	90 to 100	---	0 to 15

(d) Water. Water used shall be clean, potable, and free from harmful amounts of acids, alkalis, or organic materials. No water shall be added at the job site unless approved by the Engineer.

- (e) Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 2. Retarding Admixture: ASTM C494/C494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
 - a. Bayer Corporation.

- b. ChemMasters.
- c. Conspec Marketing & Manufacturing Co., Inc.; a Dayton Superior Company.
- d. Davis Colors.
- e. Elementis Pigments, Inc.

4.0 AIR ENTRAINED CONCRETE

Concrete used shall be air entrained. When required or directed by the Engineer, concrete shall contain an admixture for controlling the setting rate. The addition of air will be by approved admixtures or by approved Portland Cement containing admixture, conforming to A.S.T.M. C-260 or latest revision. Testing shall be in accordance with A.S.T.M. Standards.

In general, the air content shall conform to the following except when changed by the Engineer or the Testing Laboratory responsible for the design mix and plant inspection.

<u>Coarse Aggregate in Inches</u>	<u>Air Content Percent by Volume</u>
1-1/2, 2 or 2-1/2	5 1/2% +/- 1.5%
3/4 or 1	5 1/2% +/- 1.5%
3/8 or 1/2	5-1/2% +/- 1.5%

If the air content is not satisfactory, the Contractor may be required to remove and replace the concrete without extra compensation or the concrete may be refused to be poured. Concrete refused at the site cannot be used and must be permanently removed from the job site.

5.0 MIXING AND PLACING

Ready mixed concrete shall be in accordance with ASTM Specification C-94. Concrete will be conveyed to the place of deposit by methods which prevent the separation of materials. Concreting shall be carried on as a continuous operation until a section is completed. No dry to set joints will be allowed.

Concrete will be compacted during placing and shall be thoroughly worked around reinforcement, embedded fixtures, and into the corners of the forms. The number and types of the tools or equipment utilized in the compaction process shall be such that compaction can keep pace with the pouring and that compaction can be completed while the concrete is still fresh and plastic. Before beginning any pour, the Contractor shall have on hand and readily available at the location of the pour, spare tools and equipment, in good working condition that can be immediately utilized in case of the malfunction of any tools or equipment being used. Mechanical vibrators will be required with backup vibrators onsite.

Before placing concrete, debris, ice, frost, and water shall be removed from the reinforcement and forms. Forms shall be thoroughly wetted immediately prior to placing concrete, except when freezing. Concrete shall not be poured when the temperature is below 40°F or 45°F and falling unless measures and facilities for protection of the concrete have been provided. Such measures and facilities shall be subject to concurrence of the Engineer and may include insulation of the poured structure, protective covers, and heat source capable of maintaining temperature of the poured structure (forms and rebar) at 50°F or above. Concrete, at the time when deposited in forms or slabs when protection is required, shall not have a

temperature lower than 65°F. At no time shall concrete reach a temperature lower than 50°F. The maximum temperature of concrete, at any time during its production, transportation, and placement, shall not exceed 90°F. During cold weather the finished concrete shall be protected for an adequate length of time following the pouring by maintaining the temperature at a level not lower than 50°F.

After concrete has been placed, it shall be protected against loss of moisture and against damage from succeeding construction operations. Water curing methods shall be employed for all concrete unless other methods are specified herein, shown on the drawings, or concurred with in writing by the Engineer. Water used for curing shall be potable water meeting the requirement of ASTM C 94 with no properties that would stain concrete. Concrete curing methods shall be in accordance with ACI 308. Curing shall be achieved through immersion, ponding, or continuous sprinkling through soaker hoses or lawn sprinklers as required by the type of structure. Concrete surfaces shall be kept continuously wet throughout the curing period. Alternate wetting and drying of concrete surfaces shall not be allowed. Curing shall be continuous for a minimum of 7 days.

Concrete poured in beams, columns, and walls shall be kept wet by continuously sprinkling concrete with water until forms have been removed. After forms have been removed, concrete shall be wetted continuously by one of the above methods for a minimum of 7 additional days. Additional water curing time may be required by the Engineer when environmental conditions are adverse or when daytime temperatures exceed 95°. Concrete for slabs and footings shall be kept continuously wet through sprinkling, ponding, or immersion for a minimum of 7 days. Additional water curing time may be required by the Engineer when environmental conditions are adverse or when daytime temperatures exceed 95°.

In locations where concrete surfaces are specified to be rubbed, concrete shall be kept wet by continuous sprinkling until rubbing has been completed and then shall be covered after rubbing has been completed. Covering shall be by the application of polyethylene sheeting. In addition to walls and other surfaces to be rubbed, the above shall also apply to exposed beams and columns.

Liquid membrane-forming curing compounds may be used in some cases after completion of the above-stated periods of wet curing, if concurred with in writing by the Engineer. Curing compounds are not permitted on surfaces receiving surface treatments or coatings or on any surface in contact with potable water treatment structures. Curing compounds shall conform to the requirements of ASTM C309, Type 2. The compound should be applied at a uniform rate as specifically recommended by the manufacturer. The method of application shall be as recommended by the manufacturer. Application of the curing compound shall follow the recommendations of the manufacturer and ACI 308. The use of curing compounds, if allowed, shall not be a substitute for the wet curing described above.

Liquid “Cure and Seal” compounds shall be used on all floor slabs in operations buildings, pump rooms, chemical rooms, maintenance buildings, filter galleries (both upstairs and downstairs), electrical buildings or rooms, valve rooms, control rooms, laboratories, offices, and other buildings, except such compounds shall not be used on slabs or portions of slabs that will receive carpet, tile, or other type of surface treatment. All slabs, whether receiving the “Cure and Seal” or not, shall be water cured. Apply compounds in accordance with

manufactures recommendations and ACI 308. "Cure and Seal" compounds shall be Diamond Clear VOX by Euclid Chemical Company, or equal.

When placing concrete in walls, the concrete shall be deposited in tremies or by other approved methods to prevent segregation and the accumulation of hardened concrete on the reinforcement above the level of the concrete. The lower end of the tremie or spout shall be not more than six feet above the surface of the concrete.

All concrete shall be placed in continuous horizontal layers of such depth that no dry to set (cold) joints are formed, however not more than 30 minutes shall elapse between placing of successive layers. The depth of any layer shall not exceed two feet.

The concrete mix shall be so placed (without segregation) and compacted (without excessive vibration) that there will be no water on the surface of the finished layer or on the surface of the finished pour. Should water appear on the surface of any layer the pour shall be stopped, the water shall be removed, and the pour shall not be continued until corrective measures satisfactory to the Engineer are employed.

5.1 MIXING AND PLACING – SIDEWALKS, DRIVEWAYS AND PATHWAYS

For sidewalks, driveways and other miscellaneous pathways, concrete mix design and placement will conform to ALDOT Standard Specifications 501 and 618. Drawings may contain special requirements, for reinforcements, finishes, etc.

6.0 TEST

Certification of mill test from the manufacturer of cement and steel will be required. The Contractor shall submit a representative sample of aggregate to a laboratory approved by the Engineer for a design mix as follows:

100 Pounds Fine Aggregate
150 Pounds Course Aggregate
50 Pounds of Cement
3 Ounces of Additive

All concrete shall be designed to test to per required strength in 28 days and shall break at or above required strength psi in 28 days. Cylinder testing as required by A.S.T.M. C- 39 will be used for testing and be at the expense of the Owner. All concrete placed on the project, unless specifically otherwise noted, shall have all the cylinders represented by the pour break at a 28-day minimum strength shown on the contract documents for the pours to be considered acceptable. Provide higher strength concrete or grout where required by specifications or plans or by equipment manufacturers.

The specimens (cylinders) shall be carefully prepared, stored, and protected at the project site in a manner satisfactory to the Engineer until they are ready for transportation to the Testing Laboratory. The cylinders shall be stored on a level bed in a moist environment, and

shall be protected against movement, surface water, ground water, rainfall, and cold weather. The furnishing of slump cones, screeds (knife edges), and containers for the specimens shall be the responsibility of the Contractor.

7.0 WATERTIGHT CONCRETE AND TESTING

Basins, tanks, or any structure built to contain liquid shall be watertight. As soon as possible, the Contractor shall fill structure with water and if leakage should develop, the contractor shall correct leakage in a manner acceptable to the Engineer. Duration of leakage test shall be not less than 72 hours with no leakage allowed for this period for approval. The tests shall be repeated until leakage has been stopped with the work not being accepted by the Engineer until it is watertight. Before testing watertight structures, the structure roof or other bracing shall first be poured and cured, and all concrete must achieve its full strength. No backfill shall be added until structure has been accepted as watertight.

Minor concrete repairs for leaking walls shall be fixed by means to stop all leakage. Major concrete cracks in walls shall be repaired by flexible pressure injected sealant or material by a specialty contractor such as Barton Southern Company who has experience in such repairs. All exposed concrete shall be re-rubbed and finished such that the entire wall has a uniform pleasing appearance.

8.0 REINFORCING STEEL

Reinforcing steel used shall be Billet Steel, Grade 60. Steel shall comply with the latest revisions for the following:

<u>Type</u>	<u>ASTM Designation</u>
Billet Steel Bars	A-615, Grade 60
Welded Steel Wire Fabric	A-185, Grade 65
Dowels Across Expansion Joints	A-675, Grade 80

Reinforcing shall be properly bent and free from rust, mill scale, and other foreign substance. Reinforcing bars should not be bent or straightened in a manner that will injure the materials. Bars with kinks or improper bends should not be used. Bars shall not be bent in the field except for realignment of #7 through #18 rebar up to about a 30° bend and #3 through #6 rebar up to about a 45° bend. No bars partially embedded in concrete shall be field bent. Exposed reinforcement bars for future extensions shall be protected from corrosion and concrete splatter.

Reinforcing shall be in accordance with the Plans and approved Shop Drawings. The Contractor shall furnish reinforcing bar details and marking or erection diagrams to the Engineer for review. These shall be on the same size drawings as the Engineers' Plans and shall be clear and legible. Any splicing, other than that shown in the Plans or Shop Drawings, shall be approved by the Engineer.

When it is necessary to splice reinforcement at points other than shown on the Drawings, the character and location of the splices shall be detailed through the submittal process for review by the Engineer. In such places the bars shall be placed in contact and securely wired. Wherever possible splices in adjacent bars shall be staggered. Lengths of

splices or laps shall be a minimum 30 bar diameters unless indicated otherwise in the Drawings. In no case shall length of lap be less than that required by ACI 318 or the CRSI *Manual of Standard Practice*, latest edition.

Mechanical connections should be installed in accordance with the manufacturers' recommendations. A full mechanical connection is one in which the bars are connected to develop in tension or compression at least 125 percent of the specified yield strength of the bar. For welded splice, when required, the bars shall be butted and welded to develop in tension at least 125 percent of the specified yield strength of the bar. Welding shall conform to the current edition of "Structural Welding Code - Reinforcing Steel" (ANSI/AWS D1.4).

The clear distance between parallel reinforcing bars in a layer should not be less than the nominal diameter of the bars, 1 inch or 1-1/3 times the nominal maximum size of the coarse aggregate, whichever is greatest. Where parallel reinforcement is placed in two or more layers, the bars in the upper layers should be placed directly above those in the bottom layer with the clear distance between layers not less than one inch. All reinforcements shall be protected by a thickness of concrete as follows:

- A. For concrete deposited against the ground without the use of forms, the steel shall have 3 inches cover, except a 4 inch slab shall have 2 inches of cover.
- B. For concrete exposed to the weather or to the ground or to water or to the inside of wet wells, clearwells, etc., with the use of forms, the concrete cover over the steel shall be 2 inches.
- C. For slabs and walls not exposed to the ground or to the weather or to the ground or to water or to the inside of wet wells, clearwells, etc., the steel concrete cover shall not be less than 3/4 inch for #11 bars and smaller or 1-1/2 inch for #14 and #18 bars. Underside of slabs exposed to sewer and other harsh affects shall have 1 inch of cover for 6 inch slabs and 1-1/2 inches for 8 inch and greater slabs.
- D. For beams, girders, and columns not exposed to the ground or to the weather, the steel concrete cover shall not be less than 1-1/2 inches.

The steel supplier shall provide bent spacers of #3 bars. Provide larger bars where needed for proper support. The Contractor shall coordinate the dimension and details, etc., with the method in which the rebars will be arranged and supported to insure proper clearance. These spacers shall be used in walls and slabs to ensure that the steel from the concrete surfaces has proper clearance as outlined above. Reinforcing shall be maintained at the required clearance from the forms during the pouring and hardening of the concrete. Chairs shall be used to maintain clearance on slabs. Concrete supports poured on jobsite may be acceptable for slabs poured against ground if the proposed method of producing and utilizing the supports is acceptable to the Owner. The use of stakes, stones, or brick to support reinforcing shall not be acceptable. Except as modified herein, or in the Plans, bar supports and spacing of same shall be per recommendations set forth in the CRSI *Manual of Standard*

Practice, latest edition. Steel wire bar supports in concrete areas where soffits, slabs, or ceilings are exposed to view or are painted shall be Class 1 or Class 2, Types A or B; Class 3 shall be

acceptable in other areas.

Pre-tying of steel mats shall generally not be allowed. Where allowed, it shall be the responsibility solely of the contractor to coordinate all openings through the steel and all other details. Vertical and horizontal bars of pre-tied mats shall align exactly with adjoining steel and dowels, etc. If extra bars must be cut for openings through mats due to the pre-tie operation, the Contractor shall field install full length bars to replace those extra bars cut. This shall be in addition to all other bars required by other details.

9.0 FORM WORK

The Contractor shall furnish, maintain, erect, and remove all forms, molds, centers, and bulkheads, templates or profiles, and shall furnish and maintain all screeds and bonding grooves, keyway materials or other forms necessary for construction of the concrete included in this Contract. Except as hereinafter specified otherwise, forms shall be of wood or metal, and of type and condition as approved by the Engineer. Only joints indicated in the Plans or approved in the Submittals will be permitted.

The Contractor shall be responsible for the design, erection, bracing, sealing, and finishing of the form work in such a manner as to contain and support the concrete during placement. All form work is to be well built, substantially unyielding, tight, properly spaced, set true to line and elevation, properly braced, and anchored. Forms shall be held by means of wall clamp ties. Wire ties will not be permitted. No tie shall be used which are removable and leaves a hole through the concrete section, or which leaves metal within one inch of the surface of the concrete. Form ties shall be equipped with integral waterstops.

Bevel strips shall be placed at all corners of walls, at all points where angles occur in walls and at all tops (both edges) of exposed walls. All such corners, angles, or intersections exposed to view shall be chamfered.

The inside contact surfaces of forms shall be coated with non-staining mineral oil before being set in place. For potable water structures, oils shall be approved for use in potable water applications. Oil shall not be allowed to contact reinforcing steel or surfaces to which the concrete is to be bonded. Contact surfaces of forms shall have tight, flush, watertight joints, packed and taped where required so as to prevent loss of water or paste. Bottom edges of forms shall be set true and tight against footings or other receiving concrete surfaces, and shall be sealed to prevent loss of water or paste. Forms shall be wet before pouring concrete.

Temporary openings shall be provided at the base of wall forms, beam forms, and column forms to facilitate cleaning. All forms shall be thoroughly cleaned and washed immediately before beginning a pour, and all temporary openings shall be closed. In case of wall pours starting at the base slab or other levels below ground affected by the water tables, the Contractor shall provide pump sumps and pumps to completely remove all wash down water and any water containing silt or debris.

When forms have been erected for some time prior to a pour or have been exposed to changes in weather, the Contractor shall recheck all forms immediately before the pour, and shall make any adjustments necessary to bring the contact surfaces to true horizontal, vertical, or circular lines.

The Contractor shall provide special forms where required for openings in walls and floors for the installation of pipes, gates, flanges, and similar items. Where pipes are already in place, all pipe openings shall be securely blocked or bulkheaded to prevent entrance of

concrete, paste, or laitance into the pipes. Where gates, such as flat frame sluice gates or other flat frame gates are to be installed, the wall plate in the area to be occupied by the gate shall be true and even, both horizontally and vertically in order that the gate may be installed watertight and not be warped by uneven drawdown on the gate anchor bolts.

10.0 REMOVAL OF FORMS

The removal of forms shall not be started until the concrete has attained sufficient strength to withstand any live loads that may be imposed by succeeding steps in the construction process. The length of time required between placement of concrete and removal of forms may vary with weather conditions, loading conditions, and particular construction activity in the vicinity of the recently poured concrete elements. In no case, however, shall forms be removed earlier than the following unless the concurrence of the Engineer is first secured.

Beams and Elevated Slabs	14 - 21 Days
Footings and Slabs	1 - 7 Days
Columns and Walls	3 - 7 Days

11.0 FINISHING

All concrete surfaces shall be finished to the elevation shown on the Drawings. Where surfaces of concrete pours are specified and/or indicated to have final finish other than the monolithic concrete, the monolithic pour shall be terminated at such level below the final finish elevation as is correct or suitable for the particular final finish. Those surfaces over which grout is to be placed for setting or grouting-in of machinery, equipment, bed plate, foot plates, bearing plates, etc., shall be “green-cut” and cleaned prior to the placement of grout. Surfaces specified to receive special finishes shall be prepared as hereinafter specified, or required by the Plans.

Where surfaces to be finished are covered by forms, the forms shall be removed as soon as possible (following specified minimums) to permit finishing work. Immediately following removal of forms all imperfections in the surfaces of the concrete (such as form marks, projections, fins, rough areas, honeycombed areas, pits, mismatched joint marks, tie holes, etc.) shall be corrected by use of cutting tools, grinding tools, patching, plugging, and rubbing. Plastering shall not be permitted. Form tie holes and form bolt holes shall be immediately plugged. Where form ties or form bolts are left in the concrete, such accessories shall be equipped with integral waterstops, and the ends of such accessories shall not be closer than one inch to the surface of the concrete. The holes left in each face shall then be primed with a tack coat of grout mixed with an approved accelerator, a stiff mix of mortar with an approved accelerator tamped in the holes, and the surfaces finished flush with the concrete surfaces.

All interior and exterior concrete surfaces of walls, columns, beams, ceilings, etc., permanently exposed to view above ground, in galleries, rooms, tanks, basins, etc. (from 1'-0" below grade or the low water line upward), structures covered with grating shall have the walls rubbed to 1' below the minimum water level, and the ceiling of structures where the walls require rubbing, shall be rubbed while “green” with a carborundum stone to a smooth, consistent, and uniform even surface showing no marks, joints, pits, pockets, or form grain. All imperfections shall be corrected immediately after removal of forms. Rubbing of surfaces shall begin after imperfections have been corrected and shall be completed within five days after the removal of forms from such surfaces. All rubbing will leave concrete uniform, consistent, and

pleasing appearance. If concrete is stained, etc., from subsequent operations such as repair or leaks, the entire area will be re-rubbed to accomplish satisfactory results.

All interior floors shall be given a “steel trowel”, monolithic cement top finish unless otherwise shown in the Plans or specified. Enough cement finishers shall be employed to complete the finishing work before the cement has taken its initial set. Where such floors are shown to be equipped with floor drains, the surfaces of the floors shall slope evenly to the floor drains. No water shall stand on the finished floors. Floors finished before completion of the work shall be protected from damage by boards, sisal kraft building paper, or other adequate means.

Floors of basins, except those where final grout finish is specified to be swept in by the operating mechanism, shall be screeded to a reasonably smooth and uniform finish with even slopes as indicated on the Drawings. The screeding work shall continue until sufficient paste is brought up to secure a uniform cement/sand (grout) appearance, free from any exposed aggregate. Grout shall be added if necessary to secure the desired appearance. Where floors of basins are indicated to be sloped to floor drains, no standing water shall remain. Floors shall be uniformly sloped as indicated on the Drawings.

Surface of exterior concrete walkways, suspended slabs, and other exterior concrete surfaces subject to foot-traffic, shall be wood float finished and then lightly crossed- broomed. Where these surfaces are indicated to be sloped for drainage, no standing water shall remain.

The Contractor shall construct all curbs, bases, and foundations required for setting equipment called for in these Specifications or shown on the Drawings. Curbs, bases, and foundation pads shown on the Drawings are for equipment of a particular manufacturer. Should equipment of other manufacturers be furnished, the Contractor shall prepare drawings showing details of curbs, bases, and foundation pads to receive the equipment furnished. These drawings shall be submitted to the Engineer for review. No extra compensation will be allowed by reason of such changes in design of such concrete items.

The treads of all concrete steps and stairs shall be finished by trowel with 3/4 inch thickness, non-slip concrete, applied as dry as practicable at the time that steps are poured, and as an integral part of same. The aggregate for this concrete finish shall contain 33-1/3 percent abrasive aggregate (3/32 inch maximum size) manufactured by the compression and vibration process and 66-2/3 percent crushed stone (3/8 inch maximum size). This top finish shall cover the entire tread back of the non-skid nosing elsewhere specified, and shall be troweled to a smooth, even, level surface. Proportions: 2 cement, 1 sand, 3 aggregate by volume.

12.0 CONSTRUCTION JOINTS, EXPANSION JOINTS, AND WATERSTOPS

Construction joints, expansion joints, waterstops, and joint seals shall be provided at locations indicated or approved in advance by the Engineer. Changes shall be subject to the Engineer’s approval. Before concrete is placed against previously poured concrete, the contact surfaces shall be cleaned until completely free of laitance, dirt, and debris. Contact surfaces shall be kept continuously moist between successive pours of concrete and shall be thoroughly wetted immediately before placement of fresh concrete.

Waterstops shall be placed at concrete joints in all structures built to contain water. Waterstops shall be PVC material, dumbbell configuration, 6 inches wide and not less than 3/8 inch thick, ribbed pattern unless shown otherwise in the drawings. Splices of waterstops

will be by vulcanizing. All watertight joints, whether waterstop is required or not, will be sealed on the inside face by approved sealants similar and equal to these products: Duoflex by the Sika Corporation, Synthacalk GC2+ by Pecora Corporation, and Tammsflex by Euclid Chemical. Prepare the joint per manufacturer's recommendations to install sealant. No nail or wires holes or any type of penetration will be allowed in waterstops.

All expansion joints shall be sealed with backer-rod, primer, and polyurethane sealant. In the case of slabs on grade, the complete sealing process shall be applied only to top surface of joint; in the case of vertical walls the complete sealing process shall apply to joints on both faces of the wall and joints over tops of walls; and in the case of elevated slabs and beams, the complete sealing process shall apply to joints on top surfaces, on edges, and on all exposed undersides. Backer-rod shall be of premium grade polyethylene foam or Rescor type filler material, unless specifically shown otherwise in the drawings. Primer shall be an underwater type primer suitable for the surface conditions to which the joint will be subjected. Primer will be allowed to dry thoroughly if required by the manufacturer's instructions prior to application of sealants.

All PVC waterstop shipped to the project shall be new and shall not have had a shelf-life (storage after date of manufacture) of greater than eight months. All PVC waterstop received on the job shall be used (closed in concrete on both sides of a joint) within eight months after date of manufacture. The waterstop shall be stored at the job site in an indoor location and shall be protected against direct sunlight. After the waterstop is set in a concrete pour the exposed half of the waterstop shall be protected against damage resulting from the construction operations and against sunlight. The Contractor shall so schedule his pours that the joint material (waterstop) will be completely enclosed in concrete within eight months after date of manufacture.

Expansion joints for sidewalk or paving slabs abutting structures, for floor slabs meeting columns where columns pass through floor and for concrete aprons meeting ground floor slabs shall, unless indicated otherwise in the Plans, be filled with material meeting the requirements of ASTM Specification D 1751-73, and shall consist of preformed strips of cellular fibers saturated with asphalt.

13.0 FLOTATION

The Contractor shall prevent the flotation of concrete structures during construction.

14.0 FERRULES, OPENINGS, AND RECESSES IN CONCRETE

Suitable alloy-steel sleeves or wall pipe assemblies shall be set in concrete for all small piping of every kind where such piping passes through concrete walls or floors. Such sleeves or ferrules shall be set with reference to their position in the final finish. Where it is

found impossible to exactly locate the position of small pipes, openings of sufficient size shall be left in the concrete to allow the necessary latitude for later locating the sleeves and pipes, and after insertion of sleeves and pipes, the holes shall be properly filled with concrete. Annular spaces between sleeves and piping in exterior walls shall be caulked with Link-Seal (or equal) assemblies.

15.0 SETTING FITTINGS, FLANGES, ANCHOR BOLTS, EQUIPMENT ETC.

Where necessary to set flanges for gates or valves, pipes, manhole frames or castings, sleeves, pipe hanger rod inserts, frames, etc., in concrete walls, floors or slabs, particular care shall be taken by the Contractor to insure that all these fittings etc. are properly set in forms, level, plumb, lined up, and properly oriented, etc., the Contractor shall use submittals and other Contractors' or special drawings. The Contractor shall set all anchors, bolts, or other steel work in the concrete forms for motors, or other machinery or equipment in accordance with installation drawings by the supplier of the equipment, or as indicated by the Engineer. Paint all aluminum such as gates, handrails, conduit where placed against concrete or dissimilar metals with approved coating for intended service to protect from corrosion.

A watertight installation shall be secured where piping passes through tank or basin walls. Wall sleeves, wall pieces, and pipe to be placed in concrete walls shall first have tar coating on outside of the pipe or fitting burned off before the pipe is grouted or monolithically cast in place. Such pipe pieces may be furnished with outside "bare".

16.0 SETTING ELECTRIC CONDUIT AND DEVICE BODIES

Electrical conduit shall be installed in the concrete work as indicated, and provision shall be made for their protection during the pouring of the concrete. Outlet boxes shall be located with reference to the final floor, wall, or ceiling finish. Device bodies shall be so secured to the forms before the concrete is poured. Any galvanized conduit in potentially wet areas require Roboy PVC coating. Aluminum conduit entering concrete shall receive a bitumastic coating.

Prior to placing conduit, the Contractor shall use approved manufacturer shop drawings to accurately determine the correct locations and dimension for all conduit stubups, electrical gear, control panels, and all other facilities requiring power, etc.

SECTION 03 15 14 – STRIP-TYPE WATERSTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Hydrophilic rubber waterstop and non-expanding mastic waterstop.

1.2 SUBMITTALS

- A. General:
1. Submit the following items for each type, style and size of hydrophilic waterstop to be installed.
 2. Product data:
 - a. Manufacturer's product data sheets.
 - 1). Include complete physical dimensions, expansion characteristics, and laboratory test reports indicating that average material properties conform to the requirements specified.
 - 2). Provide data sheets for all materials to be included in the waterstop system.
 3. Samples:
 - a. Minimum 6-inch long samples of each type of waterstop to be used if requested by the ENGINEER.
 4. Manufacturer's installation instructions:
 - a. Installation instructions and recommended installation details for the complete waterstop system, and for each component used in that system.
- A. Where general "strip-type" waterstop is noted, provide non-expansive mastic strip waterstop.

PART 2 - PRODUCTS

2.1 HYDROPHILIC RUBBER WATERSTOP

- A. General:
1. System composed of flexible hydrophilic urethane polymer with preformed strips, adhesives, paste, fasteners, and other accessories required for a complete and watertight installation.
 - a. To ensure compatibility of materials, a single manufacturer shall provide all products and accessories for the hydrophilic waterstop system.
 - b. Products incorporating bentonite are not acceptable under this Section.
 - c. Provide waterstop and accessories resistant to degradation under cyclic wetting and drying and to chemicals typically found in water treatment structures.
- B. Hydrophilic strip waterstop.
1. Pre-formed strips of flexible hydrophilic rubber designed to undergo controlled expansion when exposed to moisture.
 - a. Strips manufactured to limit expansion in directions parallel to the plane of the joint, and to direct expansion against confining material perpendicular to that plane.
 2. Provide normal or low-expansion pressure as scheduled and as indicated on the Drawings.
 3. Manufacturers. One of the following, or equal.
 - a. Hydrophilic strip.
 - 1). Adeka Ultra Seal USA: MC-2010MN.
 - 2). Greenstreak: Hydrotite CJ1020-2K.
 - b. Low expansion hydrophilic strip.
 - 1). Adeka Ultra Seal USA: KBA-1510FP.
 - 2). Greenstreak: Hydrotite CJ0725-3K.

- C. Hydrophilic paste waterstop.
 - 1. Single-component gun grade paste of hydrophilic rubber designed to undergo controlled expansion when exposed to moisture after initial curing.
 - 2. Manufacturers: One of the following, or equal.
 - a. Adeka Ultra Seal USA: P-201.
 - b. Greenstreak: Leakmaster LV-1.

2.2 MASTIC STRIP WATERSTOP

- A. General:
 - 1. System composed of flexible non-expansive hydrocarbon mastic with preformed strips, primer, and other accessories required for a complete and watertight installation.
 - 2. To ensure compatibility of materials, a single manufacturer shall provide all products and accessories for the mastic waterstop system.
 - 3. Provide waterstop and accessories resistant to degradation under cyclic wetting and drying and to chemicals typically found in water treatment structures.
- B. Mastic strip waterstop.
 - 1. Pre-formed strips of flexible non-expansive hydrocarbon mastic designed to bond with cured concrete and fuse with fresh concrete during concrete curing.
 - 2. Manufacturer recommended primer adhesive as required for installation.
 - 3. Manufacturers. One of the following, or equal.
 - a. Henry Company, Sealants Division; Synko-Flex
 - b. Greenstreak; Lockstop
 - c. JP Specialities, Inc.; Earthshield Type 10.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and recommended details.
- B. Prepare concrete joint surfaces:
 - 1. Use wire brushing or scraping to expose an uncontaminated, solid surface.
 - 2. Clean prepared surface with high-pressure air or water to remove residue and debris.
 - 3. Confirm that prepared surfaces conform to manufacturer's recommendations for surface profile and moisture conditions before installing materials.
- C. Provide manufacturer's recommended lap, splice, and corner details for strip-type waterstops.
 - 1. Use hydrophilic paste at all corner joints and overlap splices of hydrophilic strips.
- D. Hydrophilic strip waterstop.
 - 1. Install primers and adhesives when recommended by the manufacturer before setting hydrophilic strips.
 - 2. Keep hydrophilic strip taut during the fastening process.
 - 3. Secure hydrophilic strip in place with concrete nails, screws, or adhesive.
 - 4. Provide installation with no gap between the hydrophilic strip and the concrete to which it is attached. At rough or irregular surfaces, set hydrophilic strip waterstop strip in a bead of hydrophilic paste.
 - a. Fill all voids and rough areas under the hydrophilic strip with hydrophilic paste.
 - b. Allow hydrophilic paste to cure in accordance with manufacturer's recommendations before encapsulating paste in fresh concrete.
- E. Mastic strip waterstop.

1. Install primers as recommended by the manufacturer before setting mastic strips. For cured concrete surfaces, use of primer is mandatory.
2. Secure mastic strip in place with concrete nails, as required.
3. Provide installation with no gap between the mastic strip and the concrete to which it is attached. At rough or irregular surfaces, press the mastic strip waterstop strip into the concrete surface to achieve continuous contact.

3.2 SCHEDULE

A. Hydrophilic waterstops.

1. Use the hydrophilic waterstop given in the table below.

Joint Type	Condition of Use	Hydrophilic Waterstop To Use
Concrete construction joints	Joint where hydrophilic strip waterstop is placed under all of the following conditions: 1. Slab or wall thickness is greater than 10 inches, and 2. Waterstop is placed between 2 rows of steel reinforcement. 3. Concrete cover from waterstop to nearest concrete face is at least 4 inches.	Hydrophilic strip waterstop set in bed of hydrophilic paste waterstop. Screw strip to concrete substrate.
	Joint where hydrophilic waterstop is placed under one of the following conditions: 1. Waterstop is placed on 1 side of a single row of steel reinforcement, or 2. Concrete cover from waterstop to nearest concrete face is less than 4 inches.	Low expansion hydrophilic strip waterstop set in bed of hydrophilic paste waterstop. Screw strip to concrete substrate.
Pipe penetrations through concrete	Pipe diameter less than 4 inches.	Not allowed.
	Pipe diameter of 4 to 24 inches.	Continuous bead of hydrophilic paste
	Pipe diameter greater than 24 inches.	Continuous hydrophilic strip waterstop around perimeter of pipe, with hydrophilic paste seal at lapped ends of strip.

END OF SECTION

SECTION 03 60 00 - GROUT

PART 1 - GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. C 230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
 - b. C 1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. Cement Grout (Non-shrink).
 - 1. Corps of Engineers (COE):
 - a. CRD-C 611, Flow of Grout for Prep laced Aggregate Concrete.
 - b. CRD-C 621, Specification for Non-shrink Grout

1.2 SUBMITTALS

- A. Product data for each type of product indicated.
- B. Certified test results verifying compliance with compressive strength, shrinkage and expansion requirements and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of non-shrink and epoxy grout.
- C. Fine aggregate gradation.
- D. One copy of each 30 consecutive strength test results and mix design used from a record of past performance, or one copy of laboratory trial mix and design and results, and one copy of the mix design proposed for each cementitious mixture and use under this contract.
- E. Qualification for testing agency.
- F. Material test reports: For the following from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates, Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
 - 2. Non-shrink grout.
 - 3. Epoxy grout.
- G. Material certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Non-shrink grout.
 - 3. Epoxy grout.
- H. Field quality-control tests and observation reports.
- I. Ready mix concrete (Cement Grout)
 - 1. Provide delivery tickets for ready-mix concrete (cement grout) or weigh master's certificate per ASTM C 94, include weights of cement and each size aggregate and amount of water added at the plant and a record of placements. Record the amount of water added at the job site on the delivery ticket. Water added at the plant shall account for the moisture in aggregate. If water is added at the job site, then the total water content shall not exceed the water content of the approved design mix.

2. Keep records showing time and place of each placement of concrete, joint mortar bed material or cement grout, together with transit delivery slips certifying the contents of the placement. Furnish records to Engineer.

J. Joint Mortar Bed: Provide material analysis and certification for each placement.

K. Shop Drawings:

1. Product data of grouts.
2. Curing method for grout.
3. Mix design of cement-sand grout mixture for pipe invert/structure fill.
4. Mix design of Joint Mortar Bed.

L. Information Submittals:

1. Manufacturer's written instructions for mixing of grout.
2. Manufacturer's Certificate of Compliance: Grout free from chlorides and other corrosion-causing chemicals.
3. Manufacturer's Certificate of Proper Installation.
4. Statements of Qualification: Non-shrink grout manufacturer's representative.
5. Test Reports: Test report for 24-hour evaluation of non-shrink grout.

1.3 QUALIFICATIONS

- A. Manufacturer's qualifications for cement grout and joint mortar bed: A firm experienced in manufacturing ready-mixed concrete products and a firm that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician – Grade I, Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician – Grade II.
- C. Source limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source and obtain admixtures through one source from a single manufacturer.

1.4 QUALIFICATIONS

- A. Non-shrink Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer, with minimum of 1 year experience that has resulted in successful installation of grouts similar to those for this Project.
- B. For grout suppliers not listed herein, provide completed 24-hour Evaluation of Non-shrink Grout Test Form, attached at the end of this section. Independent testing laboratory to certify that testing was conducted within last 18 months.

1.5 GUARANTEE

- A. Manufacturer's guarantee shall not contain disclaimer on the product data sheet, grout bag, or container limiting responsibility to only the purchase price of products and materials furnished.

- B. Manufacturer guarantees participation with Contractor in replacing or repairing grout found defective due to faulty materials, as determined by industry standard test methods.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand and source throughout project:
 1. Portland Cement (Nonhydraulic Above Grade Structures): ASTM C 150, Type I or II or combination of Type I with fly ash.
 2. Portland Cement (Hydraulic and Below Grade Structures): ASTM C 150 Type II or combination of Type I with fly ash.
FLY ASH: ASTM C 618, CLASS F, FLY ASH SHALL NOT EXCEED 15 PERCENT.
- B. Fine aggregates: ASTM C 33, Class 4S or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. Aggregates shall be free of materials with deleterious reactivity to alkali in cement. Aggregates for cement grout and/or mortar bed shall be provided from the same source as aggregate for the cast-in-place concrete.
- C. Water: ASTM C 94 and potable.

2.2 ADMIXTURES

- A. Comply with Section 03 00 00 Cast-In-Place Concrete.

2.3 NONSHRINK GROUT SCHEDULE

- A. Furnish non-shrink grout for applications in grout category in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 to 100 °F	20 min	Greater than 20 min
Filling tie hole	I	I	I
Machine bases 25 hp or less	II	II	II
Through-bolt openings	II	II	II
Patching Concrete Walls	II	II	II
Machine bases 26 hp and up	III	III	III
Base plates and/or soleplates with vibration, thermal movement, etc.	III	III	III
Other applications not listed	II	II	II

2.4 NONSHRINK GROUT

- A. Category I:
 1. Nonmetallic and non gas-liberating.
 2. Prepackaged natural aggregate grout requiring only the addition of water.
 3. Test in accordance with ASTM C1107:
 - a. Flowable consistency 140%, five drops in 30 seconds, in accordance with ASTM C 230.
 - b. Flowable for 15 minutes.
 4. Grout shall not bleed at maximum allowed water.

5. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
6. Manufacturers and Products:
 - a. Chemrex, Inc., Shakopee, MN; Set Grout.
 - b. Euclid Chemical Co., Cleveland, OH; NS Grout.
 - c. Dayton Superior Corp., Miamisburg, OH; 1107 Advantage Grout.
 - d. US MIX Products, Denver, CO; US Spec Multi-Purpose Grout.
 - e. L & M Construction Chemicals, Inc., Omaha, NE; Duragrout.
 - f. Master Builders.

B. Category II:

1. Nonmetallic, non gas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency - at specified times or temperatures.
4. Test in accordance with COE CRD-C 621 and ASTM C 1107, Grade B:
 - a. Fluid consistency 20 to 30 seconds in accordance with COE CRD-C 611.
 - b. Temperatures of 40, 80, and 100 °F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready- mix truck.
8. Manufacturers and Products:
 - a. Chemrex, Inc., Shakopee, MN; Master Flow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star 100.
 - c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
 - d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
 - e. L & M Construction Chemicals, Inc., Omaha, NE; Crystex.
 - f. Master Builders.

C. Category III

1. Metallic and nongas-liberating flowable fluid.
2. Prepackaged aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with CRD-C 621 and ASTM C 1107, Grade B:
 - a. Fluid consistency 20 to 30 seconds in accordance with CRD-C 611.
 - b. Temperatures of 40 and 100 °F.
5. 1 hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of grout, 4,000 psi at 1 day, 5,000 psi at 3 days, and 9,000 psi at 28 days.
7. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready-mix truck.
8. Manufacturers and Products: Chemrex, Inc., Shakopee, MN; EMBECO 885.

2.5 TOPPING GROUT AND CONCRETE/GROUT FILL

- A. Where fill is thicker than 3-inches, structural concrete 03 00 00, CONCRETE, may be used when accepted by the Engineer.
- B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water and admixtures proportioned and be mixed as indicated. Bonding Agent shall be used to enhance adhesion to basin concrete. Materials and procedures indicated for normal concrete in Section 03 00 00, CONCRETE, shall apply unless indicated otherwise.

- C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 8900 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.
- D. Aggregate shall be graded as follows:

U.S. STANDARD SIEVE SIZE	PERCENT BY WEIGHT PASSING
1/2 inch	100
3/8 inch	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

- E. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00, except that drying shrinkage tests are not required.
- F. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00.
- G. Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 days shall be 4000 psi.
- H. Topping grout used in clarifiers shall contain fiber reinforcing. Fiber shall be 100 percent virgin polypropylene fibrillated fibers specifically manufactured in a blended gradation for use as concrete secondary reinforcement. Fibers shall be added at a rate of 1.5 pounds per cubic yard of concrete. Fibers shall conform to ASTM C 1116 – Fiber Reinforced Concrete and Shotcrete. Type III.

2.6 CEMENT-GROUT (CEMENT-SAND GROUT) MIXTURE FOR PIPE INVERT/STRUCTURE FILL

- A. Prepare design mixture proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Submit proposed mixture design to Engineer for review. Comply with Section 03 00 00 Cast-In-Place Concrete and as follows.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based upon laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete and cement grout as follows:
 - 1. Fly Ash, 15 percent, Class F.
- C. Admixtures: All materials other than Portland cement, water and aggregates that are added to the concrete or cement grout, shall be subject to the approval of the Engineer. If so approved, use admixtures according to manufacturer's written instructions.
 - 1. Use water reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- D. Minimum compressive strength: 2000 psi at 28 days.
- E. Minimum cementitious material of 846 pounds (9 bags) per cubic yard of cement grout.

- F. Air content: ASTM C 94, 5 percent, plus or minus 1.0 percent at point of delivery.
- G. Aggregate shall be sand, three parts sand to one part cementitious material by volume. The sand gradation shall be such that 100% shall pass the No. 16 sieve and not more than 30% shall be retained on a No. 30 sieve.
- H. Water – cementitious material ratio. The Contractor shall submit a proposed mix design to the Engineer for review. The amount of water shall be the minimum amount of water necessary to make a workable mixture.
- I. Slump: Maximum of 4 inches.

2.7 JOINT MORTAR BED

- A. Joint Mortar Bed: Mortar placed on horizontal construction joints shall be a mixture of cement, sand and water in the same proportions used in the approved 4000 psi cast-in-place concrete mix design and/but with the coarse aggregate omitted.

PART 3 - EXECUTION

3.1 NONSHRINK GROUT

- A. General: Mix, place, and cure non-shrink grout in accordance with grout Manufacturer's representative's training instructions.
- B. Form Tie or Through-Bolt Holes: Provide non-shrink grout, Category I and II, fill space with dry pack dense grout hammered in with steel tool and hammer.
- C. Grouting Machinery Foundations:
 1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material.
 2. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts.
 3. Form with watertight forms at least 2" higher than bottom of plate.
 4. Fill space between bottom of machinery base and original concrete in accordance with Manufacturer's representative's training instructions.

3.2 CEMENT GROUT

- A. Place cement grout topping over concrete slabs where indicated on the drawings. Place in accordance with the procedures of this section and the manufacturer's or suppliers of equipment recommendations. The finish surface of the grout topping shall be similar to a steel trowel finish and which will facilitate the proper operation of the mechanical equipment. The finish of the structural slab below the cement grout topping shall be a heavy broom finish.
- B. Where cement grout is to be placed without mechanical equipment, the fresh surface of the cement grout shall be a smooth trowel finish. Placement procedure of cement grout at areas with mechanical equipment includes:
 1. Notify Project Representative or Engineer a minimum of 48 hours in advance of placement.
 2. Make a trial cement grout batch of not less than 1/2 cubic yard to allow time for adjustment in mix design if required.
 3. Clean the exposed structural slab by sandblasting and washing clean.
 4. Thoroughly broom a neat cement paste containing an epoxy binder into the concrete slab surface immediately ahead of placing the cement grout topping.

5. Where applicable, install level and true mechanical screed equipment over the floor slab to provide a minimum thickness of 2 inches +/- 1/4 inch. In areas where the distance between the mechanical screed and the structural slab is less than the above clearances, grind surface as directed by Engineer to provide such clearance. The mechanical screed shall operate at a speed acceptable to the cement grout topping placement procedures. Screeding procedures shall account for the effects of differential temperatures on the mechanical screed equipment.
6. Place cement grout topping in a continuous operation. If grouting operations are interrupted, clean the edge of the previously placed topping by water jetting and add a coat of cement paste to provide a bond to the fresh topping.
7. Temporarily equip the mechanical screed mechanism on at least two arms with a 2-inch by 10 inch continuous wood plate with light gauge metal angles and surface plates or channels. The bottom of the screed plates or steel plates shall be adjustable and set to elevations which allow the proper operation of equipment and as recommended by the equipment manufacturer or supplier.
8. Screed the topping immediately after consolidation with vibrators or tampers and provide a steel trowel finish.
9. Cure cement grout topping with water and cover with PVC sheeting to prevent damage from foot traffic for seven days. When/If the cement grout topping is found not to be acceptable, remove and replace. Cement grout topping not acceptable shall include, but is not limited to, poor bonding with the concrete slab, low strength, excessive cracking and unevenness in finish or elevation.

3.3 JOINT MORTAR BED

- A. Joint Mortar Bed: Immediately prior to placement of fresh concrete at horizontal joints, or as indicated, place joint mortar bed to cover horizontal joint and protect water stop as applicable. Spread uniformly and work into all irregularities of the surface. The water cement ratio of the joint mortar bed shall not exceed that of the concrete being placed and the consistency of the mortar shall be suitable for placing and working. The fresh concrete shall then be immediately placed in a time and manner so that the joint mortar bed and the fresh concrete mix to form a homogenous concrete meeting all requirements.

3.4 NON-SHRINK GROUT

- A. Non-Shrink grout:
 1. Used for repair of holes and defects and at locations indicated where epoxy grout is not indicated. Execution shall follow manufacturer's recommendations.
 2. Base plates and equipment where indicated. Execution shall follow manufacturer's recommendations.

3.5 EPOXY GROUT

- A. Epoxy Grout: Used to embed all anchor bolts and reinforcing steel set in grout, specific machinery base plates as indicated and at other locations where indicated. Execution shall follow manufacturer's recommendations.

3.6 FIELD QUALITY CONTROL

- A. Evaluation and Acceptance of Non-shrink Grout:
 1. Consistency: As specified in Article NON-SHRINK GROUT. Grout with consistencies outside range requirements shall be rejected.
 2. Segregation: As specified in Article NON-SHRINK GROUT. Grout when aggregate separates shall be rejected.

3.7 MANUFACTURER'S SERVICES

- A. General: Coordinate demonstrations, training sessions, and applicable site visits with grout manufacturer's representative.

3.8 SUPPLEMENTS

- A. The supplement listed below, following "END OF SECTION," is part of this Specification.
 - 1. 24-hour Evaluation of Non-shrink Grout Test Form and Grout Testing Procedures.

END OF SECTION

SECTION 04 05 17 – MORTAR AND MASONRY GROUT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes: Mortar and grout for masonry construction.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 2. ASTM C150 - Standard Specification for Portland Cement.
 - 3. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 4. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 5. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 - 6. ASTM C476 - Standard Specification for Grout for Masonry.
 - 7. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 8. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.

1.3 DEFINITIONS

- A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.

1.4 PERFORMANCE REQUIREMENTS

- A. Mortar color:
 - 1. CONTRACTOR to coordinate and verify color with OWNER prior to construction.

1.5 SUBMITTALS

- A. Product data.
- B. Shop drawings.
- C. Mortar color samples.
- D. Design Mixes for mortar and grout.
- E. Test reports:
 - 1. Mortar Strength Test Results.
 - 2. Grout Strength Test Results.

1.6 QUALITY ASSURANCE

- A. Materials for mortar and grout: Do not change source of materials which will affect the appearance of finished work after the work has started unless acceptable to ENGINEER.

1.7 PROJECT CONDITIONS

- A. Environmental requirements:
 - 1. Cold weather requirements:
 - a. Cold Weather Construction: In accordance with the building code.

- b. Provide adequate equipment for heating mortar and grout materials when air temperature is below 40 degrees Fahrenheit.
 - 1) Temperatures of separate materials, including water, shall not exceed 140 degrees Fahrenheit when placed in mixer.
 - 2) Maintain mortar temperature on boards above freezing.
 - 2. Hot weather requirements:
 - a. Wet mortar board before loading and cover mortar to retard drying when not being used.

PART 2 - PRODUCTS

1.1 MATERIALS

- A. Portland cement:
 - 1. Type II, low alkali, containing maximum 0.6 percent total alkali in accordance with ASTM C150.
- B. Hydrated lime:
 - 1. Type S in accordance with ASTM C207.
- C. Aggregate for mortar:
 - 1. Fine aggregate: Sand in accordance with ASTM C144.
- D. Aggregate for grout:
 - 1. Fine aggregate: Size Number 2 in accordance with ASTM C404.
 - 2. Coarse aggregate: Size Number 8 in accordance with ASTM C404.
- E. Admixtures:
 - 1. Mortar color admixture:
 - a. Containing maximum 15 percent lime proof, inorganic compounds, unless recommended otherwise by manufacturer.
 - b. Maximum 3 percent carbon black by weight of cement.
 - c. Factory blend for full color saturation of mortar joint.
 - d. Packaging for unitized jobsite mixing at ratio of 1 unit of color per sack of portland cement.
 - 2. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
 - 3. Grout admixture:
 - a. Manufacturers: One of the following or equal:
 - 1) Sika Corp., Sika Grout Aid, Type II.
 - 2) Concrete Emulsions, Grout Aid GA-II.
 - 4. Other admixtures:
 - a. Prohibited, unless accepted by the ENGINEER.
- F. Water: Clean, clear, potable, free of oil, soluble salts, chemicals, and other deleterious substances.
- G. Other materials:
 - 1. Prohibited, unless acceptable to ENGINEER.

1.2 MIXES

- A. Mortar mix:
 - 1. Portland cement-lime mortar.
 - 2. Mortar mix proportions by volume: As indicated in the following table:

MORTAR TYPE	PARTS BY VOLUME OF PORTLAND CEMENT	PARTS BY VOLUME OF HYDRATED LIME	AGGREGATE MEASURED IN A DAMP LOOSE CONDITION
S	1	Greater than 1/4 to 1/2	Not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials
N	1	Greater than 1/2 to 1 1/4	Not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials

3. Mortar mixing:
 - a. Mix on jobsite in accordance with ASTM C270.
 - b. Mix in mechanical mixer and only in quantities needed for immediate use.
 - c. Mix for minimum 3 minutes, and maximum of 5 minutes after materials have been added to mixer.
4. Measurement by volume: Measurement of constituents shall be accomplished by the use of a container of known capacity.
5. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units.
 - a. Use no mortar which has been standing for more than 1 hour after being mixed.
6. Whenever 90 minutes has elapsed since last batch was mixed, completely empty mixer drum of materials and wash down before placing next batch of materials.

B. Grout mix:

1. Grout mix proportions by volume: As indicated in the following table:

TYPE OF GROUT	PARTS BY VOLUME OF PORTLAND CEMENT	PARTS BY VOLUME OF HYDRATED LIME	AGGREGATE MEASURED IN A DAMP LOOSE CONDITION	
			Fine Aggregate	Coarse Aggregate
Fine grout	1	0-1/10	2-1/4 to 3 times the sum of the volumes of the cementitious materials	-
Coarse grout	1	0-1/10	2-1/4 to 3 times the sum of the volumes of the cementitious materials	1 to 2 times the sum of the volumes of the cementitious materials

2. Grout mixing:
 - a. Mix on jobsite or in a transit mix in accordance with ASTM C476.
 - b. Slump: 8 to 11 inches, unless otherwise accepted by the ENGINEER.
 - c. Use within 90 minutes after addition of mixing water.
 - d. Mix for minimum of 5 minutes after ingredients are added and until uniform mix is attained. Grout shall have sufficient water added to produce pouring consistency without segregation.

3. Use coarse grout for hollow cell masonry units with minimum 4-inch cell dimensions in both horizontal directions.
 - a. Calculate cell dimension for this criterion by subtracting diameter(s) of any horizontal reinforcement crossing the cell from clear cell dimensions of the masonry unit.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Testing of grout and mortar:
 1. During progress of construction, the OWNER will have tests made to determine whether the grout and mortar, as being produced, complies with Specifications.
 2. Compressive strength tests for mortar: In accordance with ASTM C780, Annex A7 as modified in the following paragraphs.
 - a. Spread mortar on the masonry units in a layer 1/2 to 5/8 inch thick.
 - b. Allow mortar to stand for one minute, then remove and place in a 2-inch by 4-inch cylinder mold. Place mortar in two layers compressing the mortar using the flat end of a stick or fingers. Lightly tap the mold on opposite sides. Level off and immediately cover molds, keeping them damp until taken to the laboratory.
 - c. After 48 hour set, remove mortar specimens from molds and store in a fog room until tested. Water curing (curing in tanks) is not permitted.
 - d. Test specimens in damp condition.
 3. Compressive strength test for grout: In accordance with ASTM C1019.
 4. The ENGINEER will make and deliver test specimens to the laboratory and testing expense will be borne by the OWNER.
 5. Required number of tests:
 - a. At least 2 test specimens of grout and mortar will be made per week.
 6. Do not use grout and mortar that does not meet specification.
 - a. Remove such mortar and grout from Project site.
 7. Make provisions for and furnish grout and mortar for test specimens, and provide manual assistance to the ENGINEER in preparing test specimens.
 8. Assume responsibility for care of and providing proper curing conditions for test specimens.

3.2 ADJUSTING

- A. Repair of defective masonry:
 1. Remove and replace or repair defective work.
 2. Do not patch, repair, or cover defective work without inspection by the ENGINEER.
 3. Provide repairs having strength equal to or greater than specified strength for areas involved.

END OF SECTION

SECTION 04 05 23 – MASONRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Adjustable wall ties.
 - 2. Control joint filler.
 - 3. Reinforcing bars.
 - 4. Wire joint reinforcement
- B. Related sections:
 - 1. Section 04 22 00 – Unit Masonry Assemblies.

1.2 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 3. ASTM A641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 4. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
 - 5. ASTM C549 - Standard Specification for Perlite Loose Fill Insulation.
 - 6. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
 - 7. ASTM D2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

1.3 SUBMITTALS

- A. Shop drawings.
- B. Product data.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Adjustable wall ties: 2-piece hot-dipped galvanized, minimum 3/16-inch diameter steel wire formed into hook or pin and eye pieces, capable of restraining compression and tension forces from veneer.
 - 1. Manufacturers: One of the following or equal:
 - a. Hohmann & Barnard, 270 Ladder Eye-Wire
 - b. Wire-Bond, 1800 Hook and 1801 Eye.
 - c. Approved equal
- B. Control joint filler: The key shall be of the width and shape as indicated on the Drawings. In accordance with ASTM D 2000 or ASTM D 2287.
 - 1. Manufacturers: One of the following or equal:
 - a. AA Wire Products, Inc., AA2000 Blok-Tite.
 - b. Dur-O-Wall, Rapid Poly-Joint.
 - c. Vert-A-Joint Co., Vert-A-Joint.
- C. Reinforcing bars: In accordance with ASTM A 615, Grade 60, deformed billet steel bars.

- D. Wire joint reinforcement, single Wythe type: In accordance with ASTM A 951 with ASTM A 82, 9 gauge wire side rails and 9-gauge cross ties, sized to suit application, and galvanized in accordance with ASTM A 153, Class B (minimum 1.5 ounces zinc per square foot).
 - 1. Manufacturers: One of the following or equal:
 - a. Hohmann & Barnard, 220 Ladder Mesh
 - b. Wire-Bond, Ladder Type, Series 200.
 - c. Approved equal
- E. THROUGH-WALL FLASHING
 - 1. Where shown built into masonry, and unless noted otherwise, use 5 oz. copper fabric flashing. Seal all laps with flashing mastic.
- F. WEEP HOLE/VENT PRODUCTS
 - 1. Weeps: Mortar Net USA, Ltd. "Mortar Net Weeps Vents" or approved equal.
- G. MASONRY CLEANERS
 - 1. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - a. Available Manufacturers:
 - 1) Diedrich Technologies, Inc.
 - 2) EaCo Chem, Inc.
 - 3) ProSoCo, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products as specified in Section 04 22 00.

END OF SECTION

SECTION 04 22 00 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete Masonry Units (CMU's) – split face and smooth face block
 - 2. Mortar and grout.
 - 3. Reinforcing steel.
 - 4. Masonry joint reinforcement.
 - 5. Brick masonry.
 - 6. Thru-wall flashing
 - 7. Miscellaneous masonry accessories.
- B. Related Sections:
 - 1. Section 03 00 00 – Cast-In-Place Concrete
 - 2. Section 04 05 17 – Mortar and Masonry Grout
 - 3. Section 04 05 23 – Masonry Accessories
- C. Products furnished, but not installed, under this Section include the following:
 - 1. Section 03 00 00 - Cast-in-Place Concrete.
- D. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels for unit masonry, furnished under Section 05 12 00 – Structural Steel.

1.2 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops net-area compressive strengths (f'_m) of 1900 psi at 28 days.
- B. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to the current adopted Edition of the International Building Code.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples of face brick for approval of Engineer.
- C. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
 - 3. Accessories
- D. Qualification Data: For testing agency.

- E. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - 2. Cementitious materials. Include brand, type, and name of manufacturer.
 - 3. Pre-blended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
- F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
 - 1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
 - 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. ACI Publications: Comply with the latest Edition of the following except as modified by requirements in the Contract Documents:
 - 1. ACI 530, Building Code Requirements for Masonry Structures.
 - 2. ACI 530.1, Specification for Masonry Structures.
- E. ANSI "American Standard Building Code Requirements for Masonry" and "Building Code Requirements for Reinforced Masonry".
- F. Contractor/Fabricator Qualifications: Provide documentation of prior work experience with projects of similar size, design, and unit type as this project and whose work has resulted in construction projects with a record of successful in-service performance.
 - 1. Masonry Contractor/Installer: A firm with a minimum of 5 years experience in CMU and face brick installations with a minimum of 5 commercial type projects similar in size to this specific project and able to provide references and similar project information if so requested.
- G. Conduct initial "Coordination" conference to review Contract Documents and requirements prior to any submittal. Require representatives of each entity directly concerned with Unit Masonry shall attend, including but not limited to:
 - 1. Engineer or representative.
 - 2. Contractor's superintendent
 - 3. Independent testing agency responsible for masonry testing.

4. Unit masonry subcontractor.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units and face brick on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry. Store and handle to avoid chipping.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 2. Protect sills, ledges, and projections from mortar droppings.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530-05/ASCE 5-05/TMS 402-05.
- E. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40° F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- F. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530-05/ASCE 5-05/TMS 402-05.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
- B. Regional Materials: Provide Concrete Masonry Units that have been manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.
- B. Unless otherwise indicated, 2 or 3 cell units 7-5/8" x 15-5/8" x width indicated, plus all closers, jamb units and other special sizes and shapes required to bond with and complete the work.
- C. Conform to ASTM C 90, cured 28 days minimum and dries for shrinkage.
- D. Do not use damaged units in the work.
- E. Do not use chipped units in exposed locations.

2.3 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners, unless otherwise indicated.
- B. Concrete Masonry Units: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
 - 2. Weight Classification: Normal weight.
 - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
- C. Integral Water Repellent: Provide units made with integral water repellent for exterior units.
 - 1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
 - a. Available products:
 - 1) Addiment Incorporated; Block Plus W-10.
 - 2) Grace Construction Products, a unit of W. R. Grace & Co. – Conn.; Dry-Block.

3) Master Builders, Inc.; Rheopel.

2.4 COMMON BRICK (FOR EXPOSED LOCATIONS)

- A. New common 80% hard shale or clay, ASTM C62 Grade SW.

2.5 FACE BRICK

- A. Regional Materials: Provide brick from materials that have been manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Brick to be selected by the Engineer or Owner. Brick to be modular. Material cost to be included in the base bid.
- C. Submit samples of selected brick for the Engineer's approval.
- D. Face brick shall conform to ASTM C62, Grade SW, Type FBS.
- E. Furnish matching solid brick for all locations where holes would otherwise be exposed.
- F. Deliver to job stacked. Do not use chipped brick in exposed locations.

2.6 CONCRETE AND MASONRY LINTELS

- A. Provide masonry lintels complying with requirements below.
 - 1. Masonry Lintels: Built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with grout. Temporarily support built-in-place lintels until cured.
- B. Provide concrete lintels complying with requirements below.
 - 1. ASTM C 1623, matching CMU's in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMU's.
 - 2. Precast or formed-in-place concrete lintels complying with requirements in Division 3 Section "Cast-in-Place Concrete." And with reinforcing bars indicated.

2.7 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- D. Masonry Cement: ASTM C 91.
 - 1. Available Products:
 - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
 - b. Essroc, Italcementi Group; Brixment or Velvet.
 - c. Holcim (US) Inc.; Mortamix Masonry Cement, Rainbow Mortamix Custom Buff Masonry Cement, or White Mortamix Masonry Cement.

- d. Lafarge North America Inc.; Magnolia Masonry Cement, Lafarge Masonry Cement Florida Super Masonry, Trinity Super White Masonry Type S, or Trinity White Masonry Type N.
 - e. Lehigh Cement Company; Lehigh Masonry Cement or Lehigh White Masonry Cement.
 - f. National Cement Company, Inc.; Coosa Masonry Cement.
 - 2. Regional Materials: Provide aggregate for mortar, cement, and lime that have been extracted, harvested, or recovered, as well as manufacture, within 500 miles of Project site.
- E. Mortar Cement: ASTM C 1329.
- 1. Available Products:
 - a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.
- F. Aggregate for Mortar: ASTM C 144.
- 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 3. Sand shall be clean, well screened, natural, ASTM C144.
- G. Aggregate for Grout: ASTM C 404.
- H. Water: Potable.
- I. Grout shall be 3,000 psi pea gravel concrete.
- J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
- 1. Available Products:
 - a. Addiment Incorporated; Mortar Tite.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. – Conn; Dry-Block Mortar Admixture.
 - c. Master Builders, Inc.; Rheomix Rheopel.

2.8 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.
- 1. Walls: Hot-dip galvanized, carbon steel.
 - 2. Wire Size for Side Rods: 86A (3/16).
 - 3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
 - 4. Wire Size for Veneer Ties: W1.7 or 0.148-inch diameter.
 - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement:
- 1. Standard, diagonally braced, galvanized, "Dur-O-Wall or approved equal, widths to fit concrete block walls in which used. Reinforcement shall meet ASCE/ACI Building Code requirements for Masonry Structures for design, materials and coating (1.5 oz./sq. ft. ASTM A153 Class B2). Use if face brick is laid at same time as block.
 - 2. For Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

3. For Multi-Wythe Masonry: Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.9 TIES AND ANCHORS

- A. Brick to Block Backup Walls: Galvanized “pintle and eye” adjustable wall ties, equal to “Dur-O-Wall”, with proper length pintle and eye sections for the cavity dimension indicated. Ties shall be “Dur-O-Wall D/A 515” or approved equal, meeting ASCE/ACI Building Code Requirements for Masonry Structures. Use if face brick is laid at different time than block.
- B. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with either subparagraph below, unless otherwise indicated.
 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 1064; with ASTM A 153/A 153M, Class B-2 coating.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304 or 316.
- C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 4 inches minimum parallel to face of veneer.
- D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
 1. Use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
 2. Wire: Fabricate from minimum 0.148-inch-diameter, hot-dip galvanized steel or stainless-steel wire.

2.10 CLEAR SURFACE TREATMENT REPELLENTS

- A. In addition to the integral water repellent provided within the concrete masonry units and the integral water repellent provided within the mortar, provide a compatible clear surface treatment repellent post applied in accordance with the manufacturers recommendations to all concrete masonry work.
 1. Water based, clear, specially formulated VOC compliant penetrating sealer consisting of water based blends of silanes and siloxanes to provide maximum water repellency when post applied to integrally water-repellent -treated concrete masonry unit construction.
- B. Available Products:
 1. INFINISEAL ® DB by Grave Construction Products.
 2. Approved Equal.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

- A. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- B. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
 - 1. Available Products:
 - a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
 - b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
 - c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
 - d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.12 EXPANSION AND CONTROL JOINT MATERIALS

- A. Backer rod and sealant in expansion joints and sealant in control joints as specified.

2.13 THROUGH-WALL FLASHING

- A. Install per civil drawings.

2.14 WEEP HOLE/VENT PRODUCTS

- A. Weeps: Mortar Net USA, Ltd. "Mortar Net Weeps Vents" or approved equal.

2.15 MASONRY-CELL INSULATION

- A. Install per civil drawings.

2.16 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
 - 1. Available Manufacturers:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.17 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar to portland cement and lime.
- B. Pre-blended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a pre-blended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
- D. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
 2. For reinforced masonry, use Type S.
 3. For interior non-load-bearing partitions, use Type S.
- E. Mortar Mixing:
1. Proportion and mix according to ASTM C270.
- F. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. No masonry work when ambient temperature is below 35 degrees Fahrenheit; do not build on frozen work or surface with water or frost film; protect masonry from freezing for 48 hours after being laid.
- B. Lay out coursing with story pole prior to laying masonry to insure joints of uniform thickness.
- C. Lay in plumb, true to line level course, head joints aligned; adjust to final position before mortar stiffens.
- D. Keep cavities, chases, etc., free of debris or mortar droppings.
- E. Unless otherwise required, completely fill spaces around built-in items with mortar; fill heads and jambs of hollow metal frames with mortar as the wall is laid. Install anchors, flashing, etc., as the wall is laid.
- F. Tolerance of offset between vertical faces of block masonry: 1/8".
- G. Rake control joints to depth of 3/8" and leave ready for sealant.
- H. Step back unfinished work for joining with new; do not "tooth" unless specifically approved. Protect tops or openings in exposed masonry walls from rain or snow with a strong waterproof membrane, adequately secured in place.

- I. Do not use mortar that has begun to set; do not use mortar more than 2-1/2 hours after mixing when air temperature is 80 Degrees Fahrenheit or higher or more than 3-1/2 hours after mixing when air temperature is less than 80 Degrees Fahrenheit.
- J. Brace walls to resist lateral loads in accordance with "American Standard Building Code Requirements for Masonry".
- K. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- L. Build chases and recesses to accommodate items specified in this and other Sections.
- M. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- N. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- O. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- P. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- Q. Comply with construction tolerances in ACI 530-05/ASCE 5-05/TMS 402-05 and with the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
 - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
 - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
 - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

- A. Laying Concrete Block.
 - 1. General: Cut block with masonry saws. Set head joints in running bond. For other joints, provide full mortar coverage in joints on horizontal and vertical face shells, none on web edges. Bond each course at corners. Remove sharp edges and irregularities at exposed corners of concrete block work with an abrasive block.

2. Joints: 3/8" wide, struck flush.
3. Lintels: Unless otherwise noted or indicated, construct of U-shape units filled with 3000 psi concrete, extending at least 8" beyond each side of opening. Reinforce as indicated, but not less than one No. 5 bar.
4. Joint Reinforcing: Place in first (continuous) and second bed joints (to 2 feet each side of opening) above and below openings and continuous in every second bed joint throughout remainder of structure, Lap splices 6". Bend longitudinal wires around corners to provide a continuous bond.
5. Anchors: Space not more than 16 inches o. c. vertically and 24" o. c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches around the perimeter.

B. Laying Brick:

1. Lay a sample brick panel at least 32" x 24" for approval of Engineer prior to starting other brickwork, using brick and mortar selected for the job. Mortar joints and other workmanship shall be representative of work to be done on the job.
2. Determine on the job, with the Engineer present, if brick needs to be wet before laying. Use ASTM C67 test or as directed by Engineer. If bricks have absorption rate high enough to require wetting, they shall be wet in piles by hose stream until water runs from all sides, then allowed to surface dry before laying.
3. Lay brick so that mortar oozes out at top of joints. Completely fill horizontal and vertical joints with mortar when laying. Practice of filling head joint from front only will not be acceptable; all head and bed joints are to be flushed full. Make all vertical joints same width except where inconspicuous variations may be necessary to maintain the bond. Lay brick in running bond except where soldier, rowlock or other coursing is indicated.
4. Joints:
 - a. Make all exposed mortar joints in brickwork approximately 3/8" wide. The average thickness of three adjacent joints shall not be less than 1/4" or more than 1/2". After mortar is "thumb print" hard, finish exposed joints with a 24" long pointing tool, using sufficient pressure to compact mortar and provide smoothly finished joint with mortar in positive contact with brick.
 - b. Tool exposed joints slightly concave when "thumb print" hard.
 - c. Unexposed joints below grade shall be trowel pointed; other unexposed joints shall be cut off flush.
5. Anchoring Face Brick to Block Backup Walls: Build eye section of anchor into backup walls spaced 16" o.c. vertically (in alternate courses to backup reinforcing) and 16" horizontally, one tie per 1.77 sq. ft. Build pintle sections into face wall at same locations, as the brick is laid. Both eye and pintle sections shall extend into bed joints of solidly grouted block and into brick joint a minimum of 1-1/2". Tie ends shall engage outer shell of hollow block back-up at least 1/2". Maximum misalignment of bed joints from one wythe to the other shall be 1-1/4".
6. Anchoring Face Brick to Stud Walls: Anchor with corrugated-metal veneer anchors space 16" o.c. vertically and 16" o.c. horizontally, one tie per 1.77 sq. ft. Embed anchors in brick joints for distances at least one-half of brick thickness.
7. Cavities: Keep cavity spaces free of mortar. Fill cavity solid with mortar only where indicated.
8. Weep Holes: Provide weep holes 48" o.c. in exterior wythe of masonry walls, and in brick veneer walls, above foundation and at all through-wall flashing and other waterstops in wall.

- C. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- D. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- E. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- F. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- G. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- H. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
 - 1. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
 - 2. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3.4 MORTAR BEDDING AND JOINTING

- A. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- B. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint), unless otherwise indicated.
- C. Lay hollow brick and concrete masonry units as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 3. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- D. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

3.5 MASONRY-CELL INSULATION

- A. Per manufacturer's recommendations.

3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap joint reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.

2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
 - a. Reinforcement above is in addition to continuous reinforcement.

- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 1. Install preformed control-joint gaskets designed to fit standard sash block.
 2. Unless indicated or noted otherwise, on the exterior, control joints shall occur at all interior corners of intersecting masonry walls.
 3. Square rake mortar cleanly to depth of 3/8" to receive sealant as specified in Division 7.
- C. Provide expansion joints in exterior above grade masonry walls not to exceed 40' o. c., placed as shown on drawings or as located and directed by Engineer.
- D. Use specified expansion joint materials in all expansion joints unless otherwise directed.
- E. Form expansion joints in brick made from clay or shale as follows:
 1. Build in compressible joint fillers where indicated.
 2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod.

3.8 THROUGH-WALL FLASHING

- A. Install continuous, embedded in mortar or a troweled on layer of bituminous mastic, with end joints lapped 6" and sealed with manufacturer's mylar tape, and with ends adjacent to opening jambs turned up to form a pan. Outer edge shall extend completely to face of mortar joint.
- B. At rear of through-wall flashing between stud walls and brick veneer, extend through cavity and build in as shown. Extend up between sheathing and building wrap
- C. Required Locations: Install through-wall flashing at heads and sills of windows, heads of doors in exterior walls, continuous under weep holes in brick veneer, and where shown.
- D. Where grade slopes and weep holes above grade step with the slope, through-wall flashing shall step correspondingly and shall overlap at the stepped ends a minimum of 24". Turn up ends approximately 2" and turn into head joints of masonry.

3.9 LINTELS

- A. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

3.11 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as needed. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.12 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
 - 2. Comply with Level C Quality Assurance in ACI 530-1/ASCE 6/TMS 602 Latest Edition and International Building Code Chapter 17 Structural Tests and Inspection, Latest Edition and as follows:
- B. Testing Frequency: One set of tests for each 1500 sq. ft. of wall area or portion thereof.
- C. Mortar Test (Property Specification): For each mix provided, per ASTM C 780. Test mortar for mortar air content and compressive strength.
- D. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.13 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.14 CLEAR SURFACE TREATMENT REPELLENTS

- A. In addition to the integral water repellent provided within the concrete masonry units and the integral water repellent provided within the mortar, provide a compatible clear surface treatment repellent post applied in accordance with the manufacturers recommendations to all concrete masonry work.

3.15 CLEANING

- A. Clean off loose mortar without damage to brick and CMU. Cut out defective joints, re-point and tool to match adjacent work.
- B. Insure adequate water supply for presoaking and rinsing. Delay cleaning of any section at least 28 days after topping out.
- C. Use "Sure Klean" or approved equal in strict accordance with manufacturer's instructions. Specific product shall be as recommended by the manufacturer for the type masonry involved.
- D. Protect non-masonry surfaces. Masonry below the working area shall be kept wet by flushing with water
- E. High pressure water cleaning methods are not permitted unless approved by the Engineer.

3.16 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Grout.
- B. Related sections:
 - 1. Section 01 41 00 – Structural Tests and Special Inspections.

1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC “Code of Standard Practice for Steel Buildings and Bridges,” that support design loads.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pre-tensioned and slip-critical high-strength bolted connections.
- C. Welding certificates.
- D. Qualification Data: For Installer and fabricator.
- E. Mill Test Reports: Signed by Manufacturers certifying that the following products comply with requirements:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Shop primers.
 - 4. Non-shrink grout.
- F. Source quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who regularly erects structural steel with scope and complexity similar to that of this project.
- B. Fabricator Qualifications: A qualified fabricator who regularly fabricates structural steel with scope and complexity similar to that of this project.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, “Structural Welding Code--Steel.”
- D. Comply with applicable provisions of the following specifications and documents:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC "Seismic Provisions for Structural Steel Buildings" and "Supplement No.2."
3. AISC "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
4. AISC "Specification for the Design of Steel Hollow Structural Sections."
5. AISC "Specification for Allowable Stress Design of Single-Angle Members".
6. RCSC "Specifications for Structural Joints Using ASTM F 3125 Bolts.

E. Pre-installation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
1. Store fasteners in a protected place. Re-lubricate bolts and nuts that become dry.
 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
 3. Do not clean and use rusty bolts.

