The PDF digital Contract Documents for this project consist of the Drawings and Specifications and are being released by the Engineer solely as a convenience to the Bidders. Actual hard copies of Contract Documents bearing a stamp and signature of a professional engineer shall be used for the purpose of providing a bid proposal for this project.

Users of these PDF digital Contract Documents assume all risks associated with any information contained within this digital set without any liability to the Owner and/or Engineer. It is the user's responsibility to verify the information contained within the PDF digital set of Contract Documents matches the information shown on the stamped hard copy Contract Documents. In all discrepancies or differences between the PDF digital set and the hard copy set, the hard copy set of Contract Documents shall prevail.

Please note that it is the Bidder's responsibility to obtain all documents including any addenda.

ALABAMA WATER UTILITIES, INC.
SPECIFICATIONS - CONTRACTUAL DOCUMENTS
NORTH SHELBY WRRF -
2023 FILTER IMPROVEMENTS
(PROJECT NO: P-000471.C)

7-5-2023

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

JULY 2023

ALABAMA WATER UTILITIES, INC.
SPECIFICATIONS - CONTRACTUAL DOCUMENTS
NORTH SHELBY WRRF
2023 FILTER IMPROVEMENTS
(PROJECT NO: P-000471.C)

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BIDDING DOCUMENTS
AND
CONTRACT
DOCUMENTS

INVITATION FOR BIDS

Alabama Water Utilities, Inc.
Birmingham, AL
North Shelby WRRF – 2023 Filter Improvements

General Notice

Alabama Water Utilities, Inc. (Owner) is requesting Bids from Preselected Contractors for the construction of the following Project:

North Shelby WRRF-2023 Filter Improvements
Project No. P-000471.C

Bids for the construction of the Project will be received at the **Alabama Water Utilities, Inc. office** located at **728 Volare Drive, Birmingham, AL 35244**, until **August 3, 2023,** at **2:00 pm** local time. At that time the Bids received will be **privately** opened and read.

The Project includes the following Work:

Construction of Improvements to the Effluent Filter System at the North Shelby WRRF:

- **Modification to existing Transfer Pump Station**
- **Concrete Splitter Box**
- **Addition of 2 Disk Filters in Steel Tanks with catwalk system**
- **Rebuilding of 2 existing Traveling Bridge Filters**
- **Piping, Electrical, and Miscellaneous Work**

Obtaining the Bidding Documents

Plans and Specifications may be inspected at Municipal Consultants, Inc., 200 Century Park South, Suite 212, Birmingham, Alabama 35226. They may be obtained from the office of Municipal Consultants, Inc., 200 Century Park South, Suite 212, Birmingham, Alabama 35226 upon payment of $300.00. Cost of plans and specifications are non-refundable. Bids will only be opened from Preselected Contractors.

Pre-bid Conference

A mandatory pre-bid conference for the Project will be held on **Friday, July 21, 2023,** at **9:00 am** at **the North Shelby WRRF, 161 Village Street, Birmingham, AL 35242**. Bids will not be accepted from Bidders that do not attend the mandatory pre-bid conference.

Instructions to Bidders.

For all further requirements regarding bid submittal, qualifications, procedures, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

This Invitation is issued by:

Owner: Alabama Water Utilities, Inc.
By: Harry Chandler, PE
Title: Director of Operations
Date: 2023- 07 -06

INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACT

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ARTICLE 1—DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions

ARTICLE 2—BIDDING DOCUMENTS

2.01 Bids will be received only from Contractors preselected by Alabama Water Utilities. Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.

2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.

2.03 Bid documents (plans, specifications, proposal forms, and other contract documents) may be examined at the office of **Municipal Consultants, Inc. 200 Century Park South, Suite 212, Birmingham, Alabama 35226**. General Contractors who bid must obtain documents from Municipal Consultants, Inc.

2.04 *Electronic Documents*

A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.

1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.04.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

ARTICLE 3—QUALIFICATIONS OF BIDDERS (OMITTED)

ARTICLE 4—PRE-BID CONFERENCE

4.01 A mandatory pre-bid conference will be held on **July 21, 2023,** at **9:00 a.m.** at the **North Shelby WRRF, 161 Village Street, Birmingham, AL 35242.** Representatives of Owner and Engineer will be present to discuss the Project. Proposals will not be accepted from Bidders who do not attend the conference. It is each Bidder's responsibility to sign in at the pre-bid conference to verify its participation. Bidders must sign in using the name of the organization that will be submitting a Bid. A list of qualified Bidders that attended the pre-bid conference and are eligible to submit a Bid for this Project will be issued in an Addendum.

4.02 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-Bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OTHER WORK AT THE SITE

5.01 *Site and Other Areas*

A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Express Representations and Certifications in Bid Form, Agreement*

A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.

B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.

7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing. Contact information and submittal procedures for such questions are as follows:

7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders via email. Questions received less than seven days prior to the date for opening of Bids may not be answered.

7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of five (5) percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates), not to exceed $10,000.00, and in the form of a Bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. Such Bid bond will be issued in the form included in the Bidding Documents.

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Owner's damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the

Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 9—CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.

9.02 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND "OR EQUAL" ITEMS

10.01 ~~See Section 00 43 33 Proposed Products Form for additional information~~. See Standard General Conditions Article 7.05 & 7.06.

10.02 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.01 If known at the time of the bid, contractor shall provide the owner contact information and value of work or products included for each diverse subcontractors/suppliers in the bid.

11.02 Refer to Exhibit C200-1 regarding the Owner's Contractor-Subcontractor-Supplier Diversity Program.

ARTICLE 12—PREPARATION OF BID

12.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

12.02 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located.

12.03 Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID (OMITTED)

ARTICLE 14—SUBMITTAL OF BID

14.01 The Bidding Documents include one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 2 of the Bid Form.

14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the invitation to bid and must be enclosed in a plainly marked package with the Project title, and, the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the designated location.

14.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

15.01 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16—OPENING OF BIDS

16.01 Bids will be opened privately.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE (OMITTED)

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.

18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.

18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes

of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.

18.04 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.

18.05 The lowest responsible bid shall be defined as follows:

If the Owner chooses not to accept the Alternate Deduct:

The lowest responsible bid shall be the Base Bid Grand Total as shown in Article 3.01 of EJCDC C-410.

If the Owner chooses to accept the Alternate Deduct:

The lowest responsible bid shall be the Base Bid Grand Total as shown in Article 3.01 of EJCDC C-410 minus the Alternate Deduct to the Base Bid shown in Article 3.02.

The Owner reserves the right to accept or not accept the Alternate Deduct.

ARTICLE 19—BONDS AND INSURANCE

19.01 Article 6 of the General Conditions sets forth Owner's requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.

19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.

ARTICLE 20—SIGNING OF AGREEMENT

20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 21—SALES AND USE TAXES

21.01 Owner is exempt from Alabama state sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes must not be included in the Bid.

ARTICLE 22—CONTRACTS TO BE ASSIGNED (OMITTED)

EXHIBIT C200-1

Contractor-Subcontractor-Supplier Diversity Program

for

Minority Business Enterprise (MBE), Woman Business Enterprise (WBE), Disadvantaged Business Enterprise (DBE) and/or Veteran Owned Business (VBE)

Bidders are encouraged, but not required, to solicit pricing from Minority Business Enterprise (MBE), Woman Business Enterprise (WBE), Disadvantaged Business Enterprise (DBE) and/or Veteran Owned Business (VBE) Subcontractors and Suppliers. For Subcontractors and Suppliers meeting diversity criteria, the Bidder should include a notation on the Bid Form where applicable. When diverse Subcontractors and Suppliers are utilized by the Contractor, the Contractor shall provide the Owner contact information and value of work or products included for each of the diverse Subcontractors/Suppliers in the Bid (if known at the time of the bid) and on each Application for Payment.

Below is a partial listing of resources that have published lists of various diversity Subcontractors and Suppliers.

Alabama Department of Transportation
1409 Coliseum Blvd
Montgomery, AL 36130
(334) 353 or (800) 269-5081
https://www.dot.state.al.us/cboweb/DBEProgram.html

Alabama Department of Economic and
Community Affairs
Office of Minority Business Enterprise
P.O. Box 5690
Montgomery, AL 36103-5690
(334) 353-3966
http://adeca.alabama.gov/Divisions/ced/cdp/Pages/ombe.aspx

Alabama Governor's Office of Minority Affairs
100 N. Union St. Suite 360
Montgomery, AL 36104
(334) 353-2113
info@goma.alabama.gov
https://goma.alabama.gov/

Birmingham Construction Industrial Authority
301 37th Street South
Birmingham, AL 35222
(205) 324-6202
Fax: (205) 324-6210
aorl@bcia1.org
https://bcia1.org/

Birmingham Office of Economic Development
City Hall / Third Floor
710 20th Street North
Birmingham, AL 35203
(205) 524-2799
Fax (205) 254-7741
https://oed.birminghal.gov/

U.S. Department of Commerce
Minority Business Development Agency
Atlanta MBDA Business Center
75 5th Street, NW Suite 300
Atlanta, GA 30308
(404) 894-8150
https://mbdabusinesscenter-atlanta.org/
https://www.mdba.gov/

National Association of Minority Contractors (NAMC)
The Barr Building
910 17th Street, NW, Suite 413
Washington, DC 20006
(202) 296-1644
Fax: (202) 296-1644
info@namcnational.org
http://namcnational.org

NAMC Greater Atlanta Chapter
1134 Main Street
Forest Park, GA 30297
(678) 943-9667
www.namcatlanta.org

U.S. Small Business Administration
https://www.sba.gov/
http://web.sba.gov/pro-net/search/dsp_dsbs.cfm
https://www.sba/gov/offices/headquarters/wbo/

BID FORM FOR CONSTRUCTION CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders and the General Conditions.

ARTICLE 1—OWNER AND BIDDER

1.01 This Bid is submitted to: **Alabama Water Utilities, Inc.**

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—ATTACHMENTS TO THIS BID

2.01 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security.

~~B. Section 00 43 33 – Proposed Products Form~~

C. Evidence of authority to do business in the state of the Project;

D. Contractor's license number as evidence of Bidder's State Contractor's License;

E. E-Verify

ARTICLE 3—BASIS OF BID—LUMP SUM BID AND UNIT PRICES

3.01 NORTH SHELBY WRRF - 2023 FILTER IMPROVEMENTS – BASE BID

Item	Description	Qty	Unit	Unit Price	Total
1	Allowance for Mobilization	1	Lump Sum	$300,000	$300,000
2	Removal & Replacement of Unsuitable Material Under Splitter Box & Disk Filters	2500	Cubic Yard	$	$
3	Limestone Surge Stone	435	Ton	$	$
4	Geotextile Fabric	300	Square Yard	$	$
5	Lean 2,000 PSI Concrete In Place	20	Cubic Yard	$	$

6	Ductile Iron Fittings – Extra	6	Ton	$	$
7	Sidewalks/Mowstrips - Extra	30	Square Yard	$	$
8	Class A Asphalt Paving	500	Square Yard	$	$
9	Construction of WRRF Improvements	1	Lump Sum	$	$
10	Allowance for Owner Use	1	Lump Sum	$75,000	$75,000
11	Allowance for Start-Up and use of the WRRF Improvements & Components	1	Lump Sum	$200,000	$200,000
				BASE BID GRAND TOTAL	

3.02 NORTH SHELBY WRRF – 2023 FILTER IMPROVEMENTS – ALTERNATE DEDUCT TO BASE BID

ALTERNATE DEDUCT TO BASE BID Note: Only the difference in costs from the Base Bid shall be written in below					
1A	Delete Rebuilding Traveling Bridge Filters	1	Lump Sum	$	$

3.03 List of Suppliers and Subcontractors for the Bid on this Project

The Bidder certifies that if his bid is accepted, the suppliers and subcontractors he has circled below or written below, and included with his bid, will be awarded contracts for their products and services.

SCADA Integrator (No alternate allowed): EMC

Electrical Subcontractor: Stone & Sons or Mastins
(circle the Subcontractor to be used)

Painting Subcontractor: _____

ARTICLE 4—BASIS OF BID—COST-PLUS FEE (OMITTED-RESERVED)

ARTICLE 5—PRICE-PLUS-TIME BID (OMITTED-RESERVED)

ARTICLE 6—TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

7.01 Bid Acceptance Period

A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

7.02 Instructions to Bidders

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

7.03 Receipt of Addenda

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 8—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

8.01 Bidder's Representations

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.

6. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

7. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

8. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

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

10. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

8.02 Bidder's Certifications

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.