1.6 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992.
- B. Channels, Angles, and Shapes: ASTM A 36 unless otherwise noted.
- C. Plate and Bar: ASTM A 36 unless otherwise noted.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B structural tubing.
- E. Steel Pipe: ASTM A53, Type E or S, Grade B.
1. Weight Class: Standard unless otherwise indicated.
 2. Finish: Black, except where indicated to be galvanized.
- F. Welding Electrodes: Comply with AWS requirements. Tensile strength should be the same or greater than base metal.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM F 3125 Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon steel nuts; and ASTM F 436 hardened carbon-steel washers.
1. Finish: Plain unless noted or indicated otherwise.
- B. Un-headed Anchor Rods: ASTM F 1554, Grade 36, unless otherwise indicated.
1. Configuration: as indicated.
 2. Nuts: ASTM A 563, heavy hex carbon steel.

3. Plate Washers: ASTM A 36 carbon steel.
4. Washers: ASTM F 436, hardened carbon steel.
5. Finish: Plain, unless noted or indicated otherwise.

C. Threaded Rods: ASTM A 36.

1. Nuts: ASTM A 563 heavy hex carbon steel.
2. Washers: ASTM F 436 hardened carbon steel.
3. Finish: Plain, unless noted or indicated otherwise.

D. Clevises or turnbuckles: ASTM A 108, Grade 1035, cold-finished carbon steel.

E. Eye Bolts and Nuts: ASTM A 108, Grade 1030, cold-finished carbon steel.

F. Sleeve Nuts: ASTM A 108, Grade 1018, cold-finished carbon steel.

2.3 PRIMER

A. Primer: Fabricator's standard lead and chromate free non-asphaltic rust inhibiting primer.

B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time and complying with Section 03 60 00 GROUT.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC "Code of Standard Practice for Steel Buildings and Bridges" and AISC "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design".

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

F. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

G. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure

removable stops to frames with countersunk, cross-recessed head machine screws, uniformly spaced not more than 10" o.c., unless otherwise indicated.

- H. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces.
 - 2. Base-Plate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC "Specification for Structural Joints Using ASTM F 3125 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2".
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials.
 - 5. Galvanized surfaces.
- B. Surface Preparation: Clean the surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to Manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Apply a 1-coat, non-asphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 - 1. Fill vent holes and grind smooth after galvanizing.
 - 2. Galvanize all exterior exposed structural steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedment, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design".
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow it to cure. Comply with Manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.

- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC "Specification for Structural Joints Using ASTM F 3125 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, unless noted or indicated otherwise.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design", for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC "Specification for Structural Joints Using ASTM F 3125 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and Manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION

SECTION 06 17 53 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. The design, manufacture, and quality assurance of metal-plate-connected wood trusses shall be in accordance with ANSI/TPI 1 "National Design Standard for Metal Plate Connected Wood Truss Construction."
- C. The handling, installation, restraining and bracing of trusses shall be in accordance with "Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses (BCSI)" produced by the Truss Plate Institute and the Wood Truss Council.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wood roof trusses.
 - 2. Wood truss bracing.
 - 3. Metal truss accessories.

1.3 DEFINITIONS

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.
- B. TPI: Truss Plate Institute, Inc.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. SPIB: The Southern Pine Inspection Bureau.
 - 4. WCLIB: West Coast Lumber Inspection Bureau.
 - 5. WWPAA: Western Wood Products Association.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
 - 1. Design Loads: As indicated on General Notes of Structural Drawings.
 - 2. Maximum Deflection Under Design Loads:

- a. Roof Trusses: Vertical deflection of $1/240$ Total Load and $1/360$ Live Load of span.
 - b. Apartment Floor Trusses: Vertical deflection of $1/360$ Total Load and $1/480$ Live Load of span.
- B. Design trusses for loads indicated on drawings plus concentrated loads hung from or supported on trusses. Refer to mechanical, electrical and plumbing drawings and specifications for loading information and location. Loading as required by other subcontractors, such as fire protection, shall be coordinated by the General Contractor.
- C. Trusses shall be designed in accordance with the Standard and where any applicable design feature is not specifically covered herein, design shall be in accordance with the applicable provisions of the latest edition of the American Forest & Paper Association's (AF&PA's) National Design Specification® (NDS®) for Wood Construction and all applicable Legal Requirements.
- D. Roof truss assembly shall provide a 2-hour fire rating.

1.5 SUBMITTALS

- A. Review of shop drawings will be for general considerations only. Compliance with requirements for materials, fabrication, engineering, dimensions, bracing, and erection is the Contractor's responsibility.
- B. Product Data: For wood-preservative-treated lumber, metal-plate connectors, metal truss accessories, and fasteners.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- C. Truss Submittal Package: The truss submittal package submitted by the truss manufacturer shall consist of the cover/truss index sheet, each individual truss design drawing, the truss placement diagram, the permanent individual truss member restraint/bracing method and details and any other structural details germane to the trusses.
 - 1. The Cover/Truss Index Sheet shall include, at a minimum, the information specified below:
 - a. Signature and Seal of Truss Design Engineer licensed to practice in the jurisdiction in which the building is to be constructed
 - b. Project Identification
 - c. Identification of the Construction Documents by drawing number(s) with revision dates
 - d. Specified Building Code
 - e. Dead Loads and Live Loads for roof and/or floor trusses
 - f. Wind Load Criteria
 - g. Any other design loads such as ponding, mechanical, etc.
 - h. A listing of the individual identification numbers and dates of each Truss Design Drawing referenced by the Cover/Truss Index Sheet
 - 2. The Truss Design Drawings shall include, at a minimum, the information specified below:

- a. Slope or depth, span and spacing
 - b. Location of all joints and support locations
 - c. Number of plies if greater than one and required connection
 - d. Required bearing widths
 - e. Design Loads as applicable, including:
 - 1) Top Chord live load (for roof Trusses, this shall be the controlling case of live load or snow load)
 - 2) Top chord dead load
 - 3) Bottom chord live load
 - 4) Bottom chord dead load
 - 5) Additional loads and locations
 - 6) Environmental Load Design Criteria (wind speed, snow, seismic, and all applicable factors as required to calculate the Truss loads)
 - 7) Other lateral loads, including drag strut loads
 - f. Adjustments to Wood Member and Metal Connector Plate design values for conditions of use
 - g. Maximum reaction force and direction, including maximum uplift reaction forces where applicable
 - h. Metal Connector Plate type, manufacturer, size, and thickness or gauge, and the dimensioned location of each Metal Connector Plate except where symmetrically located relative to the joint interface
 - i. Size, species and grade for each Wood Member
 - j. Truss-to-Truss connection and Truss field assembly requirements
 - k. Calculated span to deflection ratio and/or maximum vertical and horizontal deflection for live and total load and K_{CR} (creep factor) as applicable
 - l. Maximum axial tension and compression forces in the Truss members
 - m. Required Permanent Individual Truss Member Restraint location and the method and details of Restraint/Bracing to be used
3. The Truss Placement Diagram:
- a. Truss Placement Diagrams that serve only as a guide for installation and do not deviate from the Contract Documents shall not be required to bear the seal or signature of the Truss Design Engineer.
 - b. When the Truss Placement Drawing deviates from the Contract Documents, at a minimum, the Truss Design Engineer shall:
 - 1) Sign and seal the Truss Placement Diagram
 - 2) Design and submit sealed calculations for review and approval of any truss-to-truss and/or truss-to-supporting structure connections affected by the changes to the truss layout. Provide design and calculations to maintain a continuous load path to the foundation where necessary.
4. The permanent individual truss member restraint/bracing method and details:
- a. At a minimum, provide permanent individual truss member restraint/bracing per standard industry details in accordance with BCSI publications.
 - b. For trusses spanning 60 feet or greater, the Truss Design Engineer shall design and submit sealed calculations for the temporary restraint/bracing and the permanent individual truss member restraint/bracing.
- D. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.
- E. Qualification Data: For metal-plate manufacturer, fabricator, and Installer.
- F. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

- G. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Wood-preservative-treated lumber.
 2. Metal-plate connectors.
 3. Metal truss accessories.

1.6 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- C. Source Limitations for Connector Plates: Obtain metal connector plates from a single manufacturer.
- D. Comply with applicable requirements and recommendations of the following publications:
1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
 2. BCSI, "Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses"
- E. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations of "Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses (BCSI)" produced by the Truss Plate Institute and the Wood Truss Council.
1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

1.8 COORDINATION

- A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

PART 2 - PRODUCTS

2.1 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Provide dressed lumber, S4S.
 - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- B. Grade and Species: For truss chord and web members, provide dimension lumber of any species, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."
- C. Minimum Chord Size For Roof Trusses: 2 by 4 inches nominal for both top and bottom chords.
- D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Division 06 Section Rough Carpentry.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA C2[, except that trusses that are not in contact with the ground and are continuously protected from liquid water may be made from lumber treated according to AWPA C31 with inorganic boron (SBX)].
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
 - 2. For exposed trusses indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat trusses where indicated on Drawings.

2.3 METAL CONNECTOR PLATES

- A. Metal connector plates shall be manufactured by a Truss Plate Institute (TPI) member plate manufacturer and shall not be less than 0.036 in. thick (20 gauge) and shall meet or exceed *ASTM A653/A653M* grade 33, and galvanized coating shall meet or exceed *ASTM A924/924M*, coating designation G60. Working stresses in steel are to be applied to effectiveness ratios for plates as determined by test and in accordance with ANSI/TPI 1.

- B. In highly corrosive environments, special applied coatings or stainless steel may be required.
 - 1. Hot-Dip Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 - a. Use for interior locations where stainless steel is not indicated.
- C. At the request of the Building Designer, a TPI member plate manufacturer shall furnish a certified record that materials comply with steel specifications.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.5 METAL TRUSS CONNECTION HARDWARE

- A. Truss hangers and connectors shall be tested in accordance with requirements in Chapter 17 and 23 of the International Building Code.
 - 1. Truss hangers and connectors compliant with ICC-ES AC 13 "Acceptance Criteria for Joist Hangers and Similar Devices" are acceptable.
- B. Subject to compliance with requirements, provide products indicated on Contract Drawings.
 - 1. Substitution with comparable products shall be allowed provided that the products meet requirements noted above and that the products meet or exceed those indicated on the Contract Drawings.

- a. Contractor shall submit for review and approval manufacturer product data certifying code compliance and a detailed comparison of allowable loads of the substituted product and the product indicated on the Contract Drawings.
- C. All metal truss connection hardware shall have the appropriate finish as required by the location of the hardware in the structure.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.
- B. Protective Coatings: SSPC-Paint 22, epoxy-polyamide primer or SSPC-Paint 16, coal-tar epoxy-polyamide paint.

2.7 FABRICATION

- A. Trusses shall be manufactured to meet the quality requirements of ANSI/TPI 1 and in accordance with the information provided in the final approved Truss Design Drawings.
- B. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- C. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- D. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
- E. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall be responsible for the handling, installation, and temporary restraint/ bracing of the Trusses in a good workmanlike manner and in accordance with the recommendations set forth in the latest edition of *BCSI*.
- B. Truss Submittals and any supplementary information provided by the Truss Manufacturer shall be provided by the Contractor to the individual or organization responsible for the installation of the Trusses.

3.2 HANDLING

- A. Trusses shall be handled during manufacturing, delivery and by the Contractor at the job site so as not to be subjected to excessive bending.

- B. Trusses shall be unloaded in a manner so as to minimize lateral strain. Trusses shall be protected from damage that might result from on-site activities and environmental conditions. Trusses shall be handled in such a way so as to prevent toppling when banding is removed.
- C. Apparent damage to Trusses, if any, shall be reported to Truss Manufacturer prior to erection.

3.3 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- D. Trusses shall be set and secured level and plumb, and in correct location. Each Truss shall be held in correct alignment until specified permanent restraint and bracing is installed.
- E. Install wood trusses within installation tolerances in TPI 1.
- F. Cutting and altering of Trusses is not permitted. If any Truss should become broken, damaged, or altered, written concurrence and approval by a Registered Design Professional is required.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in truss accessories according to manufacturer's fastening schedules and written instructions.

3.4 RESTRAINING/BRACING

- A. Trusses shall be permanently restrained and braced in a manner consistent with good building practices as outlined in *BCSI* and in accordance with the requirements of the Construction Documents. Trusses shall furthermore be anchored or restrained to prevent out-of-plane movement so as to keep all Truss members from simultaneously buckling together in the same direction. Such permanent lateral restraint shall be accomplished by: (a) anchorage to solid end walls; (b) permanent diagonal bracing in the plane of the web members; or (c) other suitable means.
- B. Concentrated loads shall not be placed on top of Trusses until all specified restraint and bracing has been installed and decking is permanently nailed in place. Specifically avoid stacking full bundles of plywood or other concentrated loads on top of Trusses.
- C. Materials used in temporary and permanent restraint and bracing shall be furnished by Contractor.

3.5 REPAIRS AND PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- D. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
 - 1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION 061753

STANDARD
SPECIFICATIONS

ELECTRICAL

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ELECTRICAL SPECIFICATION INDEX

- 26 00 01 – All Equipment
- 26 00 10 – Electrical General
- 26 05 10 – Electrical Utility Service
- 26 05 12 – Electrical Submittals
- 26 05 16 – Coordination
- 26 05 19 – Conductors 600 Volt
- 26 05 26 – Grounding Electrical Systems
- 26 05 27 – Grounding System (Site Grid)
- 26 05 29 – Hangers and Supports for Electrical Systems
- 26 05 33 – Raceways
- 26 05 34 – Outlet Boxes and Junction Boxes
- 26 05 43 – Raceways Exterior Duct Banks
- 26 05 53 – Electrical Identification (Low Voltage)
- 26 24 16 – Panel Boards
- 26 27 26 – Wiring Devices
- 26 28 13 – Fuses
- 26 28 16 – Enclosed Switches
- 26 29 00 – Manufactured Control Panels
- 26 43 13 – Surge Protective Device for AC System
- 26 43 14 – Surge Protective Devices for Instrumentation, Control and Data Lines
- 26 51 00 – Lighting



SECTION 26 00 01 – ALL EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

1. **The requirements in this “ALL EQUIPMENT” Specification apply to all equipment, including all electrical equipment and electrical items, etc., provided for this project.** Where more stringent requirements for a piece of equipment are contained in the Contract, the more stringent requirements shall apply. **The requirements in this “ALL EQUIPMENT” specification apply to all equipment and all specifications for all equipment** and this “ALL EQUIPMENT” Specification shall be considered to be an integral part of all other equipment specifications.
2. **The requirements in this “ALL EQUIPMENT” Specification also applies to all Electrical equipment and all SCADA equipment provided for the project.** The requirements in this “ALL EQUIPMENT” specification shall be considered an integral part of all Electrical and all SCADA specifications.
3. The Contractor shall provide all labor, material, equipment, and incidentals, etc. to furnish, install, and place into proper operating condition all the equipment and appurtenances as shown on the Drawings or described in the Specifications. The equipment manufacturer shall completely design and furnish a coordinated and completely engineered system to meet all the conditions required by the project.
4. The General Specifications contain extensive, detailed submittals, shop drawing, and O&M Manual submittal requirements. The Contractor shall require all equipment manufacturers and suppliers to understand and fully comply with all shop drawing, submittal, and O & M Manual requirements in the General Specifications. The Contractor shall carefully review and comply with all Submittal and Shop Drawing requirements, including O & M Manual requirements, as per the General Specifications. All exceptions to the project requirements must be listed on the “EXCEPTIONS” sheet included with the submittal.
5. In order to assure standardization, uniform quality, ease of maintenance, and minimal parts storage, all equipment called for under individual equipment specifications shall be supplied by a single manufacturer who, through the Contractor, shall be fully responsible for its design, coordination, and performance.
6. No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of equipment for the same purposes as used on the project. The manufacturer shall have installed and had in satisfactory use for a period of not less than five (5) years a minimum of ten (10) installations of similar size as shown in plans for this project comparable to the units specified. No consideration will be given to an individually sized equipment that has not been commercially available for five (5) years.

7. The equipment assemblies shall include all necessary equipment and appurtenances. Standard manufactured equipment shall be modified if necessary to meet all requirements of the plans and specifications. The equipment is designed around the first manufacturer listed on the List of Material Suppliers and Equipment Manufacturers. If changes in the project are necessary due to the use of equipment of a different manufacturer, the Contractor shall submit such changes to the Engineer. The Contractor shall bear all costs associated with such changes. The listing of a manufacturer, whether in the plans, specifications, bid documents, or contract documents, in no way relieves that manufacturer from meeting all the requirements of the plans and specifications. Note that the equipment specified herein may be nonstandard or non-typical.
8. All equipment shall be designed and manufactured for reliable and trouble-free performance. All equipment shall provide dependable and trouble-free operation.
9. The Drawings and Specifications illustrate and specify functional and general construction requirements of the equipment and do not necessarily show or specify all components, wiring, piping, or accessories, etc. required to make a completely integrated system. The drawings do not show all details of all equipment or installation requirements. The Contractor shall provide all components, piping, wiring, mounting devices, supports, accessories and labor, etc., required for a complete, workable and integrated system. The Contractor shall coordinate these with the actual equipment manufacturer who provides the equipment and shall install all components in accordance with the manufacturer's requirements except where the requirements of the contract drawings or specifications are more stringent, in which case they shall be followed.
10. All equipment (including, but not limited to, motors, drive equipment and components, electrical components, controls, and control panels) shall be designed for and have a long trouble-free life and perform reliably and properly in the environment in which it will be installed. Where equipment or control panels are installed outdoors, it will be subject to ambient temperatures from minus 10 to plus 110 degrees, direct sunlight, blowing rain, nearly continuous high relative humidity, periodic icing, corrosive atmospheres and splashing typically associated with sewage. Equipment may be operated intermittently, continuously, or in a standby mode.
11. All equipment, etc., shall be manufactured to fit within the space allocated on the drawings. No additional space shall be available or provided. This also includes control panels, electrical appurtenances, and piping, etc. Provide special designs if needed to fit in available space. Coordinate with available space.
12. The equipment shall be powered by the electrical sources shown in the electrical drawings for the project.
13. All electrical panels, boxes, conduits, unistrut, hardware, components, and appurtenances, attachments, etc., shall be stainless steel or aluminum and shall be corrosion resistant.

14. All pipe hangers, unistrut, hardware, components, and appurtenances, attachments, etc., shall be stainless steel or aluminum and shall be corrosion resistant.
15. Orient all flowmeters, pressure gauges, light, and other instrumentation, etc. such that it is promptly and easily visible and readable.
16. When PLCs are included in a submittal, provided and whenever else requested, submit descriptions of the control methodology that will be employed. This shall include a description of operation, interlocks, and other features to fully understand the functioning and control of the system. Manufacturer-provided panels shall meet all requirements of Control Panel Specifications (in other specifications sections). Such panels shall have a main, pad-lockable circuit breaker. Prior to making the first submittal, all panels shall be completely and thoroughly coordinated with all other project equipment, controls, and SCADA system, etc. The submittal may be rejected without review if it appears that careful and comprehensive coordination was not performed by the Contractor or Manufacturer, etc.
17. All equipment shall be designed solely by the Manufacturer with safety features and guards as required to meet the standards of OSHA and applicable codes. The Manufacturer shall design all equipment to allow for safe and convenient operation and maintenance.
18. All panels shall be designed by the Panel Manufacturer to meet the requirements of the project and of the installation. If control drawings are included in the plans, the manufacturer shall consider those as conceptual drawings showing only minimum requirements. The detailed design is the responsibility solely of the panel manufacturer who shall include additional features as desirable for trouble-free, reliable operation. Include appropriate surge protection. Where located outdoors or in non-conditioned space, panels shall be furnished with condensation heaters. NEMA 4 or 4X panels shall be furnished with 3-point latches. Clips or similar closure devices shall not be permitted.
19. Miscellaneous hardware, nuts, bolts, etc., shall be stainless steel when the equipment will be located outdoors, or in non-conditioned space, or in humid areas.
20. All control panels shall be fully tested prior to shipment from the manufacturer. Written certification shall be provided to the Engineer certifying that the testing demonstrated that all contract requirements were complied with. Mechanical equipment shall be tested prior to shipment to the extent practical or required.
21. Spare parts shall be boxed separately from the regular items. A separate packing list clearly labeled "SPARE PARTS" is required for inventory purposes. Package each part individually or in sets in moisture proof containers or wrappings, clearly labeled with part name, manufacturer's parts/stock number, and the equipment it is provided for.
22. Provide all the spare parts recommended by the manufacturer for the number of units and equipment installed. Provide any special tools required to install, operate, or maintain the equipment. All spare parts shall be delivered to the Owner, in the presence of the Engineer, at the end of construction and in one occurrence (i.e. one transfer for all spare

parts). The Contractor shall prepare a detailed list of all the spare parts for the project, and the Owner shall sign for the spare parts received.

23. The Contractor shall inspect all equipment and materials against reviewed shop drawings at the time of delivery. Equipment and materials damaged or not meeting the requirements of the reviewed shop drawings shall be immediately returned for replacement or repair.
24. All equipment and its components shall be properly stored in a manner that will protect the equipment and ensure long life. As a minimum, all equipment shall be stored in accordance with the equipment manufacturer's recommendations, unless more stringent requirements are contained in the plans or specifications. All equipment shall be properly stored and maintained during storage. All storage requirements also apply to equipment that has been installed but is not in full-time normal operations.
25. The Contractor shall thoroughly coordinate all dimensions for this equipment with other shop drawings and with the plans and submit to the Engineer any required changes in concrete or piping dimensions, etc., that may be needed to allow the equipment to fit, to perform properly, and to be maintained or replaced. Concrete and appurtenances shall be placed by the Contractor well within the manufacturer's required construction tolerances. Templates provided by the manufacturer shall be utilized to set embedded anchor bolts.
26. Comply with all painting requirements as contained in the "Standard Specifications for Painting". Refer to and understand all the "Standard Specifications for Painting" for the project. Provide the primer specified in the "Standard Specifications for Painting". Finish field preparation and painting shall be performed as specified in the Painting Section. The Contractor shall touch-up all shipping damage to the paint as soon as the equipment arrives on the job site. The equipment should be totally re-coated if needed for a uniform and pleasing appearance.
27. All equipment, etc., shall be manufactured to fit within the space allocated on the drawings. No additional space shall be available or provided. Refer to and comply with all other sections of the specifications including but not limited to electrical, controls, control panels, instrumentation, and motors, etc.
28. Fully coordinate all equipment requirements, controls, and connections, etc. in a timely manner. Coordinate supports and piping, etc.
29. Provide all miscellaneous accessories, brackets, supports, instrumentation, appurtenances, and adaptors, etc. that are required for the specific installation on this project. If the equipment manufacturer recommends that the water pressure of connecting water lines be limited, he shall provide a water pressure regulator.
30. Where initial maintenance (oil changes, tightening belts or chains, etc.) are recommended to be performed at 6 months or less after startup, such maintenance shall be performed by the Contractor utilizing factory authorized personnel.

31. All anchor bolts shall be stainless steel and shall be provided by the equipment manufacturer who shall select the bolts based on the maximum possible loading for the equipment.
32. For all electrical, control, or instrumentation panels, the colors of indicator lamps shall be consistent throughout the project and plant. Swap or replace lamps and LEDs at startup as needed for consistency.
33. Prior to assembly, all stainless-steel bolts and nut threads shall be coated with a nonseizing compound by the Contractor.
34. The Contractor shall install all project components and all equipment in strict accordance with manufacturer recommendations. The Contractor shall carefully follow all manufacturer safety recommendations and shall continuously utilize effective safety practices.
35. The Contractor shall install all project components and all equipment in strict accordance with manufacturer recommendations. The Contractor shall carefully follow all manufacturer safety recommendations and shall continuously utilize effective safety practices.
36. The manufacturer shall include in his price and schedule trips to the project site as needed for equipment installation, start-up assistance, inspection of installed equipment for proper operation as noted below, and operator training, etc. The manufacturer's representative shall be from the factory and shall have a minimum of 10 years of meaningful and acceptable experience starting up such equipment. The representative shall be well qualified to perform the startup and training. The Contractor shall submit the representative's qualifications for review and approval prior to scheduling the visit.
37. After the Contractor has installed the equipment and it is capable of being operated, the equipment manufacturer shall furnish a qualified representative meeting above stated requirements to inspect the equipment and to supervise field testing and start-up.
38. Install equipment and accessories in accordance with the drawings, approved shop drawings, and the manufacturer's installation instructions and recommendations. All final electrical connections shall be made by the electrical sub-contractor. The Contractor shall make adjustments including but not limited to level, plumbness, and alignment, provide lubricants, lubricate all equipment, and adjust all controls, equipment, and appurtenances in accordance with the manufacturer's instructions and leave equipment in proper working condition. He shall carefully test all safety equipment and ensure it operates as recommended. Where required for proper installation, the Contractor shall install non-rusting, non-shrink grout. The Contractor shall verify that the electrical power available is proper and that motor rotation is correct. Unless otherwise allowed, new or rebuilt equipment shall be started up on a Monday, Tuesday, or Wednesday to allow some time for malfunction to occur prior to the weekend. Where desirable for the project, new or rebuilt equipment shall be started up in the morning. The Contractor shall demonstrate all features of the equipment and its controls and demonstrate that the equipment operates properly under all types of conditions including but not limited to high speed and low speed, etc. Where units are furnished with more than one pulley combination for speed changes,

the Contractor shall demonstrate that the equipment operates properly at all speeds provided. The Contractor shall coordinate with the Engineer to determine which set of pulleys should be left on the equipment at the conclusion of testing and demonstration. The testing shall also include safety features, operation from local and remote-control stations, and local and remote alarm simulation.

39. The Contractor shall conduct testing to demonstrate to the Owner's satisfaction that the equipment performs as required. Performance and/or installation testing shall be repeated at no cost to the Owner if requested by the Owner after experiencing problems with the equipment or after repairs or after any indication that the testing may potentially not be representative.
40. After testing, the Contractor, in conjunction with the manufacturer's representative, shall make whatever adjustments are required for the anticipated operating conditions.
41. The Manufacturer's representative shall sign a Certificate of Compliance on a form provided by the Engineer stating that he has thoroughly reviewed the equipment and its installation and it meets the requirements of the Manufacturer. All written certifications shall be delivered to Engineer before startup item is paid. All certifications shall be delivered concurrently with the performance of the work being certified and again at project completion in one single three-ring binder with a Table of Contents listing each certification contained in the binder.
42. A qualified and experienced technical representative of the manufacture shall provide operator training for Owner's personnel after system is operational. He shall be from the factory and shall have a minimum of 10 years experience with the equipment. If time and conditions permit, training may take place while manufacturer's representative is at the job site for inspection. All training shall occur at a time that is convenient for the Owner, operators, and Engineer. Training may be videotaped or otherwise recorded by the Owner, operator, or Engineer if they wish even if prior approval or arrangements have not been made. For operating facilities, it may be necessary to conduct the training in two separate independent sessions so that all operators can attend. If training is conducted before equipment fully and properly operational, it may be necessary to repeat the training after the equipment is fully and properly operational.
43. No warranty period shall begin prior to the final acceptance by the Owner.
44. All equipment shall be warranted by the manufacturer for a period of one (1) year from the date of final acceptance by the Owner. Longer warranty periods are required where noted in individual equipment specifications. Warranties shall be non-prorated. Manufacturer warranties shall in no way relieve the Contractor of his warranty requirements established by the Contract Documents.

END OF SECTION 26 00 01

SECTION 26 00 10 - ELECTRICAL GENERAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The "General Specifications" and "Special Provisions" of Contract as written and referred to hereinbefore are adopted and made part of Division 26.

1.2 DESCRIPTION OF WORK

- A. Provide equipment, labor, etc., to install complete working electrical system as shown on drawings and specified.
- B. Provide equipment and/or wiring normally furnished or required for complete electrical systems but not specifically specified on drawings or in specifications, as though specified by both.
- C. All equipment and wiring shall be new and bear U.L. label.
- D. Electrical work includes, but is not limited to:
 - 1. Arrange with local utility company for service as shown or specified.
 - 2. Complete 240-volt Distribution System. Provide meters, switchboards, panelboards, motor control centers, circuit breakers, power outlets, convenience outlets, switches, and/or other equipment forming part of system.
 - 3. Complete raceway systems and terminal facilities for SCADA systems.
 - 4. Connection of all equipment.
 - 5. Complete electrical connections for Owner furnished engine-generator package for pre-commissioning and commissioning.
 - 6. Manual transfer switch with connections for generator.
 - 7. Complete exterior lighting.
 - 8. General conditions call for General Contractor to provide power for construction. This contractor shall verify and provide what general requires.
 - 9. All requirements shown in Contract Drawings.

1.3 WORK NOT INCLUDED

- A. Installation of motors except where specifically noted.
- B. Control wiring for mechanical systems, except where indicated to be provided by Electrical Contractor.
- C. Installation of SCADA Systems.
- D. Flashing of conduits into roofs and outside walls. Inform General Contractor of number and size of roof penetrations and/or wall penetrations prior to bidding.

1.4 RELATED WORK SPECIFIED ELSEWHERE:

- A. Classification of excavation:
- B. Painting:
- C. Concrete Work:

1.5 REQUIREMENTS OF REGULATORY AGENCIES:

- A. Obtain and pay for all permits required for work. Comply with all ordinances pertaining to work described herein.
- B. Install work under this Division per drawings, specifications, latest edition of the National Electrical Code, Local Building Codes, and any special codes having jurisdiction over specific portions within complete installation. In event of conflict, install work per most stringent code requirements determined by Engineer.
- C. Arrange, pay fees for and complete work to pass required tests by agencies having authority over work. Deliver to Engineer Certificates of Inspection and approval issued by authorities.

1.6 QUALIFICATIONS OF CONTRACTOR:

- A. Has completed minimum five projects same size and scope in past five (5) years.
- B. This qualification applies to Sub-Contractors.
- C. Use workmen experienced in their respective trade. Submit qualifications of Superintendent for review.
- D. Owner reserves right to reject bid of Contractor failing to meet these qualifications.

1.7 GENERAL JOB REQUIREMENTS:

- A. Drawings and Specifications:

1. Electrical work is shown on "E" series drawings inclusive. Follow supplementary drawings as though listed above.
2. Drawings and specifications are complementary. Work called for by one is binding as if called for by both.
3. Drawings show general run of circuits and approximate location of equipment. Right is reserved to change location of equipment and devices, and routing of conduits to a reasonable extent, without extra cost to Owner.
4. Refer conflicts between drawings and specifications describing electrical work and work under other Divisions to Engineer for remedial action.
5. Use dimensions in figures in preference to scaled dimensions. Do not scale drawings for exact sizes or locations.
6. Execution of Contract is evidence Contractor examined all drawings and specifications related to work and is informed to extent and character of work. Later claims for labor and materials required due to difficulties encountered, which could have been foreseen had examination been made, will not be recognized.
7. Charges for extra work not allowed unless work authorized by written order from Engineer approving charge for work.

B. Visit to Site:

1. Visit site to survey existing conditions affecting work. Include necessary materials and labor to accomplish the electrical work. No consideration given to future claims due to existing conditions.

C. Definitions:

- | | | |
|----|----------|--|
| 1. | Provide: | Furnish, install and connect complete. |
| 2. | Wire: | Furnish all necessary wiring and connect complete. |
| 3. | Install: | Set in place and wire complete. |
| 4. | Work: | Materials completely installed and connected. |
| 5. | AWG: | American Wire Gage. |

6.	NEC:	National Electrical Code (latest edition)
7.	NFPA:	National Fire Protection Association.
8.	OSHA:	Occupation Safety and Health Administration.
9.	UL:	Underwriters Laboratories, Inc.
10.	NEMA:	National Electrical Manufacturers Association.
11.	IEEE:	Institute of Electrical and Electronic Engineers.

D. Workmanship, Guarantee and Approval:

1. Work under this Division shall be first class with emphasis on neatness and workmanship.
2. Install work using competent mechanics supervised by foreman, all duly certified by local authorities. Installation subject to Engineer's observation, final approval, and acceptance. Engineer may reject unsuitable work.
3. Furnish Engineer written guarantee, stating workmanship and/or material executed under this Division proven defective within one (1) year after final acceptance, such defects and other work damaged will be repaired and/or replaced at no cost to owner.
4. If project is occupied or systems placed in operation in several phases at Owner's request, guarantee will begin on date each system or item of equipment accepted by Owner.

E. Observations of Work and Demonstration of Operation:

1. At observations of work, open panel covers, junction box covers, pull box covers, device covers, and other equipment with removable plates for check. Provide sufficient personnel to expedite removal and replacement.
2. Contractor to assist Engineer in demonstration of operation of new systems to satisfaction of Owner. Contractor to have manufacturer available for demonstration of systems where requested by Owner.

F. Testing of Electrical Systems:

1. Test Completed work as follows:

- a. Perform test required by Engineer to indicate compliance with specifications, drawings and applicable codes. Provide instruments, labor and materials for tests.
- b. Insulation - use 1000 VDC insulation tester (0-500 megohm fullscale), equal to "Megger" as manufactured by Biddle Company. Test conductors and busses of all systems, including feeders, main service busway, branches, motors, devices, equipment, etc. Test branches for one (1) minute; test feeders, bus ducts, busses, etc., for 15 minutes with readings at one-minute intervals.
- c. Receptacles:
 - (1) Use Woodhead Ground Loop Impedance Tester. Test each receptacle. Record readings.

2. Ground Testing:

- a. Testing of Made Ground Electrodes:
 - (1) Test Ground Systems Indicated.
 - (2) Using a measuring device which generates minimum of 500 VDC, calibrated in ohms (maximum 200-ohm scale) J.C. Biddle "Vibrotester" or approved equivalent.
 - (3) Provide test electrode in accordance with Measuring Device Manufacturer's instructions. Use ground rods as specified in Section "Grounding".
 - (4) Follow instructions of measuring device manufacturer for proper results.
 - (5) Test grounds only when earth is dry.
 - (6) Record ambient temperature, date, time, approximate water table level (as obtained from local geologists); type of earth material.

3. All material shall be new, with U.L. label. If U.L. label is not available, material shall be manufactured in accordance with applicable NEMA; IEEE and Federal Standards.

4. No material shall be substituted for specified, except by prior written approval of Engineer. Specified catalog numbers are used for description of equipment and standard of quality. Equivalent material given consideration if adequate comparison data including samples are provided. Approval required prior to bid date. Bid substituted material only if approved in writing by Engineer.
5. Submit Engineer within 30 days after award of contract a complete list of proposed material manufacturers. List does not preclude submission of shop drawings. Approval of manufacturer on list does not constitute approval of specific material or equipment.

G. Submittals, Shop and Erection Drawings:

1. Submit Engineer within 30 days after award of contract a complete list of proposed material manufacturers. List does not preclude submission of shop drawings. Approval of manufacturer on list does not constitute approval of specific material or equipment.
2. Submit complete shop drawings for all material and equipment furnished under Division 26 of specifications, to Engineer for review within 30 days after award of contract. Shop drawings shall be submitted timely to allow adequate time for review, re-submission if necessary, manufacture and delivery to allow access of material to project at correct time based on schedule established by Engineer/Contractor. Include complete descriptive data with dimensions, operating data and weight for each item of equipment. Carefully examine shop drawings for compliance with drawings and specifications prior to submittal to Engineer. Shop drawings and submittals shall bear stamp of approval of Electrical and General Contractor as evidence drawings have been reviewed for compliance with contract documents. Submittals without stamp of approval will not be considered and returned for proper resubmission.
3. Submittals, shop and erection drawings may be submitted as electronic portable document files (PDF) format.
4. Submit electronic copies as follows:
 - a. Submit one (1) electronic file for review Engineer will return electronic file to Contractor with comments. Contractor is responsible for reproducing the reviewed submittal for distribution.
5. Review of shop drawings does not relieve Contractor of responsibility for errors and omissions in shop drawings. Contractor is responsible for dimensions and sizes of equipment. Inform Engineer in writing of equipment differing from that shown.

6. Prepare installation drawings required by Engineer. Investigate all conditions affecting work and indicate on drawing. Engineer will review drawings before work commences.
7. Provide for Owner one (1)] hard copy and one (1) electronic copy in portable document file (PDF) format of final shop and erection drawings.
8. Coordination shop drawings are required for the following areas, drawn to a scale of not smaller than 1/4" - 1'-0":
 - a. Electrical equipment rooms and areas.
 - b. Electrical and mechanical equipment areas.
 - c. Drawings shall be submitted to General Contractor for final coordination.
 - d. After General Contractor has approved drawings they shall be submitted to the Engineer for approval.

H. Cooperation:

1. Carefully coordinate work with other contractors. Refer conflicts between trades to Engineer.
2. Work to be installed as progress of project will allow. Schedule of work determined by General Contractor and/or Engineer.

I. Maintenance and Operating Instructions for Equipment:

1. Submit to Engineer data prepared by manufacturer for each item of electrical equipment completely describing equipment. Data to include parts lists, description of operation, shop drawings, wiring diagrams, maintenance procedures and other literature required for maintenance of equipment. Provide one (1) hard copy and one (1) electronic copy in portable document (PDF) format. Bind hard copy in booklet form for presentation and bind PDF copy in similar manner.

J. Record Drawings:

1. Provide "Record" drawings at the completion of job.
2. Keep a complete set of contract drawings on job and record day-to-day changes with red pencil. Indicate actual location of conduit systems, outlets, and equipment. Drawing set shall be maintained in good order. Turn prints over to Engineer at final observation.

3. Contractor shall transfer information from marked-up record drawings to AutoCAD files and turn both over to Engineer as a part of close-out documents.

K. Items for Owner:

1. Provide following items for Owner at time of substantial completion:
 - a. Certificates of inspection and approval from authorities having jurisdiction.
 - b. Written guarantees.
 - c. Record drawings.
 - d. Final approved submittals and shop drawings, one (1) hard copy and one (1) electronic copy in PDF format.
 - e. Spare fuses (furnish receipt).
 - f. Maintenance data, one (1) hard copy and one (1) electronic copy in PDF format.
 - g. Affidavit of Owner Instruction (1 copy).

L. Protection and Storage:

1. Provide warning lights, bracing, shoring, rails, guards and covers necessary to prevent damage or injury.
2. Do not leave exposed or unprotected, electrical items carrying current. Protect personnel from exposure to contact with electricity.
3. Protect work and materials from damage by weather, entrance of water or dirt. Cap conduit during installation.
4. Avoid damage to materials and equipment in place. Repair, or remove and replace damaged work and materials.
5. Exercise particular care when working around telephone (electronic) equipment to prevent entrance of dust, moisture and debris into the equipment. Provide dust barriers and partitions as required.
6. Deliver equipment and materials to job site in original, unopened, labeled container. Store to prevent damage and injury. Store ferrous materials to prevent rusting. Store finished materials and equipment to prevent staining and discoloring. Store materials affected by condensation in warm dry areas. Provide heaters. Storage space on site and in building designated by Owner Engineer.

7. Install equipment per manufacturer's recommendations. Conflicts between contract documents and these recommendations, referred to Engineer.

M. Excavation and Backfill:

1. Excavate for work in this Division.
2. Avoid existing facilities in excavating. Contractor is responsible for repair and replacement of damaged facilities in executing work.
3. Backfill in twelve inch (12") lifts, wetted down and tamped. Compaction minimum 95% of adjacent earth. 100% compaction required under structures or paved areas.
4. Repairing to be comparable to work cut including new asphalt paving, concrete paving, sod, replanting shrubbery, etc. Engineer will observe repair work, and reject unsuitable work.

N. Cutting and Repairing:

1. Cut and repair walls, floors, roof, etc., required to install work. Where work cut is finished, employ original installer of finish to repair finish. Do not cut structural members.

O. Anchors:

1. Provide anchors for all equipment, raceways, hangers, etc. to safely support weight of item involved. Anchors to consist of expansion type devices similar to "Redhead" or lead expansion anchors. Plastic anchors are not acceptable. Protect electronic equipment from drilling residue.

P. Cleaning and Painting:

1. Clean equipment furnished in this Division after completion of work.
2. Touch-up or re-paint damaged painted finishes.
3. Remove debris, packing cartons, scrap, etc., from site.

Q. Control Wiring:

1. Control Wiring including low voltage and line voltage interlock wiring is provided in Division 26 as shown on drawings and specified herein. Submit Control Wiring shop drawings where indicated

U. Code Compliance:

1. Entire electrical installation shall comply with all aspects of code including local interpretations. This includes but is not limited to:

- a. Installation adjustment to meet all code clearances between electrical such as ductwork, other HVAC, plumbing, fire protection, and structural systems.

2. No additional compensation will be allowed for code compliance. Notify Engineer of difficulty encountered for assistance.

END OF SECTION 26 00 10

SECTION 26 05 10 – ELECTRICAL UTILITY SERVICE

PART 1 - GENERAL

1.1 RATING:

- A. Secondary Service: 120/240 volts, 1 phase, 3 wire plus ground, grounded neutral, wye connection.

1.2 SERVICE AND UTILITIES:

- A. Arrange with local electric service company for service to be brought to project, and installation of meter. Pay all charges (if any) in connection therewith, including permanent meter deposit, which deposit will be refunded to Contractor at time of Owner's occupancy of the building.
- B. Electrical contractor, prior to bid, shall re-affirm with Utility Companies involved, locations, arrangement, Power Company voltage, phase, metering required, and connections to utility service are in accordance with their regulations and requirements. If requirements are at variance with these drawings and specifications, contract price shall include additional cost necessary to meet regulations without extra cost to Owner after bids are accepted.
- C. Obtain from Utility Company additional charges for service of type, size and location called for. Include charges in bid to be paid by Contractor to appropriate party. Provide payment of charges to allow logical progression of construction and avoid delay of completion.
- D. Should cost above not be available prior to bid, submit with bid a letter signed by responsible Utility Company personnel stating cost is not available. Prime Contractor shall submit letter with his bid to Owner. Cost will then be omitted from contract and become responsibility of Owner.
- E. Furnish with shop drawings a signed document from each utility company describing location and type of service to be supplied and requirements for service. Document shall be signed by the appropriate responsible representative of the respective Utility Company.

PART 2 – PRODUCTS

Not Applicable:

PART 3 – EXECUTION

3.1 POLE MOUNTED TRANSFORMER SERVICE:

- A. An Underground service from pole mounted transformer to service entrance equipment.

ELECTRICAL UTILITY SERVICE

B. Power Company furnishes and installs following:

1. All facilities on primary riser pole and transformer.

C. Provide the following:

1. Underground secondary service from transformer pole consists of conductors in conduit. Make secondary connections to transformer. Leave necessary slack conductors for secondary connections.
2. Coordinate all service work with Utility Company and install work in accordance with their requirements and recommendations.

3.2 METERING:

- A. Install devices and conduit for Power Company metering of secondary service as shown. Power Company will furnish meter, meter socket, to Contractor for installation. Install any additional conduit, junction boxes, etc., as required by Power Company.
- B. Install meter equipment in accordance with Power Company requirements.

END OF SECTION 26 05 10

SECTION 26 05 12 - ELECTRICAL SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION OF SUBMITTAL CATEGORIES:

- A. Submittals required are defined below and specified in each section.
- B. Shop Drawings include fabrication, layout, wiring diagrams, erection, settings, coordination, similar drawings, diagrams and performance data.
- C. Manufacturer's Data is standard printed product information concerning standard portions of manufacturer's products.
- D. Certifications are written statements, executed specifically for project application by authorized officer of contracting firm, manufacturer or other firm as designated, certifying to compliance with specified requirements.
- E. Test Reports are specific reports prepared by independent testing laboratories, showing the results of specified testing. Industry Standards are printed copies of current standards in the industry.
- F. Manufacturer's Product Warranties are manufacturer's standard printed commitment in reference to specific product and normal application, stating, certain acts of restitution will be performed by manufacturer if product fails under certain conditions and time limits.
- G. Operating Instructions are written instructions by manufacturer, fabricator or installer of equipment or systems, detailing procedures to be followed by Owner in operation, control and shut-down.
- H. Maintenance Manuals are compiled information provided for the Owner's maintenance of each system of operating equipment. Maintenance Materials are extra stock of parts or materials for Owner's initial use in maintaining equipment and systems in operation.
- I. Guarantees are signed commitments to Owner that certain acts of restitution will be performed if certain portions of work fail within certain conditions and time limits.
- J. Product Data includes manufacturer's data pertaining to products, materials and equipment of work.

1.2 SUBMITTAL FORM AND PROCEDURES:

- A. Submittals shall be made within 30 days of the contract's Notice to Proceed date.
- B. Submit shop drawings for all material and equipment furnished under Division 26.

- C. Multiple System Items: Where a required submittal relates to an operational item of equipment used in more than one system, increase the number of copies as necessary to complete maintenance manuals for each system.
- D. Response to Submittals: Submittals will be returned with indication documents comply with specifications or documents do not comply and what action must be taken for compliance.
- E. Coordinate electrical submittals through Contractor to Engineer and assist Contractor in preparation of submittal.
- F. Submittals shall bear the stamp and signature of electrical and general contractor indicating both have reviewed the submittal for compliance with requirements of contract documents. Submittals or shop drawings without stamps will be returned without review to the contractor for re-submittal.
- G. Provide submittal Certification And Exceptions Forms per the Special Provisions of the contract.

1.3 SPECIFIC SUBMITTAL REQUIREMENTS:

- A. Shop Drawings:
 - 1. To accurate scale except where diagrammatic representations are specifically indicated.
 - 2. To show clearance dimensions of critical locations and show dimensions of spaces required for operation and maintenance of equipment.
 - 3. To show conduit and conductor connections and other service connections.
 - 4. To show interfaces with other work including structural support.
 - 5. To include complete descriptive data, with dimensions, operating data and weight.
 - 6. To indicate deviation from the contract documents.
 - 7. To explain deviations.
 - 8. To show how deviations coordinate with portions of the work, currently or previously submitted.
- B. Review of shop drawings shall not relieve Contractor of responsibility for errors or omissions in shop drawings. Any equipment which will not fit into space shown on drawings shall be called to the attention of the Engineer in writing. Proper adjustments shall be made to accommodate size.

C. Manufacturer's Data:

1. Where pre-printed data covers more than one distinct item, mark copy to indicate which item is provided.
2. Delete portions of data not applicable.
3. Mark data showing portion of operating range required for project application.
4. Elaboration of standard data describing a non-standard product processed as a shop drawing.

D. For each product include:

1. Manufacturer's production specifications.
2. Installation or fabrication instructions.
3. Source of supply.
4. Sizes, weights, speeds and operating capacities.
5. Conduit and wire connection sizes and locations.
6. Statements of compliance with required standard and governing regulations.
7. Performance data, as applicable.
8. Other information needed to confirm compliance. Manufacturer's recommended parts list.

E. Certifications: Submit with notarized execution.

F. Test Reports: Submit notarized test reports signed and dated by manufacturer.

G. Manufacturer's Product Warranties: Where published warranty includes deviation from required warranty, product is disqualified from use on project, unless manufacturer issues a specific project warranty.

H. Operating Instructions submittal required:

1. Manufacturer's operating instructions for each item of electrical equipment.
2. Supplement additional project instructions where necessary.

3. Specific operating instructions for each electrical system which involves multiple items of equipment. Instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar operations.
 4. Typewritten in completely explained and easily understood English language.
- I. Maintenance Manual Requirements:
1. Emergency instructions including addresses and telephone numbers for service sources.
 2. Regular system maintenance procedures.
 3. Proper use of tools and accessories.
 4. Wiring and control diagram for each system.
 5. Manufacturer's data for each operational item in each system.
 6. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
 7. Shop drawings relating to the system.
 8. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binders, plus pocket-folders for folded drawings. Index with thumb tab for sections. Mark the back spine and front cover of each binder with system identification and volume number.
- J. Maintenance Materials: Deliver to Owner in fully identified containers or packages suitable for storage.
- K. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears corporate seal. Submit draft of each guarantee prior to execution.

END OF SECTION 26 05 12

SECTION 26 05 16 – COORDINATION

PART 1 - GENERAL

1.1 PURPOSE

- A. Electrical contractor is responsible for coordinating system(s) installation and equipment requirements with other trades to avoid conflicts and ensure proper electrical connections are provided for equipment furnished by others. Failure to do so is not justification for additional cost.

1.2 COORDINATION WITH OTHER TRADES

- A. Contract drawings contain diagrammatic layouts and indicate general arrangement of equipment, system components, devices, boxes, conduit, etc.
- B. Prior to installation of material and equipment, review and coordinate work with Structural and Civil Engineering drawings and other Division work for exact space conditions; where not readily discernable request information from Engineer before proceeding.
- C. Check Drawings of other trades to verify extent of material and equipment to be installed in spaces available and consider layout alternatives so all requirements can be accommodated.
- D. Coordinate installations with other trades prior to proceeding to prevent conflict with work of other trades and cooperate in making reasonable modifications in layout as needed.
- E. Where conflicts occur with placement of water transmission system and electrical materials as they relate to placement of other building materials, Engineer shall be consulted for assistance in coordination of available space to accommodate trades.
- F. Coordinate equipment installation to maintain manufacturer and code required working clearances.

1.3 PRIORITY OF CONSTRUCTION SPACE

- A. Following is the Order of Priority for Construction Space:
 - 1. All portions of building and systems supporting the basic function of water transmission.

1.4 COORDINATION DOCUMENTS

- A. This Contractor, in cooperation with the General Contractor and other trades, shall verify the exact characteristics of other system requiring electrical connection.

- B. Fabrication of electrical panels shall not start until coordination is acknowledged by Contractor in writing to Engineer.
- C. Coordination Schedule Document:
 - 1. The electrical contractor shall obtain from the General contractor a schedule providing electrical characteristics of equipment requiring electrical connection. Information provided shall include:
 - a. Unit Designation
 - b. Voltage
 - c. MCA
 - d. MOCP/MFS
 - e. FLA
 - f. Disconnect
 - g. Starter Requirement
 - h. Alarm Wiring Requirements
 - 2. The Electrical Contractor shall review the Coordination Schedule and all pertinent electrical accommodations indicated.
 - a. Breaker size.
 - b. Wire size / conduit size.
 - c. Disconnect with fuse size.
 - 3. Once the coordination schedule is completed forward to engineers for review and approval.
- D. Conflicts due to incomplete coordination schedule not completed shall be responsibility of the contractors. All costs for correction or remedial work shall be done at contractor's expense. No added cost to owner will be allowed.

END OF SECTION 26 05 16

SECTION 26 05 19 - CONDUCTORS 600 VOLTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Furnishing, installing and testing 600-volt conductors for lighting, power, and auxiliary systems.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

- A. 98% conductivity copper; #12 AWG minimum; #10 AWG and smaller solid, #8 and larger stranded.
- B. Conductors furnished with NEC, 600 volt, insulation as follows:

Dry locations:
6 AWG and smaller - type THW, THWN or XHHW (do not intermix in circuits)
Wet Locations:
4 AWG and larger - type RHH-RHW2-USE 2.
- C. Wiring for controls and auxiliary systems #14 AWG stranded minimum with NEC type THWN insulation.
- D. Color Code as follows and/or per local ordinances. Conductors #10 and smaller with colored insulation. For conductors #8, and larger color code with colored pressure sensitive tape. Apply minimum 2" of tape to each individual phase or neutral conductor in half lapped pattern. The equipment ground conductor shall be taped green for its entire exposed length. Color-code as follows:

<u>Phase</u>	<u>120/240V</u>
A	Black
B	Red
Neutral	White
Equip. Ground	Green

- E. Manufacturers of copper conductors: Pirelli, Phelps Dodge, Capital Cable, Rome Southwire, Senator, Essex, American, or approved equal.

PART 3 - EXECUTION

- A. Install wiring complete with connections to equipment.
- B. No wiring installed until after plastering and similar work is complete and dry.
- C. Install wiring so conductors are not in tension in completed system.
- D. Form wiring neatly and group in circuits. Tie grouped conductors with nylon ties, T&B "Tyrap" or approved equal.
- E. Use pulling compound of Ideal "Yellow 77", Minerallac No. 100, or approved equal. Do not use pulling compound for circuits on secondary side of ungrounded isolation transformers.
- F. Join and terminate copper conductors individually.
 - 1. Lugs connected to copper bus: Solid 98% conductivity long copper barrel, tin plated, compression type connectors, Thomas & Betts color keyed, Burndy "Hydent" or approved equal; applied with appropriate hydraulic tool.
- G. Provide lugs where not furnished as part of equipment -furnish as specified above, to connect all conductors.
- H. Furnish lugs for conductors #2/0 and larger with two bolt tongue or approved equivalent.
- I. Make conductor taps #8 and larger from a second conductor with 98% conductivity bolted insulated connector, T&B "IDT", IlSCO "KUP-L-TAP" or approved equivalent. Insulate splices with 600 volt "heat shrink" covers T&B or equal.
- J. Splice conductors #8 and larger with solid copper barrel, type fittings applied with an appropriate hydraulic tool. Splices used only where approved. Splice fittings: Burndy "Hydent". Insulate splices with 600 volt "heat shrink" covers T&B or equal.
- K. Joints #10 and smaller: T&B Sta-Kon wire joints EPT66M, with insulating caps, installed with WT161 Tool or C nest of WT11M Tool; Ideal Super/Nuts; Ideal Wing Nuts; 3M "Scotchlock" or Buchanan Electric Products B Cap or Series 2000 Pressure connectors complete with nylon snap on insulators installed with C24 pressure tool. Where conductors are connected to screw terminals, use nylon insulated, locking fork, T&B Sta-Kon or approved equal. Where joints are made in damp or wet locations insulate splices with 600 volt "heat shrink" covers T&B or equal.

- L. Provide cable supports: As required by NEC. Supports with malleable screwed conduit fitting and non-conductive wedges drilled for the conductors; O.Z. Manufacturing Company or approved equal. Furnish pullbox, sized per NEC for each cable support.
- M. Bond circuit ground wires where installed to all devices, equipment, outlet and junction boxes, and grounding bushings (where provided) with a full-size conductor and screw type connection.
- N. Securely fasten non-ferrous identifying tapes, pressure sensitive labels or engraved nameplates to all cables, feeders and power circuits in vaults, pull boxes, manholes, switchboard rooms, terminations of cables, etc.
- O. Mark all branch circuit conductors at panel terminations including neutrals with pressure sensitive numbers to correspond to circuit numbers connected.
- P. Connect circuits and feeders as shown on drawings. Drawings are diagrammatic and do not show every detail required in the wiring system. Detail wiring accomplished per NEC.
- Q. All conductors making up parallel feeders to be same size, same type, and same insulation, all cut same length. Bond each group of conductors making up a phase or neutral at both ends in an approved manner.
- R. DO NOT COMBINE CIRCUITS unless specifically approved by the Engineer. No more than 3 phase or current carrying conductors in a circuit.

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. Grounding Details and site grounding grid alterations and additions.

PART 2 - PRODUCTS

2.1 SYSTEM GROUNDING:

- A. Bond and ground main service neutral, cabinets, equipment, conduits, metallic piping systems, etc., per the latest edition of NEC.
- B. Ground conductors - 98% conductivity copper, either bare or with green THW insulation. Other conductor requirements same as described for low voltage, 600 volts, conductors.
- C. Ground Connections:
 - 1. Make with mechanical connectors where accessible and "Cadweld" where inaccessible.
 - 2. Use high alloy cast copper and/or silicon bronze mechanical connectors with Hex or Allen head bolts where permitted.
 - 3. For mechanical connections Burndy "GAR", Penn Union type CPL or approved equivalent.
 - 4. Size as required for piping connections.
 - 5. Thoroughly clean prior to installation of clamps and/or lugs.
 - 6. Use bolted or screwed on mechanical connectors. Do not use clip-on connections.
 - 7. Bond ground conductor to metal raceway at each end of the run.
 - 8. Seal connections between dissimilar metals (i.e.: bronze to steel), with approved epoxy resin.
 - 9. Coat connections with "No-OXID-A" compound as manufactured by Dearborn Chemical Company.
- D. Provide lighting and power circuits with green covered ground wire sized per NEC, or as shown, except not smaller than #12 AWG. Bond ground wire to all outlet boxes, junction and pull boxes, cabinets, equipment, etc., with self-tapping screw

or bolt and appropriate lug. See Section covering "Raceways" for use of grounding bushing.

2.2 DRIVEN GROUND SYSTEM:

- A. Provide driven ground rods and buried ground conductor interconnecting ground rods as shown on drawings and required by code.
- B. Ground rods 3/4"x10'-0" copper clad steel, Thompson #558 or approved equal. Ground rods installed with tops driven to 1'-6" minimum below grade. Connect ground wire to ground rod with Cadweld or equal.
- C. Exterior buried ground conductor #2/0, soft drawn, bare, tinned copper, installed 2'-0" minimum below grade.
- D. Bond all masses of metal, i.e.: pipes, conduits, fence posts, etc., within 6'-0" of the buried ground conductor to ground conductor with #6 AWG bare, solid, tinned copper wire unless otherwise shown, attached to object with appropriate clamp, lug, etc., (Cadweld or equal). Obtain complete set of drawings to determine quantity and location of required connections.
- E. All connectors lugs, hardware, etc., for building ground system similar to that for other grounding as described above.

PART 3 - EXECUTION

3.1 EQUIPMENT GROUND 'GREEN WIRE CONCEPT':

- A. Ground electrical equipment enclosures and conductor enclosures including but not limited to metal raceways, outlet boxes, cabinets, switch boxes, motor frames, diesel engine frame, transformer cases, metallic piping systems such as water, gas, waste, air and metallic enclosures for all electrical equipment.
- B. Provide separate grounding conductor for all circuits to insure adequate ground fault return path.
- C. Install separate ground conductors in conduit.
- D. Bond green wire to equipment enclosure at source and at apparatus served.
- E. Insulate grounding conductors size to carry ground fault current safely. Minimum size for green wire grounding lead per N.E.C. or as indicated.
- F. Do not use grounded current return conductors (neutrals) for equipment grounding. Connect common grounding lead jumper (main bonding jumper) on supply side of service disconnect unit only.

- G. For each separately derived system do not ground neutral conductor after it has been grounded at service entrance, transformer or generator.
- H. Maintain electrical continuity of conduit systems by threaded fittings with joints made-up wrench tight. Install insulated bushing and locknuts on terminating conduits. Provide conduits containing ground wires with grounding bushings bonded to ground wire with short full-size jumper.
- I. Provide receptacles with approved green covered bonding jumper from the grounding terminal screw connected to outlet box.
- J. Test ground systems as specified in Section 26 00 10.
- K. Install tags on ground connections to piping or electrode systems for all SCADA equipment grounds.

END OF SECTION 26 05 26

SECTION 26 05 27 – GROUNDING SYSTEMS (SITE GRID)

PART 1 - GENERAL

1.1 SCOPE:

- A. Furnish and install all materials and labor required to provide a complete functional common ground system as shown and detailed on plans, in accordance with this section of specifications and applicable contract drawings.

1.2 STANDARDS AND QUALITY ASSURANCE:

- A. The following specifications and standards of the latest current issue form a part of this specification.
- B. All materials shall be new standard product of a manufacturer regularly engaged in the production of grounding systems of the latest approved designs. Equipment shall be UL listed. For approval of manufacturer other specified, complete proposed material data and installation drawings must be submitted to Engineer or review not less than 10 days prior to bid date.

1.3 SHOP DRAWINGS:

- A. Complete shop drawings of entire common grounding system showing the type, size, mounting details, and location of all equipment, grounds and cable routings, etc., shall be submitted to the Engineer for approval prior to start of work. Any departures of consequence from Approved Shop Drawings are deemed necessary by Contractor, details shall be submitted and approval obtained, before work is resumed and completed.

1.4 SYSTEM:

- A. System materials in general shall be copper and high copper-content bronze castings, and shall comply in weight, size, and composition for the class of structure to be protected, as specified in above mentioned Codes. The system shall consist of all necessary cables, fittings, couplings, connectors, fasteners, etc., as required to give a complete and coordinated system.
- B. Supplier of system shall review all drawings to obtain items required to be connected to system. Drawings show only main aspects of system.
- C. System conductors shall be completely concealed wherever practical. All main downloads and roof risers shall be concealed within the building walls or columns, on new work or extensions to existing structures. Downloads and risers to be run in 1" PVC conduit in locations shown on Shop Drawings. Down leads in steel frame buildings shall be bonded at the top and bottom. Install suitable junction boxes in conduit system for bonding taps which shall be made with full-size

conductor. Rebar steel in these columns shall be lapped a minimum of 24 diameters and ties shall be installed per A.S.T.M. standards.

- D. System fittings except cable holders, regardless of Structure classification shall be heavy-duty type made from bronze castings and secured with bolted-pressure clamps. Pressure plates made from stamped or pressed metal parts, or fittings utilizing crimp-type pressure devices will not be allowed. All bolts, screws and related type hardware shall be stainless steel.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

- A. Materials shall be copper or copper alloys as described above, UL approved and labeled as required, and of the size, weight, and construction to suit the application where used in accordance with Code requirements for the Class of structure involved, and as per manufacturer recommendations.
- B. Conductors shall be smooth twist or rope-lay stranding commercially pure copper cable, sized as shown.
- C. Ground rods shall be 3/4" diameter and 10'-0" long copper-clad steel, connected to system downlead cable with two-bolt bronze clamp with stainless steel cap screws. Driven depth to be minimum of 12 feet.
- D. Cable fasteners shall be substantial in construction, compatible with the conductor and mounting surfaces, and spaced according to Code requirements.
- E. Bonding devices, cable splicers, and miscellaneous connectors shall be cast bronze with bolt pressure cable connections with stainless steel hardware. Any connections between dissimilar metals shall be made with approved bi-metallic connectors or spacers.

PART 3 - EXECUTION

3.1 SYSTEM DESIGN:

- A. Contractor shall have supplier of system design system in accordance these specifications furnishing shop drawing for approval.

3.2 INSTALLATION:

- A. Equipment and materials shall be installed in neat workmanlike manner by skilled installers.
- B. System installation shall be complete; including necessary cable networks on the bonding networks and taps for grounding equipment and conductors routed concealed in building structure to ground level.

- C. Installers shall coordinate their work with other trades to insure a correct, neat, and unobtrusive complete installation.

3.3 BONDING AND SYSTEM GROUNDS:

- A. A common ground shall be provided between the grounding system and the building electric and telephone service grounds. In addition, all underground metallic piping systems shall be bonded with full size conductor; including water, gas, sewer, fuel oil, and any other piping system, at points where these pipings enter the building.
- B. The building electrical services shall be provided with a set of surge protector devices as shown on drawings.
- C. Bonding of all metallic objects shall be complete. Primary bonds for metal bodies of conductance shall be bonded with appropriate fittings and full-time conductor; and shall consist of but not limited to the following: ladders, exterior metal fascia. The structure, shall also be bonded, if not inherently bonded thru the building frame.
- D. Metal bodies of inductance located within six feet of a conductor or object with primary bonds, shall be bonded with secondary cable and fittings. Typical of these are: plumbing vent stacks, roof flashings, parapet coping caps, gravel guards, isolated metal building panels or siding, roof drains, down spouts, roof ventilators, exterior balcony handrails, lower-level sizeable miscellaneous metals, etc.

3.4 SHOP DRAWINGS:

- A. Shop drawing as-built with certifications by installer shall be turned over at close out.

END OF SECTION 26 05 27

SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.3 SUBMITTALS

- A. Product Data: For each type product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Hangers.
 - b. Steel slotted support systems.
 - c. Nonmetallic support systems.
 - d. Trapeze hangers.
 - e. Clamps.
 - f. Turnbuckles.
 - g. Sockets.
 - h. Eye nuts.
 - i. Saddles.
 - j. Brackets.
 - 2. Include rated capacities and furnished specialties and accessories.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

- B. Coordinate exterior concrete pad requirements and locations with Structural and Civil site Plan drawings and associated specifications.
- C. Coordinate anchoring points and supports with approved shop drawings of electrical equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Provide details demonstrating "Quality Requirements," to design hangar and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D 635.
- C. All devices shall be stainless steel.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 1. Manufacturers: subject to compliance with requirements, provide products by one of the following:
 - a. Allied tube & Conduit
 - b. Cooper B-Line, Inc.; a division of Cooper Industries
 - c. ERICO International Corporation.
 - d. Thomas & Betts Corporation.
 - e. Unistrut; Tyco International, Lt.
 - 2. Material: Stainless Steel
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Stainless steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonamored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

- D. Structural Stainless Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; stainless steel.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 6) No Substitutions.
 - 2. Concrete Inserts: Stainless Steel, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All steel springhead type.
 - 6. Hangar Rods: Threaded stainless steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-stainless steel shapes, shop or field fabricated to fit dimensions.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application for hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways".
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists

maximum spacing that are less than those stated in NFPA 70. Minimum rod size shall be ½ inch (12 mm) in diameter.

- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps using spring friction action for retention in support channel.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1- ½ inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To New Concrete: Bolt to concrete inserts.
 - 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 3. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 4. To Light Steel: Stainless steel Sheet metal screws.
 - 5. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted channel racks attached to substrate by means that comply with seismic restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete".
- C. Anchor equipment to concrete base as follows:
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 26 05 29

SECTION 26 05 33 – RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Installation of raceway systems and necessary fittings for all work in Division 26 600 volts rated or less.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Metallic Raceways:

- | | |
|--------------|-------------|
| 1. Republic | 5. Triangle |
| 2. Wheatland | 6. Walker |
| 3. Allied | 7. Western |
| 4. Clifton | 8. AFC |

B. Non-Metallic Raceways:

- | | |
|-----------------------------|------------|
| 1. Carlon | 3. Can-Tex |
| 2. National Pipe & plastics | 4. Allied |

C. Fittings

- | | |
|---------------------------|---------------|
| 1. Thomas & Betts | 5. EFCOR |
| 2. Hubbell: RACO; Killark | 6. OZ Gedney |
| 3. Appleton | 7. Bridgeport |
| 4. Midwest | 8. AFC |

2.2 RACEWAYS

A. Rigid galvanized steel conduit with PVC coating:

1. Conform to ASA Standard C80.1 and U.L. Standard No. 6 for rigid metallic conduit, except hot dipped galvanized after threading and have 40 mills PVC coating.
2. Fittings, ells, couplings, etc., galvanized threaded type meeting above standards. Threadless fittings not allowed.
3. Terminate rigid conduit with two locknuts, one inside, one outside of the cabinet, junction or outlet and a bushing. Bushing - malleable iron with smooth bakelite ring molded into edge of bushing to prevent damage to cable, OZ Mfg. Co., type "B" or approved equal.

4. Where grounding bushings are required, construction of bushing similar to above except a lug provided for grounding connection, OZ type "BLG" or approved equal.
- B. Rigid intermediate grade conduit, IMC, to conform to UL Standard No.1242; hot dipped galvanized or approved equivalent with 40 mills PVC coating.
 1. All fittings, ells, couplings, etc., constructed to same standards as rigid steel conduit. Fittings - threaded type with all threads engaged. Use "Uniswivel" couplings in dry locations only.
 2. Conduit terminations same as rigid steel conduit with PVC coating.
- C. Liquid tight flexible steel conduit
 1. Shall be galvanized steel-core sealtite, code approved for grounding
 2. Fitting Assembly - sealing type, with steel gland, nylon ring and ground cone inside locknut. All fittings with insulated throat, U.L. approved for grounding means.
 3. Shall have an outer liquid tight, non-metallic, sun light resistant jacket over an inner flexible metal core.
 4. Shall be as manufactured by Electri-Flex, Anaconda or equal
- D. Aluminum rigid conduit to conform to UL standard No. 6A for rigid aluminum conduit.
 1. Use aluminum fittings, except use stainless steel locknuts. Join and terminate similar to rigid steel conduit. Lubricate all joints with compound.
- E. Plastic conduit, PVC, polyvinyl chloride compound, rated for direct burial, Schedule 40, except as noted otherwise.
 1. Fittings same material as conduit and installed with watertight joint compound recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. 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 conduits prior to exiting concrete-

encasement or direct earth burial. See "transition" below for additional requirements. Conduits shall be left exposed until after Engineer's observation.

4. Interior, Exposed:
 - a. Hazardous Locations: Rigid Aluminum.
 - b. Wet Locations (including, but not limited to, Pump Rooms, Areas with exposed piping, Dewatering Rooms, Wet Wells, Underground Vaults, and other similar locations): Rigid Aluminum.
 - c. Dry Locations: Rigid Aluminum.
 - d. Extremely Corrosive Locations (Chlorine Storage Rooms, Fluoride Storage Rooms and other similar areas): Schedule 80 PVC.
5. Interior, Concealed:
 - a. Embedded inside Poured Concrete Walls, Ceilings or Floors, with a minimum of 2" of concrete between finished surface and outer wall of conduit on all sides, where no anchor bolts, screws or other similar items will be installed: Schedule 40 PVC. PVC conduit shall convert to metallic conduit (exact type as specified elsewhere within this section) prior to exiting poured concrete-encasement of wall, ceiling, floor or ductbank. See "transition" items below for additional requirements.
 - b. Other Raceways Embedded inside Poured Concrete Walls, Ceilings or Floors (not meeting requirements above): PVC-Coated Rigid Steel
 - c. Other Raceways: E.M.T.
6. Raceways used for Instrumentation Circuits:
 - a. Typical Dry or Wet Locations: Rigid Aluminum.
 - b. Underground or Locations Embedded inside Poured Concrete: PVC-Coated Rigid Steel.
 - c. Extremely Corrosive Locations (Chlorine Storage Rooms, Fluoride Storage Rooms and other similar areas): PVC-Coated Rigid Steel.
7. Terminations at motors, transformers and other equipment which has moving or vibrating parts:
 - a. Exterior or Wet Locations (including, but not limited to, Pump Rooms, Wet Wells, Underground Vaults, and other similar locations): Liquidtight Flexible Metallic Conduit (shall generally not exceed 24 inches in length) with watertight fittings.
 - b. Dry, Interior Locations: Flexible Metallic Conduit (shall generally not exceed 24 inches in length).
8. Termination at instruments:
 - a. Liquidtight Flexible Metallic Conduit (shall generally not exceed 12 inches in length) with watertight fittings.
9. Terminations at fixtures mounted in grid-type ceilings:
 - a. Flexible Metallic Conduit or MC cabling (shall generally not exceed 72 inches in length and shall run from junction box to fixture, not from fixture to fixture).
10. Transition from underground or concrete-encased to exposed:
 - a. Convert PVC to PVC-Coated Rigid Steel utilizing PVC-Coated Rigid Steel 90-degree bends (and vertical conduits as required by application) prior to exiting concrete/grade (except at outdoor pull boxes and under freestanding electrical equipment, where terminations shall be by PVC end bells installed flush with top of

slab). Exposed portions of these coated conduits shall extend a minimum of 6" above floor level and shall be installed at uniform heights.

- B. Size conduit per NEC. Minimum size 3/4" diameter.
- C. Run conduit concealed where possible. Multiple conduits grouped and run parallel.
- D. In concrete slab: Install conduits in center of concrete slabs and tie to reinforcing steel with tie wires. Do not install conduit larger than 1" in concrete slabs unless approved by Engineer. Install with minimum of 2" between parallel runs. Do not cross conduits in slab unless necessary, then only one conduit crossover in 12" space.
- E. Exposed Conduit: Use only where specifically shown or approved. Run perpendicular to building walls and partitions and tight against structure. Conceal vertical portion of conduits where possible.
- F. Underground metal conduit to have factory PVC coating. Make underground conduit fittings watertight using Teflon tape. Do not use split couplings and similar fittings underground and exposed to moisture. Run underground conduits minimum 24" below grade. Do not run conduit in slag fill.
- G. Paint conduit fittings and threads exposed to moisture with Rustoleum silver paint after installation.
- H. Furnish offsets required to meet field conditions. Make bends in conduit in accordance with the National Electrical Code, except make minimum radius of 6 times conduit diameter or 6" whichever is greater. Bend IMC conduit without deforming.
- I. Where conduit crosses expansion joints, install expansion type fittings OZ type EX with bonding jumper or approved equal.
- J. Make connections to equipment away from wall with conduit extensions exposed from ceiling to floor, anchored with floor flange and/or angle frame as required. Make connections to equipment with flexible conduit from tee conduit in conduit riser.
- K. Vibrating equipment and equipment requiring adjustment, i.e.: motors, transformers, etc: make final connections with liquid tight flexible conduit.
- L. Isolate conduit connections to equipment on roof from roof penetration of conduit with short section of flexible conduit between roof penetration and equipment.
- M. Use liquidtight flexible conduit where exposed to moisture, oil, etc.