3. Bidder has not solicited or induced any individual or entity to refrain from bidding.

4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:

a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.

b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.

d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

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BIDDER hereby submits this Bid as set forth above:

Bidder:

_____

(typed or printed name of organization)

By: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

Address for giving notices:

_____

_____

Bidder's Contact:

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Phone: _____

Email: _____

Address:

_____

_____

_____

Bidder's Contractor License No.: _____

BID BOND (PENAL SUM FORM)

Bidder	**Surety**
Name:	Name:
Address *(principal place of business)*:	Address *(principal place of business)*:
Owner	**Bid**
Name: **Alabama Water Utilities, Inc.**	North Shelby WRRF-2023 Filter Improvements 161 Village Street Birmingham, AL 35242
Address *(principal place of business)*: **728 Volare Drive** **Birmingham, AL 35244**	Bid Due Date:
Bond	
Penal Sum:	
Date of Bond:	

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

Bidder	Surety
_____ *(Full formal name of Bidder)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature) (Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title:	Title:

Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
    3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
    3.2. All Bids are rejected by Owner, or
    3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

NOTICE OF AWARD

Date of Issuance:

Owner:	Alabama Water Utilities, Inc.	Owner's Project No.:	P-000471.C
Engineer:	Municipal Consultants, Inc.	Engineer's Project No.:	
Project:	North Shelby WRRF-2023 Filter Improvements		
Contract Name:			
Bidder:			
Bidder's Address:			

You are notified that Owner has accepted your Bid dated **[date]** for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

North Shelby WRRF-2023 Filter Improvements The Contract Price of the awarded Contract is $**[Contract Price]**. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

The Agreement (Form C520) will be signed electronically through the Owner's ContractWorks software once all bonds and insurance are provided and approved. Contract date will be determined at that time – no contract dates shall be entered prior.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Secure and deliver the Contract security (required performance and payment bonds) and insurance certificates, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
2. Other conditions precedent (if any): **N/A**

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner:

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

Copy: Engineer

AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION OF NORTH SHELBY WRRF-2023 FILTER IMPROVEMENTS

This Agreement is by and between **Alabama Utilities, Inc.** ("Owner") and **[name of contracting entity]** ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: **North Shelby WRRF-2023 Filter Improvements**

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **North Shelby WRRF-2023 Filter Improvements**

ARTICLE 3—ENGINEER

3.01 The Owner has retained **Municipal Consultants, Inc.** ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

3.02 INTENTIONALLY OMITTED

ARTICLE 4—CONTRACT TIMES

4.01 *Time is of the Essence*

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

4.02 INTENTIONALLY OMITTED

4.03 *Contract Times: Days*

A. The Work will be substantially complete within **550** days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within **580** days after the date when the Contract Times commence to run.

4.05 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time.

Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner $**750** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $**400** for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 5—CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

A. For all Work other than Unit Price, Work, a lump sum of $_____. All specific cash allowances are included in the above price in accordance with Paragraph 13.02 of the General Conditions.

B. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item.)

Item No.	Description	Unit	Estimated Quantity	Unit Price	Extended Price
				$	$
				$	$
				$	$

Total of all Extended Prices for Unit Price Work (subject to final adjustment based on actual quantities) $

The extended prices for Unit Price work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions,

estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer.

C. Total of Lump Sum Amount and Unit Price Work (subject to final Unit Price adjustment) $_____

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the **25th** day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

a. **Ninety (90)** percent of the value of the Work completed (with the balance being retainage).

Once 50 percent or more of the Work has been completed, as determined by Engineer, there will be no additional retainage.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price (including retainage) in accordance with Paragraph 15.06 of the General Conditions.

6.04 *Consent of Surety*

A. Owner will not make final payment, or return or release retainage, unless Contractor submits written consent of the surety to such payment, return, or release.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

A. The Contract Documents consist of all of the following:

1. This Agreement.

2. Bonds:

a. Performance bond (together with power of attorney).

b. Payment bond (together with power of attorney).

3. General Conditions.

4. Specifications as listed in the table of contents of the project manual (copy of list attached).

5. Drawings: ***Plans are referenced into this Contract Document:***

SHT.# DWG# DRAWING DESCRIPTION

6. Addenda (numbers **[number]** to **[number]**, inclusive).

7. Exhibits to the General Conditions, numbered as follows:

   Exhibit 4.05 – Foreseeable Bad Weather Days

   Exhibit 6.02 – Required Insurance

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

   a. Notice to Proceed.

   b. Work Change Directives.

   c. Change Orders.

   d. Field Orders.

   e. Warranty Bond, if any.

B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 7.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 *Contractor's Representations*

A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:

1. Contractor has examined and carefully studied the Contract Documents, including Addenda.

2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the General Conditions, with respect to the Technical Data in such reports and drawings.

5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the General Conditions, with respect to Technical Data in such reports and drawings.

6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the General Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of

discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

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

11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

8.02 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 *Standard General Conditions*

A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout).

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on **[indicate date on which Contract becomes effective]** (which is the Effective Date of the Contract).

Owner:	Contractor:
Alabama Water Utilities, Inc. *(typed or printed name of organization)*	 *(typed or printed name of organization)*
By: _____ *(individual's signature)*	By: _____ *(individual's signature)*
Date: _____ *(date signed)*	Date: _____ *(date signed)*
Name: Craig Sorensen *(typed or printed)*	Name: _____ *(typed or printed)*
Title: President *(typed or printed)*	Title: _____ *(typed or printed)* *(If **[Type of Entity]** is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)*
Attest: _____ *(individual's signature)*	Attest: _____ *(individual's signature)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address for giving notices: 728 Volare Drive Birmingham, AL 35244	Address for giving notices:
With a copy that does not constitute notice via e-mail to : legal@swwc.com	
Designated Representative: Name: _____ *(typed or printed)* Title: _____ *(typed or printed)*	Designated Representative: Name: _____ *(typed or printed)* Title: _____ *(typed or printed)*
Address: 728 Volare Drive Birmingham, AL 35244	Address:
Phone: _____	Phone: _____
Email: [___]@swwc.com	Email: _____ License No.: _____ State: _____

NOTICE TO PROCEED

Owner:		Owner's Project No.:	
Engineer:		Engineer's Project No.:	
Contractor:		Contractor's Project No.:	
Project:			
Contract Name:			
Effective Date of Contract:			

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on **[date Contract Times are to start]** pursuant to Paragraph 4.01 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement:

> The number of days to achieve Substantial Completion is **[number of days, from Agreement]** from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of **[date, calculated from commencement date above]**; and the number of days to achieve readiness for final payment is **[number of days, from Agreement]** from the commencement date of the Contract Times, resulting in a date for readiness for final payment of **[date, calculated from commencement date above]**.

Owner:	**Alabama Water Utilities, Inc.**
By *(signature)*:	
Name *(printed)*:	
Title:	
Date Issued:	

Copy: Engineer

PERFORMANCE BOND

Contractor	**Surety**
Name: **[Full formal name of Contractor]** Address *(principal place of business)*: **[Address of Contractor's principal place of business]**	Name: **[Full formal name of Surety]** Address *(principal place of business)*: **[Address of Surety's principal place of business]**
Owner	**Contract**
Name: **Alabama Water Utilities, Inc.** Mailing address *(principal place of business)*: **728 Volare Drive** **Birmingham, AL 35244**	Description *(name and location)*: **North Shelby WRRF-2023 Filter Improvements** **161 Village Street** **Birmingham, AL 35242** Contract Price: **[Amount from Contract]** Effective Date of Contract: **[Date from Contract]**

Bond

Bond Amount: **[Amount]**

Date of Bond: **[Date]**

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

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

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:

    3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;

    3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

    3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

    5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

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

    5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

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

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

   7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

   7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

   7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

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

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

11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

    14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

    14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

    14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

    14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

    14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

16. Modifications to this Bond are as follows: **None**

PAYMENT BOND

Contractor	**Surety**
Name: **[Full formal name of Contractor]** Address *(principal place of business)*: **[Address of Contractor's principal place of business]**	Name: **[Full formal name of Surety]** Address *(principal place of business)*: **[Address of Surety's principal place of business]**
Owner Name: **Alabama Water Utilities, Inc.** Mailing address *(principal place of business)*: **728 Volare Drive** **Birmingham, AL 35244**	**Contract** Description *(name and location)*: **North Shelby WRRF-2023 Filter Improvements** **161 Village Street** **Birmingham, AL 35242** Contract Price: **[Amount, from Contract]** Effective Date of Contract: **[Date, from Contract]**

Bond

Bond Amount: **[Amount]**

Date of Bond: **[Date]**

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
    5.1. Claimants who do not have a direct contract with the Contractor
        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
    7.2. Pay or arrange for payment of any undisputed amounts.
    7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

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

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

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

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

    16.1. *Claim*—A written statement by the Claimant including at a minimum:

        16.1.1. The name of the Claimant;

        16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

        16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

        16.1.4. A brief description of the labor, materials, or equipment furnished;

16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

18. Modifications to this Bond are as follows: **None**

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: Alabama Water Utilities, Inc.
Engineer: Municipal Consultants, Inc.
Contractor:
Project: North Shelby WRRF – 2023 Filter Improvements
Contract Name:

Owner's Project No.: P-000471.C
Engineer's Project No.:
Contractor's Project No.:

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: **[Enter date, as determined by Engineer]**

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure 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.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

NOTICE OF ACCEPTABILITY OF WORK

Owner: Alabama Water Utilities, Inc.
Engineer: Municipal Consultants, Inc.
Contractor:
Project: North Shelby WRRF-2023 Filter Improvements
Contract Name:
Notice Date:
Effective Date of the Construction Contract:

Owner's Project No.: P-000147.C
Engineer's Project No.:
Contractor's Project No.:

The Engineer hereby gives notice to the Owner and Contractor that Engineer recommends final payment to Contractor, and that the Work furnished and performed by Contractor under the Construction Contract is acceptable, expressly subject to the provisions of the Construction Contract's Contract Documents ("Contract Documents") and of the Agreement between Owner and Engineer for Professional Services dated **[date of professional services agreement]** ("Owner-Engineer Agreement"). This Notice of Acceptability of Work (Notice) is made expressly subject to the following terms and conditions to which all who receive and rely on said Notice agree:

1. This Notice has been prepared with the skill and care ordinarily used by members of the engineering profession practicing under similar conditions at the same time and in the same locality.
2. This Notice reflects and is an expression of the Engineer's professional opinion.
3. This Notice has been prepared to the best of Engineer's knowledge, information, and belief as of the Notice Date.
4. This Notice is based entirely on and expressly limited by the scope of services Engineer has been employed by Owner to perform or furnish during construction of the Project (including observation of the Contractor's Work) under the Owner-Engineer Agreement, and applies only to facts that are within Engineer's knowledge or could reasonably have been ascertained by Engineer as a result of carrying out the responsibilities specifically assigned to Engineer under such Owner-Engineer Agreement.
5. This Notice is not a guarantee or warranty of Contractor's performance under the Construction Contract, an acceptance of Work that is not in accordance with the Contract Documents, including but not limited to defective Work discovered after final inspection, nor an assumption of responsibility for any failure of Contractor to furnish and perform the Work thereunder in accordance with the Contract Documents, or to otherwise comply with the Contract Documents or the terms of any special guarantees specified therein.
6. This Notice does not relieve Contractor of any surviving obligations under the Construction Contract, and is subject to Owner's reservations of rights with respect to completion and final payment.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

STANDARD GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT

For the North Shelby WRRF-2023 Filter Improvements

By and Between

ALABAMA WATER UTILITIES, INC.

And

(CONTRACTOR)

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STANDARD GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT

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STANDARD GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

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

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract

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Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions,

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including sending and receipt; (c) printing of the transmitted Electronic Document by the recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.

23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

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

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

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.

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32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

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

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.

36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

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

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part

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thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.

44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

46. *Technical Data*

    a. Those items expressly identified as Technical Data in the ~~Supplementary~~ **General** Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

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

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

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50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*: The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents;

2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. *Furnish, Install, Perform, Provide*

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

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

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

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4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. *Contract Price or Contract Times*: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. *Evidence of Contractor's Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6~~, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies~~.

C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor ~~four printed copies of the Contract (including~~ one **copy of conformed Contract Documents, including an electronically** ~~fully~~ signed counterpart of the Agreement ~~), and one copy~~ in electronic portable document format (PDF) **incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract.** ~~Additional printed copies will be furnished upon request at the cost of reproduction.~~

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

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2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

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

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

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2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

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

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

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3.02 *Reference Standards*

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

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

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in

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resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

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

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

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ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run ~~on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given,~~ on the day indicated in the Notice to Proceed~~. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.~~

4.02 *Starting the Work*

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

4.03 *Reference Points*

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

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption,

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and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
2. Abnormal weather conditions;
3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
4. Acts of war or terrorism.
5. ***Weather-Related Delays***

a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled.

b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following:

1) The Contractor shall submit a nearby weather station (rain gauge) for Owner and Engineer review and approval prior to beginning work.

2) Contractor shall provide the monthly number of days receiving measurable rain for the previous 5 years from the approved weather station along with the previous month's days receiving measurable rain. Such data will substantially conform to the format of Exhibit 4.05. The calculated exceedance will be considered for weather days.

D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or

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interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.

G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

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

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

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5.02 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

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

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

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

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5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The ~~Supplementary~~ ~~Conditions~~ ~~identify~~ **Exhibit 5.03 identifies**:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

B. *Underground Facilities*: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

C. *Reliance by Contractor on Technical Data*: Contractor may rely upon the accuracy of the Technical Data expressly identified in **Exhibit 5.03** ~~the Supplementary Conditions~~ with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

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

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

3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or

4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;

2. is of such a nature as to require a change in the Drawings or Specifications;

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

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

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

   b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

   c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

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2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

    a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;

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

    c. Contractor failed to give the written notice required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: ~~Unless it is otherwise expressly provided in the Supplementary Conditions, the~~ **The** cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;

4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after

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becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. *Engineer's Review*: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

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

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and

c. Contractor gave the notice required in Paragraph 5.05.B.

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2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The ~~Supplementary~~ ~~Conditions identify~~ **Exhibit 5.06 identifies**:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the ~~Supplementary~~ **General** Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

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

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

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such

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removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and

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charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, ~~the Supplementary Conditions~~, or other provisions of the Contract.

1. *Required Performance Bond Form:* The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond (2018 edition).

2. *Required Payment Bond Form:* The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond (2018 edition).

B. Contractor shall also furnish such other bonds (if any) as are required by the ~~Supplementary Conditions or~~ other provisions of the Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and

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supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 ***Required Insurance*** ~~*—General Provisions*~~

A. **Contractor shall obtain and maintain insurance at Contractor's sole cost, as set forth in Exhibit 6.02 to this Agreement.** ~~Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.~~

~~B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.~~

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the ~~Supplementary~~ **General** Conditions.