- N. Install conduit to avoid hot water pipes. Maintain 9" clearance of such pipes, unless closer crossings are unavoidable. Maintain minimum 1" clearance from covering of pipe crossed.
- O. Support conduit per NEC. Support individual conduits with stainless steel hangers and rods as follows:
 - 1" diameter and smaller ¼" dia. rod
 - 1-¼" to 3" diameter 3/8" dia. rod
 - Larger than 3" diameter ½" dia. rod
- P. Individual conduit hangers - Minnerallac, or approved equal. Support EMT near each joint. Support for multiple conduit runs consist of Uni-strut channel as required with 1/2" diameter galvanized bolts or rods anchored to structure. Provide "U" bolt clamps for each conduit on hangers. Support vertical riser conduits with galvanized bolted clamps at each floor. Do not support conduit to ceiling support system.
- Q. Terminate conduits entering sheet metal boxes with double locknuts and bushings. Terminate conduit exposed to moisture with watertight hubs.
- R. Install appropriate seal-off where conduits exit hazardous areas, areas of temperature differential etc.
- S. Where ground conductor installed in conduits 1-1/4" and larger provide grounding bushings, and bond full size ground wire to bushings and from bushing to box or cabinet. Bond with self-tapping screw and appropriate lug. Where ground wires are run in smaller conduits, bond to outlet and junction boxes with self-tapping screw lug. Provide other conduits with non-grounding bushings as described under another article. Provide all service entrance metallic raceways with grounding bushing and bond to ground bus; bond sized per N.E.C.
- T. Install aluminum conduit using "No-OXID-A" compound (Dearborn Chemical Company) on all threads.
- U. Conduit work in hazardous areas, or areas with large temperature differential: Use rigid steel or IMC conduit with sealing fittings, poured with hardening compound after conductors are pulled-in. Seals installed per NEC. Conduit seals Crouse-Hinds type EYS or approved equal.
- V. PVC Conduit Installation:
 - 1. Below grade: Encase per details.
 - 2. Make elbows, bends, etc. with heated bender when factory bends are not available. When below slab, provide rigid elbows.
 - 3. Make cuts with hacksaw and deburr ends.
 - 4. Make joints as follows: Clean outside of conduit to depth of socket, and inside of socket with approved cleaner. Apply solvent cement to interior of

socket and exterior of conduit, insert conduit in socket and rotate 1/4 to 1/2 turn and allow to dry.

5. Where non-metallic conduit is used for power wiring install insulated ground wire, sized per NEC unless shown larger.

W. Sleeves:

1. Provide sleeves for raceways penetrating floor and structural members.
Sleeves consist of Electrical Metallic Tubing set in forms. (Exception: Use Schedule 40 PVC for individual ground conductors).
2. Size sleeves to allow 1/2" clearance around raceway extending from bottom of floor construction to 2" above floor, minimum sleeve size 2-1/2" diameter. After raceways are installed, seal space between the raceway and sleeve with non-hardening, fireproof, compound, CTC PR-855 sealant, T&B "Flame Safe" for 2-hour fire rating or approved equal.

END OF SECTION 26 05 33

SECTION 26 05 34 - OUTLET BOXES AND JUNCTION BOXES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Outlet, junction boxes, conduit bodies, wiring gutters and their installation.

PART 2 - PRODUCTS

2.1 OUTLET AND JUNCTION BOXES

- A. Provide outlet boxes for all wiring devices, fixtures and special system outlets.
 - 1. Use cast iron or cast aluminum conduit fittings similar to "Condulets" or "Unilets" with threaded hubs for exposed boxes outside and exposed to moisture.
- B. Use surface type weatherproof boxes with appropriate gasketed cover for surface mounted wall outlets in exterior areas with surface mounted conduit and exposed to moisture conduit. Red Dot, Raco, Appleton or approved equal.

2.2 LARGE JUNCTION BOXES

- A. Furnish pull, tap and cable support boxes required by NEC for excessive number of 90 degree conduit bends, conductor taps and cable supports.
 - 1. Box construction per NEC and manufactured with stainless steel sheet steel, 12 gage minimum, with angle iron frame where required for rigidity; welded or bolted construction. Install bolts to prevent damage to cables in box.
 - 2. Boxes with removable screw type covers and stainless-steel screws. Provide split covers where necessary for access. Maximum single piece cover - 36" x 36".
 - 3. Provide separate junction boxes for each feeder. If conduit is installed so separate junction boxes are not practical, one large pull-box may be used with each set of feeder conductors separated by 12 gage steel barriers. Furnish junction box or each compartment in junction box with ground lug for connection of ground wire.

2.3 CONDUIT BODIES

- A. Conduit bodies shall be installed to provide ease of pulling conductors and to provide neat appearance of conduit installation, and as shown on drawings. Conduit bodies constructed of malleable iron or copper free aluminum castings. Bodies shall be finished with standard durable exterior coatings of manufacturer specified. Provide rollers in type "C" and type "LB" bodies, 1-1/4" size and larger.

- Provide gasketed plated steel or malleable iron covers.
- B. Conduit bodies shall be manufactured by Crouse-Hinds, Pyle National, Killark, Appleton or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION OF OUTLET BOXES

- A. Fasten outlet boxes securely to structure.
- B. Set all flush outlet boxes so edge of device flange is flush with finished surface.
- C. Open no more knockouts in outlet box than required. Any un-used openings in the box shall be plugged.
- D. Seal boxes during construction.
- E. Coordinate and verify rough-in location and mounting height of all boxes with drawings and other trades prior to installation.
- F. Support All Boxes:
 - 1. Outlet boxes - with 1/4" diameter galvanized rods or bolts anchored to structure.
 - 2. Outlet boxes for surface mounted luminaires on furred ceilings with 3/4" channel iron fastened to ceiling channels. See Section covering "Luminaires".
 - 3. Pull, junction and cable boxes with 3/8" diameter galvanized rods or bolts (4 minimum).
- G. Install adjacent outlets at different levels in one vertical line where possible.
- H. Provide green covered bonding jumper, screw connected to outlet box in all receptacle boxes.
- I. Paint wiring connections in ground mounted outlets or floor outlets in wet locations with "Scotchkote" and fill box with "Duxseal".
- J. Install outlets located on columns on centerline of column and bend or shift reinforcing so that the outlet box will be flush with the finished concrete. Provide plaster rings as required so that the plate is flush with the finished plaster or exterior concrete surface.
- K. Where outlets installed in waterproofed columns or walls, provide 6"x6"x3" deep wood box placed in the forms before concrete is poured. Box will be removed before waterproofing is applied. General Contractor will waterproof wall and

opening, after which Electrical Contractor will install outlet box. General Contractor will grout around box. Set boxes carefully so that cover plates will be flush.

- L. Install conduit bodies where shown or where required for sharp bends and/or aesthetics in raceway system. Do not use in lieu of pullboxes except in limited space or as directed by Engineer.

3.2 INSTALLATION OF JUNCTION BOXES:

- A. All junction boxes shall be accessible.
- B. Exterior below grade boxes shall be embedded 6" of concrete on sides and bottom. Top shall be level with finished grade unless shown otherwise.
- C. There shall be no more knockouts opened in any box than are actually required.
- D. Provide identification

END OF SECTION 26 05 34

SECTION 26 05 43 - RACEWAYS EXTERIOR DUCT BANKS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Installation of raceway systems for all work in Division 26 and required fittings. For medium voltage and low voltage distribution system, SCADA, and telephone.

PART 2 - PRODUCTS

- A. Rigid galvanized steel conduit. See Raceways 26 05 33.
- B. Rigid intermediate grade conduit. See Raceways 26 05 33.
- C. Plastic conduit, PVC, polyvinyl chloride compound, rated for direct burial, Schedule 40, except as noted otherwise, manufactured by Carlon, Sedco, ETP, Can-Tex or approved equivalent.
- D. PVC Coated Rigid Steel. See Raceway 26 05 33.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Concrete encased ducts banks:
 - 1. Lay duct lines to a minimum grade of 4" per 100 feet slope toward pad or vault. Terminate at pad or vault with end bells. Make changes in direction of runs using couplings or bends manufactured for purpose. Install duct lines so top of concrete is minimum 36" below finished grade or paving.
 - 2. Clean conduit before laying and plug ends during construction to keep conduits clean.
 - 3. After duct line is completed, pull 12" long mandrel, having a cross-section 1/4" less than conduit, through each conduit. After mandrelling, pull brush with stiff bristles and swabs through to remove particles of earth, sand or gravel.
 - 4. Encase each conduit or group of conduits in concrete as indicated on drawings. Thickness of concrete encasement shown is minimum and may be increased to fit actual shape of trench.
 - 5. Use concrete or PVC spacing blocks 5'-0" on center maximum.
 - 6. Stagger joints in conduits 6".

7. Anchor ducts to prevent movement during placement of concrete.
8. Use plain concrete except where reinforced concrete is specified or indicated.
9. Use monolithic concrete construction. Where connection is made to existing duct line bond concrete encasement to existing encasement with 1/2" dowels set 12" into each side of concrete joint.
10. Install 4/0 bare copper ground in all duct banks, concrete encasement.
11. Install plastic line marker 12 inches below finished grade above duct banks.

END OF SECTION 26 05 43

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION (LOW VOLTAGE)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

Systems and equipment requiring identification are shown on the drawings, and extent of identification is specified herein and in individual sections of work.

A. Types of electrical identification include:

1. Exposed conduit color marking.
2. Buried cable and conduit warnings.
3. Cable/conductor identification.
4. Operational instructions and warnings.
5. Danger signs.
6. Equipment/system identification signs (nameplates).

1.2 SUBMITTALS:

A. Manufacturer's Data:

1. Product specifications and installation instructions for each material and device.

B. Samples:

1. Provide for each color, lettering style and other graphic representation.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION MATERIAL:

A. Color-Coded Conduit Markers:

1. Color code all conduit with 3/4 inch wide band of vinyl plastic electrical tape, 3M Company "Scotch 35", applied two (2) full turns around conduit, 6" from all conduit terminations into switchboards, panelboards, motor control centers, starters, cabinets, control panels, pullboxes, outlet boxes, etc., on each side of walls, floors or roof penetrated by conduit and where conduit enters wall to outlets below.

CONDUIT COLOR CODE SYSTEM

120/240 Volts - Normal

Instrumentation and Control

COLOR

Black

Orange

B. Where authority does not allow tape use paint acceptable to authority.

C. Underground Line Marker/ Warning tape:

1. Permanent colored, detectable plastic tape with foil core (color per AWPA Standard for utility being identified), with continuous-printed legend; for directburial service; minimum 6" wide x 4 mils thick. Legend to indicate type service of cable (e.g. "WARNING: Buried Electric Line").

D. Cable/Conductor Identification Bands:

1. Manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers, wrap-around type; pre-numbered plastic coated, or write-on type with clear plastic self-adhesive cover flap, lettered to show circuit identification.

E. Self-Adhesive Plastic Signs:

1. Manufacturer's standard, self-adhesive, pre-printed, flexible vinyl signs for operational instructions or warnings. Sizes suitable for application and visibility, with proper wording for application.
2. Color: Orange with black lettering.

F. Danger Signs:

1. Manufacturer's standard "DANGER" signs, baked enamel finish on 20 gage steel; standard red, black and white graphics; 14" x 10" unless 10" x 7" is largest which can be applied, or where larger size is needed for visibility use recognized explanation wording (as examples: HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH).

G. Engraved Signs (Nameplates)

1. 1/8" thick melamine plastic laminate, complying with FS LP-387, sizes as indicated, engrave with standard letter style of sizes and wording indicated (1/4" letters minimum) white field, black letters for normal service; red field, white letters for essential service; yellow field, blue letters for D.C. service; orange field, white letters for UPS service. Punched for screws.
2. Fasteners: Self-tapping stainless steel screws, except contact epoxy adhesive where screws cannot or should not penetrate substrate.

H. Lettering and Graphics:

1. Coordinate names, abbreviations and other designations used with those shown or specified. Provide numbers, lettering, and wording as indicated or required for identification and operation/maintenance.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

- A. General Installation Requirements:
 - 1. After completion of painting.
 - 2. Comply with governing regulations and requests of governing authorities for identification of electrical work.
- B. Conduit Identification:
 - 1. Where high voltage conduit is exposed, apply identification to conduit.
- C. Underground Cable and Duct Identification:
 - 1. During back-filling of underground cable or duct, install continuous marker warning tape, directly over buried line 6" to 12" below finished grade. Where multiple lines are buried in common trench not exceeding 24" width, install a single line marker.
 - 2. Install line marker warning tape for every buried ductbank.
- D. Operational Identification and Warnings:
 - 1. Provide operational signs for main switch.
- E. Engraved Plastic Laminated Signs: Install on each major unit of electrical equipment in the building. Provide single line of text, 1/4" high lettering on 1" high sign (1-1/2" high where 2 lines required). Matching terminology and numbering of contract documents. Provide signs for each unit of the following categories (signs shall identify item fed, voltage and where fed from):
 - 1. Electrical cabinets and enclosures. Indicate voltage.
 - 2. Access panel/doors to electrical facilities.
 - 3. Major electrical switchgear (indicate voltage).
 - 4. Safety switches and circuit breakers.
 - 5. Transformers.
 - 6. Feeders in pull and junction boxes and in all switchgear. Fasten with nylon ties.
 - 7. All equipment furnished in this Division of the specifications.
 - 8. Install signs where indicated or most visible. Secure with screws or epoxy adhesive. Secure to feeder cables with nylon ties.

9. Nameplate sign shall include system voltage and source of feed (where applicable).
- F. Outlet pull, and junction boxes shall be identified with circuit number(s), and source panel or switchgear/switchboard indicated with legible text written with permanent black marker. Write text and box cover.
 - G. Branch circuit and feeder conductors shall be identified where they enter pullboxes, switchgear, switchboards, panelboards, transformers, and handholes. Feeder identification shall include source, conductor size, and phase identification.
 - H. Provide engraved device plates for wiring devices where indicated on drawings or related sections of the specifications.
 1. Use black letters for devices on normal circuits; use red letters for essential circuits.

END OF SECTION 26 05 53

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Furnish and install lighting and power panelboard. Factory wired in motor control center.

1.2 SUBMITTALS:

- A. Provide shop drawings including an individual diagram of each panelboard showing all specified requirements.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Panelboards shown are based on Square D's published information relative to physical size and arrangement. The contractor shall verify that equipment to be furnished can be mounted in space provided and meet the requirements of the National Electric Code for clearances.
- B. Panelboards to be constructed in accordance with latest NEMA and UL standards.
- C. Panelboard assembly to be UL labeled, and UL labeled as service entrance equipment where used for that purpose.
- D. Panelboards to have integrated equipment fault rating equal to interrupting rating of lowest rated overcurrent device.
- E. Panelboard shall be factory assembled and breakers shall be arranged exactly as shown on the drawings and factory installed in motor control center.

2.2 PANEL INTERIOR:

- A. Bussing:
 - 1. 98% conductivity copper, silver-plated at joints.
 - 2. Bus assembly designed for a maximum temperature rise of 55 degree C above 40 degree C ambient temperature when carrying rated current.
 - 3. Minimum thickness of bus bars - 3/32".
 - 4. Bussing braced to withstand a fault current equal to the highest device interrupting capacity in panel.

5. Neutral bus full size copper insulated from the cabinet.
6. Arrange bus bar connections so adjacent vertical circuit protective devices are consecutively connected to phases A, B, and C throughout panel. full capacity ground bus in each panel cabinet. Where indicated for Isolated Ground, provide second ground bus isolated from cabinet.

B. Circuit breakers:

1. Molded case, thermal-magnetic, quick-make, quick-break, trip free on faults, thermal-inverse time delay element and magnetic instantaneous trip coil in each ungrounded phase conductor, or approved equivalent solid state trip unit.
2. Engrave breaker ampere rating on handle or trip unit.
3. Furnish multi-pole breakers with internal common trip.
4. Ground fault breakers class "A" type to trip on fault currents of 4-6 ma.
5. Main circuit breakers UL rated for service entrance use.
6. Switch "SWD" rated where required by NEC.

C. Surge Protection Device / Transient Voltage Surge Suppression:

1. See Section 26 43 13 Surge Suppression Device

D. Panelboards classified by type over-current protection as follows:

1. BQL Bolted quick-lag circuit breaker distribution, 0-100 ampere branches, with minimum interrupting rating of 10,000 symmetrical amperes at 250 volts. Equivalent to Square D type "NQOD", General Electric type 'AQ' or Eaton/CutlerHammer type 'PRL2

2.3 CABINETS:

- A. Code thickness, hot dip galvanized steel or painted with trim and door. Hardware: combination latch and cylinder lock, all keyed the same. Provide celluloid or plastic covered directory card holder on the inside of door. Trim, door and exposed interior shall be finished with factory prime and smooth finish coat of the color selected by Engineer. Reinforce cabinets as necessary for service and short circuit rating intended.
- B. Mount in motor control center.

- C. Provide panels with fully hinged front cover. (Door in door construction)
- D. For panels installed outside furnish NEMA 4 x stainless steel enclosures.

2.4 MANUFACTURERS:

- A. Panelboards manufactured by Square D, ABB, or Eaton/CutlerHammer.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install where shown on the drawings.

3.2 IDENTIFICATION:

- A. Provide and engraved laminated plastic nameplate showing name and voltage on each panelboard.
- B. Permanently attach nameplates and circuit numbers to panel using screws or an epoxy adhesive.
- C. Use horizontal consecutive circuit numbers for lighting and appliance panels as shown in panelboard schedules.
- D. Provide typewritten circuit directories describing service of each circuit.
- E. Provide engraved laminated plastic nameplate circuit identification.

END OF SECTION 26 24 16

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Furnish and install all wiring devices, complete with coverplates, shown on drawings and/or as required for equipment.

1.2 QUALITY ASSURANCE

- A. Insofar as they are available all devices and coverplates shall be from a single manufacturer.

1.3 SUBMITTALS:

- A. Provide manufacturer product data for each device to be furnished. Submittal data shall include device ratings, materials, construction.

PART 2 - PRODUCTS

2.1 DEVICES:

- A. Light Switches:

- 1. Light switches shall be toggle quiet AC type, 120/277 volts, 20 amp specification grade, contacts shall be silver alloy and switch shall have one piece Lexan lever and cam. Terminals shall be spring loaded, color coded and suitable for side wiring.

- B. Receptacles:

- 1. General purpose receptacles shall be automatic grounding type, finger-groove face, industrial grade, nylon face and back, single piece wraparound galvanized steel strap with provisions for back wiring by means of spring-staked screwed or side wiring with captive held binding screws, shall be constructed of arc-resistant material. Provide tamper resistant and weather resistant where shown on the drawings and/or where required by code.
 - 2. Ground fault interrupting (GFI) type receptacles shall be self contained, automatic grounding type, NEMA 5-20R configuration, specification grade, with trip indicator light, test and reset buttons. Device shall meet all UL943 and UL498 requirements for GFI receptacles. Trip threshold shall be 4-6 milliamperes and trip within .025 seconds of fault detection.

- C. All devices shall be brown in color.

2.2 Exterior outlets and outlets marked "WP" (weatherproof) shall be complete with weatherproof plate with hinged cover or covers in accordance with NEC 70 and a neoprene gasket between the plate, box and mounting surface. Red Dot CKS series or equal.

2.3 DEVICE PLATES:

- A. All outlets shall have a standard coverplate, blank, receptacle, switch, or cord hole as required by outlet symbol. Multiple devices shall be mounted on a one-piece gang-plate of appropriate design. No sectionalized plates will be permitted. All plates throughout building shall be of the same manufacture and design.
- B. Furnish devices with cast aluminum cover plates.
- C. Device plates manufactured by Sierra or Hubbell.

PART 3 - EXECUTION

- A. Install receptacles plumb with ground wire from ground screw connected to outlet box.
- B. Install devices vertical with ground slot up unless shown otherwise.
- C. The Engineer reserves the right to change location of any outlet a distance of six (6) feet in any direction from plan location, before work is actually roughed-in, at no extra charge.
- D. Coverplates shall fit tight against the finished wall surface.
- E. Furnish devices as follows:

TABLE 1 – BASIS-OF-DESIGN WIRING DEVICES

DEVICE	NEMA` CONFIGURATION	MANUFACTURER	HEAVY DUTY SPEC GRADE CATALOG NO.
Single Receptacle 20A, 120V	5-20R	Hubbell	HBL5361
Locking Single Receptacle 20A, 120V	L5-20R	Hubbell	HBL2310
Duplex Receptacle 20A, 120V	5-20R	Hubbell	HBL5362

Duplex Receptacle, Isolated Ground 20A, 120V	5-20R IG	Hubbell	IG5362
GFCI Duplex Receptacle 20 A, 120V	5-20R GF	Hubbell	GF5362
Wall Switch 20 A, 120/277V	Single Pole Toggle	Hubbell	CS1221
20 A, 120/277V Wall Switch 1-Pole	Single Pole Toggle	Hubbell	CS1222
20 A, 120/277V Wall Switch 1-Pole	Single Pole Toggle	Hubbell	CS1223
20 A, 120/277V Wall Switch 1-Pole	Single Pole Toggle	Hubbell	CS1224
Wall Switch, SPDT Momentary Contact, Center OFF	20A, 120/277V	Hubbell	HBL1557

END OF SECTION 26 27 26

SECTION 26 28 13 – FUSES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish and install fuses rated 600V and less in switches as shown described herein or as required by the equipment served.
- B. Furnish and install a spare fuse cabinet.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Specifications, apply to this Section.

1.3 SUBMITTALS

- A. Product Data: Include following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Let-through current curves for fuses with current-limiting characteristics.
 - 3. Time-current curves, coordination charts and tables, and related data.
 - 4. Fuse size for elevator feeders and elevator disconnect switches.
- B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - 1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - 2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
- C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40° F (5° C) or more than 100° F (38° C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and power system study.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc.
 - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
- B. Basis of design products:
 - 1. Class L, current-limiting time delay – Bussman “Low Peak” KRP-C
 - 2. Class RK1, time-delay, dual-element – Bussman “Low Peak”, LPS-RK
 - 3. Class RK5, time-delay, dual-element – Bussman “Fusetron” FRS-R
 - 4. Class J, time-delay, dual-element – Bussman “Low Peak” LPJ
 - 5. Class L, fast-acting, current-limiting, Bussman “Limitron” KTU

2.3 SPARE-FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.

2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.
5. Place in the main electrical room.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits:
 1. Motors larger than 5 hp – RK1
 2. Motors 5 hp and smaller – RK5
- B. Other Branch Circuits: Class RK5, time delay.
- C. Low-Voltage Transformer: Class RK1

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Documents: Drawings, General Conditions of the Contract and Division 01 Sections apply to this Section
- B. Section 26 28 13 Fuses

1.2 SUMMARY:

- A. This Section includes the following individually mounted, enclosed switches:
 - 1. Fusible switches.
 - 2. Non-fusible switches.
 - 3. Molded-case switches.
 - 4. Enclosures.

1.3 DEFINITIONS

- 1. GD: - General Duty
- 2. GFCI: - Ground-Fault Circuit Interrupter
- 3. HD: - Heavy Duty
- 4. RMS: - Root Mean Square
- 5. SPDT: - Single Pole, Double Throw
- 6. SS: - Stainless Steel Enclosure

1.4 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. UL Listing for series rating of installed devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.

- C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition, include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES:

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. Siemens Energy & Automation, Inc.
 - 3. Square D/Group Schneider.
 - 4. ABB
- B. Fusible switch, NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Non-fusible switch, NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 - 3. Auxiliary Contact Kit: 2 Auxiliary setS of contacts arranged to open before switch blades open. (Break first, make last).

2.2 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 - 1. Outdoor Locations: NEMA 250, Type 4x.
 - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4x.
 - 3. Stainless Steel Enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems".
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated plastic nameplate as specified in Division 26 Section "Electrical Identification."

3.4 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

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. Submittals shall be in accordance with the General Specifications.
- B. 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.
- C. A Bill of Materials shall be included with catalog information on all components.
- D. Information shall be included on any proprietary logic component sufficient to demonstrate its ability to perform the required functions.
- E. The following calculations shall be submitted:
 - 1. Thermal calculations showing amount of panel cooling/ventilating/heating required for each control panel, per ambient requirements listed below and operating temperature limitations of all equipment/devices within each control panel. See Part 2 below for requirements for forced air ventilation rather than air conditioning. Panel shall be oversized, interior equipment/devices shall be derated, and solar shielding shall be provided as required to allow the use of forced air ventilation as the cooling method. Air conditioning, ventilation, and/or heating equipment shall each have ratings/capacities at least 20% larger than required by calculations below unless noted otherwise:

- a. Thermal calculations used for sizing cooling/ventilation systems for each control panel located in exterior or non-conditioned spaces shall assume:
 - 1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.
 - 2) Full solar contact where applicable (not applicable where enclosures are fully protected from solar contact using solar shields separated from panel enclosure with standoffs or similar).
 - 3) No wind.
 - 4) Heat loss from interior equipment (electronics, etc.) per equipment supplier's information.
- b. Thermal calculations used for sizing heating systems for each control panel shall assume:
 - 1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.
 - 2) No heat loss by interior components of control panel.
 - 3) No solar gain on exterior of control panel.
 - 4) Doubling of heating wattage required to account for wind where control panels are located outdoors.
 - 5) Minimum temperature difference (due to heating) of 10 degrees F to prevent condensation, regardless of equipment temperature limitations.
2. Load calculations showing the sizing of all power supplies provided (with spare capacity as specified). Power supplies shall each have ratings/capacities at least 20% larger than required by load calculations unless noted otherwise.
3. Load calculations showing the sizing and anticipated runtime of all Uninterruptible Power Supply systems provided (with spare capacity as specified).

PART 2 - PRODUCTS

2.1 GENERAL

- A. Control panels shall be Underwriters' Laboratories labeled by the panel manufacturer. Control panel manufacturers not capable of applying the U.L. label to their products are unacceptable.
- B. All human interface equipment/devices (indicator lights, selector switches, pushbuttons, time switches, displays, keypads, and other similar items used for control, adjustments or monitoring) shall be mounted on the non-energized side of enclosure door(s) in such a way as to be accessible without exposing the user to energized parts.

2.2 RATINGS

- A. All Control Panels shall have short circuit current ratings at least equal to the lesser of the following, unless noted otherwise on plans:
 1. The short circuit current rating of the electrical distribution equipment that feeds the Control Panel.

2. 150% of the available fault current at the Control Panel as determined by a Short Circuit Current study prepared by a licensed professional electrical engineer.
- B. All equipment/devices installed within control panels shall be rated to operate in ambient temperatures of 50 degrees C (122 degrees F) or higher.

2.3 ENCLOSURES

- A. All enclosures (with any required accessories or auxiliary items) shall fit within the space shown on the Plans. Any costs associated with furnishing equipment which exceeds the available space shall be borne by the Contractor.
- B. Enclosures (with any required accessories or auxiliary items) shall be suitable for the environment where installed.
- C. Enclosure materials shall be as follows unless noted otherwise:
 1. Control Stations:
 - a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
 - b. Where located in other wet, process or outdoor areas: NEMA 4X of type 304 stainless steel construction (with stainless steel hardware).
 - c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 of die cast zinc/aluminum construction.
 2. Control Panels:
 - a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
 - b. Where located in other wet, process or outdoor areas: NEMA 4X of type 304 stainless steel construction (with stainless steel hardware).
 - c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 or 12.
- D. Control Panel Enclosure Construction:
 1. Non-metallic control panel enclosure material, where specified, shall be reinforced polyester resin or equivalent, with a minimum thickness of 3/16 inch for all surfaces except those requiring reinforcement. Panels shall be precision molded to form a one piece unit with all corners rounded. Exterior surfaces shall be gel-coated to provide a corrosion-resistant maintenance-free satin finish which shall never need painting. Color pigments shall be molded into the resin. Color shall be grey.
 2. Metallic control panel enclosures, where specified, shall be fabricated using a minimum of 14 gauge steel for wall or frame mounted enclosures and a minimum of 12 gauge for freestanding enclosures. Continuously weld all exterior seams and grind smooth. Reinforce sheet steel with steel angles where necessary support equipment and ensure rigidity and preclude resonant vibrations.
 3. Use pan-type construction for doors.
 4. Door widths shall not exceed 36-inches.
 5. Mount doors with full length, heavy duty piano hinge with hinge pins.
 6. Provide gasket completely around each door opening.

7. Mount and secure all internal components to removable back plate assembly.
 8. For NEMA 1 or 12 enclosures, provide handle-operated key-lockable three point stainless steel latching system for each door.
 9. For NEMA 4X enclosures, provide provisions for padlocking all doors and provide clamps on three (3) sides of each door.
- E. Control panel enclosures (and associated backpanels and other similar accessories) shall be manufactured by Hoffman Engineering Co., or Saginaw Control & Engineering.

2.4 CONTROL PANEL ACCESSORIES:

- A. Panel ventilation systems shall be provided if so required by the application to maintain temperatures within the acceptable ranges of the interior equipment. In no case (regardless of temperature ratings of internal equipment) shall maximum temperatures within control panels be allowed to exceed 50 degrees C (122 degrees F). Panel Air Conditioners or Heat Exchangers (to satisfy the specified thermal calculation requirements) are generally NOT acceptable unless specifically stated otherwise in these specifications, and shall not be provided for panels without specific written direction from the engineer PRIOR to submission of panel shop drawings. Panels shall be oversized, provided with standoffs/shields, and/or ventilated as required to meet the contract requirements. Thermostats shall be provided to control cooling without need of manual operation. Thermostat setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Cooling units shall be as manufactured by Hoffman Engineering Co., Rittal or approved equal and shall be thermostatically controlled.
- B. Space heaters shall be provided for condensation and temperature control. Thermostats AND hygrometers (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 gasketed 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 PLC PANEL COMPONENTS

- A. Programmable logic controllers (PLCs). Where PLCs are specified for control panels in other specifications, Panels shall meet the following requirements:

- 1. Controller Devices

- a. The followings specs for the controller shall be considered minimum requirements. It is the full responsibility of the Panel manufacturer to fully understand the project requirements and select the proper Controller. Controller device, as a minimum, shall be: Rockwell CompactLogix ~~5370 series 1769-L33ER/ERM~~ processors, 2MB of user memory, 8GB secure digital memory card, (2) integral 10Mbps/100Mbps/1Gbps Ethernet ports, (1) USB client, and chassis and other accessories as required

5069 series 5069-L330ER

by:CD

- 2. Input/Output modules:

- a. Provide I/O modules on associated controller backplane as required by point lists provided on plans. Spare I/O: A quantity of spare I/O equal to 25% of the quantity specified for the PLC, of each I/O point type, or two of each I/O point type (whichever is greater) shall be provided for each PLC. For example, a PLC with 20 Discrete Inputs, 9 Discrete Outputs and 4 Analog Inputs shall additionally be provided with the following spare I/O: 5 Discrete Inputs, 3 Discrete Outputs, 2 Analog Inputs and 2 Analog Outputs (including spares). This applies to the following I/O point types:
 - 1) Discrete Input
 - 2) Discrete Output
 - 3) Analog Input
 - 4) Analog Output
- b. Discrete inputs & outputs to/from motor starters (or other panels with 120VAC controls/CPTs) shall generally be rated for 120VAC unless noted or required otherwise (to coordinate with typical 120VAC CPTs at motor starters). Discrete inputs & outputs to/from equipment only rated for 24V discrete signals shall be rated for 24V. PLC supplier shall coordinate all I/O voltage rating requirements with associated remote panels/starters/equipment/devices prior to submitting panel shop

drawings. Provide isolation relaying/etc. as required to use same voltage classes for discrete inputs and outputs to each piece of equipment such as to allow a common conduit/raceway system to be used .

- c. Provide network/communication I/O modules (for Ethernet, Profibus, DeviceNet, etc. connections) as required by point lists provided on plans. All networked points listed are representative only. Prior to preparation of submittals, PLC panels supplier shall collect register lists identifying all available networked points for the associated systems from the system supplier(s) and shall review the lists with the owner and engineer for determination of final points to be monitored/controlled. PLC panel supplier shall provide programming/HMI for all networked points chosen by the owner/engineer for these systems.

B. Touchscreen:

- 1. Provide 15-inch Allen Bradley Panelview OIT/touchscreen: # 2711P-T15C22
- 2. Mounted on the deadfront door (outer-most door of panels mounted in dry locations, inner door of panels mounted in exterior locations).
- 3. Programming/Screens:
 - a. Programmed with screens as directed by civil engineer to allow full control and monitoring of the processes connected to the associated PLC.
- 4. Specifications:
 - a. NEMA 4X rating
 - b. Color TFT LCD display with 1024 x 768 XGA resolution, 4:3 aspect ratio
 - c. Rated for operational temperatures of 0 degrees C to 55 degrees C.
 - d. Connectors are required to coordinate with associated PLC/etc.
- 5. Furnished with OIT/HMI software as required. Shall be connected to local PLC such as to allow local control/monitoring of PLC processes in the event of remote network failure(s).

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C. Ethernet Switches:

- 1. For PLC Panels with copper Ethernet drops external to panel (such as to workstations, servers, printers field instruments, etc.): provide Managed Industrial Ethernet Switch, with copper ports for all required copper Ethernet connections plus 50% spares and SC-type fiber optic ports for all required fiber optic connections: Rockwell Stratix series or equal by Moxa or NTron.
- 2. For PLC Panel with no copper Ethernet drops external to panel (drops only for internal controllers, HMI, laptop ports, etc.): provide Unmanaged Industrial Ethernet Switch, with copper ports for all required copper Ethernet connections plus 50% spares and SC-type fiber optic ports for all required fiber optic connections: Rockwell Stratix series or equal by Moxa or NTron.

D. Fiber optic patch panel(s):

- 1. Shall be as required by application and/or as shown on network diagrams on plans.

E. Ambient Air Temperature Transmitter:

- 1. Provide ambient air temperature transmitter factory-mounted to the outside of the PLC enclosure, with engraved nameplate to identify instrument name/tag/function and factory-wired as an analog input to the associated PLC by the panel supplier.

- F. Flash-Drive Programming Backup:
 - 1. Provide portable flash-drive (exact type as required to be easily loadable into panel equipment) mounted to retractable cord hung from inside surface of inner door downloaded with final copies of all programming, etc. for equipment within panel (controller, touchscreen, etc.). Provide engraved nameplate to read: "PROGRAMMING BACKUP".
- G. Communication Equipment:
 - 1. Fiber-connected PLC Panels:
 - a. Provide SC-type fiber-optic ports within Ethernet Switch within PLC panel as required for all required fiber optic connections.
 - 2. Internet-connected PLC Panels:
 - a. Provide copper Ethernet ports within Ethernet Switch within PLC panel as required for internet connections. Ethernet Switch shall be connected to owner's internet connection as directed.
 - 3. Cellular-connected PLC Panels:
 - a. Provide Cellular Modem/Gateway, antenna, Microcontroller (if required), and other appurtenances required to bridge communication protocols for remote data access, ensuring secure cloud connection, efficient data transmission, etc.

2.6 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, unless indicated otherwise to have a single push-to-test button that tests all pilot lights simultaneously.
- 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 1/4" diameter, mushroom-style, maintained contact push buttons
 - b. With a minimum of one (1) normally open dry contact and three normally closed dry contacts.

- c. Connections made such that pushing “in” the button will shutoff the associated equipment.
- d. Provided with a red engraved nameplate with ½” lettering to read “Emergency Shutoff”.

D. Relays:

1. Control relays shall have the following characteristics, unless noted otherwise:
 - a. General purpose, plug-in type.
 - b. Minimum mechanical life of 10 million operations.
 - c. Coil voltage as indicated or required by application.
 - d. Single-break contacts rated 12 amperes, resistive at 240 volts.
 - e. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each individual relay shall have 3PDT contacts. Where required, multiple control relays shall be provided (to provide the required quantities of contacts) for each “relay” function shown on plans/diagrams.
 - f. Furnished with RC transient suppressor to suppress coil-generated transients to 200% of peak voltage.
 - g. LED on/off indicator light and manual operator.
 - h. Industry standard wiring and pin terminal arrangements.
 - i. Equal to Square D 8501KP series with matching plug-in socket.
2. Interposing/isolation relays used to isolate discrete output field wiring (and where required for voltage translation for other discrete signals) to/from PLC inputs/outputs shall be terminal-block style. Terminal-block style relays shall have the following characteristics, unless noted otherwise:
 - a. Minimum mechanical life of 10 million operations.
 - b. Single-break contacts rated 6 amperes, resistive at 120 volts.
 - c. One (1) N.O. contact per relay.
 - d. Furnished with integral transient protection.
 - e. LED on/off indicator light.
 - f. DIN-rail mounted.
 - g. Equal to Square D type Zelio RSL.
3. Timer relays shall be electronic, adjustable plug-in devices meeting the following characteristics, unless noted otherwise:
 - a. General purpose, plug-in type.
 - b. Minimum mechanical life of 10 million operations.
 - c. Single-break contacts rated 10 amperes, resistive at 240 volts.
 - d. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each relay shall have DPDT contacts (2 N.O. & 2N.C.). Where required, multiple timer or control relays shall be provided (to provide the required quantities of contacts) for each “relay” function shown on plans/diagrams.
 - e. Rotary-thumbwheel adjustments for time value, timing range and function.
 - f. Time value adjustments from .05 seconds to 999 hours
 - g. Selectable Timing Functions, including the following:
 - 1) On Delay
 - 2) Interval
 - 3) Off Delay
 - 4) One Shot

- 5) Repeat Cycle-Off
- 6) Repeat Cycle-On
- 7) On/Off Delay
- 8) One Shot Falling Edge
- 9) Watchdog
- 10) Trigger On Delay
- h. Accuracy shall be $\pm 2\%$ and repeatability shall be $\pm 0.1\%$.
- i. Furnished with integral transient protection.
- j. LED indicator light(s) for "timing" and "on/off status"
- k. Held in place with hold-down spring
- l. Equal to Square D type JCK with matching plug-in socket.

2.7 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.

2.8 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.

2.9 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 UPS make and model is provided elsewhere and 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. As a minimum and unless specified elsewhere, 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.

2.10 DISCONNECTS

- A. A main disconnect switch or circuit breaker shall be supplied integral to all control panels. The main disconnect or circuit breaker shall be accessible/operable without exposing the operator to energized sections of the control panel(s), and shall be lockable in the open/off position.
- B. Individual circuit breakers shall be provided integral to the manufactured control panel for each separate power circuit originating within the control panel.
- C. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated (or can be adjusted to is 1200A or higher, breakers shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.
- D. Manufacturers:
 - 1. Square 'D' or Cutler Hammer.

2.11 COMBINATION STARTERS

- A. All combination starters shall utilize a unit disconnect. Magnetic starters shall be furnished in all combination starter units unless specifically shown otherwise. All starters shall utilize full NEMA/EEMAC rated contactors (size 1 minimum).

- B. Starters shall be provided with a three-pole, external (door mounted) manual reset, solid state overload relay. Solid state overload relay shall have switch-selectable trip class and shall provide protection from:
 - 1. Overload.
 - 2. Phase Unbalance.
 - 3. Phase Loss.
 - 4. Ground Fault (Class II detection).
- C. Unless specifically shown otherwise, each combination starter or each group of starters shall be furnished with a control circuit transformer including two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads (including motor space heaters and other similar loads where specified). The transformer rating shall be fully visible from the front when the unit door is opened. Unless otherwise indicated, control voltage shall be 120V AC. Control power shall be provided by individual unit control power transformers.
- D. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
- E. Auxiliary control circuit interlocks shall be provided where indicated. Auxiliary interlocks shall be field convertible to normally open or normally closed operation.
- F. NEMA/EEMAC Size 1-4 starters shall be mounted directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger starters shall be arranged so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.
- G. Each starter shall be equipped with a minimum of the following control devices:
 - 1. Door-mounted reset button.
 - 2. Two (2) field-reversible (N.O./N.C.) auxiliary contacts
 - 3. For reversing and two-speed starters: Four (4) field-reversible (N.O./N.C.) auxiliary contacts
 - 4. Additional control devices as indicated on plans.
- H. Control Wiring Terminal Blocks
 - 1. Terminal blocks shall generally be:
 - a. Feed-thru, screw-in type
 - b. DIN rail mounted
 - c. Furnished with the stationary portion of the block secured to the unit bottom plate
 - d. Furnished with unit-mounted control terminal blocks for each field wire.
 - e. Rated for the voltage and current of the proposed application per UL/NEC standards.
 - f. Sized (by supplier) for the associated wire gauges/types/quantities.
 - g. Phoenix Contact UT-4 series, Weidmuller WDU-4 series (or equivalent) unless required otherwise by application.
- I. Nameplates

1. Each unit shall be properly labeled with an engraved phenolic nameplate with a white background and black letters.
 2. Each pilot device shall be properly labeled with a legend plate or an engraved phenolic nameplate.
- J. Manufacturers:
1. Square 'D' or Cutler Hammer.

2.12 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.

2.13 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 8/20 μ s 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 Frequency Noise Filtering device required above.
 - b. Provide surge protection device at any connection of multi-pole AC power to panels containing programmable logic controllers, remote I/O equipment, UPS's, transmitters, radios, VFDs, Reduced Voltage Soft Starters or other electronic equipment. Device shall:
 - 1) Be mounted internal to the associated panel, with dedicated overcurrent protection.
 - 2) Provide protection for all phases.
 - 3) Have 40kA (per phase) peak surge current rating.
 - 4) Have maximum continuous operating voltage (MCOV) rating as required by the associated circuit voltage.
 - 5) Visually indicate operational status.
 - 6) Be Square D SDSA or HWA series or equal.
3. Analog I/O Panel Terminations Surge Protection:
 - a. Provide surge protection device at the PLC (or similar) panel connection of each analog I/O signal. Device shall:
 - 1) Be mounted internal to the associated panel.
 - 2) Be of two-part (base and SPD), DIN-rail mountable construction.
 - 3) Have the following nominal discharge current ratings:
 - a) D1 Lightning impulse current (10/350 μ s) per line: 1 kA
 - b) C2 Total nominal discharge current (8/20 μ s): 20 kA
 - c) C2 Nominal discharge current (8/20 μ s) per line: 10 kA
 - 4) Have maximum continuous operating voltage (MCOV) rating as required by the associated signal.
 - 5) Manufacturer and Model:
 - a) DEHN BSP M4 BE 24 (926 324) with 920300 base.
 - b) Phoenix Contact 2801263 with included base.
 - c) Weidmuller 1093400000 with 8951710000 base.
4. Discrete I/O Panel Terminations Surge Protection:
 - a. Provide isolation relay at the PLC (or similar) panel connection of each discrete output signal (within the associated panel). See above for isolation relay requirements.
5. Low Voltage Power Supply Load Side Surge Protection:

- a. Provide surge protection device at the PLC (or similar) panel on the load side of each low voltage power supply that has low voltage connections extending external to the panel. Device shall:
 - 1) Be mounted internal to the associated panel.
 - 2) Be of two-part (base and SPD), DIN-rail mountable construction.
 - 3) Have 10kA total nominal discharge current per line (based on 8/20 μ s 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 8/20 μ s waveform).
 - 4) Be designed specifically for the associated network connection type (Ethernet, RS485, RS232, etc.).
 - 5) Be MTL Zonebarrier series or equal.
 - 7. Antenna Cable Terminations Surge Protection:
 - a. Provide surge protection device at the connection of antenna cable to the radio panel. Device shall:
 - 1) Be mounted internal to the associated panel.
 - 2) Provide coarse protection via replaceable gas-filled surge voltage arrestor
 - 3) Be Phoenix Contact CN-LAMBDA series or equal.
- C. Installation and grounding of suppressor: As directed by manufacturer. Provide coordination and inspection of grounding.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE & HANDLING

- A. Provide Site and warehouse storage facilities for all equipment.
- B. Prior to shipment, include corrosive-inhibitive vapor capsules in shipping containers, and related equipment as recommended by the capsule manufacturer.
- C. Prior to installation, store items in dry indoor locations. Provide heating in storage areas for items subject to corrosion under damp conditions.
- D. Cover panels and other elements that are exposed to dusty construction environments.

3.2 INSTALLATION

- A. Provide enclosure mounting supports as required for floor, frame or wall mounting. All supports in exterior, wet or process areas shall be stainless steel unless noted otherwise.

All floor-mounted panels or other similar distribution equipment shall be mounted on 6" concrete housekeeping pads unless specifically shown otherwise.

- B. All enclosures used outside shall be solid bottom unless otherwise specified. All cable and piping openings shall be sealed watertight. Cable and piping shall enter the enclosure as shown on drawings or specified herein.
- C. All equipment and components shall be solidly grounded to the control panel. One grounded terminal unit shall be provided in each control panel for connection to plant ground system. Grounding digital and analog components shall be performed in accordance with the instrument supplier's installation recommendations. Signal ground shall be solidly connected to the ground system so as to prevent ground loops

3.3 PAINTING

- A. For enclosures other than NEMA 4X stainless steel or fiberglass:
 - 1. Completely clean all surfaces so that they are free of corrosive residue. Then, phosphatize all surfaces for corrosion protection.
 - 2. Prime with two (2) coats and finish with one coat of factory finish textured polyurethane. Paint shall be Sherwin-Williams Polane "T" or approved equal.
 - 3. Color to be selected during shop drawing review phase.

3.4 IDENTIFICATION & DOCUMENTATION

- A. Refer to specification section 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.

3.5 OWNER TRAINING

- A. Fully train the owner in the proper operation of all control panels/equipment, describing and demonstrating full operation, including function of each door-mounted device.

3.6 SPARE EQUIPMENT

- A. Provide the following spare equipment:
 1. Fuses: 10% (minimum of 3) of each size and type utilized, mounted within a pocket within the associated control panel.
 2. Where control panel contains programmable controller (or similar equipment): Flash drive containing copies of all final programs utilized within the control panel, with provisions/cable assemblies as required to connect the flash drive provided to the controller to download the programs. Flash drive shall be attached to retractable cord (long enough to reach the associated port) attached to the inside of the panel door.

END OF SECTION 26 29 00

SECTION 26 43 13 - SURGE PROTECTIVE DEVICE FOR AC SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section describes materials and installation requirements for suppressive devices (SPD) surge for protection of all AC electrical circuits from effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Electrical General - Section 26 00 10
- B. Grounding - Section 26 05 26

1.3 QUALITY ASSURANCE:

All Surge Protective Devices (SPDs) shall be tested and **listed** to **ANSI/UL 1449-2006 (UL 1449 3rd or 4th Edition)** and Complimentary Listed to UL 1283 by an independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction. This agency must comply with ANSI/IEEE C62.45 test procedures for all categories established in C62.41 (1991). "Manufactured in accordance with UL 1449" is not equivalent to being listed to ANSI/UL 1449-2006 and does not meet the intention of this specification.

1.4 CODES AND STANDARDS:

1. ANSI/IEEE Std C62.41.1™-2002, IEEE Guide on the Surge Environment in Low- Voltage (1000 V and Less) AC Power Circuits
2. ANSI/IEEE Std C62.41.2™-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
3. ANSI/IEEE Std C62.45™ -2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
4. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)
5. ANSI/IEEE Standard 1100-2005, IEEE Recommended Practice for Power and Grounding Electronic Equipment (Emerald Book) – Clause 8.6.1
6. National Fire Protection Association (NFPA) 70 (N.E.C.) – 2002 - Article 285

7. ANSI/UL Standards 1449-2006 Listed (UL 1449 Third Edition), UL 1283 Listed, CUL Listed and CE compliant “low-voltage directive.”
8. IEEE Standard C62.72™ - 2007 – IEEE Guide for the Application of Surge-Protective Devices for Low-Voltage (1000 V or less) AC Power Circuits

1.5 MANUFACTURER QUALIFICATIONS:

All surge suppression devices shall be manufactured by an ISO 9001-2008 certified company normally engaged in the design, development, and manufacture of such equipment, with at least 10 years of engineering experience in the design and manufacture of permanently connected SPD devices. The surge suppressor manufacturer shall provide unlimited free replacement of the entire SPD for all inoperable SPD units during the warranty period. The use of any mechanical or electro-mechanical thermal/over-current protection (i.e. moving parts and/or springs and shutters), in combination with or for the All SPDs shall be manufactured by the same manufacturer. The listing of a manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. Subject to compliance with requirements, provide products by the following manufacturers and models listed below only:

- Surge Suppression Incorporated (Advantage Series (888-212-2728)).
- Emerson (Liebert) Corp. (560xx16 & 570xx17 Series) / 614-888-0246.
- Current Technology (SL3-150 Series) / 800-238-5000.

1.6 SUBMITTALS:

Surge suppression submittals shall include, but shall not be limited to the following items:

Complete schematic data for all suppressors indicating part numbers, conductor sizes, etc.

Dimensioned drawing of each suppressor type indicating mounting arrangement.

Manufacturer’s ANSI/UL 1449-2006 Third Edition listing classification page and listing number(s).

Manufacturer’s UL 1283 listing classification page and listing number(s). Certified test data documenting ANSI/IEEE C62.41-2002 performance and the ability of the device to meet or exceed all requirements of this specification. Include complete let-through voltage/measured limiting voltage test data (not Voltage Protection Rating), test graphs, and scope traces for each mode for each product submitted for Category’s C, B, A (including Cat A, 2 kV, 67 A, 100 kHz ring wave at both 90 and 270 degree electrical phase angles).

Letter from manufacturer stating products are in strict compliance with the recommendations of IEEE Standard 1100-2005, Clause 8.6.1 and **incorporate 10 individual dedicated discrete modes of protection for three-phase Wye systems, including direct line-to-line components. (Reduced-mode variations will not be accepted).**

Certificate of declaration that product is CE low voltage directive compliant.
Statement of manufacturer’s warranty duration and replacement policy.

PART 2 – PRODUCTS

2.1 REQUIREMENTS:

- A. The Surge Protective Devices (SPDs) shall be of a parallel-connected design using fast-acting transient energy protection components that will divert and dissipate the surge energy.
- B. All SPDs shall be tested and listed to ANSI/UL 1449-2006 (UL 1449 3rd Edition) and Complimentary Listed to UL 1283 by a Nationally Recognized Testing Laboratory (NRTL) (i.e. CSA, UL, etc).

The SPD for the service entrance shall be a Type 1 or Type 2 SPD. All other SPDs shall be Type 2 SPDs; Type 4 SPDs are not permitted. (Definitions: Type 1 SPD – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device. Type 2 SPD – Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel. Type 4 SPD – Recognized Component SPDs, including discrete components as well as component assemblies, which bear specific conditions of acceptability.)

- C. The SPD shall be tested and listed by an NRTL as a complete assembly to a symmetrical fault current rating greater than or equal to the available fault current at the location of installation at the connected panel, in accordance with NEC Article 285 and shall be marked with the Short Circuit Current Rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC.

Permanently connected devices mounted parallel to the service, distribution, and sub panels are required. SPD device drawings shall be made available upon request.

- D. The service entrance SPD shall have a **Nominal Discharge Current (In)** of 20 kA. All other SPDs shall have a Nominal Discharge Current (In) of 10 kA. (The Nominal Discharge Current Test was designed to establish that the SPD remains functional after 15 surges at various currents (3 kA, 5 kA, 10 kA, and 20 kA) using the test procedure described in ANSI/UL 1449-2006.)

Fusing:

1. The SPD shall provide as a minimum, over-current, over temperature protection in the form of component-level thermal fusing to ensure safe failure and prevent thermal runaway. This component-level fusing shall be an integral part of the MOV itself and not silver wire (or other) independently laid across each MOV. SPDs without thermal fuses or disconnects, or SPDs with shared thermal devices that disconnect more than one MOV are not acceptable
2. Surge protective devices shall contain integral short circuit current safety fusing within each device for over-current requirements of the NEC. This fusing will be independent of the “component-level” fusing and be specifically for over-current protection and shall be constructed utilizing surge rated, cartridge fuses and not rated ‘silver-fuse-wire’ (or other).
3. The use of any mechanical or electro-mechanical thermal/over- current protection (i.e. moving parts and/or springs and shutters) in combination

with or for the protection of the suppression elements is expressly prohibited and will be rejected. Large-Block 34mm (50kA) square Thermal Protected MOVs are expressly prohibited and will not be accepted

4. The fusing mechanisms employed must effectively coordinate their performance in conjunction with the high current abnormal over-voltage testing under ANSI/UL 1449-2006 (a.k.a. UL 1449 3rd Edition).

E. **MCOV:** The SPD shall have a maximum continuous operating voltage (MCOV) capable of sustaining 115% of nominal RMS voltage continuously without degrading.

Component Limitations: The SPD shall only use solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that “crowbar” short-circuit the AC power system (e.g. spark gaps, gas tubes, selenium cells, or SCR’s) shall not be acceptable. Device circuitry shall be bi-directional, enclosed in a UL listed encapsulated thermal stress reducing compound, and be of a parallel design.

Per Phase Ratings: ‘Per-Phase’ ratings for a three-phase Wye-connected SPD are determined by multiplying the kA per mode times the number of **discrete modes of protection (directly connected suppression components)**, minus the value for the Neutral to Ground mode, divided by the number of phases.

$$\text{Per-Phase} = (((\text{kA per mode}) \times (\# \text{ of modes})) - (\text{N-G mode kA})) / (\# \text{ of phases})$$

Protection Modes: The SPD system shall provide (per IEEE Std. 1100-1999 8.6.1) dedicated, independent, distinct, individual protection circuitry for every possible mode in the electrical distribution system at the point of SPD application. For example, a 277/480V, 3-phase Wye, 4-wire plus ground system has **10 distinct modes** that require independent and dedicated protection (i.e., L1-L2, L2-L3, L3-L1, L1-N, L2-N, L3-N, L1-G, L2-G, L3-G, N-G). None of these modes of protection depend on protection elements purposed for other protection modes. Reduced mode SPD with only 3, 4, or 7 dedicated, distinct, independent protection modes are not acceptable and are not to be submitted. For 6 mode delta systems, 6 dedicated, independent, distinct protection modes are required (L1-L2, L2-L3, L3-L1, L1-G, L2-G, L3-G). When a mode of protection is specified, the protective mode *must* be specifically included. Thus, Line-to-Neutral-to-Line is *not acceptable* where Line-to-Line is specified.

Frequency Responsive Circuitry (FRC) (a.k.a. Sinewave Tracking Capability): The service entrance as well as power panels and MCCs serving

Responsive Circuitry (FRC) intended to mitigate the effects of switching or ringing surges that is specifically designed so that it can survive the surge environment. **EMI/RFI filtering specifically will not be considered as equal to FRC!** The performance of FRC is defined by the level to which it mitigates Ring

Wave transients and can be demonstrated in the test results of IEEE C62.41.2 2002, Category A 2kV, 30 Ohm Ring Wave. To demonstrate the FRC capability of the submitted devices, manufacturers shall submit 3rd party, independent tests results for units claiming FRC capability. Such tests shall include testing under the standards of ANSI/IEEE C62.41 and C62.45 category A (2kV, 67A, 100kHz ring wave) applied at the 270 degree phase angle, positive polarity, on a 120/208Vrms, 3 phase Wye device, on each of the following modes: line-to-neutral, line-to-ground, and line-to-line (dynamic tests with normal voltage applied to the unit under test), and neutral-to-ground (static test with no normal voltage applied to unit under test). The “let-through voltage” derived from each of these tests shall have a maximum amplitude of less than 50V peak deviation from the insertion point of the surge on the sine wave to the peak of the transient.

Measurement of the let-through voltage shall be made with six-inches of lead length external to the SPD housing in accordance with ANSI/UL 1449-2006. Performance requirements are as stated in the table in Section VIII below (ANSI/IEEE C62.41 Let-Through Voltage) at Test Category A Ring Wave (2kV).

Status Indicators: SPD units shall have panel front status monitors to indicate a continuous positive status of each protected phase. All SPD units that are mounted inside a panel shall have remote LED's mounted on the external face of the panel indicating the status of each power phase protected by the SPD. In addition, remote audible alarm option must be supplied where the specifying engineer deems it necessary and cost effective under the circumstances.

Equipment Certification: Items shall be listed to ANSI/UL 1449-2006, shall bear the seal of the NRTL, shall bear the Marking "Listed to UL 1449", shall have been tested under ANSI/UL 1449-2006, and shall be marked in accordance with the referenced standard. SPD units shall be UL 1283 Listed as an Electromagnetic Interference Filter and marked accordingly. All surge suppression devices shall be manufactured by an ISO 9001-2008 certified company normally engaged in the design, development, and manufacture of such equipment.

Circuit Configuration: The circuit configuration of the suppression units shall be bi-directional, thermal stress reducing, encapsulated, custom parallel connected, and solid state. (Series units or units equipped with "load carrying" components are expressly prohibited due to the possibility of single point series failures causing power interruption to protected loads.)

Enclosures: Unless otherwise noted, provide NEMA 1 or better enclosures for indoor mounting and NEMA 4 enclosures or better for all outdoor locations. All units will contain Form C, N/O or N/C, dry relay contacts, if so specified, and weatherproof fittings to maintain the required NEMA integrity.

Maintenance Restrictions: No suppression unit shall be supplied which requires scheduled preventive maintenance or replacement parts. Units requiring functional testing, special test equipment, or special training to monitor surge protection device (SPD) status are not acceptable. SPD shall require NO routine maintenance. SPD devices are considered non-repairable items and shall be fully replaced upon failure.

Commonality: All SPDs at the service entrance, distribution panels, and sub-panels shall be from the same manufacturer.

All SPDs shall meet or exceed the following performance criteria:

Service Entrance (Category C): The SPD shall provide a minimum protection of **300kA per phase** (three-phase Wye), be of frequency responsive design, and be capable of meeting the Category C-High LetThrough Voltage criteria as shown in the Section VII, below.

Building Distribution Panels (Category B): The SPD shall provide a minimum protection of **180 kA per phase** and be capable of meeting the Category B-High Let- Through Voltage criteria as shown in the Section VII, below.

Branch Panels/Panelboards (Non-Electronics) (Category A): The SPD shall provide a minimum protection of **120kA per phase** and be capable of meeting the Category B-High Let-Through Voltage criteria as shown in the Section VII, below.

Branch Panels/Panelboards (Electronics) (Category A): The SPD shall provide a minimum protection of **120kA per phase**, be of **frequency responsive** design, and be capable of meeting the Category A LetThrough Voltage criteria as shown in the Section VII, below.

Per Phase Ratings: 'Per-Phase' ratings for a three-phase Wye-connected SPD are determined by multiplying the kA per mode times the number of discrete modes of protection (directly connected suppression components), minus the value for the Neutral to Ground mode, divided by the number of phases.

$$\text{Per-Phase} = (((\text{kA per mode}) \times (\# \text{ of modes})) - (\text{N-G mode kA})) / (\# \text{ of phases})$$

2.2 ANSI/IEEE C62.41 LET-THROUGH VOLTAGE:

The SPD shall meet the Let-Through Voltage requirements shown in the tables below for voltage and locations specified. All voltages shall be peak ($\pm 10\%$), Positive Polarity, Time base = $10\mu\text{s}$, Sampling Rate = 500 Megasamples per second to ensure maximum transient capture. [These settings assure Let through Voltage test results are accurate]. Surge voltages shall be measured from the insertion of the surge on the sine wave to the peak of the surge. All tests are Static (unpowered), except for the 120V circuits that are Dynamic (powered). Let-through voltages on static tests calculated by subtracting sine wave peak from let-through measured from zero. All tests shall be performed in accordance with UL 1449 Third Edition with measurements performed at a point on the leads 15.24 cm (6 inches) outside of the device enclosure. No data measured at a module, lugs, component, or undefined location will be accepted. These settings assure Let-through Voltage test results are accurate. SPDs shall meet the following criteria:

Service Entrance ANSI/IEEE Cat. C Impulse Wave The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the

ANSI/IEEE Cat. C Impulse Wave (20kV, 10,000 amps) at the 90 degree phase angle, shall be less than (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sine wave to the peak of the transient):

<i>Mode / Voltage</i>	<i>120/240V & 120/208</i>	<i>277/480Y</i>	<i>480V, 3Ø</i>
L-N	1075V	1340V	N/A
L-L	1390V	1990V	1990V
L-G	1060V	1310V	2150V
N-G	1450V	1730V	N/A

Distribution and Branch Panels/Panelboards (Non-Electronics) ANSI/IEEE Cat. A Combination Wave Impulse Let-Through Voltage: The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. A Combination Wave Impulse (6kV, 200 amps) at the 90 degree phase angle, shall be less than; (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sine wave to the peak of the transient):

<i>Mode / Voltage</i>	<i>120/208Y</i>	<i>277/480Y</i>	<i>480V, 3Ø</i>
L-N	315V	440V	N/A
L-L	470V	530V	505V
L-G	315V	430V	505V
N-G	596V	966V	N/A

Branch Panels/Panelboards (*Electronics*) ANSI/IEEE Cat. A Ring Wave Let- through-Voltage: The let-through voltage based on ANSI/IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. A Ring Wave (2kV, 67 amps, 100 kHz ring wave) at the 270 degree phase angle, shall be less than (values are total let-through voltage (LTV) measured from the insertion point of the transient on the sinewave to the peak of the transient):

<i>Mode / Voltage</i>	<i>120/208Y</i>	<i>277/480Y</i>	<i>480V, 3Ø</i>
L-N	30V	65V	N/A
L-L	40V	110V	114V
L-G	50V	85V	1605V
N-G	50V	65V	N/A

2.3 ANSI/UL 1449-2006 VOLTAGE PROTECTIVE RATING:

1. **Voltage Protection Rating (VPR)** is a rating selected from a list of preferred values as detailed in ANSI/UL 1449-2006 and assigned to each mode of protection. The value of a VPR is determined as the nearest highest value taken from a list of preferred values (as detailed in ANSI/UL 1449-2006) compared to the measured limiting voltage determined during the transient voltage surge suppression test using the combination wave generator at a setting of 6 kV, 3 kA.
2. The SPD shall have Voltage Protection Ratings (VPRs) no greater than those shown below:

<i>Nominal System Voltage</i>	<i>Mode</i>	<i>VPR</i>
Single-Phase 120/240	L-N	600 V
	L-G	600 V
	N-G	700 V
	L-L	1000 V

Three-Phase 120/240 Delta	L-N HL-N L-G HL-G N-G L-L HL-L	600 V 1200 V 600 V 1200 V 600 V 1000 V 1000 V
120/208 Wye	L-N L-G N-G L-L	600 V 600 V 600 V 1000 V
277/480 Wye	L-N L-G N-G L-L	1200 V 1200 V 1200 V 1800 V
480 No Neutral (Delta)	L-G L-L	1800 V 1800 V

2.4 WARRANTY:

All SPD devices shall be warranted to be free from defects in materials and workmanship under normal use in accordance with the instructions provided for a period of twenty-five (25) years from date of substantial completion. Any SPD device that shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced as a complete unit (not just modules, subassemblies, or components) by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period that starts at the date of substantial completion of the system to which the surge SPD manufacturers whose warranty does not meet the requirements listed above standard shall submit a letter extending the warranty to meet these standards with the product submittal

2.5 INSTALLATION:

GENERAL: There are a few basic principles for surge suppression installation. They are:

For proper performance, the SPD must be installed with the wires as short and straight as humanly possible. Any sharp bend in the wire is unacceptable! This applies to phase, neutral, and ground leads. The objective is to reduce the lengths of wire provided on each unit, not add to it. The priority is to the phase leads, then the neutral, and then the ground lead.

Install the SPD on the side of the panel closest to the neutral bus, if present, and use a breaker on the same side.

Use a breaker close to the neutral bus and the SPD to keep the wires as short and straight as humanly possible.

The ground wire may be connected to the panel by using a ground lug installed near the SPD in the can or frame as they are grounded. If necessary, once this is done, the ground wire can be extended from the lug to the ground bus if the AHJ requires this connection.

Install the SPD on a dedicated breaker. If the unit is piggybacked on a breaker that feeds other equipment, when that breaker is turned off to service the other equipment, you have lost the surge suppression for that panel.

- A. Provide surge suppressor at each building service entrance and at other distribution and panelboard locations as indicated on the drawings. The SPD shall be located immediately adjacent to the switchboard or panelboard being protected (close-nipple to panel-boards). The SPD may not be located integral (switchgear manufacturer installed) within the switchboard or panelboard(s) unless the switchgear manufacturer providing such SPD products expressly meets or exceeds ALL parameters of this specification for the SPD. These SPDs shall be individually tested and Listed to ANSI/UL 1449-2006 according to their type (Type 1 or Type 2) and not be listed solely as part of the larger assembly (e.g. Type 4). SPD devices not meeting or exceeding the performance of this specification will be deemed unacceptable.
- B. Do not energize or connect service entrance equipment and panelboards to their sources until SPD devices are properly installed and connected.
- C. Do not perform insulation resistance tests of the distribution wiring equipment with the SPD installed. Disconnect before conducting insulation resistance tests, and reconnect immediately after the testing is over.
- D. Install the SPD with #10 AWG minimum conductors to dedicated 30-amp breaker(s) in panel per manufacturer's installation instructions and close to the Neutral Bus. The dedicated breaker shall serve as a means of service disconnect for the SPD so that the electrical panel remains energized during SPD servicing. The installer may rearrange breaker locations to ensure the shortest and straightest leads to the SPD. If a dedicated breaker is not provided, an SPD with internal 30-amp fuse or a UL Listed disconnect switch shall be installed as a minimum. The conductors serving the SPD shall be twisted together (one twist per 12" of wire) to reduce the SPD system input impedance and shall be kept at the minimum length. The SPD shall be installed in strict accordance with the manufacturer's recommended practices and in compliance with N.E.C. requirements, State, and Local Codes.
- E. If any lead lengths exceed 18", the Contractor responsible for installation must contact the specifying electrical engineer and the surge suppression manufacturer or distributor for installation assistance.
- F. The electrical contractor shall verify the proper application of the SPD (i.e., voltage, phases, etc.). The electrical contractor shall ensure that all Neutral conductors are bonded to the system ground at the service entrance the serving isolation transformer prior to installation of the associated SPD. The electrical contractor will ensure that neutral-to-ground bonds do not exist at locations that are not service entrances or newly derived power sources.
- G. The electrical contractor shall furnish all labor, materials, equipment, and services necessary for and incidental to the installation of the SPD system components as specified herein.

- H. The electrical contractor shall coordinate with other electrical work as necessary to interface installation of the transient voltage surge suppression systems with other work on the site.
- I. The SPD installation shall be certified by a licensed electrician that the installation is in accordance with the manufacturer's recommendations, applicable electrical code requirements and the requirements of the specification above. Any deficiencies noted shall be corrected by the Contractor. Provide written documentation of this inspection as part of the closeout documentation

The SPD installation must be inspected and certified by a factory-trained representative of the SPD manufacturer. In completing this start-up, the factory-trained inspector shall furnish the Engineer with a letter/report stating that all devices are the correct specified model numbers, in the correct locations and designations, and installed in strict accordance with the intent of this specification and the requirements of the manufacturer. The Contractor must make the manufacturer aware of the available dates to perform this inspection and must give at least 45 days notice of the required deadline date. The cost for this service must be included in the package price of the SPD device and is to be part of the construction bid package. The inspection will include one on-site visit and inspection accompanied by the report as stated above. Subsequent visits to correct problems created by the installer and not in accordance with the intent of the requirements of this specification and the installation instructions furnished by the manufacturer as noted in the report will be the ultimate responsibility of the Contractor and will be billed on a time and travel reimbursable basis until the Engineer receives final satisfactory certification from the manufacturer of the specified system. Any additional site visits required to correct problems shall be the responsibility of the Contractor and will be at no additional cost to the Owner and no additional Contract time.

END OF SECTION 26 43 13

SECTION 26 43 14 – SURGE PROTECTIVE DEVICES FOR INSTRUMENTATION, CONTROL AND DATA LINES

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section describe the materials and installation requirements for transient voltage surge suppressors (TVSS) for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- | | | |
|----|--------------------|-------------------|
| A. | Electrical General | -Section 26 00 10 |
| B. | Panelboards | -Section 26 24 16 |
| C. | Switchboards | -Section 26 24 13 |
| D. | Grounding | -Section 26 05 26 |

1.3 SUMMARY:

- A. Description: The surge protective devices (SPD) shall be designed to protect all dedicated circuits within control panels; all data transmission circuits and connected equipment; and all point-of-use loads. The devices will protect the following:
 - 1. Dedicated 120-volt AC circuits, series connected.
 - 2. Dedicated 120-volt control signals.
 - 3. Analog instrumentation signal, field mounted.
 - 4. Analog instrumentation signal, control panel mounted.
 - 5. Combination 120-volt AC circuit and analog signal, field mounted.
 - 6. Low voltage control signal, control panel mounted.
 - 7. Data line, control panel mounted.

1.4 QUALITY ASSURANCE:

- A. Referenced Codes and Standards (latest revisions if applicable):
 - 1. ANSI/IEEE Std C62.41.1™-2002, IEEE Guide on the Surge Environment in Low- Voltage (1000 V and Less) AC Power Circuits
 - 2. ANSI/IEEE Std C62.41.2™-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
 - 3. ANSI/IEEE Std C62.45™ -2002, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
 - 4. ANSI C84.1, American National Standard for Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)
 - 5. ANSI/IEEE Standard 1100-2005, IEEE Recommended Practice for Power and Grounding Electronic Equipment (Emerald Book) - Clause 8.6.1

6. National Fire Protection Association (NFPA) 70 (N.E.C.) – 2002 - Article 285
7. ANSI/UL Standards 1449-2006 Listed (UL 1449 Third Edition), UL 1283 Listed, CUL Listed and CE compliant “low-voltage directive.”
8. IEEE Standard C62.72™ - 2007 – IEEE Guide for the Application of Surge-Protective Devices for Low-Voltage (1000 V or less) AC Power Circuits
9. UL 1283, Standard for Safety Electromagnetic Interference Filters
10. UL 497B - Protectors for Data Communications and Fire Alarm Circuits, June 14, 2004

B. Qualifications:

1. Operates a Quality System Certified manufacturing facility as ISO 9001:2000 Compliant.
2. Provide devices from a manufacturer who has been regularly engaged in the development, design, testing, and manufacturing of SPDs of the type and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
3. All SPDs shall be from the same manufacturer.

1.5 DEFINITIONS:

- A. Let-Through Voltage (LTV) – The voltage that is measured at the end of the output leads of the surge protective device (SPD) measured from the zero-voltage reference to the peak of the surge when the applied surge is induced at a specified phase angle; i.e., 90- or 270-degree phase angle.
- B. Clamping Voltage – The voltage level where the SPD begins to conduct and handle the excess energy of the surge thus providing a low-resistance direct path for the surge.
- C. Maximum Continuous Operating Voltage (MCOV) – The maximum steady state voltage at which the SPD can operate and meet its specification. This is the maximum designated root-means square (RMS) value of the power frequency voltage that may be continuously applied to each mode of protection of the SPD.
- D. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements; i.e. line-to-neutral (L-N), line-to-ground (L-G), and neutral-to-ground (N-G).
- E. Peak Surge Current (PSC): The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 percent deviation of clamping voltage at a specified current.
- F. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 120-volt system the L-N peak voltage is 170 volts).

- G. EMI/RFI Filtering (Electromagnetic/Radio Frequency Interference): This filter is designed to attenuate unwanted electromagnetic and radio frequency signals (such as noise and interference) generated from electromagnetic sources.
- H. Sine Wave Tracking (SWT): A term used to describe the circuitry of a low-pass filter designed to attenuate “switching” or “ring wave” transients/surges.

1.6 SUBMITTALS:

Surge suppression submittals shall include, but shall not be limited to the following items:

- A. Complete schematic data for all suppressors indicating part numbers, conductor sizes, etc.
- B. Dimensioned drawing of each suppressor type indicating mounting arrangement.
- C. Manufacturer’s ANSI/UL 1449-2006 Third Edition listing classification page and listing number(s).
- D. Manufacturer’s UL 1283 listing classification page and listing number(s).
- E. Certified test data documenting ANSI/IEEE C62.41-2002 performance and the ability of the device to meet or exceed all requirements of this specification. Include complete let-through voltage/measured limiting voltage test data (not Voltage Protection Rating), test graphs, and scope traces for each mode for each product submitted for Category’s C, B, A (including Cat A, 2 kV, 67 A, 100 kHz ring wave at both 90- and 270-degree electrical phase angles).
- F. Letter from manufacturer stating products are in strict compliance with the recommendations of IEEE Standard 1100-2005, Clause 8.6.1 and incorporate individual dedicated discrete modes of protection for each mode including direct line-to-line components. (Reduced-mode variations will not be accepted).
- G. Certificate of declaration that product is CE low voltage directive compliant.
- H. Statement of manufacturer’s warranty duration and replacement policy.

1.7 WARRANTY:

- A. All SPD devices shall be warranted to be free from defects in materials and workmanship under normal use in accordance with the instructions provided for a period of twenty-five (25) years from date of substantial completion.
- B. Any SPD device that shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced as a complete unit (not just modules, subassemblies, or components) by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period that starts at the date of substantial completion of the system to which the surge suppressor is installed.

- C. SPD manufacturers whose warranty does not meet the requirements listed above standard shall submit a letter extending the warranty to meet these standards with the product submittal.