~~D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor,~~

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~~Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.~~

~~E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.~~

F. Failure of Owner or Contractor to demand ~~such~~ certificates **of insurance** or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

~~G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.~~

~~H. Contractor shall require:~~

~~1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and~~

~~2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.~~

I. If ~~either party~~ **Contractor** does not purchase or maintain the **required** insurance ~~required of such party by the~~ **Contractor**, such party shall notify the other party **Owner** in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if ~~a party~~ **Contractor** has failed to obtain required insurance, ~~the other party~~ **Owner** may elect (but is in no way obligated) to obtain equivalent insurance to protect ~~such other party~~ **Owner**'s interests at ~~the~~ **Contractor's** expense ~~of the party who was required to provide such coverage~~, and the Contract Price will be adjusted accordingly.

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L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

~~N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.~~

~~6.03 *Contractor's Insurance*~~

~~A. *Required Insurance*: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.~~

~~B. *General Provisions*: The policies of insurance required by this Paragraph 6.03 as supplemented must:~~

~~1. include at least the specific coverages required;~~

~~2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;~~

~~3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;~~

~~4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and~~

~~5. include all necessary endorsements to support the stated requirements.~~

~~C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:~~

~~1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;~~

~~2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;~~

~~3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);~~

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4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

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Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.

2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

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~~6.06 *Receipt and Application of Property Insurance Proceeds*~~

~~A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.~~

~~B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.~~

~~C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.~~

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

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B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For

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the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that the proposed item:

1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) has a proven record of performance and availability of responsive service; and

4) is not objectionable to Owner.

b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for

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review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:

   a. will certify that the proposed substitute item will:

      1) perform adequately the functions and achieve the results called for by the general design;

      2) be similar in substance to the item specified; and

      3) be suited to the same use as the item specified.

   b. will state:

      1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;

      2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

      3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

   c. will identify:

      1) all variations of the proposed substitute item from the item specified; and

      2) available engineering, sales, maintenance, repair, and replacement services.

   d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

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

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D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall

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initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees,

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agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

A. **Owner is exempt from payment of sales and compensating use taxes of the State of Alabama on all materials to be incorporated into the Work.** Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

1. **Owner will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work. Contractor shall submit required forms.**

2. **Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.**

7.11 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

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C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

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

7.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

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

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

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

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or

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indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. ~~Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.~~ **Owner and Contractor shall review the applicable Safety programs and initiate required coordination during a pre-construction meeting.**

H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

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

7.15 *Emergencies*

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

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7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

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

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. *Samples*

a. Contractor shall submit the number of Samples required in the Specifications.

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b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

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

C. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. *Resubmittal Procedures for Shop Drawings and Samples*

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

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2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. *Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03. 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and

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2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.

C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer;

2. Recommendation by Engineer or payment by Owner of any progress or final payment;

3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. Use or occupancy of the Work or any part thereof by Owner;

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

6. The issuance of a notice of acceptability by Engineer;

7. The end of the correction period established in Paragraph 15.08;

8. Any inspection, test, or approval by others; or

9. Any correction of defective Work by Owner.

E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly

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employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and

3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

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G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

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

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

A. ~~If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be~~

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~~set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:~~

1. ~~The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;~~
2. ~~An itemization of the specific matters to be covered by such authority and responsibility; and~~
3. ~~The extent of such authority and responsibilities.~~

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

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

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C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

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

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

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9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

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

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

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

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

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

10.02 *Visits to Site*

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

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B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the ~~Supplementary~~ **General** Conditions, and limitations on the responsibilities thereof will be as provided in ~~the Supplementary Conditions and in~~ Paragraph 10.07.

~~B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.~~

C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:

1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.

2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.

3. *Liaison*

a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.

c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.

4. *Review of Work; Defective Work*

a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.

b. Observe whether any Work in place appears to be defective.

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c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.

5. *Inspections and Tests*

a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.

b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.

6. *Payment Requests:* Review Applications for Payment with Contractor.

7. *Completion*

a. Participate in Engineer's visits regarding Substantial Completion.

b. Assist in the preparation of a punch list of items to be completed or corrected.

c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.

d. Observe whether items on the final punch list have been completed or corrected.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.

5 Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.

7. Authorize Owner to occupy the Project in whole or in part.

10.04 *Engineer's Authority*

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

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D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

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

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

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

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

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

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ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

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

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

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B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

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1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:
   1. A mutually acceptable fixed fee; or
   2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
      a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
      b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
      c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
      d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
      e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
      f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to

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each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

    a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

    b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

    The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of

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the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

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

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the

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Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

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ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

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

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

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4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.

5. Other costs consisting of the following:

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

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

        1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

    c. *Construction Equipment Rental*

        1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

        ~~2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.~~

        3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

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

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

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f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

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

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

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

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

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

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

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b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal

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to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

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

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

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B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

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

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
3. by manufacturers of equipment furnished under the Contract Documents;
4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed,

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or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and

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pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

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

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on

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the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

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

5. Each Application for Payment shall specifically identify the diverse Subcontractors/Suppliers whose work or products are included in the Application for Payment, and the value of work or products included in that Application for Payment.

C. *Review of Applications*

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

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

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b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

   a. to supervise, direct, or control the Work;

   b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

   c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;

   d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

   e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

   a. the Work is defective, requiring correction or replacement;

   b. the Contract Price has been reduced by Change Orders;

   c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

   d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

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e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

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

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the

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specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in

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writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.~~04~~ **02** regarding builder's risk or other property insurance.

15.05 *Final Inspection*

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

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15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

   d. a list of all duly pending Change Proposals and Claims; and

   e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

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C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim, appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the ~~Supplementary~~ **General** Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;

2. correct such defective Work;

3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

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C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

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

F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

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B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in

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connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in ~~the Supplementary Conditions~~ **Section 17.02**; **or**

2. agree with the other party to submit the dispute to another dispute resolution process.~~; or~~

~~3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.~~

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17.02 Arbitration

A. All matters subject to final resolution under this Article will be settled by arbitration administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules. Any controversy or claim in the amount of $100,000 or less will be settled in accordance with the American Arbitration Association's supplemental rules for Fixed Time and Cost Construction Arbitration. This agreement to arbitrate will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitration administrator, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in Article 17, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event will any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations.

C. The arbitrator(s) must be licensed engineers, contractors, attorneys, or construction managers. Hearings will take place pursuant to the standard procedures of the Construction Arbitration Rules that contemplate in-person hearings. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages, except as may be required by statute or the Contract. Any award in an arbitration initiated under this clause will be limited to monetary damages and include no injunction or direction to any party other than the direction to pay a monetary amount.

D. The Arbitrators will have the authority to allocate the costs of the arbitration process among the parties, but will only have the authority to allocate attorneys' fees if a specific Law or Regulation or this Contract permits them to do so.

E. The award of the arbitrators must be accompanied by a reasoned written opinion and a concise breakdown of the award. The written opinion will cite the Contract provisions deemed applicable and relied on in making the award.

F. The parties agree that failure or refusal of a party to pay its required share of the deposits for arbitrator compensation or administrative charges will constitute a waiver by that party to present evidence or cross-examine witness. In such event, the other party shall be required to present evidence and legal argument as the arbitrator(s) may require for the making of an award. Such waiver will not allow for a default judgment against the non-paying party in the absence of evidence presented as provided for above.

G. No arbitration arising out of or relating to the Contract will include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. the inclusion of such other individual or entity will allow complete relief to be afforded among those who are already parties to the arbitration;

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration, and which will arise in such proceedings;

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3. such other individual or entity is subject to arbitration under a contract with either Owner or Contractor, or consents to being joined in the arbitration; and

4. the consolidation or joinder is in compliance with the arbitration administrator's procedural rules.

H. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.

I. Except as may be required by Laws or Regulations, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties, with the exception of any disclosure required by Laws and Regulations or the Contract. To the extent any disclosure is allowed pursuant to the exception, the disclosure must be strictly and narrowly limited to maintain confidentiality to the extent possible.

17.03 Attorneys' Fees

A. For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

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

18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or

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by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Assignment of Contract*

A. ~~Unless expressly agreed to elsewhere in the Contract~~, ~~no~~ **No** assignment by **Contractor** ~~a party to this Contract~~ of any rights under or interests in the Contract will be binding on **Owner** ~~the other party~~ without ~~the~~ **Owner's** written consent ~~of the party sought to be bound~~; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

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

18.10 *Headings*

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

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EXHIBIT 4.05 - FORESEEABLE BAD WEATHER DAYS

Contractor shall provide 5-year average rain data from approved nearby rain gauge in format similar to:

LOCATION, AL

Month	Number of Foreseeable Bad Weather Days in Month Based on Precipitation (5 year average)	2023	2024
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			
Notes:			

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EXHIBIT 5.03 – TECHNICAL REPORTS AND DATA RELATING TO SUBSURFACE CONDITIONS

The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely, but these reports and data are not Contract Documents:

Report Title	Date of Report	Technical Data
Geotechnical Engineering Exploration	**August 2, 2022**	**All, except all backfill and fill shall be imported limestone.**
North Shelby WRRF Filter Improvements		

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EXHIBIT 5.06 – TECHNICAL REPORTS AND DATA RELATING TO HAZARDOUS ENVIRONMENTAL CONDITIONS

Report Title	Date of Report	Technical Data
N/A		

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A. Minimum required insurance coverages and limits--

1) **Workers' compensation and employer's liability ("WC/EL")**: insurance as required by the state where the work is performed with statutory WC limits and Employer's Liability limits in an amount not less than $1,000,000 per accident for bodily injury by accident, $1,000,000 policy limit by disease and $1,000,000 per employee for bodily injury by disease.

2) **Business automobile liability**: insurance covering claims for injuries to members of the public and/or damages to property of others arising from use of motor vehicles, including onsite and offsite operations, and owned, non-owned, or hired vehicles, with $1,000,000 limits for bodily injury and property damage, combined.

3) **Commercial general liability ("CGL")**: insurance covering claims for injuries to members of the public or damage to property of others arising out of any covered negligent act or omission of Contractor or of any of its employees, agents, or Subcontractors, with $1,000,000 per occurrence and $2,000,000 in the aggregate, per project. In addition, coverages to include minimum limits of $2,000,000 aggregate, covering Products and Completed Operations, $1,000,000 for each occurrence of Personal and Advertising Injury, and Contractual Liability coverage in an amount sufficient to cover CONTRACTOR's indemnity obligations but not less than $1,000,000 for each occurrence and in the aggregate.

4) **Professional Liability/Errors and Omissions**: construction management coverage with policy limits of no less than $3,000,000 for each claim and annual aggregate.

5) **Completed operations**: Coverages for Products and Completed Operations and Professional Liability/Errors and Omissions shall be maintained for a period of at least three (3) years after acceptance of completed work. Coverage must include all operations involved in the project/scope of work in this contract.

6) **Contractors pollution liability:** if pollutants, chemicals or wastewater/sludge are involved, coverage of not less than $5,000,000 per occurrence and in the aggregate.

7) **Umbrella/Excess Liability**: with policy limits of not less than $5,000,000 per occurrence and annual aggregate, as excess over CGL, automobile liability and employer's liability policies.

8) **Builder's Risk Insurance**: The Contractor shall obtain, at its sole expense, Builder's Risk Insurance, covering all risks of physical loss, and including workmanship acceptable to the Owner, with limits at all times equal to 100% of the insurable value of materials delivered and labor performed. The policy so issued in the name of the Contractor shall also name its Subcontractors and the Owner as additional insured, as their respective interests may appear. The policy shall have endorsements as follows:

> "*This insurance shall be specific and primary as to coverage and not considered as contributing or excess insurance with any permanent insurance maintained on the present premises.*"

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B. Other insurance requirements--

1) Alabama Water Utilities, Inc. to be named as Certificate Holder on Certificate(s) of Insurance.

2) Contractor policies shall be endorsed to name Alabama Water Utilities, Inc. and Municipal Consultants, Inc. as an ADDITIONAL INSURED on all policies (except Workers' Compensation/EL) on ISO forms CG 20 10 or CG 20 38 (during performance of work) and CG 20 37 (completed operations), or equivalent forms of such endorsement forms that specify "blanket where required by written contract". ISO form 20 33 is not equivalent and is not acceptable whenever Contractor uses a Subcontractor to perform some of the work under this contract.

3) CGL, Auto and Umbrella policies shall contain a SEPARATION OF INSUREDS provision

4) All policies shall be endorsed with WAIVER OF SUBROGATION in favor of Alabama Water Utilities, Inc. and Municipal Consultants, Inc.

5) Notwithstanding any other provision in these requirements, in the event of the occurrence of a casualty or other loss, and insurance maintained by Alabama Water Utilities, Inc. and Municipal Consultants, Inc. and Contractor are both applicable to such casualty or loss, then the insurance maintained by Contractor will be PRIMARY and NON-CONTRIBUTORY with respect to any insurance maintained by Alabama Water Utilities, Inc. and Municipal Consultants, Inc. All insurance policies shall include coverage for defense costs and related expenses.

6) Alabama Water Utilities, Inc. and Municipal Consultants, Inc. to be provided with thirty (30) days' advance written notice of any cancellation to the required insurance policies.

7) All insurance policies shall be issued by companies licensed to do business in the states where the Services are delivered and will be rated "A-"or better by A.M. Best (or as otherwise acceptable to Alabama Water Utilities, Inc..