PART 2 – PRODUCTS

2.1 MANUFACTURER QUALIFICATIONS:

- A. All surge suppression devices shall be manufactured by an ISO 9001-2000 certified company normally engaged in the design, development, and manufacture of such equipment, with at least 10 years of engineering experience in the design and manufacture of permanently connected SPD devices.
- B. The surge suppressor manufacturer shall provide unlimited free replacement of the entire SPD for all inoperable SPD units during the warranty period.
- C. The use of any mechanical or electro-mechanical thermal/over-current protection (i.e. moving parts and/or springs and shutters), in combination with or for the protection of the suppression elements are expressly prohibited and will be rejected.
- D. The listing of a manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included herein. Subject to compliance with requirements, provide products by the following manufacturers and specific models listed below only:

Surge Suppression Incorporated / 888-212-2728) or equal

2.2 REQUIREMENTS:

When a product model number is listed in these specifications it shall be considered a base model number for the purposes of establishing a standard of quality and as such, shall not be considered the exact model number required. The Contractor and manufacturer/vendor shall review the Plans and Specifications in their entirety and coordinate with the electrical subcontractor, panel manufacturers, other vendors, etc. as required to determine all required options, features, accessories, appurtenances, etc. when generating the exact model number to be provided. Exact model numbers shall be fully coordinated during the submittal process.

A. **120 Volt AC Power Supply Circuit Protection** (Surge Suppression Incorporated Model CKLA1P1-21) or equal:

- 1. Maximum Continuous Operating Voltage: 150 volts
- 2. Maximum Continuous Operating Current: 400 Amps
- 3. Peak Surge Current: 40 kA per mode; 120 kA total
- 4. Fusing: Internal component level thermal fusing and internal, circuit board mounted, over-current fusing.
- 5. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. SPD shall be bi-directional and encapsulated in a UL listed/recognized high dielectric compound.

6. Discrete and dedicated protection components must be provided for each mode of protection (L-N, Normal Mode) (L-G, N-G Common Mode).
7. Sine Wave Tracking must be provided for each mode of protection. Products utilizing basic EMI/RFI filter performance (dB insertion loss rating) will not be considered.
8. Let-Through Voltages of product tested with the ANSI/IEEE C62.41.1TM2002, C62.41.2TM-2002, C62.45TM-2002, and C62.62TM-2010; 100 KHz Ring Wave and Combination Wave must be equal to or better than the following:

Cat A, 30 Ohm 100 kHz Ring Wave, 2 kV/67 Amp at 270-degree Phase Angle

L-N	30 volts
L-G	46 volts
N-G	45 volts

9. Enclosure: Devices shall be enclosed in an enclosure constructed of a superior temperature/fire-rated material (UL94-5VA high-range temperature material) and must be electrically non-conductive.
10. Warranty: 25 Years Unlimited Free Replacement

B. 120 Volt AC Control Circuit Protection (Surge Suppression Incorporated Model TC130DxDIN-B-21 (The "x" equals 2, 4, 6, 8, or 12 wires)) or equal:

1. Maximum Continuous Operating Voltage: 175 volts
2. Maximum Continuous Operating Current: 5 Amps
3. Peak Surge Current: 30 kA per pair
4. SPD circuitry shall be series wired, parallel connected hybrid design incorporation discrete all mode protection. SPD shall be encapsulated in a UL listed/recognized high dielectric compound.
5. Discrete and dedicated protection components must be provided for each mode of protection (Normal Mode) and Common Mode).
6. Let-Through Voltages of product tested with the IEEE C62.41.1 and C62.41.2-2002; Category C Combination Wave must be equal to or less than 150 volts.
7. Enclosure: Devices shall be enclosed in an enclosure constructed of a superior temperature/fire-rated material (UL94-5VA high-range temperature material) and must be electrically non-conductive.
8. Warranty: 25 Years Unlimited Free Replacement

C. Analog Signal/Current Loop (4-20 mA) Circuit Protection (Surge Suppression Incorporated Model CLP24AxDINS-B-21 (The "x" equals 2, 4, or 6 wires). The CLP24A6DINS-B-21 can accommodate up to three 2- wire loops) or equal:

1. Products shall be listed to UL 497B, Protectors for Data Communications Circuits and Fire Alarm Circuits, June 14, 2004.
2. Maximum Continuous Operating Voltage: 36 volts DC
3. Maximum Continuous Operating Current: 500mA

4. Series Resistance: 5 Ohms per wire (10 Ohms loop)
5. Maximum Data Rate: 2 Mbps
6. Peak Surge Current: 10 kA per mode; 20 kA total per loop.
7. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Model shall be encapsulated in a high dielectric compound.
8. Discrete and dedicated protection components must be provided for each mode of protection. (L-L, Normal Mode) (L-G, Common Mode)
9. Let-Through Voltages of product tested with the IEEE C62.45 and C62.41-2002; Cat B, 2 Ohm Impulse (Combination) Wave, 6kV/3k Amp at 90-degree Phase Angle must be equal to or better than the following:

L-L < 40 volts

L-G < 40 volts

10. Enclosure: Devices shall be enclosed in an enclosure constructed of a superior temperature/fire-rated material (UL94 5VA high-range temperature material) and must be electrically non-conductive. DIN rail mounted.
11. Warranty: 25 Years Unlimited Free Replacement

D. High Speed Data Circuit Protection (2 Mbps) Terminated on Terminal Blocks (Surge Suppression Incorporated Model DP2-XXAnDIN-B-21 21 (The "XX" equals the signal voltage of the circuit (12, 24, 48, or 140. The "n" equals the number of conductors - 4 or 8) or equal.

1. Products shall be listed to UL 497B, Protectors for Data Communications Circuits and Fire Alarm Circuits, June 14, 2004.
2. Signal/Operating Voltage: 12 to 200 Volts.
3. Data Rates: **Up to 2 Mbps**
4. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. The device shall be encapsulated in a high dielectric compound.
5. Protection Modes: Data transmission pairs shall be protected Line-toLine and Line-to-Ground.
6. Each data carrying conductor shall have no internal series resistance per wire and no internal series resistance on the shield or signal ground conductor.
7. Each pair of data conductors must have a peak surge current rating of 10 kA.
8. The device must be designed to be series connected and mounted internally to control panels for protection of equipment connected to data lines.
9. Enclosure: Devices shall be enclosed in a plastic enclosure constructed of a superior temperature/fire-rated material (UL94 5VA high-range temperature material) and must be electrically non-conductive. DIN rail mounted.
10. Warranty: 25 Years Unlimited Free Replacement

- E. **Network Cable - High Speed Data Circuit Protection (100 Mbps) with RJ45 Modular Connections** (Surge Suppression Incorporated Model D2RJ45XXC8DIN-B-21) The "XX" equals the signal voltage of the circuit (12, 24, 48, or 140) or equal.

1. Products shall be listed to UL 497B, Protectors for Data Communications Circuits and Fire Alarm Circuits, June 14, 2004.
2. SPD devices shall be rated for the class of service necessary for the application.
3. Signal/Operating Voltage: 14 to 200 Volts.
4. Data Rates: **Up to 100 Mbps**
5. SPD circuitry shall include only solid-state clamping components consisting of a multi-stage hybrid design. Device shall be bi-directional, enclosed in a UL listed/recognized encapsulated thermal stress reducing compound.
6. Protection Modes: Data transmission pairs shall be protected Line-to-Line and Line-to-Ground.
7. Each data carrying conductor shall have no internal series resistance.
8. Each pair of data conductors must have a peak surge current rating of 1,500 Watts per mode (4,500 watts total).
9. The device must be designed to be series connected and mounted internally to control panels for protection of equipment connected to data lines.
10. Enclosure: Devices shall be enclosed in a plastic enclosure constructed of a superior temperature/fire-rated material (UL94 5VA high-range temperature material) and must be electrically non-conductive. DIN rail mounted.
11. Warranty: 25 Years Unlimited Free Replacement

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Contractor and manufacturer/vendor shall fully coordinate all the manufacturer's installation requirements and recommendations with the electrical subcontractor, panel manufacturers, other vendors etc.
- B. Connect the Ground of the SPD to the grounding bar of the control cabinet using a minimum of No. 10 AWG wire. Further, the grounding bar of the cabinet shall be connected to the basic grounding system using a minimum of No. 6 AWG wire.
- C. All labor, materials, equipment, and services necessary for, and incidental to the installation of the SPDs as specified, shall be provided by the electrical contractor (installer).

The SPD installation must be inspected and certified by a factory-trained representative of the SPD manufacturer. In completing this start-up, the factory-trained inspector shall furnish the Engineer with a letter/report stating that all devices are the correct specified model numbers, in the correct locations and

designations, and installed in strict accordance with the intent of this specification and the requirements of the manufacturer. The Contractor must make the manufacturer aware of the available dates to perform this inspection and must give at least 45 days notice of the required deadline date. The cost for this service must be included in the package price of the SPD device and is to be part of the construction bid package. The inspection will include one on-site visit and inspection accompanied by the report as stated above. Subsequent visits to correct problems created by the installer and not in accordance with the intent of the requirements of this specification and the installation instructions furnished by the manufacturer as noted in the report will be the ultimate responsibility of the Contractor and will be billed on a time and travel reimbursable basis until the Engineer receives final satisfactory certification from the manufacturer of the specified system. Any additional site visits required to correct problems shall be the responsibility of the Contractor and will be at no additional cost to the Owner and no additional Contract time.

END OF SECTION 26 43 14

SECTION 26 51 00 – LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Furnish and install lighting luminaires, with necessary accessories, lamps, drivers, etc. as shown, specified, and/or scheduled.

1.2 ABBREVIATIONS:

- A. LED Light Emitting Diode
- B. PF Power Factor
- C. RLO Relative Light Output
- D. THD Total harmonic distortion

1.3 SUBMITTALS:

- A. Refer to Section 26 00 10 for submittal requirements.
- B. Shop drawing submittals for luminaires shall include the following for each Luminaire: complete construction details including all dimensions, complete Description of materials used, complete electrical data (including operating Voltage), photometric test report from an independent testing lab, complete description of finish, and manufacturer catalog cutsheet of lamp to be used.

PART 2 - PRODUCTS

2.1 LUMINAIRES:

- A. Furnish and install luminaires as shown in lighting schedule or otherwise indicated on the drawings. Manufacturer catalog numbers shown are for general descriptive purposes, intended to establish standard of quality.
- B. Locations of luminaires shown on electrical drawings are diagrammatic. Verify location of luminaires with Engineer prior to installation.
- C. Provide luminaires complete with all options, accessories required for complete installation. Coordinate fixture mounting with construction.
- D. All luminaires shall be UL listed for application.
- E. Metal luminaire housings shall be free of tool marks, dents, burrs and sharp edges. All metal parts shall be painted, galvanized, or otherwise corrosion resistant.

- F. Reflector surfaces shall be finished specular, semi-specular, diffuse or painted as indicated. Specular finish materials shall have a minimum reflectance value of 83%. Semi-specular or diffuse finish shall have reflectance of 75% and white painted finish materials shall have reflectance of 88%.
- G. Plastic lenses and shielding shall meet NFPA and local building code requirements for light transmitting plastics.

2.2 LED PRODUCTS

A. Lumen Output:

1. Minimum initial delivered lumen output of the luminaire shall be as follows for the lumens exiting the luminaire in the 0-to-360-degree zone, as measured by IESNA Standard LM-79-08 in an accredited lab. Exact testing lumen output shall be clearly noted on shop drawings.
 - a. Lumen output shall not decrease by more than 10% over the minimum operational life of 50,000 hours at rated ambient operating temperature.
2. Individual LEDs shall be connected such that a catastrophic loss one LED will not result in the loss of all LEDs within luminaire.
3. LED boards shall be suitable for field maintenance and have plug-in connectors. LED boards shall be upgradeable.
4. Light Color/Quality:
 - a. Correlated Color Temperature (CCT) range as specification, between 3000K, 3500K and 4000K correlated to chromaticity as defined by the absolute (X,Y) coordinates on the 2-D CIE chromaticity chart.
 - b. Color shift over 6,000 hours shall be <0.007 change in u' v' as demonstrated in IES LM80 report.
 - c. LED boards to be tested for color consistency and shall be within a space of 2.5 MacAdam ellipses on the CIE chromaticity chart.

B. LED Power Supply and Drive

1. Driver:
 - a. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.

- b. Drive shall be UL Recognized under component program and shall be modular for simple replacement. Drivers not meeting these requirements will not be accepted.
- c. Electrical characteristics: 120-277 volt, UL Listed, CSA Certified, Sound Rated A+. Driver shall be $\geq 80\%$ efficient at full load across all input voltages. Input wires shall be 18AWG solid copper minimum.

C. Electrical

- 1. Operation Voltage – Luminaire shall operate from a 60 Hz $\pm$ 3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage of ($\pm 10\%$) shall have no visible effect on luminous output.
- 2. Power Factor: Luminaire shall have a power factor of 90% or greater at all standard operating voltages and full lumen output.
- 3. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference and withstand up to a 1,000-volt surge without impairment of performance as defined by ANSI C62.41 Category A.

D. Photometric Requirements

- 1. Luminaire performance shall be tested and performance shall be judged against specified minimum illuminance in specified pattern for particular application.
- 2. Luminaire lighting performance shall be adjusted (depreciated) for the minimum life expectancy.

E. Thermal Management

- 1. Thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life (Section 2.2.7 (c)).

F. Optics

- 1. Optics shall consist of high performance advanced optical film, diffuser, and metal reflector.
- 2. Optics shall eliminate source image.

G. Luminaire Identification

- 1. Each luminaire shall have manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside each unit and the outside of each packaging box.

H. WARRANTY

1. Manufacturer shall provide a single source, 5 year limited warranty against loss of performance and defects in materials and workmanship for all components of luminaire. Warranty is from time of acceptance of the luminaires. All warranty documentation shall be provided to customer prior to shipment.

2.3 EMERGENCY LIGHTING:

- A. Provide egress luminaires with self-contained battery power supplies as indicated. All equipment shall conform to UL924-Emergency Lighting and Power Equipment.
- B. Battery shall be sealed, maintenance-free nickel-cadmium (outdoors or unconditioned spaces) with 10-year nominal life. Unit shall incorporate a fullyautomatic solid state charger and automatic transformer relay to transformer to backup battery power supply upon failure of normal power.
- C. Emergency supply shall be self-contained battery-inverter units mounted within the luminaire housing. In emergency operation, lamps shall operate continuously for a minimum of 90 minutes. Once normal power is restored, the unit shall automatically transfer to charging mode.
- D. Emergency lighting equipment shall be equipped with means to test operation with LED indicating battery status.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support luminaires from building structure, independent of ceiling membrane or finish material. Luminaire shall be set level, plumb, and square with ceilings and walls.
- B. Install luminaires free and clear of structural and mechanical interferences above ceiling. If location indicated on the drawing conflicts with other elements, notify the Engineer for directions for remedial action.
- C. Attach surface and pendant mounted luminaires to 3/16" fixture stud in outlet box. Luminaires in excess of 20 pounds shall have supplemental support anchored to the structure above the ceiling.
- D. Wall mounted luminaires shall be anchored to wall structure. Luminaire shall fully conceal the outlet box.
- E. Provide equipment, labor and materials, as needed for final aiming of adjustable luminaires. Aiming shall take place immediately before final occupancy.

END OF SECTION 26 51 00

EQUIPMENT SPECIFICATIONS

EQUIPMENT SPECIFICATION FOR ALL EQUIPMENT

SECTION E-1

1.0 GENERAL

The requirements in this “ALL EQUIPMENT” Specification apply to all equipment provided for this project. Where more stringent requirements for a piece of equipment are contained in the Contract, the more stringent requirements shall apply. **The requirements in this “ALL EQUIPMENT” specification apply to all equipment and all specifications for all equipment** and this “ALL EQUIPMENT” Specification shall be considered to be an integral part of all other equipment specifications.

The requirements in this “ALL EQUIPMENT” Specification also applies to all Electrical equipment and all SCADA equipment provided for the project. The requirements in this “ALL EQUIPMENT” specification shall be considered an integral part of all Electrical and all SCADA specifications.

The Contractor shall provide all labor, material, equipment, and incidentals, etc. to furnish, install, and place into proper operating condition all the equipment and appurtenances as shown on the Drawings or described in the Specifications. The equipment manufacturer shall completely design and furnish a coordinated and completely engineered system to meet all the conditions required by the project.

The General Specifications contain extensive, detailed submittals, shop drawing, and O&M Manual submittal requirements. The Contractor shall require all equipment manufacturers and suppliers to understand and fully comply with all shop drawing, submittal, and O & M Manual requirements in the General Specifications. The Contractor shall carefully review and comply with all Submittal and Shop Drawing requirements, including O & M Manual requirements, as per the General Specifications. **All exceptions to the project requirements must be listed on the “EXCEPTIONS” sheet included with the submittal.**

In order to assure standardization, uniform quality, ease of maintenance, and minimal parts storage, all equipment called for under individual equipment specifications shall be supplied by a single manufacturer who, through the Contractor, shall be fully responsible for its design, coordination, and performance.

No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of equipment for the same purposes as used on the project. The manufacturer shall have installed and had in satisfactory use for a period of not less than five (5) years a minimum of ten (10) installations of similar size as shown in plans for this project comparable to the units specified. No consideration will be given to an individually sized equipment that has not been commercially available for five (5) years.

The equipment assemblies shall include all necessary equipment and appurtenances. Standard manufactured equipment shall be modified if necessary to meet all requirements of the plans and specifications. The equipment is designed around the first manufacturer listed on the List of Material Suppliers and Equipment Manufacturers, where applicable. If changes in the project are necessary due to the use of equipment of a different manufacturer, the Contractor shall submit such changes to the Engineer. The Contractor shall

bear all costs associated with such changes. The listing of a manufacturer, whether in the plans, specifications, bid documents, or anywhere else in the Contract Documents, in no way relieves that manufacturer from meeting all the requirements of the plans and specifications. Note that the equipment specified herein may be non-standard or non-typical.

All equipment shall be designed and manufactured for reliable and trouble-free performance. All equipment shall provide dependable and trouble-free operation.

The Drawings and Specifications illustrate and specify functional and general construction requirements of the equipment and do not necessarily show or specify all components, wiring, piping, or accessories, etc. required to make a completely integrated system. The drawings do not show all details of all equipment or installation requirements. The Contractor shall provide all components, piping, wiring, mounting devices, supports, accessories and labor, etc., required for a complete, workable and integrated system. The Contractor shall coordinate these with the actual equipment manufacturer who provides the equipment and shall install all components in accordance with the manufacturer's requirements except where the requirements of the contract drawings or specifications are more stringent, in which case they shall be followed.

All equipment (including, but not limited to, motors, drive equipment and components, electrical components, controls, and control panels) shall be designed for and have a long trouble-free life and perform reliably and properly in the environment in which it will be installed. Where equipment or control panels are installed outdoors, it will be subject to ambient temperatures from minus 10 to plus 110 degrees, direct sunlight, blowing rain, nearly continuous high relative humidity, periodic icing, corrosive atmospheres and splashing typically associated with sewage. Equipment may be operated intermittently, continuously, or in a standby mode.

All equipment, etc., shall be manufactured to fit within the space allocated on the drawings. No additional space shall be available or provided. This also includes control panels, electrical appurtenances, and piping, etc. Provide special designs if needed to fit in available space. Coordinate with available space.

The equipment shall be powered by the electrical sources shown in the electrical drawings for the project.

All electrical panels, boxes, conduits, unistrut, hardware, components, and appurtenances, attachments, etc., shall be stainless steel or aluminum and shall be corrosion resistant. Coated steel components are permitted only where noted.

All pipe hangers, unistrut, hardware, components, and appurtenances, attachments, etc., shall be stainless steel or aluminum and shall be corrosion resistant. Provide non-metallic components where called for in the drawings.

Orient all flowmeters, pressure gauges, light, and other instrumentation, etc. such that it is promptly and easily visible and readable.

When PLCs are included in a submittal, provided and whenever else requested, submit descriptions of the control methodology that will be employed. This shall include a description of operation, interlocks, and other features to fully understand the functioning and control of the system. Manufacturer-provided panels shall meet all requirements of Control Panel Specifications (in other specifications sections). Such panels shall have a main, pad-lockable circuit breaker. Prior to making the first submittal, all panels shall be completely and thoroughly coordinated with all other project equipment, controls, and SCADA system, etc. The submittal may be rejected without review if it appears that careful and comprehensive coordination was not performed by the Contractor or Manufacturer, etc.

All equipment shall be designed solely by the Manufacturer with all safety features and guards, etc., as required to meet all standards of OSHA and all applicable codes, etc. The Manufacturer shall design all equipment to allow for safe and convenient operation and maintenance, etc. The manufacturer shall design and provide all safety features and guards, etc., as desirable or recommended for the safety and protection of operators, maintenance personnel, and others.

All panels shall be designed by the Panel Manufacturer to meet the requirements of the project and of the installation. If control drawings are included in the plans, the manufacturer shall consider those as conceptual drawings showing only minimum requirements. The detailed design is the responsibility solely of the panel manufacturer who shall include additional features as desirable for trouble-free, reliable operation. Include appropriate surge protection. Where located outdoors or in non-conditioned space, panels shall be furnished with condensation heaters. NEMA 4 or 4X panels shall be furnished with 3-point latches. Clips or similar closure devices shall not be permitted.

Miscellaneous hardware, nuts, bolts, etc., shall be stainless steel when the equipment will be located outdoors, or in non-conditioned space, or in humid areas.

All control panels shall be fully tested prior to shipment from the manufacturer. Written certification shall be provided to the Engineer certifying that the testing demonstrated that all contract requirements were complied with. Mechanical equipment shall be tested prior to shipment to the extent practical or required.

Spare parts shall be boxed separately from the regular items. A separate packing list clearly labeled "SPARE PARTS" is required for inventory purposes. Package each part individually or in sets in moisture proof containers or wrappings, clearly labeled with part name, manufacturer's parts/stock number, and the equipment it is provided for.

Provide all the spare parts recommended by the manufacturer for the number of units and equipment installed. Provide any special tools required to install, operate, or maintain the equipment. All spare parts shall be delivered to the Owner, in the presence of the Engineer, at the end of construction and in one occurrence (i.e. one transfer for all spare parts). The Contractor shall prepare a detailed list of all the spare parts for the project, and the Owner shall sign for the spare parts received.

The Contractor shall inspect all equipment and materials against reviewed shop drawings at the time of delivery. Equipment and materials damaged or not meeting the requirements of the reviewed shop drawings shall be immediately returned for replacement or repair.

All equipment and its components shall be properly stored in a manner that will protect the equipment and ensure long life. As a minimum, all equipment shall be stored in accordance with the equipment manufacturer's recommendations, unless more stringent requirements are contained in the plans or specifications. All equipment shall be properly stored and maintained during storage. All storage requirements also apply to equipment that has been installed but is not in full-time normal operations.

The Contractor shall thoroughly coordinate all dimensions for equipment with other shop drawings and with the plans and submit to the Engineer any required changes in concrete or piping dimensions, etc., that may be needed to allow the equipment to fit, to perform properly, and to be maintained or replaced. Concrete and appurtenances shall be placed by the Contractor well within the manufacturer's required construction tolerances. Templates provided

by the manufacturer shall be utilized to set embedded anchor bolts.

Comply with all painting requirements as contained in the "Standard Specifications for Painting". Refer to and understand all the "Standard Specifications for Painting" for the project. Provide the primer specified in the "Standard Specifications for Painting". Finish field preparation and painting shall be performed as specified in the Painting Section. The Contractor shall touch-up all shipping damage to the paint as soon as the equipment arrives on the job site. The equipment should be totally re-coated if needed for a uniform and pleasing appearance.

All equipment, etc., shall be manufactured to fit within the space allocated on the drawings. No additional space shall be available or provided.

Refer to and comply with all other sections of the specifications including but not limited to electrical, controls, control panels, instrumentation, and motors, etc.

Fully coordinate all equipment requirements, controls, and connections, etc. in a timely manner. Coordinate supports and piping, etc.

Provide all miscellaneous accessories, brackets, supports, instrumentation, appurtenances, and adaptors, etc. that are required for the specific installation on this project. If the equipment manufacturer recommends that the water pressure of connecting water lines be limited, he shall provide a water pressure regulator.

Where initial maintenance (oil changes, tightening belts or chains, etc.) are recommended to be performed at 6 months or less after startup, such maintenance shall be performed by the Contractor utilizing factory authorized personnel.

All anchor bolts shall be stainless steel and shall be provided by the equipment manufacturer who shall select the bolts based on the maximum possible loading for the equipment.

For all electrical, control, or instrumentation panels, the colors of indicator lamps shall be consistent throughout the project and plant. Swap or replace lamps and LEDs at startup as needed for consistency.

Prior to assembly, all stainless-steel bolts and nut threads shall be coated with a non-seizing compound by the Contractor.

The Contractor shall install all project components and all equipment in strict accordance with manufacturer recommendations. The Contractor shall carefully follow all manufacturer safety recommendations and shall continuously utilize effective safety practices.

The Contractor shall install all project components and all equipment in strict accordance with manufacturer recommendations. The Contractor shall carefully follow all manufacturer safety recommendations and shall continuously utilize effective safety practices.

The manufacturer shall include in his price and schedule trips to the project site as needed for equipment installation, start-up assistance, inspection of installed equipment for proper operation as noted below, and operator training, etc. The manufacturer's representative shall be from the factory and shall have a minimum of 10 years of meaningful and acceptable experience starting up such equipment. The representative shall be well qualified to perform the startup and training. The Contractor shall submit the representative's qualifications for review and approval prior to scheduling the visit.

After the Contractor has installed the equipment and it is capable of being operated, the equipment manufacturer shall furnish a qualified representative meeting above stated requirements to inspect the equipment and to supervise field testing and start-up.

Install equipment and accessories in accordance with the drawings, approved shop drawings, and the manufacturer's installation instructions and recommendations. All final electrical connections shall be made by the electrical sub-contractor. The Contractor shall make adjustments including but not limited to level, plumbness, and alignment, provide lubricants, lubricate all equipment, and adjust all controls, equipment, and appurtenances in accordance with the manufacturer's instructions and leave equipment in proper working condition. He shall carefully test all safety equipment and ensure it operates as recommended. Where required for proper installation, the Contractor shall install non-rusting, non-shrink grout. The Contractor shall verify that the electrical power available is proper and that motor rotation is correct. Unless otherwise allowed, new or rebuilt equipment shall be started up on a Monday, Tuesday, or Wednesday to allow some time for malfunction to occur prior to the weekend. Where desirable for the project, new or rebuilt equipment shall be started up in the morning. The Contractor shall demonstrate all features of the equipment and its controls and demonstrate that the equipment operates properly under all types of conditions including but not limited to high speed and low speed, etc. Where units are furnished with more than one pulley combination for speed changes, the Contractor shall demonstrate that the equipment operates properly at all speeds provided. The Contractor shall coordinate with the Engineer to determine which set of pulleys should be left on the equipment at the conclusion of testing and demonstration. The testing shall also include safety features, operation from local and remote-control stations, and local and remote alarm simulation.

The Contractor shall conduct testing to demonstrate to the Owner's satisfaction that the equipment performs as required. Performance and/or installation testing shall be repeated at no cost to the Owner if requested by the Owner after experiencing problems with the equipment or after repairs or after any indication that the testing may potentially not be representative.

After testing, the Contractor, in conjunction with the manufacturer's representative, shall make whatever adjustments are required for the anticipated operating conditions.

The Manufacturer's representative shall sign a Certificate of Compliance on a form provided by the Engineer stating that he has thoroughly reviewed the equipment and its installation and it meets the requirements of the Manufacturer. All written certifications shall be delivered to Engineer before startup item is paid. All certifications shall be delivered concurrently with the performance of the work being certified and again at project completion in one single three-ring binder with a Table of Contents listing each certification contained in the binder.

A qualified and experienced technical representative of the manufacture shall provide operator training for Owner's personnel after system is operational. He shall be from the factory and shall have a minimum of 10 years' experience with the equipment. If time and conditions permit, training may take place while manufacturer's representative is at the job site for inspection. All training shall occur at a time that is convenient for the Owner, operators, and Engineer. Training may be videotaped or otherwise recorded by the Owner, operator, or Engineer if they wish even if prior approval or arrangements have not be made. For operating facilities, it may be necessary to conduct the training in two separate independent sessions so that

all operators can attend. If training is conducted before equipment fully and properly operational, it may be necessary to repeat the training after the equipment is fully and properly operational.

No warranty period shall begin prior to the final acceptance by the Owner.

All equipment shall be warranted by the manufacturer for a period of one (1) year from the date of final acceptance by the Owner. Longer warranty periods are required where noted in individual equipment specifications. Warranties shall be non-prorated. Manufacturer warranties shall in no way relieve the Contractor of his warranty requirements established by the Contract Documents.

EQUIPMENT SPECIFICATION FOR MAGNETIC FLOW METERS

SECTION E-2

PART 1 - GENERAL

1.1 SCOPE

This section describes the requirements for an electromagnetic flow meter and microprocessor-based signal transmitter. Under this item, the contractor shall furnish and install the mag meter equipment and accessories as indicated on the plans and as herein specified.

The “ALL EQUIPMENT” specification – Section 1 of the Equipment Specifications- shall fully apply to the equipment in this specification section and to all equipment provided on this project. Refer to the “ALL EQUIPMENT” specification for additional requirements not contained in this specific equipment specification.

1.1 SUBMITTALS

The following information shall be included in the submittal for this section:

1. Data sheets and catalog literature for the magmeter and the microprocessor-based signal transmitter.
2. Connection diagrams for equipment wiring.
3. List of spare parts and optional equipment.

PART 2 - PRODUCTS

2.1 ELECTROMAGNETIC FLOWMETER (MAG METER)

The electromagnetic flow meter shall consist of a flow sensor based on Faraday’s Law of Electromagnetic Induction and microprocessor-based signal transmitter.

A. Sensor:

1. Operating principle: Utilizing Faraday’s Law of Electromagnetic Induction, the flow of liquid through the sensor induces an electrical voltage that is proportional to the velocity of the flow.
2. Construction:
 - a. The sensor flow tube shall be NEMA 6P rated.
 - b. Flow tube shall be constructed of 304 Stainless Steel.
 - c. The liner material shall be Ultra Liner NSF approved fusion bonded epoxy. The liner shall carry a lifetime guarantee.
 - d. Measurement and grounding electrodes shall be 316 Stainless Steel.
 - e. Connecting flanges shall be ANSI 150# Flat Face Carbon Steel.
3. ANSI Flanges shall be provided.

4. Two Stainless Steel grounding rings shall be supplied with each flow meter.
 5. Installation:
 - a. The flow meter shall only require a minimum of 0 pipe diameters up stream and 0 pipe diameter downstream for sizes 1.5"– 3" to achieve the required performance specified herein.
 - b. The flow meter shall only require a minimum of 1 pipe diameters up stream and 0 pipe diameters downstream for sizes 4"– 48" to achieve the required performance specified herein.
 6. Flow tube Operating Temp: +14 to +140° F.
 7. Submergence: The sensor shall be capable of continual submergence at up to 6 ft. with standard strain relief cable or up to 30 ft. with optional quick connect cabling system.
- B. Transmitter:
1. Electronic Enclosure: Shall be a NEMA 4X, IP67 rated enclosure.
 2. Transmitter/display: Background illumination with alphanumeric 8-line graphical backlit LCD display with 6-key touch programming to indicate flow rate, direction of flow, totalized values, settings, and faults as a minimum.
 3. Power Supply: Power supplies must be modular and able to be changed in the field.
 - a. 90-265 VAC
 - b. 10-35 VDC
 4. Operating temperature: -4 to +140 degrees F.
 5. Outputs:
 - a. Single, 4-20mA (active or passive)
 - b. Two separate digital programmable outputs:
 - 1) Open collector transistor usable for pulse
 - 2) Frequency and alarm settings
 6. Communications - Optional: Communications Protocols must be modular and able to be changed in the field.
 - a. HART or secondary 4-20mA (active or passive)
 - b. Modbus
 - c. Ethernet IP
 - d. AMI Smart Output (Sensus, Itron 6, Itron 9)
 7. Transmitter Self Diagnostics – Data logger and Alarm information
 8. Sensor and signal transmitter performance:
 - a. Flow Range: 0.2 FPS to 32 FPS for accuracies stated below.
 - b. Accuracy:
 - 1) AC or DC Power: Plus, or minus 0.2% of actual flow.
 - c. Cable Length: Remote Mount
 - 1) AC or DC Power: Up to 500'/152.4m

- d. Manufacturer shall offer optional Quick Connect cabling for remote mounted installations.
 - e. Repeatability: $\pm 0.05\%$ or $\pm 0.0008 \text{ ft/s}$ ($\pm 0.25 \text{ mm/s}$), whichever is greater
 - f. Conductivity: Minimum $5 \mu\text{S/cm}$
 - g. Bi-directional flow capabilities shall be standard.
 - h. Power & Signal Cabling: The power and signal between the transmitter and sensor shall be isolated within single cable.
 - i. Flow Direction Measurement: Forward and reverse flow indication and forward, reverse, net totalization shall be standard on all meters.
9. The electromagnetic flow meter shall be McCrometer/Hach's Ultra Mag 5000 or approved equal.

2.2 SPARE PARTS

A. Spare parts for the equipment shall include the following, unless otherwise noted:

- 1. Three extra operation manuals shall be provided.

2.3 OPERATOR FUNCTIONS

A. Calibration

- 1. Each flow sensor shall have a 3 or 5- point wet flow calibration of the complete meter flow tube and its signal transmitter. The calibration facilities must be traceable to the National Institute of Standards and Technology (N.I.S.T). All the calibration information and factory settings matching the sensor shall be stored in an integrally mounted memory unit. The memory unit shall store sensor calibration data and signal transmitter settings for the lifetime of the product. At initial commissioning, the flow meter shall commence measurement without any initial programming. Any customer specified settings shall be downloaded to the memory unit. Should the signal transmitter need to be replaced, the new signal transmitter shall upload all previous settings and resume measurement without any need for reprogramming or rewiring.
- 2. Manufacturer shall provide a calibrated meter set which includes the sensor tube, the cabling and the transmitter.
- 3. An N.I.S.T. certificate of calibration shall accompany each flow sensor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Follow manufacturer's recommendation for the minimum upstream and downstream installation requirements for the flow sensor.
- B. Wiring between flow sensors and remote mounted signal transmitters shall use cable type and procedures as per the manufacturers' recommendations.

3.2 MANUFACTURER'S ASSISTANCE

A. Warranty

1. The manufacturer of the electromagnetic flow meter shall provide a two-year warranty that the equipment shall be free from defects in design, workmanship, or materials. Extended warranties up to five years shall be available for additional cost.
2. The manufacturer of the electromagnetic flow meter shall provide a Lifetime Guarantee on the flow tubes Ultra Liner fusion bonded epoxy liner.
3. In the event a component fails to perform as specified or is proven defective in service during the guarantee period, the manufacturer shall promptly repair or replace the defective part at no cost to the owner.

**EQUIPMENT SPECIFICATION
FOR
CONTROL/DISPLAY PANELS &
SCADA SYSTEM MODIFICATIONS/ADDITIONS**

SECTION E-3

1.0 GENERAL

This specification covers three Control Valve Relay Panels, one Meter Display Panel, one SCADA RTU/PLC panel, modifications/additions to the Owner's existing global VT SCADA system, and all associated interconnections, cabling, terminations, programming, global graphics generation, sub-graphics (pop-ups), sub-routines, power supplies, communications, warnings/alarms as required by the Engineer and Owner, calibrations, antennas, cellular equipment, routers, gateways, switches, miscellaneous appurtenances, start-up, field supervision, etc. as required to fully and accurately control/monitor the North-South Connector (NSC) Control Valve Station (locally and remotely) and fully integrate the station into Shelby County Water's existing global VT SCADA system.

The "ALL EQUIPMENT" specification – Section 1 of the Equipment Specifications- shall fully apply to the equipment in this specification section and to all equipment provided on this project. Refer to the "ALL EQUIPMENT" specification for additional requirements not contained in this specific equipment specification.

All panels and work shall be in accordance with the Project's Electrical Specifications, and specifically the "Manufactured Control Panels" Specification included in the Project's Electrical Specifications. Only NEMA-rated components shall be used. The manufacturer shall furnish detailed shop drawings in accordance with the General Specifications. Surge suppression shall be provided at all inputs, outputs, and power supply to the panel. Surge suppression shall be in accordance with the electrical specifications and as recommended and specified by the panel manufacturer.

The panel manufacturer shall perform a Factory Acceptance Test (FAT) that fully demonstrates the capabilities and performance of each panel meeting the requirements of these Specifications and any control schematics provided in the Contract Drawings. Documentation of this test and any corrective actions required/made since the submittal review process was completed shall be provided to the Engineer prior to shipping each panel. The Engineer is in no way obligated to review this post submittal process documentation. The date of the FAT shall be coordinated with the Engineer, and the Engineer shall be invited to attend.

Shelby County Water Service's global VT SCADA system shall be modified/expanded to include control and monitoring of the North South Connector (NSC) Control Valve Station and the Southern Transmission Line (STL) Control Valve

Station. The construction of the STL Control Valve Station is a separate project; however, the Owner's global VT SCADA system shall be modified (as part of this NSC Control Valve project) as required to include provisions for this station which will have SCADA requirements similar to the NSC Control Valve Station discussed herein.

New SCADA system components (RTU with PLC, Battery Back-up, Communications, etc.) shall be installed at the NSC Control Valve Station as required to allow the station to be controlled and monitored by Shelby County's global/master VT SCADA system. The RTU shall have a large HMI (15" min.) with intuitive touch screen selections and graphics. The RTU HMI home screen shall display the complete control valve station piping arrangement in detail, graphically depict the current settings/selections for the station, and graphically depict the water pathways through the station based on inputs received from the control valve relay panels and inputs/settings selected by the operator at the RTU via the RTU HMI. This work shall also include any SCADA software and component updates/modifications required at the South Water Treatment Plant (including updated computer graphics to reflect the addition of the new stations) to allow for control and monitoring of both control valve stations.

The NSC Control Valve Station will have three control valves, and each control valve will have its own dedicated control/relay panel. Each control valve relay panel will directly control the opening/closing of its respective control valve by energizing/de-energizing solenoid valves located in the pilot piping on the valve. The control valve relay panels will also transmit the position of the valve to the SCADA system. The SCADA system shall be able to monitor the position of each valve and control the valves by sending open/close/hold commands to each control valve relay panels which, in turn, will energize/de-energize the appropriate solenoid valves on the control valves. Conceptual control schematics for the control valve relay panels are provided in the Contract Drawings. The NSC Control Valve Station shall also include a Meter Display Panel that includes five Redlion analog panel meters as shown in the Contract Drawings. The SCADA system shall power this panel and monitor all data available from the Meter Display Panel.

The SCADA RTU/PLC Panel shall include a building thermostat (provided by the RTU provider) for monitoring the temperature inside the NSC control valve station, transmitting the temperature reading to SCADA, and issuing an alarm to SCADA whenever the temperature has reached an operator-adjustable low setpoint (initially set at 38 deg F). See the Project Plans for control/monitoring signals associated with the NSC Control Valve Station. Included herein are descriptions for the required operational scenarios/schemes associated with the three control valves (two 16" control valves and one 12" control valve) at the NSC Control Valve Station.

Due to the inherent complexity of these specialized panels and the required SCADA system modifications/additions that must be seamlessly integrated into the Owner's existing global SCADA system, the panels and work covered by this specification shall be as manufactured and provided by the Electric Machine Control, Inc. (EMC) or pre-approved equal.

2.0

ALL CONTROL VALVE RELAY PANELS (THREE TOTAL)

There will be three water control valves, two 16" valves (CV#1 and CV#2) and one 12" valve (CV#3), installed in the NS Connector Control Valve Station. CV#1 is primarily intended to feed Tank T1A (the Hwy 280 corridor). CV#2 is primarily intended to feed Tank T1A but can also be used as a back-up to feed the Chelsea Park Tank. CV#1 and CV#2 are associated with Flowmeter #1. CV#3 is primarily intended to feed the Chelsea Park Tank but can also be used as a back-up to feed Tank T1A. CV#3 is associated with Flowmeter #2.

Each control valve located at the control valve station will have its own relay panel that shall have a primary two-position selector switch (HAND – or – SCADA RTU). When this switch is in the HAND position, the valve shall be controlled by operating the pushbuttons on the relay panel door only – the local SCADA RTU shall have no control over the valve; however, the SCADA RTU shall monitor the position of the valve at all times. When this switch is in the SCADA RTU position, the local SCADA RTU/PLC shall be in control of the valve. Once the switch is placed in the SCADA RTU position, the SCADA RTU will receive an input that it has control of the valve, and the SCADA RTU shall, in return, close a contact that energizes a light on the respective control valve relay panel. The light shall initially flash for an adjustable time period to prompt the operator to make a mode selection at the SCADA RTU. The local SCADA RTU/PLC shall have an HMI which shall allow the operator to select whether the RTU shall receive signals from the PLANT (i.e., PLANT mode) to control the valve or if the valve is to be controlled locally by the local RTU/PLC using a LOCAL FLOW CONTROL SETPOINT (i.e., LOCAL FLOW CONTROL SETPOINT mode) entered into the local RTU HMI by the operator. The default selection shall be PLANT mode and if the operator does not select a mode on the HMI, the active mode shall remain PLANT mode and the flashing light at the control valve panel shall stop flashing after an adjustable time period but still illuminate. If the operator does make a mode selection at the RTU HMI, the flashing/continuous light on the control valve panel shall stop illuminating altogether. If PLANT mode is selected at the RTU HMI, control of the valve shall be from the Shelby County South PLANT.

If a control valve's relay panel is set to SCADA RTU mode, then a "Freeze Protection Mode" shall be a feature for that valve that can be enabled or disabled either from the RTU HMI or via SCADA. The "Freeze Protection Mode" logic shall reside in the local RTU. The "Freeze Protection Mode" shall have the following adjustable parameters as a minimum:

- 1) temperature set-point to activate freeze protection cycle
- 2) cycle time for freeze protection in minutes
- 3) % movement of valve both directions (opening and closing) to be achieved during a freeze protection cycle

Once the freeze protection mode has been activated due to the ambient temperature inside the building (as monitored by the RTU's thermostat) dropping below the temperature setpoint, then the local SCADA RTU shall cause that valve to open by the % movement and then immediately close by the % movement such that the valve returns to its original position (i.e., its position prior to the initiation of the freeze protection cycle). This order of operation shall reverse if the current position of the valve will not allow it to open by the % movement required. This freeze protection cycle will cause water to circulate through the pilot piping to prevent freezing. This freeze protection cycle shall repeat based on the freeze protection cycle timer. When the valve is not in a freeze protection cycle, the valve shall function normally as described herein based on the operational mode it is in. There shall be a flashing amber light on the local RTU HMI whenever the freeze protection mode has been activated, and a warning/alarm shall be issued to SCADA. When the building temperature rises back above the low temperature setpoint, the freeze protection mode shall be terminated.

2.1 TWO 16" CONTROL VALVE RELAY PANELS (CV#1 AND CV#2):

If the control relay panels for both 16" control valves (CV#1 and CV#2) have their local primary two-position selector switches set to the SCADA RTU position, then the local RTU HMI shall default to PLANT mode for both of the 16" valves, but the operator shall be able to change the mode of operation via the local RTU HMI. If the operator changes the mode of operation at the local RTU HMI to LOCAL FLOW CONTROL SETPOINT, then both 16" valves must use this mode as described below (i.e., the RTU shall not allow one 16" valve to be in PLANT mode and the other 16" valve be in LOCAL FLOW CONTROL SETPOINT mode). However, it shall be acceptable for one 16" control valve relay panel to be in HAND mode and the other 16" control valve relay panel to be in SCADA RTU mode without any limitations on the valve that is in SCADA RTU mode. If only one 16" control valve relay panel has its primary two-position selector switch set to SCADA RTU position, then the local RTU HMI shall default to PLANT mode for this 16" valve, but the operator shall be able to change the mode of operation for this 16" valve at the local RTU HMI to LOCAL FLOW CONTROL SETPOINT mode. The local RTU shall always transmit/communicate all operational parameters and settings monitored by the local RTU to the PLANT via SCADA.

LOCAL FLOW CONTROL SETPOINT MODE:

If both 16" control valve relay panels have been set to SCADA RTU mode (via their primary two-position selector switches) and then the LOCAL FLOW CONTROL SETPOINT MODE has been selected at the local RTU HMI, both control valves shall operate in a LEAD-LAG format to maintain the flowrate through the station at the LOCAL FLOW CONTROL SETPOINT (with a user-defined operational deadband). The operator shall also be able to select whether a specific control valve shall always be LEAD or if the control valves are to ALTERNATE. If valve ALTERNATION is selected, then there shall be a user-defined input for the Valve Alternation Cycle in hours. If both valves ever fully

close, then this shall also initiate valve alternation. During the alternation process, each valve shall simultaneously assume the position that the other valve was at when the alternation process initiated. There shall also be an operator input for the flow control setpoint in GALLONS PER MINUTE.

Once these inputs have been established, the local RTU shall monitor the station's Flowmeter #1 reading (this flowmeter measures the flowrate associated with the 16" flow control valves which feeds Tank T1A (i.e., the Hwy 280 Corridor) and operate the valves in a LEAD-LAG format to achieve and maintain the LOCAL FLOW CONTROL SETPOINT using a PID control loop. If the LEAD valve reaches 100% open and cannot achieve the LOCAL FLOW CONTROL SETPOINT, then the LAG valve shall be automatically opened and adjusted to supplement the flow as required to achieve and maintain the LOCAL FLOW CONTROL SETPOINT. The RTU shall not open the LAG valve unless the LEAD valve is 100% open. In addition, when the station's Flowmeter #1 reading exceeds the LOCAL FLOW CONTROL SETPOINT, the LEAD valve shall not begin closing/modulating unless the LAG valve has already been fully closed and was unable to reduce the station's flowrate to the LOCAL FLOW CONTROL SETPOINT. In other words, the flowrate PID control loop shall only modulate the position of one valve at a time in order to achieve and maintain the LOCAL FLOW CONTROL SETPOINT. If both valves are open (meaning the LEAD valve must be 100% open), then the LEAD valve remains at 100% open while the LAG valve is modulated to achieve the LOCAL FLOW CONTROL SETPOINT. If the LAG valve ever reaches 100% open (meaning both valves should be at 100% open) and remains at 100% open for a user defined timeframe setpoint and the flowrate through the station is still below the LOCAL FLOW CONTROL SETPOINT, the local RTU shall issue an alarm locally and to the PLANT via SCADA indicating that the LOCAL FLOW CONTROL SETPOINT cannot be achieved.

If only one control valve relay panel has been set to the SCADA RTU mode (via its primary two-position selector switch), and then the LOCAL FLOW CONTROL SETPOINT MODE has been selected at the local RTU HMI for that valve, then the local RTU shall monitor the station's Flowmeter #1 reading and operate this valve to achieve and maintain the LOCAL FLOW CONTROL SETPOINT. If the valve reaches 100% open and remains at 100% open for a user-defined timeframe setpoint and the flowrate through the station is still below the LOCAL FLOW CONTROL SETPOINT, the local RTU shall issue an alarm locally and to the PLANT via SCADA indicating that the LOCAL FLOW CONTROL SETPOINT cannot be achieved.

The flowrate PID control loop logic shall reside in the local RTU/PLC and therefore shall not require SCADA communications to operate correctly. The Owner shall be provided with two copies of the programming logic on two thumb drives.

PLANT MODE:

If both local control valve relay panels have been set to SCADA RTU mode (via their primary two-position selector switches), then the local RTU HMI shall automatically default to PLANT mode for both valves as discussed previously (although the operator should still select PLANT mode on the RTU HMI to confirm that this is the mode he wants since the flashing light on the control valve panel will be prompting him to do so). If only one control valve relay panel has been set to SCADA RTU mode (via its primary two-position selector switch), then the local RTU HMI shall default to PLANT mode for this particular valve (although the operator should still select PLANT mode on the RTU HMI to confirm that this is the mode he wants since the flashing light on the control valve panel will be prompting him to do so).

When in PLANT mode, the Shelby County South Plant shall be able to control the valve in either a POSITION SETPOINT mode or FLOW CONTROL SETPOINT mode. In POSITION SETPOINT mode, the Shelby County South Plant shall be able to set the position of the valve(s) from 0% to 100% open. In FLOW CONTROL SETPOINT mode, the Shelby County South Plant shall be able to dictate automatic operation of the valve(s) using a FLOW CONTROL SETPOINT. This FLOW CONTROL SETPOINT mode of operation shall have the identical user-defined parameters/setpoints as discussed above for the LOCAL FLOW CONTROL SETPOINT mode of operation (e.g., FLOW CONTROL SETPOINT, LEAD-LAG operation, ALTERNATION, etc.); however, the user-defined parameters/setpoints shall be inputted by the plant operators from the PLANT SCADA computer(s) instead of locally at the control valve station RTU HMI. If both valves are in PLANT mode, normal operation would be for the plant operators to operate both valves in the same mode (i.e., both in POSITION SETPOINT mode or both in FLOW CONTROL SETPOINT mode). However, the plant operator shall also be able to operate one valve in POSITION SETPOINT mode and the other valve in FLOW CONTROL SETPOINT mode. If both valves are in FLOW CONTROL SETPOINT mode, they shall operate in a LEAD-LAG format, and the LAG valve shall not be open unless the LEAD valve is at 100% open. Similar to the discussion above for the LOCAL FLOW CONTROL SETPOINT mode, the flowrate PID control loop shall only modulate the position of one valve at a time in order to achieve and maintain the FLOW CONTROL SETPOINT. The flowrate PID control loop logic for controlling the valves in FLOW CONTROL SETPOINT mode shall reside in the local RTU/PLC located at the control valve station such that the local RTU is monitoring the station's Flowmeter #1 and controlling the position of the valve(s) based on the parameters established remotely by the PLANT operators. If SCADA communications are lost between the control valve station and the PLANT, the local RTU/PLC at the control valve station shall retain the settings that existed at the time SCADA communications were lost and continue to operate the valve(s) as intended.

If, while in PLANT mode, an operator at the control valve station changes the operational mode to LOCAL FLOW CONTROL SETPOINT mode via the

local RTU HMI, the LOCAL FLOW CONTROL SETPOINT shall default to the same value that the PLANT had established for this parameter; however, the operator at the station shall be able to change the LOCAL FLOW CONTROL SETPOINT locally on the local RTU HMI.

The relay panel for CV#1 shall also have a secondary two-position selector switch for TANK T1A – or – OFFLINE. If the selector switch is set to TANK T1A, this shall mean that the water valving inside the station has been set to ensure that water through CV#1 will feed TANK T1A. The CV#1 relay panel will issue a Tank T1A signal to the SCADA RTU so it will know to allow all modes of operation for CV#1 as discussed above. However, this shall cause the SCADA RTU to prevent CV#2 from using the flow control setpoint modes (i.e., LOCAL FLOW CONTROL SETPOINT MODE and PLANT FLOW CONTROL SETPOINT MODE) if, and only if, CV#2's secondary selector switch on its relay panel has been set to feed the CHELSEA PARK TANK. However, the PLANT POSITION SETPOINT MODE shall be available for use by CV#2 under this situation (see further discussion for CV#2 and CV#3). If CV#1's secondary two-position selector switch is set to OFFLINE, this shall mean that the operator intends for CV#1 to be offline such that it is not providing water to TANK T1A and it shall not be available for any modes of operation except HAND mode from the CV#1 relay panel. Under this situation, the SCADA RTU shall allow CV#2 to feed the CHELSEA PARK TANK using any of the modes of operation (including the flow control modes). See the control schematics for all three control valve relay panels included in the Plans.

The relay panel for CV#2 shall also have a secondary three-position selector switch for TANK T1A – OFFLINE – CHELSEA PARK TANK. If the selector switch is set to TANK T1A, this shall mean that the valving inside the station has been set to ensure that water through CV#2 will only feed TANK T1A. The CV#2 relay panel will issue a TANK T1A signal to the SCADA RTU so it will know to allow all modes of operation for CV#2 as discussed above. If the secondary three-position selector switch is set to OFFLINE, this shall mean that the operator intends for CV#2 to be offline such that it is not providing water to TANK T1A or the CHELSEA PARK TANK and therefore, shall not be available for any modes of operation except HAND mode from the CV#2 relay panel. If the secondary three-position selector switch is set to CHELSEA PARK TANK, this shall mean that the valving inside the station has been set to ensure that water through CV#2 will only feed the CHELSEA PARK TANK. The CV#2 relay panel will issue a CHELSEA PARK TANK signal to the SCADA RTU so it will know that CV#2 is feeding the CHELSEA PARK TANK. If CV#1 is set to OFFLINE on its relay panel as discussed above, the CV#1 relay panel will send the OFFLINE signal to the SCADA RTU and then the SCADA RTU shall allow all modes of operation for CV#2. However, if CV#1 is set to TANK T1A, then the SCADA RTU shall prevent CV#2 from operating using the flow control setpoint modes (i.e., LOCAL FLOW CONTROL SETPOINT MODE and PLANT FLOW CONTROL SETPOINT MODE). However, the PLANT POSITION SETPOINT MODE shall be available for use by CV#2. See the control schematics for all three control valve relay panels included in the Plans.

2.2 ONE 12" CONTROL VALVE RELAY PANEL (CV#3)

If the 12" control valve relay panel has its local two-position selector switch set to the SCADA RTU position, then the local RTU HMI shall default to PLANT mode for the 12" control valve, but the operator shall be able to change the mode of operation via the local RTU HMI. If the operator changes the mode of operation at the local RTU HMI to LOCAL FLOW CONTROL SETPOINT, then the 12" valve shall use this mode as described below. The LOCAL FLOW CONTROL SETPOINT MODE and the PLANT MODE of operation for the 12" control valve are discussed below. The local RTU shall always transmit/communicate all operational parameters and settings monitored by the local RTU to the PLANT via SCADA.

LOCAL FLOW CONTROL SETPOINT MODE:

If the 12" control valve relay panel has been set to SCADA RTU mode (via its two-position selector switch) and then the LOCAL FLOW CONTROL SETPOINT MODE has been selected at the local RTU HMI, the control valve shall operate to maintain the flowrate through the 12" control valve at the LOCAL FLOW CONTROL SETPOINT (with a user-defined operational deadband). As such, there shall be an operator input for the LOCAL FLOW CONTROL SETPOINT in GALLONS PER MINUTE.

Once the local flow control setpoint input has been established, the local RTU shall monitor the station's Flowmeter #2 reading (this flowmeter monitors only the flowrate through the 12" control valve which will normally feed the Chelsea Park Tank) and operate/modulate the valve to achieve and maintain the LOCAL FLOW CONTROL SETPOINT using a PID control loop. If the valve reaches 100% open for a user defined timeframe setpoint and the flowrate through Flowmeter #2 is still below the LOCAL FLOW CONTROL SETPOINT, the local RTU shall issue an alarm locally and to the PLANT via SCADA indicating that the LOCAL FLOW CONTROL SETPOINT cannot be achieved.

The flowrate PID control loop logic shall reside in the local SCADA RTU/PLC and therefore shall not require SCADA communications to operate correctly. The Owner shall be provided with two copies of the programming logic on two thumb drives.

PLANT MODE:

If the local control valve relay panel for the 12" control valve has been set to SCADA RTU mode (via its two-position selector switch), then the local RTU HMI shall automatically default to PLANT mode for the valve (although the operator should still select PLANT mode on the RTU HMI to confirm that this is the mode he wants since the flashing light on the control valve panel will be prompting him to do so).

When in PLANT mode, the Shelby County South Plant shall be able to control the valve in either a POSITION SETPOINT mode or a FLOW CONTROL SETPOINT mode. In POSITION SETPOINT mode, the Shelby County South Plant shall be able to set the position of the valve from 0% to 100% open. The valve shall go to this position and hold this position. In FLOW CONTROL SETPOINT mode, the Shelby County South Plant shall be able to dictate the automatic operation of the valve using a FLOW CONTROL SETPOINT. This FLOW CONTROL SETPOINT mode of operation shall have the identical user-defined flow control setpoint as discussed above for the LOCAL FLOW CONTROL SETPOINT mode of operation for the 12" control valve; however, the user-defined setpoint shall be inputted by the plant operators from the PLANT SCADA computer(s) instead of locally at the control valve station RTU HMI.

Similar to the discussion above for the LOCAL FLOW CONTROL SETPOINT mode, the flowrate PID control loop shall modulate the position of the 12" control valve in order to achieve and maintain the FLOW CONTROL SETPOINT through Flowmeter #2. The flowrate PID control loop logic for controlling the valve in FLOW CONTROL SETPOINT mode shall reside in the local RTU/PLC located at the control valve station such that the local RTU is monitoring the station's Flowmeter #2 and controlling the position of the 12" valve based on the flow control setpoint established remotely by the plant operator. If SCADA communications are lost between the control valve station and the PLANT, the local RTU/PLC at the control valve station shall retain the settings that existed at the time SCADA communications were lost and continue to operate the valve as intended.

If, while in PLANT mode, an operator at the control valve station changes the operational mode to LOCAL FLOW CONTROL SETPOINT mode via the local RTU HMI, the LOCAL FLOW CONTROL SETPOINT shall default to the same value that the PLANT had established for this parameter; however, the operator at the station shall be able to change the LOCAL FLOW CONTROL SETPOINT locally on the local RTU HMI.

The relay panel for CV#3 shall also have a secondary three-position selector switch for TANK T1A – OFFLINE – CHELSEA PARK TANK. If the secondary selector switch is set to TANK T1A, this shall mean that the valving inside the station has been set to ensure that water through CV#3 will only feed TANK T1A. The CV#3 relay panel will issue a TANK T1A signal to the SCADA RTU so it will know to allow all modes of operation for CV#3. If the secondary three-position selector switch is set to OFFLINE, the valve relay panel will send this OFFLINE signal to the SCADA RTU and this shall mean that the operator intends for CV#3 to be offline such that it is not providing water to TANK T1A or the CHELSEA PARK TANK. Therefore, it shall not be available for any modes of operation except HAND mode from the CV#3 relay panel. If the secondary three-position selector switch is set to CHELSEA PARK TANK, this shall mean that the valving inside the station has been set to ensure that water through

CV#3 will only feed the CHELSEA PARK TANK. The CV#3 relay panel will issue a CHELSEA PARK TANK signal to the SCADA RTU so it will know to allow all modes of operation for CV#3. See the control schematics for all three control valve relay panels included in the Plans.

2.3 ALL THREE CONTROL VALVES – FUNCTIONALITY WHEN TARGET TANK BECOMES FULL:

If Tank T1A becomes full, the control valve(s) that has been selected to supply Tank T1A (as determined by the selector switch on each control valve relay panel) shall automatically close if they are currently open and in SCADA RTU mode (i.e., not in HAND mode) at their respective control relay panel. If Chelsea Park Tank becomes full, the control valve(s) that has been selected to supply the Chelsea Park Tank shall automatically close if it is currently open and in SCADA RTU mode (i.e., not in HAND mode) at its respective control relay panel. The South WTP shall also be notified if a tank is full such that the South WTP operators shall be able to decide when the plant pump(s) should be turned off. This decision will also need to consider the status of Tank T1S. Once SCADA has automatically closed a control valve at the NSC Control Valve Station due to a target tank becoming full, that control valve shall not re-open unless initiated by the South WTP operator via SCADA. The SCADA system shall issue a system wide notification identifying which control valve automatically closed due to its target tank becoming full. If LOCAL FLOW CONTROL SETPOINT has been selected at the SCADA RTU/PLC, then the following two options shall be available to the operator locally. If PLANT MODE has been selected at the SCADA RTU/PLC, then the following two options shall be available to the operator remotely at the South WTP.

Option 1) A manual reset which shall require the operator to reset the operation of the valve and confirm the operational parameters for the valve in order for the valve to re-open.

Option 2) An automatic reset which allows the valve to re-open and resume its previous operation once the target tank level drops below an adjustable level setpoint. This automatic reset shall repeat itself for as long as the “automatic reset” option is active.

If the valve is currently closed due to its target tank being full and if “Freeze Protection Mode” is currently enabled and has been activated (due to low building interior temperature), the operator shall be prompted (at the local RTU HMI or via SCADA respectively) to allow or disallow the freeze protection cycle to continue. If the operator does not make a selection, the default selection shall be for the freeze protection cycles to continue.

2.4 SPECIAL OPERATIONAL WARNINGS

As discussed above, the SCADA system shall issue a warning whenever a Flowrate Setpoint has been established for the NSC Connector Control Valve Station,

and the flowrate setpoint cannot be achieved and/or maintained (as measured by the local flowmeters). These warnings shall have operator-adjustable deadbands and time delays. These warnings shall be defeatable.

3.0 LOCAL SCADA RTU/PLC PANEL & ASSOCIATED GLOBAL SCADA SYSTEM MODIFICATIONS/ADDITIONS

The local SCADA RTU/PLC panel (NEMA 3R) to be provided shall serve as the brains for the NSC Control Valve Station as already described herein. The panel shall have a thru-the-door power disconnect, a control power ON indicator light (push-to-test), and a 3-point door latching system with a single opening handle (no door clips allowed). The panel shall be designed and also include all other door mounted components typically included to be consistent with the Owner's RTU standards and other similar existing RTU panels provided by the panel manufacturer for this Owner. This panel shall power other instruments/devices at the NSC Control Valve Station and directly monitor a high level float switch (located in piping sump/trench) as shown and specified in the Contract Drawings. See Contract Drawings for other requirements.

The programming, control algorithms, PID Control loops, etc. shall be specifically programmed for the applications described herein and be calibrated/tuned as required to achieve proper performance of the flow control valves in the field. For example, the PID control loops required for maintaining the Flow Control Setpoints shall be fine-tuned based on the actual flow/throttling characteristics (C_v values) of each flow control valve over the entire operational range of the valve. It is expected that the algorithms and PID control loops will need to be adjusted during start-up to achieve the best performance under all operational conditions. Start-up activities shall simulate varying operational conditions to demonstrate the proper performance of the programming.

New SCADA system components (RTU with PLC, I/O modules, switches, Battery Back-up, Communications, etc.) shall be provided and installed at the NSC Control Valve Station as required to allow the station to be controlled and monitored by Shelby County's global/master VT SCADA system. The local RTU shall have a large HMI (15" min. – provide larger HMI if required to achieve the necessary detailed graphics) with intuitive touch screen selections and graphics. The RTU HMI home screen shall display the complete control valve station piping arrangement in detail, graphically depict the current an active settings/selections for the station, and graphically depict the water pathways through the station based on inputs received from the control valve relay panels and inputs/settings selected locally by the operator at the RTU via the RTU HMI. The battery back-up for this panel shall be similar to those provided for the Control Valve Relay Panels and have similar run times. This work shall also include any SCADA software, new components, and component updates/modifications required at the South Water Treatment Plant including updated computer graphics to reflect the addition of the new NSC Connector Control Valve Station (and the new STL Control Valve Station) and to allow for control and monitoring of all the station's parameters.

The local SCADA RTU/PLC HMI shall also include a dedicated graphics screen that displays data related to other components/facilities within Shelby County's water system that have an operational effect on the NSC Control Valve Station. As a minimum, this screen shall display the following information:

1. Tank T1A Water Elevation (AMSL) and % Full
2. Tank T1 Water Elevation (AMSL) and % Full
3. Tank T1S Water Elevation (AMSL) and % Full
4. Chelsea Park Tank Water Elevation (AMSL) and % Full
5. Statuses for all High Service Pumps at the South WTP
6. High service pumpage rate for the South WTP
7. Statuses of all Booster Station B2N pumps
8. Pumpage Rate of Booster Station B2N
9. Flowrate through the new Southern Transmission Line Control Valve Station (This flowmeter has the ability to measure forward and reverse flow. Forward flow means water is going into/towards Tank T1S. Reverse flow means water is coming out of Tank T1S (flowing towards the NSC Control Valve Station))
10. Statuses of the Chelsea Park Booster Station pumps.

4.0 METER DISPLAY PANEL

The meter display panel shall be (NEMA 3R) and shall include a thru-the-door power disconnect, a control power ON indicator light (push-to-test), and 3-point door latching system with single opening handle (no door clips allowed). This panel shall also be provided with 5 Redlion analog panel meters for displaying upstream pressure, downstream pressure #1 (Hwy 280 feed), downstream pressure #2 (Chelsea Park feed), flowrate #1, and flowrate #2. The display screen for each panel meter shall be mounted to the front door of the meter display panel enclosure. Each analog panel meter shall display its reading with the correct units (i.e., psi, gpm) and output a 4-20 MADC signal for the reading to the SCADA RTU/PLC panel. The Meter Display Panel shall be powered by the SCADA RTU/PLC panel via a separate breaker (i.e., independent of the SCADA PLC). The Meter Display Panel shall also provide separate fused power supplies to the two magnetic flowmeters as required (120vac or 24vdc). All power supplies shall be connected to the SCADA RTU's battery back-up.

5.0 FIELD SUPERVISION

The services of an authorized technical, factory trained, qualified representative shall be provided for a minimum of three 8 hour days to inspect the completed installation, make all adjustment necessary to place the system in trouble-free operation including fully interfacing with the Plant's SCADA system to the satisfaction of the Owner and instruct the operating personnel in the proper care and operation of the

equipment. Once the system has been thoroughly tested and the Engineer has approved the installation, wiring, functionality, integration, etc., of all panels, the representative that inspected the installation shall dedicate an additional 8-hour day for training at the NSC Control Valve Station (morning) and at the South WTP (afternoon).

6.0 GUARANTEE

At a minimum, all equipment shall be guaranteed against defects in material, workmanship, and functionality for a period of one year from the date of Owner's final inspection and acceptance to the effect that any defective equipment and/or bugs in programming/performance shall be repaired, replaced, corrected without cost or obligation.

SHELBY CO. WATER - NORTH/SOUTH CONNECTOR CVS - SCADA PANEL RTU-NSC I/O LIST

INPUTS

No.	SIGNAL DESCRIPTION	SIGNAL TYPE	FROM	TO	POWER SOURCE
NSCI 1	Control Valve #1 - Control Power ON	Digital - 120 VAC	Control Valve #1 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 2	Control Valve #1 - AC Power OK	Digital - 120 VAC	Control Valve #1 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 3	Control Valve #1 - UPS OK	Digital - 120 VAC	Control Valve #1 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 4	Control Valve #1 - Hand Mode	Digital - 120 VAC	Control Valve #1 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 5	Control Valve #1 - SCADA RTU Mode	Digital - 120 VAC	Control Valve #1 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 6	Control Valve #1 - CV#1 used for Filling Tank T1A	Digital - 120 VAC	Control Valve #1 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 7	Control Valve #1 - CV#1 Off-line	Digital - 120 VAC	Control Valve #1 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 8	Control Valve #1 - Valve Position	Analog 4-20 MADC	Control Valve #1 Relay Panel - Analog Meter	SCADA Panel (24 VDC)	SCADA Panel (24 VDC)
NSCI 9	Control Valve #2 - Control Power ON	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 10	Control Valve #2 - AC Power OK	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 11	Control Valve #2 - UPS OK	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 12	Control Valve #2 - Hand Mode	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 13	Control Valve #2 - SCADA RTU Mode	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 14	Control Valve #2 - CV#2 used for Filling Tank T1A	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 15	Control Valve #2 - CV#2 used for Filling Chelsea Park Tank	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 16	Control Valve #2 - CV#2 & CV#3 Contradict	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 17	Control Valve #2 - Warning - Flow Control Mode Unavailable	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 18	Control Valve #2 - CV#2 Off-line	Digital - 120 VAC	Control Valve #2 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 19	Control Valve #2 - Valve Position	Analog 4-20 MADC	Control Valve #2 Relay Panel - Analog Meter	SCADA Panel (24 VDC)	SCADA Panel (24 VDC)
NSCI 20	Control Valve #3 - Control Power ON	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 21	Control Valve #3 - AC Power OK	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 22	Control Valve #3 - UPS OK	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 23	Control Valve #3 - Hand Mode	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 24	Control Valve #3 - SCADA RTU Mode	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 25	Control Valve #3 - CV#3 used for Filling Tank T1A	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 26	Control Valve #3 - CV#3 used for Filling Chelsea Park Tank	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 27	Control Valve #3 - CV#2 & CV#3 Contradict	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 28	Control Valve #3 - CV#3 Off-line	Digital - 120 VAC	Control Valve #3 Relay Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)
NSCI 29	Control Valve #3 - Valve Position	Analog 4-20 MADC	Control Valve #3 Relay Panel - Analog Meter	SCADA Panel (24 VDC)	SCADA Panel (24 VDC)
NSCI 30	Sump - High Water Level	Digital - 120 VAC	Sump High Level Float Switch	SCADA Panel	SCADA Panel (24 VDC)
NSCI 31	Upstream Pressure	Analog 4-20 MADC	Analog Meter Display Panel	SCADA Panel	SCADA Panel (24 VDC)
NSCI 32	Downstream Pressure (Hwy 280 Feed)	Analog 4-20 MADC	Analog Meter Display Panel	SCADA Panel	SCADA Panel (24 VDC)
NSCI 33	Downstream Pressure (Chelsea Park Tank Feed)	Analog 4-20 MADC	Analog Meter Display Panel	SCADA Panel	SCADA Panel (24 VDC)
NSCI 34	Flowrate #1 (Hwy 280 Feed)	Analog 4-20 MADC	Analog Meter Display Panel	SCADA Panel	SCADA Panel (24 VDC)
NSCI 35	Flowrate #2 (Chelsea Park Tank Feed)	Analog 4-20 MADC	Analog Meter Display Panel	SCADA Panel	SCADA Panel (24 VDC)
NSCI 36	Four Spare	Analog 4-20 MADC	SCADA Panel	SCADA Panel	SCADA Panel (24 VDC)
NSCI 37	Four Spare	Digital - 120 VAC	SCADA Panel	SCADA Panel	SCADA Panel (120 VAC or 24 VDC)

OUTPUTS

No.	SIGNAL DESCRIPTION	SIGNAL TYPE	FROM	TO	POWER SOURCE
NSCO 1	Control Valve #1 - Open Command	Digital - 120 VAC	SCADA Panel	Control Valve #1 Relay Panel	CV#1 Relay Panel (120 VAC)
NSCO 2	Control Valve #1 - Close Command	Digital - 120 VAC	SCADA Panel	Control Valve #1 Relay Panel	CV#1 Relay Panel (120 VAC)
NSCO 3	Control Valve #1 - Hold Command	Digital - 120 VAC	SCADA Panel	Control Valve #1 Relay Panel	CV#1 Relay Panel (120 VAC)
NSCO 4	Control Valve #1 - Confirm Mode at SCADA RTU	Digital - 120 VAC	SCADA Panel	Control Valve #1 Relay Panel	CV#1 Relay Panel (120 VAC)
NSCO 5	Control Valve #1 - Confirm Mode at SCADA RTU Reminder	Digital - 120 VAC	SCADA Panel	Control Valve #1 Relay Panel	CV#1 Relay Panel (120 VAC)
NSCO 6	Control Valve #1 - Local Flow Control Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #1 Relay Panel	CV#1 Relay Panel (120 VAC)
NSCO 7	Control Valve #1 - Plant Mode - Flow Control Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #1 Relay Panel	CV#1 Relay Panel (120 VAC)
NSCO 8	Control Valve #1 - Plant Mode - Valve Position Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #1 Relay Panel	CV#1 Relay Panel (120 VAC)
NSCO 9	Control Valve #2 - Open Command	Digital - 120 VAC	SCADA Panel	Control Valve #2 Relay Panel	CV#2 Relay Panel (120 VAC)
NSCO 10	Control Valve #2 - Close Command	Digital - 120 VAC	SCADA Panel	Control Valve #2 Relay Panel	CV#2 Relay Panel (120 VAC)
NSCO 11	Control Valve #2 - Hold Command	Digital - 120 VAC	SCADA Panel	Control Valve #2 Relay Panel	CV#2 Relay Panel (120 VAC)
NSCO 12	Control Valve #2 - Confirm Mode at SCADA RTU	Digital - 120 VAC	SCADA Panel	Control Valve #2 Relay Panel	CV#2 Relay Panel (120 VAC)
NSCO 13	Control Valve #2 - Confirm Mode at SCADA RTU Reminder	Digital - 120 VAC	SCADA Panel	Control Valve #2 Relay Panel	CV#2 Relay Panel (120 VAC)
NSCO 14	Control Valve #2 - Local Flow Control Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #2 Relay Panel	CV#2 Relay Panel (120 VAC)
NSCO 15	Control Valve #2 - Plant Mode - Flow Control Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #2 Relay Panel	CV#2 Relay Panel (120 VAC)
NSCO 16	Control Valve #2 - Plant Mode - Valve Position Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #2 Relay Panel	CV#2 Relay Panel (120 VAC)
NSCO 17	Control Valve #3 - Open Command	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)
NSCO 18	Control Valve #3 - Close Command	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)
NSCO 19	Control Valve #3 - Hold Command	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)
NSCO 20	Control Valve #3 - Confirm Mode at SCADA RTU	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)
NSCO 21	Control Valve #3 - Confirm Mode at SCADA RTU Reminder	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)
NSCO 22	Control Valve #3 - Local Flow Control Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)
NSCO 23	Control Valve #3 - Plant Mode - Flow Control Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)
NSCO 24	Control Valve #3 - Plant Mode - Valve Position Setpoint Active	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)
NSCO 25	Four Spare	Digital - 120 VAC	SCADA Panel	Control Valve #3 Relay Panel	CV#3 Relay Panel (120 VAC)