8) Any Subcontractors used by Contractor for any part of the work provided to Alabama Water Utilities, Inc. under this contract shall be required to meet these same insurance requirements as set forth herein, including endorsement of their policies in favor of Alabama Water Utilities, Inc. and Municipal Consultants, Inc. Contractor shall be responsible for verifying and maintaining the certificates of insurance provided by each subcontractor. In the event that any Subcontractor engaged by Contractor fails to meet any of these insurance requirements, Contractor shall be required to include such Subcontractor as an additional insured under Contractor's insurance policies.

9) Prior to commencing work, Contractor shall provide Alabama Water Utilities, Inc. and Municipal Consultants, Inc. with certificates of insurance evidencing that each required insurance policy is in force. Contractor shall provide Alabama Water Utilities, Inc. and Municipal Consultants, Inc. with certificates of insurance promptly upon any modification or renewal of such required insurance policies.

10) Contractor shall provide Alabama Water Utilities, Inc. copies of any insurance policies, amendments and endorsements required hereunder upon request.

11) The insurance policies and other requirements stipulated herein are mandatory and shall not be cancelled, reduced in coverage or in limits.

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STANDARD SPECIFICATIONS GENERAL

SPECIFICATION
FOR

BASIS OF PAYMENT

SECTION 1

BASE BID

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 Specification-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.**

ITEM 1 - 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, 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 2 - REMOVAL & REPLACEMENT OF UNSUITABLE MATERIAL UNDER SPLITTER BOX AND DISK FILTERS

The item applies only to the unsuitable material under, and extending approximately 10 feet beyond, the footprint of the slab that supports the Splitter Box and the two Disk Filters. The exact area and depth of unsuitable material shall be determined by the Geotechnical Engineer based on the material encountered during construction. No payment will be made for excavation or for fill beyond the limit determined necessary by the Geotechnical Engineer. This payment item does not include any other material excavated and/or replaced in other parts of the project. This payment item shall cover the cost of removal of existing unsuitable material and its replacement with compacted crushed limestone as required by the contract. The quantity of material to be paid shall be determined by cross-sectional field measurement of the site after demolition of the existing Effluent Pump Station and UV structures and excavation of the unsuitable material. The Contractor shall retain an Alabama licensed surveyor to measure cross sections under the observation of the Owner's Engineer. The cross sections shall be measured both before excavation and after excavation of the unsuitable material. The licensed surveyor shall calculate the volume of the excavated area, and the Contractor shall furnish the stamped calculations to the Engineer for review. All measurements and calculations shall be provided to the Engineer for review. The Contractor shall be responsible for assisting the surveyor and the Engineer in safely and accurately measuring the volume of the excavation that will be replaced and in evaluating the subgrade and soil conditions in the excavation. The volume of the excavation to be paid shall be the gross volume with no deduction for the space occupied by the demolished effluent pump station or UV structure. There shall be no payment for material that the contractor removes without prior determination by the Geotechnical Engineer that its removal was required. The Contractor shall be responsible for dewatering and for keeping water out of the excavation.

The quantity shown is based on very limited data, numerous assumptions, and rough estimations. The quantity actually paid for may be substantially more or less and thus the Contractor shall use his actual cost in the unit price he bids. The Contractor shall be careful not to order or take delivery of excessive stone until he knows that it will be required as he will not be paid for stone not installed and he must haul off any stone not installed. All recommendations and determinations made by the Geotechnical Engineer shall be communicated to the Contractor by the Engineer.

ITEM 3 - LIMESTONE SURGE STONE

The Contract Unit Price per ton shall be payment in full for furnishing limestone surge stone imported from offsite and installing and forcing it into the subgrade under the slab for the splitter box and disk filters. The surge stone shall be installed as needed and as described in the Geotechnical Engineer Exploration report (pages 11 to 12). The need, location, and amount of

surge stone shall be as determined by the Geotechnical Engineer as the work progresses. The surge stone shall be 8 to 12 inches in maximum dimension unless modified by the Geotechnical Engineer after excavation has been completed. It is anticipated that the surge stone will be placed in an approximately 24" layer beginning after 15 feet of overburden has been removed. The surge stone will then be driven and forced into the subgrade with a large, heavy smooth drum roller acceptable to the Geotechnical Engineer. The process may then be repeated with a second 24" layer which will also be forced into the previous layer of surge stone and subgrade. The thickness of the layers of surge stone may be adjusted by the Geotechnical Engineer based on the subgrade conditions observed after excavation of the overburden. The installation method shall be acceptable to the Geotechnical Engineer and shall develop a strong subgrade as necessary to support the Splitter Box and the Disk Filters without settlement. The Contractor shall be responsible for dewatering and for keeping water out of the excavation. Payment will be made based on the weight installed in the locations and by the methods designated by the Geotechnical Engineer. No payment will be made for quantities not designated by the Geotechnical Engineer. All recommendations and determinations made by the Geotechnical Engineer shall be communicated to the Contractor by the Engineer.

ITEM 4 - GEOTEXTILE FABRIC

The Contract Unit Price per square yard installed shall be payment in full for the furnishing of all labor, materials, equipment, and all incidentals necessary to install the Geotextile Fabric. This item shall be used to pay for Mirafi 600X filter fabric or other fabric determined during construction based on the need. If determined necessary by the Geotechnical Engineer during site excavation, this material shall be installed where designated.

ITEM 5 - LEAN 2,000 PSI CONCRETE IN PLACE

The Contract Unit Price per cubic yard shall be payment in full for furnishing, forming, and installing lean, unreinforced 2,000 psi concrete as required by the Engineer. Payment shall be based on in-place quantities measured by the Engineer. This item of payment shall not be used for concrete shown on the Plans or called for in the Specifications. This item shall only be used where determined necessary by the Engineer during construction. This item shall include the removal, handling, and disposal of unsuitable soil/material when the lean 2,000 psi concrete is to be used as a replacement material. Unauthorized concrete will not be paid for.

ITEM 6 - DUCTILE IRON FITTINGS – 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. The extra fittings may be due to locations of existing utilities, piping, structures, or other existing facilities that must be avoided or due to the Engineer's requirements. Fittings requested by the Contractor to avoid certain soil conditions (e.g., rock) will be not 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.). This item shall include all incidentals associated with this work.

ITEMS 7 and 8 - SIDEWALKS/MOWSTRIPS & ASPHALT PAVING

The Contract Unit Price Bid shall be payment in full for the furnishing of all labor, materials, equipment, and all incidentals necessary to install the following surfaces at locations determined during construction by the Owner and Engineer:

1) New sidewalks/mowstrips per Standard Details in new locations not shown on the drawings. Replacement of existing sidewalks that are damaged or removed during construction shall be considered an incidental and will not be paid under this item.
2) Asphalt paving per Standard Details for areas where it was necessary to remove existing asphalt paving in order to construct the work. The Contractor shall use care throughout construction such that it is not necessary to remove more asphalt paving than necessary.

These items shall include, but not be limited to, all excavation; fill; compaction; base; stone; crushed stone cushion under paving; milling when required; asphalt including tack coat seal on base before binder is applied; concrete; concrete curbing; concrete guttering; reinforcing; installation of joints; joint material; forms; compacted base; and all incidentals necessary and required to complete the work in accordance with the Plans and Specifications.

These items shall not be used to pay for repairs or replacement of sidewalks/mowstrips, asphalt paving, or concrete paving where such surfaces are unnecessarily affected by the Contractor's installation of piping, conduit, or any other activities. The cost of such repairs or replacement shall be included in the Contractor's Lump Sum Bid for Pay Item 9 (Construction of WRRF Improvements).

ITEM 9 - CONSTRUCTION OF WRRF IMPROVEMENTS

The Contract Lump Sum Price shall be payment in full for the furnishing of all labor, materials, equipment, and all incidentals to construct the proposed WRRF Improvements and all components. It shall include all demolition work required, all structures, all modifications, rebuilding the existing Traveling Bridge Filters, bypass pumping and all other accommodations needed to perform work in existing facilities that must be kept in operation, all electrical work, all SCADA work, all piping and fittings (except for "Extra" Fittings as described under the "Ductile Iron Fittings – Extra" pay item), and all excavation, fill and backfill (except for the

removal and replacement of unsuitable material as described under the "Removal & Replacement of Unsuitable Material Under Splitter Box & Disk Filters" pay item), and other miscellaneous work. It shall include all appurtenances, incidentals, and miscellaneous equipment shown or specified for these facilities or as reasonably inferred or required for complete and operable facilities, in full compliance with the Contract. It shall include all work not specifically paid for under another pay item.

ITEM 10 - ALLOWANCE FOR OWNER USE:

This item shall be used at the sole discretion of the Owner. This item shall not be used to pay for any work that is required by or reasonably inferred to be required by the Contract. In order for this item to be used, the Owner will issue a directive to the Contractor. All requirements of the Contract will apply to any work performed under this item.

ITEM 11 – ALLOWANCE FOR START-UP AND USE OF THE WRRF IMPROVEMENTS AND COMPONENTS

The Contractor Lump Sum Allowance shall be paid for furnishing the Owner the operable and completed water resource recovery facility improvements which have 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 testing, adjustment, coordination with controls and other equipment, startup, operator training, demonstration that the equipment complies 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 plant's components are an integral part of the entire WRRF needed by the Owner. 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 plant components must be in operation, however the following work elements, generally cosmetic, do not have to be completed: painting of items which can be properly painted after treatment components are in service; and cleanup not necessary or desirable for plant operation.

ALTERNATE DEDUCT

ITEM 1A - DELETE REBUILDING OF TRAVELING BRIDGE FILTERS

The Contract Lump Sum Price shall represent a deduct from the Lump Sum Price for Bid Item 9 – "Construction of WRRF Improvements". The deduct shall include the deletion of the following work associated with the existing Traveling Bridge Filters:

The demolition work applicable specifically to the to the traveling bridge filter equipment itself (i.e. the bridges, the rails, the sand, and the underdrains) shown on Drawing D-4 will not be required. However, the influent and effluent piping must be demolished and must be replaced with larger piping as shown on sheet 14, and the rerouting/replacement of the 6" mudwell discharge piping line must be performed. With the exception of the new influent piping, new effluent piping, and 6" mudwell discharge piping, and note 8 on TBF-1 regarding piping modifications (filtration required, careful sequencing, and bypass pumping), none of the traveling bridge filter or associated handrail work shown on Drawings TBF-1 and TBF-2 will be required. None of the work indicated on sample drawings TBF-3 through TBF-9 will be required except for connection of the new power circuits to the existing festoon system. None of the work specified by the "Specification For Rebuilding Traveling Bridge Filters (Automatic Backwash Filters)" shall be required.

The interior components of the existing traveling bridge filters (including the bridges themselves, the rails, sand media, and the underdrains) shall be remain "as-is" with the exception that the influent piping shall be upsized to 30" diameter and the effluent piping shall be upsized to 30" diameter as described in the drawings. The bridge-mounted control panels and the electrical festoon system shall remain "as-is". The existing handrail associated with the traveling bridge filters shall remain "as-is".

All electrical demolition work shown on Drawing E1.01 shall continue to be required with the exception of the work inside the dashed rectangle identified as "(EX) TRAVELING BRDIGE FILTERS" and its associated Note 2. The electrical work shown on Electrical Drawings E1.04 and E4.01 shall continue to be required with the only exceptions being that the new festoon cables will not be required nor will it be necessary to connect wiring to the bridge-mounted pumps (backwash pump, washwater pump, and scum pump).

Note that new power supplies from the proposed 480 volt power panel PP-FILT to the existing traveling bridge filters will continue to be required. The new power supplies and all required work pertaining to the existing Mudwell Pump Station on the south side of the traveling bridge filters will continue to be required. The new power supplies to the existing traveling bridge filters and all work associated with the Mudwell Pump Station must be completed and fully operational prior to beginning the demolition of Control Station G or the demolition of the existing circuits from Control Station G to the traveling bridge filters and the mudwell.

Only the items specifically changed above will be deleted. All other work shall be performed in accordance with the drawings and specifications.

SPECIFICATION
FOR
GENERAL REQUIREMENTS

SECTION 2

1.0 SHOP DRAWINGS, SUBMITTALS, AND O&M MANUALS

In addition to all the requirements in the Standard General Conditions, the Contractor shall mark out (strike through) all information in Shop Drawings, Submittals, and O&M Manuals that does not apply specifically to this project. Where certain items may be described as "optional" in the manufacturer's standard literature, the Contractor shall mark out the optional indication if the "option" is provided. If the "option" is not provided, the Contractor shall mark out the optional indication and the entire item to make it clear that the "optional" item is not being provided.

Shop Drawings and submittals shall contain sufficient information for the Engineer to clearly determine – if he desires – if the proposed item fully complies with all the requirements of the plans and specifications. However, there shall be no duty on the Engineer to review the shop drawings or submittals and it is the responsibility of the Contractor to verify that the proposed items fully comply with all requirements.

Submittals and other information shall contain clearly written storage instructions specific to this project.

Manufacturers shall prepare detailed O&M Manuals that include clear descriptions of all potential hazards and safety procedures associated with the use of the item covered by the O&M Manual.

Each O&M Manual shall contain a Maintenance Summary table that clearly outlines all recommended maintenance including frequency and required lubricant type and amount. The Maintenance Summary table shall be separately and clearly tabbed to allow it to be quickly and easily located by maintenance personnel.

2.0 EQUIPMENT STORAGE

All equipment shall be properly stored in accordance with recommendations of the manufacturer. All equipment shall be properly maintained during storage in accordance with recommendations of the manufacturer. This shall include special storage lubricants and periodic rotation if applicable. Any special storage lubricants shall be drained, the equipment properly flushed, and the proper lubricant applied prior to startup. Any spillage shall be promptly cleaned.

Unless specifically called out to the contrary, all electrical panels shall be stored indoors with a low wattage light bulb in their interior to reduce the potential for condensation. Where impractical to store large equipment indoors and if such equipment is designed for outdoor installation, the electrical panels shall be stored with a low wattage light bulb in their interior to reduce the potential for condensation and shall be appropriately covered in a manner to prevent condensation from forming under the cover.

3.0 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.

SPECIFICATION
FOR
PERFORMING WORK IN EXISTING FACILITIES

SECTION 3

1.0 GENERAL

This project involves work in an existing water or wastewater (or "sewer") facility. Where the word "facility" is used in this specification, it shall be understood to refer to all lift stations, pumping stations, wet wells, pipes, vaults, valve pits, manholes, stormwater handling components, structures, basins, tanks, and treatment plants (both water and wastewater), etc. "Facility" shall include any and all components of a water or wastewater system. As such, there are many unavoidable risks associated with many aspects of the work. It is the responsibility solely of the Contractor to always identify all risks and to take all appropriate precautions. This section contains some very basic introductory information to remind the Contractor of some - but by no means all - of the many additional safety matters that may be encountered by the Contractor when working in existing facilities. All these and others must be understood, considered, and properly addressed by the Contractor. This partial listing of some examples of additional hazards in existing facilities by no means includes the many other safety issues inherent in all construction. It is the duty of only the Contractor to recognize and identify all the dangers – including the many dangers not listed - that he may encounter in this project and to take all the actions necessary for proper safety.

Pumping Stations, Lift Stations, Water and Wastewater Treatment Plants, and all other facilities contain many dangers and many safety hazards. These include, **but are by no means limited to**, such dangers as confined spaces, deadly atmospheres with dangerously low oxygen levels, toxic and explosive gases, etc., potentially hazardous (poisonous) gases and chemicals stored and used onsite, natural gas lines and gas facilities, digesters and digester gas (explosive methane), piping and facilities, sewage and sludge with pathogens (infectious disease hazards), non-potable water systems (water systems containing water that is not safe to drink or wash with, etc.), electrical hazards, falling hazards, drowning hazards, unanticipated equipment starting, rotating or moving equipment, and trench dangers, among many others. Note that power in a panel, an enclosure, or at equipment, etc., may originate from multiple, different and independent sources. Therefore, turning off the main power supply for a panel often will NOT kill all power in the panel. The Contractor shall have a thorough understanding of all the dangers and hazards associated, or possibly associated, with this type of work. This shall also include all additional potential dangers not listed herein. It shall be the responsibility solely of the Contractor to fully educate himself and all his personnel, subcontractors, and suppliers, etc., regarding all the potential hazards and dangers. The Contractor shall fully understand all the possible hazards and dangers and shall continuously follow all appropriate safety procedures at all times. The Contractor shall ensure that all his personnel and all subcontractor personnel, suppliers, etc., follow all appropriate safety precautions at all times. Continuously and fully comply with all OSHA regulations and requirements, etc. and always follow good, effective safety practices.

When working on equipment and circuits in existing facilities, the Electrical Subcontractor shall always positively lock off the power supply to all the components on which or near which he will be working. It shall be the responsibility of the Contractor and his Electrical Subcontractor to positively determine the correct circuit(s) to be locked out. He shall lock out all such circuits with his own padlocks. He shall tag out the facilities not to be made hot in accordance with OSHA procedures. All such work shall be carefully coordinated with the Owner. The Contractor shall provide clear written notice to the Owner and Engineer that the facilities have been locked out and are not to be operated unless the Contractor removes his lock and advises the Owner in writing that it is safe to restore power and operate the facilities. All interruptions must be carefully coordinated with and approved by the Owner. It shall be the responsibility of the Contractor (and his Electrical Subcontractor and other subcontractors, etc.) to always perform all work involving existing facilities in a careful and safe manner. See other important requirements in the project plans and specifications regarding work in existing facilities and interruption of existing facilities.

The Contractor should anticipate that the equipment in operation, flowrates, and conditions in the facility, etc. may change numerous times throughout a day as well as throughout the duration of the project. Equipment can suddenly start automatically and unexpectedly at any time. Equipment can start in response to water levels, flowrates, time clocks, remote controls, levels of various products, rainfall, the operation of other equipment, or due to many other reasons. Some equipment operates silently or very quietly and can present an unheard hazard.

In addition to panel, equipment, or similar type hazards, many additional electrical hazards can exist due to buried wiring and conduits, overhead wiring, exposed wiring, wiring concealed in walls, floors, or ceilings, etc. The exact location and depth of buried conduits is unknown. Any locations shown on drawings should be considered only a rough approximation of the general area where an electrical facility may be located. Overhead wiring and other wiring or conduits are often not shown on drawings, and it is the responsibility solely of the Contractor to always take appropriate safety precautions and to carefully locate all wiring.

The Contractor shall understand that most hazardous atmospheres in water and wastewater systems or plants or other facilities, etc., cannot be detected by smell as most have no odor. The Contractor shall also note that the atmosphere in confined spaces and other areas is always subject to change – sometimes dramatically and quickly – due to a wide variety of causes. Atmospheres that were not dangerous when previously entered may suddenly become deadly for many different reasons.

The Contractor shall be alert for buried and exposed natural gas, LP gas, or propane gas lines, etc., and other facilities that may be potential hazards.

The Contractor shall be aware that all components of existing facilities are subject to deterioration and failures due to corrosion, aging, overuse, insufficient maintenance, or many other reasons. The Contractor shall never assume that existing components of facilities will operate as originally intended when they were first installed. Ladders, handrails, access doors, grating, manhole steps, valves, flow control gates, electrical items, ventilation fans, exhaust fans, and many other components, etc., are always subject to failure. Existing alarm devices of all types should not be relied upon by the Contractor as his sole source of

protection. The Contractor shall always provide his own equipment to allow safe working in existing facilities.

The Contractor shall be aware that this is an operating facility and that facility personnel must make their rounds through all areas and buildings in Plants or Lift Stations or other Facilities at any time during the day or night. Even if a Facility is unstaffed or only staffed for one shift per day, etc., it is possible that operators or maintenance personnel may have to make repairs at night. Operators or maintenance personnel may have to access Facilities (including for emergency outages) at anytime, day or night. As such, the Contractor must carefully plan his activities and always provide adequate safety barriers and other measures as desirable, etc., to continuously protect Pumping Station, Lift Station, plant, and all other facilities personnel and visitors, as well as his own personnel.

The Contractor shall provide temporary facilities for safety, including but by no means limited to, guardrails, barriers, fencing, covers over openings, lighting, and signs, etc., as desirable for the protection of his own personnel and subcontractors and the facility visitors and personnel who must operate and maintain the facility throughout the course of construction. Additionally, the Contractor shall provide temporary walkways, steps, or pedestrian bridges or similar temporary facilities where access to existing structures or buildings, etc., are interrupted, or made inconvenient, or made potentially unsafe, etc., by the activities of the Contractor. The Contractor shall perform his work and maintain clean and clear passages in a manner to eliminate tripping hazards during construction to the greatest extent possible. The Contractor shall promptly remove all his equipment, materials, and supplies, etc., not immediately needed from areas where the Owner's operation and maintenance personnel must periodically walk, inspect, check, observe, or maintain equipment, etc.

Pumping Stations, Lift Stations, Plants, and all other facilities have many hazards from which the general public must be protected. The Contractor shall always perform and coordinate all his work to maintain the facility security. This shall include, but not be limited to, continuously maintaining secure fencing around the entire site (or sites if there is more than one site) at all times. Temporary fencing that properly maintains facility security shall be provided at all times whenever the existing fence is removed or whenever the existing fence does not provide adequate security. The Contractor shall be responsible for locking and controlling access through gates and for taking other measures as applicable to maintain a secure site at all times, whether or not work is ongoing.

Safety is the responsibility solely of the Contractor. Neither the Owner nor the Engineer have any duty to review the safety practices of the Contractor.

Wet wells and valve pits, and many other structures, etc. are confined spaces. As with other wastewater and water treatment components and tanks, they should always be assumed to contain deadly atmospheres. The contents of such atmospheres at lift stations and in treatment plants can vary and can suddenly and unexpectedly become deadly due to a wide variety of reasons. Effective gas monitoring and effective ventilation, as well as other safety procedures, shall always be carefully utilized by the Contractor at all times. The Contractor is solely responsible for identifying confined spaces and facilities that are potentially dangerous or may become dangerous. The Contractor should anticipate that the equipment in operation, flowrates, and conditions in the facility, etc. may change numerous times throughout a day as

well as throughout the duration of the project. The Contractor shall always carefully and fully comply with all OSHA requirements.

Whenever the Contractor turns off power to existing equipment or new equipment, he shall always carefully verify that the correct breaker(s) and disconnect switches, etc. have been correctly locked out. He shall always be alert for confusing, outdated, or incorrect labels for breakers and equipment, etc. He shall always determine if and verify that labels are correct. The Contractor shall be aware that electrical drawings and diagrams, etc., for existing wiring and equipment, etc., are often incorrect. Electrical drawings are often outdated due to changes that have been previously made both during construction and after the original facility was initially constructed. It shall be the responsibility of the Contractor to identify the actual circuits and wiring, etc., that must be turned off and/or disconnected, etc., so that the work can proceed safely.

The Contractor shall always utilize only project personnel who are completely knowledgeable about and fully understand all the risks and potential safety hazards to which they will or may be exposed. The Contractor shall not use personnel – and shall not allow any subcontractor, etc., to use personnel – who will not carefully follow all appropriate safety precautions at all times.

The sole purpose of this section is to remind the Contractor of his duty to properly address the many dangers throughout the existing facilities. It is not the intent of the plans or specifications, nor is it possible for the plans or specifications, to list all the possible dangers that will be encountered or all the actions the Contractor is required to take to insure that his work is always performed in a safe manner. It is the duty of the Contractor to be knowledgeable about all the potential hazards associated with this project. It is the duty of the Contractor (and only the Contractor) to identify all possible hazards and to take all actions necessary to keep all persons at the site safe.

2.0 RESTRICTIONS ON INTERRUPTIONS AND/OR BYPASS PUMPING

The improvements in this project will be constructed in an operating pumping station, lift station, and/or treatment plant or facility that must remain in operation throughout construction. Where the word "facility" is used throughout this specification, it shall be understood to refer to any component of a water or wastewater system. The Contractor shall carefully plan and conduct his work in a manner that minimizes the interruption of normal facility operations. The following restrictions on the interruption of normal facility operations and other sequencing notes are made for the Contractor's benefit and to advise the Contractor of certain sequencing requirements for this project. All appropriate sequencing details, requirements, and limitations, etc., on interruptions of normal operations have not been listed. It is the responsibility of the Contractor to plan all work and conduct it in a manner such that the pumping station(s), lift station(s), plant, or other facilities can be maintained in operation, to prevent bypassing or permit violations, and to avoid damage to existing equipment and facilities.

The Contractor shall maintain access for the Owner to all existing facilities throughout construction. The Owner must have access to all facilities for operation and maintenance. Where it is necessary to cut roads, the Contractor shall schedule this with the

Owner and Engineer and shall backfill the cuts as quickly as possible to allow the Owner access. If the Contractor interrupts a utility (e.g., power, phone, internet, water, natural gas, sewer, etc.) or a treatment process or pipeline, he shall immediately notify the Owner and Engineer and restore service as quickly as possible.

Prior to beginning the work, the Contractor shall develop a detailed schedule for all work clearly indicating where interruptions to normal operation are required. However, the failure to include such work in the schedule or the duration of the work, nor any changes in the schedule, etc., shall not constitute a justification for an increase in construction time or an increase in cost.

The plans and specifications may contain some partial construction sequencing notes. These notes are provided for the Contractor's benefit to help him understand at bidding time that construction sequencing will be an important part of the project that must be considered during bidding and construction. These notes are not a detailed or complete sequence but rather a very general guideline and a listing of some minimum requirements. These notes shall be considered by the Contractor in preparing his detailed construction sequence and project schedule. It is the duty solely of the Contractor to understand water and wastewater facility operations and to fully consider all restrictions associated with this type of work in the interruptions of existing facilities. The Contractor shall bid and plan his work accordingly.

Tie-ins and interruptions of existing facilities (i.e. pumping stations, lift station(s), and/or plant(s), etc.) can be done only at certain times when (1) the flowrate into the facility is sufficiently low, (2) rainfall is not forecast to occur until well after the tie-in work has been fully completed, (3) the operator workload allows them, and (4) facility limitations, etc., allow them. For water plants and water systems, additional factors may include extent of dry weather and water customer demand, etc. Tie-ins or other interruptions of normal facility operations shall not be performed when the SCADA System is not capable of properly receiving and issuing all alarms. Carefully coordinate all such work with the Owner and make requests for interruptions through the Engineer in a timely manner. Carefully plan work to insure it can be fully completed within the allowable period of interruption to be established by the Owner. The allowable schedule for performing the work addressed by this specification and other interruptions shall depend on existing and anticipated facility flows, as well as other limitations. The work shall not be performed at a time that is not suitable to the Owner. The work shall not be performed at a time that may jeopardize permit compliance.

If bypass pumping is required or needed to perform the work, it shall be designed by and provided by the Contractor. The bypass pump(s) must be capable of handling the highest peak flow that may be expected or was experienced in the past. In addition to the bypass pump (or pumps) required to handle the highest peak flow, a stand-by bypass pump shall be provided. The standby pump capacity shall be at least equal to or greater than the largest duty bypass pump. The stand-by pump shall be piped and controlled so that it will start functioning automatically and immediately if one of the duty pumps fails or if a high level is reached. The standby pump control system shall be independent of the duty pumps so that a failure of the duty pump controls will not prevent operation of the standby pump. The Contractor shall have a qualified and dependable person on the jobsite who shall carefully monitor the bypass pumping continuously (24-hours per day, including weekends and holidays)

whenever it is in operation or set to start automatically or set to start when needed. Monitoring by video camera or similar monitoring does not meet the requirement to have a person on the jobsite. All bypass pumps shall be in high quality acoustic enclosures that will prevent complaints from neighbors. All bypass pumps (including the standby pump) shall be new, or in like-new condition, and shall be highly dependable. All bypass pumps shall be fully tested before delivery to the jobsite. Once installed, all pumps, all their controls, and all the bypass piping shall be fully and completely tested to ensure proper functionality before taking any existing components out of service. Install floats or other controls such that entanglement (which could prevent proper functionality), etc., is prevented. The entire bypass pumping system must be highly reliable. The Contractor shall be solely responsible for any failure of his bypass pumping system. If other bypass pumping requirements are contained in either the plans or specifications, the more stringent requirements shall prevail. No additional payment will be made for bypass pumping unless additional payment is clearly established by the Basis of Payment and specifically approved by the Owner prior to the pumping.

Where a facility utilizes UV disinfection, chlorination, and/or dechlorination, such treatment must be provided continuously. The Contactor shall not take UV, chlorination, or dechlorination facilities offline until all new disinfection facilities have been fully tested, are in reliable operation, are capable of fully complying with all permits regulatory requirements, and the SCADA system is sufficiently complete that it will send a remote alarm in the event of a problem or failure.

Some tie-ins and interruptions at water and wastewater facilities are best performed during and may be restricted to early morning hours (e.g., from 12 a.m. to 5 a.m.) during dry weather. Where appropriate to facilitate work, the Contractor shall perform as much work as possible in preparation for making the actual tie-in. This shall include work such as: thorough coordination with the Owner and Engineer; having all required materials on-site and ready; preassembly of fittings, piping, etc. to the greatest extent possible; verifying satisfactory operation and dependability of all equipment to be used for completing the tie-in; having back-up equipment and materials on-site and ready for immediate operation in case monitoring by video camera or similar monitoring does not meet the requirement to have a reliable person on the jobsite original equipment malfunctions or fails or if additional material is needed, etc.

The Contractor shall carefully plan all interruptions and ensure that all material and equipment are onsite prior to initiating an interruption. The Contractor shall have backup (spare) equipment onsite and completely ready to be immediately used to ensure the work can proceed expeditiously if the primary equipment fails. For each requested interruption in normal operations, the Contractor shall provide the Owner and Engineer a detailed, step-by-step, written description of and schedule for (1) how he plans to make the tie-in or other work activity, (2) the equipment, materials, and personnel that he will have on hand, and (3) his schedule for fully completing all the work required. This description shall be submitted for Owner consideration a minimum of seven days before requested interruptions.

Note that when structures and pipelines, etc., are isolated for the purposes of making tie-ins, etc., the Contractor shall expect that existing valves and gates will be difficult to operate and will leak. It shall be the Contractor's responsibility to handle these leakages. The Contractor is responsible for properly handling any sludge, sewage, grit, and material,

etc., remaining in the piping or force mains, tanks, or other structures after they are drained to the extent possible.

Once an interruption is initiated, the Contractor shall work expeditiously to complete the work as soon as possible and to return the facility to normal service. The Contractor shall not divert resources away from completing the work until the work has been completed and the facility returned to normal operation. Generally, an interruption shall not extend beyond normal business hours of the same day it was initiated. If it is necessary for the interruption to extend beyond the end of the day, the Contractor shall work continuously if approved or if requested by the Owner to return the facility to normal operations. Interruptions shall not be initiated on Fridays. Interruptions shall not extend into a weekend or holiday.

The Contractor shall email to the Engineer and Owner a list with Contractor cell phone numbers or other emergency numbers to allow the Contractor's personnel to be contacted should an emergency develop during an interruption or after an interruption has been completed. This phone list shall also include the Contractor's electrical subcontractor, systems integrator, SCADA personnel, and any other appropriate personnel who may be able to provide assistance in an emergency. Additionally, a copy of this list shall be posted in the facility's main office.

The Contractor shall be responsible for any and all damages and costs due to his activities including but by no means limited to flooding, overflows, bypassing, and fines, etc.

3.0 ELECTRICAL, CONTROL, AND SCADA CONSIDERATIONS

This is an operating facility. Where the work requires the modification, abandonment, or removal of existing electrical facilities, the existing facilities must remain in operation until such time as the Contract states that they may be removed. Unless stated otherwise, existing facilities must remain in normal operation until the new replacement facilities have been completed, started up, proven to be ready for reliable operation, and approved for permanent service. Any and all work involving the existing electrical system, control system, or SCADA system, etc., must be carefully coordinated by the Contractor with the Owner through the Engineer. Existing electrical, control, or SCADA circuits may be de-energized or removed from service only with the approval of the Owner. Where shutdowns or interruptions may be allowed, the allowable duration of such shutdowns may be extremely brief. The timing for performing such work, as well as the allowable duration of the interruption, will be limited by factors such as recent rainfall, predicted rainfall, plant operations, plant limitations, or other situations. The Contractor shall develop a detailed step-by-step written plan of his proposed activities during any requested interruption. The written plan shall be furnished to the Engineer for review. Whenever the Contractor is working on a circuit that must be de-energized, he shall insure that all possible power sources are locked out with his own padlocks. Note that power in a panel, an enclosure, or at equipment, etc., may originate from multiple, different, and independent sources. The Contractor shall also tag all lockout locations with appropriate warning information. The Contractor shall also give written notice to the Owner (with a copy to the Engineer) regarding the work and the need to keep the power locked off until it is safe to re-energize.

When modifications to the existing SCADA system are required, the Contractor shall carefully plan all work and shall work promptly to ensure the SCADA system can be completed, fully tested, and returned to normal service as soon as practical. This work shall be coordinated in advance with the Owner. A detailed work plan and schedule shall be furnished to the Owner for his review of this work. The plan and schedule shall be modified if, in the Owner's opinion, such modifications are needed to provide the level of protection the Owner deems appropriate for facility operations. All possible preparatory work shall be performed prior to any necessary interruptions such that all interruptions can be reduced to the shortest possible duration. This shall include, but by no means be limited to, such tasks as pre-assembly of components, programming, testing, etc.

If a SCADA system (or Telemetry System or remote alarm system) is interrupted or modified during the project, it shall be returned to service the same day so that the Owner's personnel can receive alarms at all times including after normal work hours. The capability to receive alarms is especially important during construction projects and during startup as those are periods when there may be a greater potential for a failure or other problem to occur. The Contractor shall take special care not to interrupt alarms and to verify that all alarms, including new alarms, are properly functional during construction. Carefully and promptly verify by field testing the continued performance of any alarm that has been modified or may have been unintentionally modified or disabled by the Contractor's activities.

The General Electrical Notes and/or other notes in the drawings or specifications may contain further restrictions and information. However, neither the plan notes nor the specifications describe all the issues the Contractor will face in performing the electrical, control, instrumentation, and SCADA work.

4.0 SEQUENCING

As is typical when performing work in an existing facility that must remain in operation and in full compliance with its permit, some work in this project must be performed in a specific sequence to allow this.

Many connections and tie-ins to existing facilities or piping cannot be initiated until certain other work has been completed. These restrictions are not necessarily called out on the drawings or in this Specifications. In some cases, the connections and tie-ins cannot be performed until associated tanks or other facilities have been drained or modified. The Owner's approval must be obtained before such work can be performed. The Contractor shall be responsible for draining the tanks and associated piping, but only after receiving the Owner's clearly stated approval and the Owner's conditions associated with the approval.

This Specification and other sections of the plans or specifications contain only some examples of scheduling and sequencing considerations that will affect the project. These are listed for the convenience of the Contractor. There are many other considerations not listed but inherent when working in an existing wastewater or water facility. It is the responsibility of the Contractor to develop his own detailed schedule considering all the restrictions involved in performing the work.

The plans or other specifications may have some abbreviated sequencing notes regarding certain work items that must be performed in a particular sequence. These notes

may give only general sequencing considerations that shall be considered the minimum. The Contractor shall determine the full scope of the sequencing considerations for these items and present a step-by-step plan to the Engineer for comment.

In addition to the work where abbreviated sequencing notes are contained in the plans, there are other work items where sequencing is required but no sequencing considerations are stated. The Contractor shall be responsible for determining those work items and shall determine the full scope of the sequencing considerations and present a step-by-step plan to the Engineer for comment. It is the responsibility solely of the Contractor to determine and comply with all necessary sequencing considerations. The Contractor shall have and utilize project personnel with sufficient experience on similar projects in other pump stations, plants, and facilities and that have a high level of understanding of the type of work items where sequencing and/or plant interruption minimization are necessary. Note that the electrical work will also have to be carefully coordinated with the other work to fully comply with sequencing requirements.

5.0 OVERALL PROJECT SCHEDULE

The Contractor shall develop a schedule for his work that allows it to proceed in an orderly and logical manner. The schedule shall consider all requirements contained in the Contract as well as other restrictions inherent in performing the work in a facility that must remain in operation.

The Contractor shall carefully excavate to determine the location, depth, materials, orientation, and nature of existing piping, conduit, and other buried facilities in a timely manner to allow him to plan his work and order the appropriate materials. The actual location and depth of underground facilities is unknown. The Contractor shall perform this exploratory work carefully and early in the project before proceeding with other work, before making piping submittals, and before ordering materials that may be affected. This exploratory excavation shall be done wherever called for on the drawings, at all underground tie-ins, at all potential conflicts with new facilities, and wherever else desirable to avoid potential problems. The Contractor shall record the actual location and elevation of the piping and shall promptly provide field sketches to the Engineer showing this information. Field measurements are required where appropriate and should be completed in a timely manner. No extra time shall be given for changes necessitated by actual pipe locations, conflicts, type pipe, and fittings, etc.

To facilitate scheduling and final testing, piping, equipment, and structures shall be tested to the extent practical prior to formal testing.

6.0 EXPLORATORY EXCAVATION AND CONFLICTS

As is typical when performing work in an existing facility, there will inevitably be conflicts between the existing facilities (including but by no means limited to structures, piping, electrical components, underground conflicts, and above ground conflicts, etc.) and the proposed work. The Contractor shall carefully investigate, plan, and schedule his work to minimize the potential for all possible impacts of conflicts. These plans do not show all the

details necessary to avoid or address such conflicts. It shall be the responsibility solely of the Contractor to perform timely investigations of and explorations into all proposed work to learn of all conflicts and properly address them in a timely manner and in a method that is acceptable to the Owner.

7.0 MISCELLANEOUS

The existing conduit and electrical line locations and depths are not known and generally are not shown. In some cases, the assumed routing of wiring, conduits, or duct banks entering or leaving the pull boxes may be shown. The Contractor shall conduct his work carefully and coordinate with the facility staff. However, the staff does not know the exact location or depth of these lines. The Contractor shall carefully coordinate his excavation activity in the vicinity of suspected or possible electrical facilities with the facility superintendent.

Much information is based on drawings prepared for the previous construction of the facilities. Much of this information has not been and/or cannot be verified.

The Contractor shall provide adequate temporary support as needed to support existing piping, structures, electrical conduits or cables, and other existing facilities during construction. The Contractor shall be solely responsible for any damages or accidents due to his failure to support and protect existing facilities.

This project requires work in and connections to an existing, operating facility. As such, the Contractor should anticipate the problems associated with such work, including but not limited to, coordination of all work with the Owner (through the engineer) including making tie-ins, electrical tie-ins and modifications, and all other interruptions during suitable periods, thoroughly planning work activities to minimize interruptions of normal operations, maintaining plant safety at all times for the plant operations and maintenance staff, and leaking gates and valves, etc. Some activities may be best performed during the very early morning hours of dry weather. The Owner shall have the sole authority to make the final decision as to whether or not tie-ins and interruptions can be allowed at the time requested by the Contractor.

The Contractor shall be fully responsible for all fines and costs, etc., due to bypassing or inadequate treatment, or permit violations, etc., that are due to the Contractor's operations.

The above considerations do not include all the issues, sequencing, limitations, conflicts, or restrictions, etc., that the Contractor will face in performing the work and making modification and tie-ins (mechanical and electrical, etc.) required by the Contract. The Contractor shall expect and plan for such issues as they are inherent in making modifications in existing water and wastewater facilities. There shall be no extra time or payment for any such issues encountered in the performance of the work.

The Contractor shall remain fully and solely responsible for all safety associated with all interruptions, sequencing, conflicts, and all other work regardless of time limitations and other constraints, etc.

The Contractor should anticipate that wet wells, tanks, structures, basins, channels, and piping, etc., will contain debris, grit, and sludge, etc. It shall be the Contractor’s responsibility to remove and properly dispose of such material to the extent

necessary to properly perform the work required by the project. The material shall not be disposed of at a facility of the Owner. Where required by the Contract or necessary to perform, all such material shall be removed, and the location cleaned from which it was removed. Comply with all environmental regulations in the disposal of all removed materials.

Coordinate and cooperate with other Contractors, subcontractors, manufacturers, suppliers, and vendors, etc., who may be working on the same project or at the same location(s).

All equipment and processes shall be tested to the maximum extent practical prior to placing them into service. It is the responsibility of the Contractor to test all facilities in compliance with the Contract.

All equipment shall be operated trouble-free a minimum of 7 -10 consecutive days prior to being placed into service unless indicated otherwise. New facilities must be approved by the Owner to be placed into operation before they may be placed into service. Where allowed, pump disinfected plant effluent water or clean stream water to test units. Clean any remaining debris, etc. Unless explicitly stated otherwise, the Contractor shall purchase any potable water used for testing and cleaning, etc. The Contractor shall be solely responsible for providing all pump(s), piping, fuel, and labor, etc. necessary for such testing. To facilitate scheduling and final testing, piping, equipment, and structures shall be tested to the extent practical prior to formal testing.

No demolition shall be performed until the replacement process and all associated piping and controls and alarms, etc., that are necessary for proper operation, etc., have passed testing, been started up, and been approved to be placed into service. The Contractor must request in writing the Owner's approval to demolish structures on a case-by-case basis. Approval of the Owner must be obtained on a case-by-case basis before demolition can be performed. The Contractor shall carefully plan demolition. The Contractor shall take all proper safety precautions when demolishing any item particularly any that contains, or any that may have previously contained, any potentially explosive or flammable or hazardous materials, etc. The Contractor shall not damage any item not intended to be demolished. He shall carefully protect facilities intended to remain in operation.

Where demolition will include, or potentially may include any wiring or any electrical items, the Contractor shall first verify that all possible sources of power have been definitely identified, locked off, and tagged out. The Contractor shall be aware that drawings of existing facilities may not show, or may not accurately show, all electrical wiring, components, circuits, or power sources, etc. Circuits may be mislabeled or may have been changed from available drawings.

New facilities must operate trouble-free in the intended mode of normal operation for a minimum of seven consecutive days unless indicated otherwise before they may be placed into service. New facilities must be approved by the Owner to be placed into operation before they may be placed into service. See other requirements elsewhere.

If the Owner determines it is in his best interest, he may allow new facilities to be placed in operation due to extenuating circumstances. However, if this occurs, it shall not be an indication of any of the following: (1) that the facilities are complete, (2) the facilities have met the requirements of the "Start-up and Use of …" payment item, (3) the facilities have been accepted, or (4) the facilities meet all Contract requirements. It shall not be an

indication that the warranty for the facilities has started. The Owner shall not be obligated to make full payment on such facilities but may withhold a sufficient amount to fully pay all costs (including any remediation costs to correct non-complying work) associated with bringing the project into full compliance with the Contract.

Due to the need to schedule the work such that some new facilities will be in operation while others are still under construction, it will be necessary for the Contractor to clearly communicate to the Owner and Engineer regarding his plans and the status of equipment that he has installed. These communications shall be clearly stated in writing which will help the personnel (including evening shift and weekend shift as applicable) at the Facility to receive the instructions. The Contractor shall lock out with his own padlocks any equipment that he does not intend for the Owner to operate. The Contractor shall take other means as appropriate to prevent accidental damage to equipment due to the sequencing associated with the project.

Due to the work being performed in an existing Facility that must be staffed, operated, and maintained, the Contractor shall take appropriate actions to prevent all operating and maintenance personnel (including, but not limited to, all shifts other than the normal day shift, as applicable) from being injured due to the Contractor's activities. It shall be the duty solely of the Contractor to determine these actions and to provide any and all temporary barriers, walks, lighting, closures at openings, warning signs, and whatever other measures may be desirable to protect the operators.

The Plans and Specifications do not list all scheduling or sequencing considerations. These shall be developed by the Contractor as he plans his work with the understanding of the necessity to keep certain lines, processes, equipment, and tanks online until new processes are tested and ready to be placed into operation.

Some interruptions of Facility operation or tie-ins, etc., may require bypass pumping and the associated temporary piping. The Contractor shall bid and plan his work accordingly. It may also be necessary to pump flow or tank contents from one tank to another to allow certain work to be performed. Multiple such transfers may be needed. The plans and specifications do not necessarily call out all the various bypass operations that will be needed to properly perform the work. The Contractor shall provide bypass pumping wherever needed to properly perform his work.

All costs associated with performing all the work in this existing plant while maintaining existing plant operations shall be included in the price bid. There shall be no extra payment or extra time due to the necessary sequencing and procedures necessary to properly perform the work while allowing the existing plant to remain in operation. There shall be no extra payment or extra time due to the Contractor's failure to properly plan all required work activities and material acquisition.

See the plans and specifications for other information that will affect scheduling and sequencing. See the "All Equipment" specification for additional information regarding start-up and training. The "All Equipment" specification applies to all equipment provided on the project.

While some restrictions regarding scheduling and sequencing are listed, and some requirements for exploratory excavation, etc., are contained in this Specification, this by

no means relieves the Contractor of his responsibility for the means and methods of construction or for safety.

The above considerations do not include all the issues, sequencing, limitations, or restrictions, etc., that the Contractor will face in performing the work and making tie-ins (mechanical and electrical, etc.) required by the Contract. The Contractor shall expect and plan for such issues as they are often inherent in making modifications in existing water and wastewater facilities. There shall be no extra time or payment for such issues encountered in the performance of the work.

The Contractor shall diligently keep construction-related dust, dirt, and mud etc. off of roads in existing facilities. Promptly clean off any such substances that get on roads in facilities as well as other roads. Clean roads multiple times per day if needed or if requested by the Owner.

The Contractor shall limit his use of existing facility roads to those that must be utilized for access. When temporary construction roads are called to be constructed to limit the Contractor's use of existing roads, the Contractor shall construct those roads in a timely manner to avoid the use of the existing roads. The Contractor shall be responsible for designing and maintaining his construction roads. Do not block drainage with temporary roads. If requested by the Owner, remove construction roads when no longer needed. The Contractor shall be responsible for damage to existing roads that were used when his construction roads were supposed to have been used instead.

The Contractor shall carefully coordinate with the Owner regarding access through normally closed or locked gates to the facility. The Contractor shall insure that facility access gates are closed and/or locked when he leaves the facility so that unauthorized persons cannot get into the facility.

Unless specified otherwise, the Contractor shall provide the labor to operate valves, slide gates, and sluice gates, etc., as needed to control flows, etc., during construction. All valve and gate operation shall be very carefully coordinated with the Owner through the Engineer to avoid confusion or misunderstanding or incorrect operation. No valves or gates shall be operated by the Contractor without the presence at the valve or gate of the Owner's facility operator who can confirm that that correct valve or gate is being properly operated and that the operation will not have unintended consequences. At the appropriate time, and with the presence of the Owner's operator, restore the valve or gate to the previous position as needed. Note that valve or gate operation has the potential to cause sewage or sludge to overflow to the stream where it can have serious consequences and result in fines, etc.

These requirements apply throughout the entire course of construction including but not limited to prior to mobilization, mobilization, demolition, construction, startup, troubleshooting, inspections, change order work, demobilization, and warranty work, etc.

STANDARD SPECIFICATIONS

BUILDING (GENERAL) AND SITEWORK

STANDARD SPECIFICATION

FOR

DEMOLITION

SECTION 1

Prior to initiating demolition in an area, the Contractor shall ensure that all potential power sources to or through the demolition area are padlocked in the off position such that they cannot be unintentionally repowered. Note that buried, encased, concealed, or hidden sources likely will not be evident. The Contractor shall be alert for and understand the potential for mislabeled circuit breakers, multiple sources of power, etc.

The Contractor shall ensure that piping or other facilities being demolished have been isolated and remains isolated so that unintended flow cannot enter the area being demolished. The Contractor shall be responsible for handling and properly disposing of any flow or material in piping or structures, etc.

No blasting is allowed for demolition.

Provide dust control as needed. The Contractor shall prevent dust from entering electrical panels or devices or motors or bearings or any other equipment or components that may be adversely affected by dust.

Where various items are demolished or removed but the structure and/or other components remain, cut off anchor bolts or similar appurtenances flush. Perform all demolition work (including any work where existing components or items are removed or relocated) in a manner such that uneven or sharp surfaces or edges, etc., that may present the potential for tripping or otherwise being injured do not remain.

Prior to proceeding with any demolition, the Contractor shall make himself fully aware of any components or structures or other items, etc. that are not intended to be demolished or disturbed, including but not limited to those within or adjacent to or in the vicinity of the demolition work. It is the Contractor's responsibility to carefully determine the components not to be damaged during demolition or modifications to existing facilities. Use care and do not disturb or damage any components or structures or other items, etc. that are intended to be reused or kept as is. If the Contractor damages any such components, or structures, or other items, etc., he shall promptly replace or restore them at his cost and in a manner that is satisfactory and acceptable to the Owner.

Where openings are being enlarged or cut in existing slabs and walls, etc., do not overcut beyond the inside dimension of the opening. Such overcut could severely weaken the structure and/or expose reinforcing steel to corrosion which will further weaken the structure.

Where only a portion of an existing structure or item, etc. is being removed or demolished, perform work in a manner that such that the remaining portion has a neat appearance. Sawcut paving and sidewalks, etc., at the boundary between the part being removed and the part remaining such that a smooth and straight edge remains. In general, much (or all) of the concrete being demolished will typically contain reinforcing steel.

The Contractor shall coordinate the timing and sequence, etc. for demolition. Where required by the plans or specifications, or where otherwise necessary to maintain plant or facility performance or permit compliance, the Contractor shall not initiate demolition until other work has been completed and, if appropriate, placed into operation.

The Contractor's responsibility for means, methods, and safety, etc. is the same during any demolition as during all other parts of the project. The Contractor is solely responsible for safety during all demolition and during any associated or similar work. Confined space hazards and other dangers may remain deadly even in abandoned structures or inactive structures or facilities, etc.

Where demolition or modification to existing structures or facilities, etc., results in potentially unsafe or dangerous conditions, the Contractor shall immediately install and continuously maintain adequate barriers, guards, and other facilities, and take other measures as needed to fully protect his personnel, plant personnel, and all other personnel and visitors, etc., from such conditions.

Do not allow any demolished material, debris, dust, mud, and other such substances, etc., to enter a process, piping, channel, or tank, etc., where it could potentially interfere with treatment or clog equipment or piping, etc. Promptly clean up any demolished material, debris, dust, mud, and other such substances, etc., resulting from demolition.

All equipment, components, debris, and any other material, etc. resulting from demolition shall be hauled offsite and disposed of at an acceptable landfill and in accordance with all environmental regulations. In some cases, the Owner may wish to keep some part of the equipment or materials, etc., in lieu of the Contractor hauling it off. In such cases, the Contractor shall deliver such items to an Owner-selected location onsite. The Contractor shall place such equipment or materials in a manner such that they are safely stored and not subject to falling or rolling, etc. that could cause damage or injury. The material resulting from demolition shall not be placed on top of existing piping or ductbanks or any facilities that could be damaged by the placement of the material. The Owner does not represent that sufficient space is available for the temporary placement of material resulting from demolition. Regardless, the material resulting from demolition shall not be stored on site for longer than approximately 2 weeks before being hauled off site for disposal.

If demolition damages piping or electrical facilities, or other items that are needed for proper operation and performance, the Contractor shall promptly and properly repair such facilities so that they can be returned to service as soon as possible.

Comply with demolition requirements in the drawings.

See and comply with the requirements and/or specifications, etc. for Performing Work in Existing Facilities.

Unless demolition is specifically listed as a payment item, the Contractor shall include all costs associated with demolition in other payment items.

STANDARD SPECIFICATION

FOR

SITEWORK, EXCAVATION, AND EARTHWORK

SECTION 2

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 too 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 slop 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 overexcavation 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 3

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. If Type II is not available, then C595 Type IL MS may be used provided the cement manufacturer provided written certification that it has similar sulfate resistance to Type II. 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.

Coarse Aggregate in Inches	Air Content Percent by Volume
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:

Type	ASTM Designation
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 Contract 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, and Tammsflex by Euclid Chemical, or equal. 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 throughly 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 4

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 Section, 825 Type B (compacted pug mix). Subgrade and base shall be compacted to a minimum of 100% MPD. 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 asphalting 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 straight edge 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 5

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 bahiagrass 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. Bailing twin 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 competed 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 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

MISCELLANEOUS STEEL AND OTHER METALS

(FOR STEEL/METALS NOT COVERED/SHOWN IN STRUCTURAL DRAWINGS)

SECTION 6

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.

Pipe Size (Inches)											
1/2	3/4	1	1-1/2	2	2-1/2	3	3-1/2	4	5	6	8
Maximum Span (Feet)											
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. 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. Tread surfaces shall be slip resistance with longitudinal grooves performed by the extrusion process. 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. Grating shall be Bordens I-bar or equal.

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.

Clearspan Opening	*Lintels - Steel Angles*	
	Brick	***Block***
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 7

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 mineral fiber with a kraft 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 component solvent release (Butyl Rubber) sealant and conform to ASTM C1311 (latest revision). The sealant manufacturer and the ASTM C1193 Standard Guide for Use of Joint Sealants shall be referenced for proper sealant selection for each specific application. If joints are deeper than 1/2", joint backing shall be Tremco joint backing or equal unless indicated otherwise. Equal products manufactured by Dow, DAP, 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 insure 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

ARCHITECTURAL

STANDARD SPECIFICATION
FOR
DOORS AND ACCESSORIES

SECTION 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 as manufactured by Steelcraft or equal.

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. Door frames required or specified to be filled with mortar/grout during installation shall have an internal bitumastic coating to ensure no contact corrosion due to the mortar/grout, and door frame manufacturer shall provide instructions for filling door frame with grout/mortar. All steel doors shall conform to the Steel Door Institutes (SDI) Standards for the application.

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 and frames 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. Door frames required or specified to be filled with mortar/grout during installation shall have an internal bitumastic coating to ensure no contact corrosion due to the mortar/grout, and door frame manufacturer shall provide instructions for filling door frame with grout/mortar. Aluminum doors and frames 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".
3. Architectural Woodwork Standards (Latest Edition)

Each wood door shall be marked with WDMA Wood Flush Door Certification Hallmark certifying compliance with applicable requirements of ANSI/WDMA I.S.1A Series. For manufacturers not participating in WDMA 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 NFPA 252, UL10B, and UL10C and be, 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 WDMA 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 Eggers Hardwood Products Corporation, Oshkosh Architectural Door Company, Masonite Architectural, 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 AWS 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 AWS and 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 11 Line; Corbin Russwin CL3100 Series;; or equal by Schlage 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 shown or 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 unless recommended otherwise by the door manufacturer. Specialty doors shall have the number of hinges as recommended by the door manufacturer or shown on the drawings.

Locksets for Safety Exit Doors shall be mortise lock type exit device and shall

conform to the latest and most stringent Federal Specifications governing these type locksets. Locksets 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; Ruskin; CS Products (Construction Specialties); ; 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 gravity 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 unless indicated otherwise on the Plans. 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 sound-proofing, 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 unless indicated otherwise on the Plans

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.

Any special modifications required to standard doors (such as block-outs for monorail beams) shall be designed by the door manufacturer to ensure a neat and professional appearance. Design shall include all trim-work, attachment hardware, necessary seals/weatherstripping, to ensure a uniform and aesthetically pleasing appearance that is weather-tight. Contractor and door manufacturer shall coordinate all requirements for door modifications prior to submitting the first door submittal.

STANDARD SPECIFICATION
FOR
PAINTING

SECTION 2

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 unform 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 NAPF 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 unform 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 While 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 Psychometric 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 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 two coats (12 – 16 mils DFT) of MasterProtect HB 400 (fine texture) by Master Builders Solutions, Tnemec Series 157 Enviro-Crete, or equal by Tex-Cote. For water containing structures, two coats of MasterSeal 581 by Master Builders Solutions 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 waterproof 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

Item	*Prime Coat*	*Finish Coat(s)*
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 mils DFT
Masonry – Exterior Above Grade	NONE	2 coats 156 Enviro-Crete @ 8.0 – 10.0 mils DFT per coat
Masonry - Exterior Below Grade	NONE	2 coats 46-465 @ 8.0 – 10.0 mils 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 mils 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 mils DFT
Concrete Floors - Opaque Finish *	208 Epoxoprime MVT @ 6.0 – 8.0 mils DFT	2 Coats 280 Tneme-Glaze @ 6.0 - 8.0 mils 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 mils DFT
Chemical Sumps *	218 MortarClad @ 1/16" minimum. Fill all bug holes, voids, and seal surface	2 coats 239SC Chembloc @ 6.0 – 8.0 mils DFT per coat.
Concrete Floors - Double * Laminate Quartz Floor	222 Deco-Tread @ 20 mils DFT-Broadcast to refusal - Repeat	One grout coat 222 Deco- Tread @ 6.0 – 8.0 mils One finish coat of 248 Everthane;@ 2.0 - 3.0 mils DFT
Wood Interior and Exterior	10-99W Primer @ 1.0 - 2.0 mils DFT	2 coats 1029 Enduratone @ 1.0 - 2.0 DFT per coat
Interior and Exterior Non-Submerged Metal	Prime: Series 91 H20 Hydro-Zinc @ 2.5 – 3.5 mils DFT Intermediate: Series 66 Epoxoline @ 2.0 - 3.0 mils DFT	1094 @ 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

Item	*Prime Coat*	*Finish Coat(s)*
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

* Where called for on Drawings.

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:

Outside Diameter of Pipe or Covering	**Minimum Height of Letters**
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:

	Generic Color	Tnemec Color I.D.
Chlorine (Gas and Solution)	Yellow	OSHA Safety Yellow (02SF)
Compressed Air	Dark Green	Balsam (91GN)
Fire Hydrant	Red	OSHA Safety Red (06SF)
Lime	Light Green	Irish Spring (37GN)
Polymers or Coagulant Aids	Purple	OSHA Safety Purple (14SF)
Potable Water	Dark Blue	Safety Blue (11SF)
Sewage Plant Effluent (Non-Potable Water)	Clay	Terra Cotta (07RD)
Sewer (Sanitary or Other)	Dark Gray	Deep Space (34GR)
Sludge (Dark Brown)	Dark Brown	Weathered Bark (84BR)
Primary Sludge	Dark Brown with	Weathered Bark (84BR)
	Yellow Label (Primary)	OSHA Safety Yellow (02SF)
Return Activated Sludge	Dark Brown with Red Label (RAS)	Weathered Bark (84BR) OSHA Safety Red (SC09)
Waste Activated Sludge	Dark Brown with Light Green Label (WAS)	Weathered Bark (84BR) Daiquiri Ice (PA30)
Primary Scum	Dark Brown with Light Gray Label (Scum)	Weathered Bark (84BR) Light Gray (IN01)
All Other Non-Process Lines	Light Gray	Light Gray (32GR)

STANDARD SPECIFICATION
FOR
CANOPY

SECTION 3

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. The Plans and Specifications shall be worked together to meet all project requirements.

1.2 ENGINEERING DESIGN CRITERIA

A. International Building Code 2015
B. ASCE 7-10, Minimum Design Loads for Buildings and Other Structures
C. Aluminum Design Manual 2015
D. AWS D1.2 – 2014, Structural Welding Code - Aluminum
E. Local governing codes and standards for site location
F. See Project's Structural Drawings for any Design Criteria for Site Location

1.3 GENERAL DESCRIPTION OF WORK

A. Work in this section shall include design, fabrication, and installation of pre- engineered, pre-finished aluminum protective canopies and all associated components, accessories, and appurtenances. All work shall be in accordance with the shop drawings and this specification section.

1.4 PROJECT CONDITIONS

A. Field Measurements: The Contractor and/or manufacturer shall field verify dimensions shown on drawings and all other field conditions by taking field measurements to ensure proper fit and attachment of component parts and no conflicts.

1.5 SUBMITTALS

A. All Shop Drawings shall be in accordance with the General Specifications.
B. Shop Drawings – Submit complete shop drawings including:
    1) Overall canopy layout dimensions including dimensions for all columns or other support locations. See Contract Drawings for any specific layout requirements and/or dimensions.
    2) Cut section details including elevation, bent layout dimensions, canopy connection details, column connection details, and wall connection details (if applicable).
    3) Flashing details pertaining to aluminum canopy

4) Concrete footing and/or canopy anchorage details

C. Product Data – Submit manufacturer's product information, specifications, and installation instructions for the aluminum canopy.

D. Samples – Submit color selection samples of actual coated aluminum material or actual anodized aluminum material.

E. Certification – Provide Professional Engineer certification that the proposed canopy design and layout meets or exceeds all applicable loadings (ex: wind load, rain live load, dead load, snow load) for the job location (city & state) in accordance with IBC 2015 and ASCE 7-10.

1.6 DELIVERY AND STORAGE

A. Deliver and store protective covers components in manufacturer's original packaging until time of installation.

B. Protect protective covers components from damage (including corrosion, deformation, discoloration, and deterioration.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum five years experience in design, fabrication, and production of aluminum protective covers.

B. Components shall be assembled in shop to greatest extent possible to minimize field assembly.

C. Aluminum protective cover, including material and workmanship, shall be warranted from defects for a period of five years from date of completion of aluminum protective cover installation.

PART 2: PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

A. Tennessee Valley Metals
190 Industrial Park
Rd Oneonta, AL
35121

B. Superior Mason Products
451 Industrial Lane
Birmingham, AL
35211

C. Mitchell Metals,
LLC 1761 McCoba
Drive Smyrna, GA
30080

2.2 **DESIGN & ASSEMBLY**

The manufacturer of the canopy shall be solely responsible for the design of the canopy.

A. Canopy shall be mechanically fastened using internally welded brackets and concealed stainless steel fasteners. Welded connections can be used if shipping allows.

B. Canopy shall use perimeter extruded gutter and extruded decking. Beams are to be notched to receive the extruded gutter to allow decking to sit flush to the top of the beam. Extruded Decking shall be a roll-locked design where the extruded cap and pan shall interlock to make a rigid structure. Overall design of decking profile (i.e. flush deck and flat pan) shall be by the manufacturer to provide the fewest possible locations (i.e. cavities) for birds and insects to nest.

C. Fascia and drainage beams shall be extruded aluminum with a minimum water carrying capacity (i.e. that enclosed area that lies below the bottom of the decking) of 14.0 square inches. If used, pans are to be welded at ends to prevent water leakage. Standard T- flashing shall be used where decking is separated at a drainage beam. Fascia is to be secured using a rivet every 4'-0" on center connecting the fascia to the edge pans. Tie back straps are to be installed connecting the top of the fascia to the decking.

D. Canopies shall drain from the decking to the perimeter gutter, into the drain beam (if applicable) and discharge at the bottom of the column. For long directions, the canopies shall drain from the decking into the drain beam and discharge at the bottom of the column.

E. Deflector plates are to be installed at the bottom of the column to discharge the water away from the column. The deflector plates are to be caulked inside the column and fastened to the column using rivets.

F. Columns are to be locked into the column foundation per the Manufacturer's design requirements.

G. There shall be no exposed hand holes or ledges for occupants to grasp. Fasteners must be concealed and tamper-proof.

2.3 **MATERIALS**

A. Columns

1) Columns are to be radius cornered aluminum tubular extrusions. Size of column used shall exceed loading requirements in section 1.2 – Engineering Design Criteria. Minimum column size shall be 4"x 4" at minimum 0.125" thick and have a minimum yield strength of 25 KSI.
2) Column brackets that transmit run-off from fascia or drainage beam to the column must have a single orifice of at least 6.0 square inches to prevent clogging with leaves or other debris.
3) A clear acrylic protection or bituminous paint protection shall be provided between the aluminum column and the concrete foundation.
4) Tombstone shaped water outlet holes are to be cut at the bottom of all

draining columns with deflector plates installed inside.

B. Beams
   1) Beams are to be open topped aluminum tubular extrusions.
   2) Size of beam used shall exceed loading requirements in section 1.2 – Engineering Design Criteria. Minimum beam size shall be 4"x 6" at 0.125" thick minimum. The extruded aluminum alloy must have a minimum yield of at least 35 KSI.

C. Decking
   1) Overall design of decking profile (i.e. flush deck and flat pan) shall be by the manufacturer to provide the fewest possible locations (i.e. cavities) for birds and insects to nest.
   2) Decking shall be a rigid roll-locked or other approved design that is self flashing and utilizes interlocking sections.
   3) Extruded decking shall exceed loading requirements in section 1.2 – Engineering Design Criteria. Minimum 3" x 6" cap and pan.
   4) For long directions, the ends of the pans shall be welded closed where decking does not terminate into a drain beam.

D. Gutter
   1) Gutter shall be radius cornered aluminum extrusion that exceeds loading requirements in section 1.2 – Engineering Design Criteria. Minimum gutter size shall be 4"x 6" at 0.093" thick.

E. False Fascia
   1) False Fascia shall be aluminum extrusion that exceeds loading requirements in section 1.2 – Engineering Design Criteria. Minimum fascia size shall be 1"x 6" at 0.070" thick.

F. Flashing
   1) Flashing shall be made of aluminum sheet painted to match the color of the canopy. Minimum flashing thickness shall be 0.040" thick. Provide counterflashing permanently embedded in adjoining concrete or masonry, etc. to achieve permanent watertightness.

2.4 **FASTENERS**

A. All framing fasteners shall be stainless steel with neoprene washers. All rivets shall be 3/16" aluminum. All decking fasteners shall be stainless steel with a stainless steel cap and neoprene washer.

2.5 **FINISHES**

A. All exposed sides of canopy components to be factory applied two-coat polyester resin or be anodized.
   1) Color is to be as selected by Owner from manufacturer's standard color chart. Dark bronze and bronze shall be considered standard colors.

2.6 MISCELLANEOUS

A. Baseplates
The edges of the baseplates shall be beveled at 45° to minimize the potential for tripping.

PART 3: INSTALLATION AND EXECUTION

3.1 ERECTION

A. Canopies are to be installed according to approved shop drawings and plans and based on field measurements.
B. The entire structure shall be installed straight, true, and plumb according to standard construction procedures. All connections shall be tight and clean.
C. Canopies shall be installed with minimal slope to allow water flow from top of canopy to draining columns and eliminate ponding.
D. Non-draining columns shall have weep holes installed at top of concrete to remove condensation from post. Minimum weep hole size shall be ¼" in diameter.
E. All joints, corners, and connections shall be tight and clean.
F. All exposed fasteners are to be painted to match the canopy color.
G. Decking is to be aligned and secured to aluminum frame structure.

3.2 CONNECTIONS TO FOUNDATIONS

A. Aluminum columns shall be mounted to foundations as shown on the Plans. Stainless Steel wedge anchors shall be designed and provided by the canopy manufacturer to secure the complete canopy assembly under the design loading conditions. All anchorage and associated hardware shall be stainless steel.

3.3 CLEANING

A. All exposed canopy surfaces are to be cleaned after installation is complete.
B. Clean and repair dirty and damaged surfaces.
C. Replace any components that are damaged beyond repair.
D. Surplus materials and debris shall be removed from the jobsite after installation is complete.

3.4 PROTECTION

A. General Contractor shall take all necessary precautions to ensure protection of installed aluminum canopies from other construction activities so that canopies are without damage at time of completion of project.

STANDARD SPECIFICATION
FOR
MISCELLANEOUS ITEMS

SECTION 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. Provide and mount a fire extinguisher in the VFD Electrical Building.

3.0 WARNING SIGNS

The following engraved 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 – Disk Filter Structure
- 3 – Traveling Bridge Filter Structure
- 2 – Transfer Pump Station

Danger - High Voltage

Provide on every Electrical Panel, SCADA Panel, and Equipment Control Panel.

In addition to those signs called for above, three (3) additional signs shall be provided and installed at locations determined during construction. The language for these signs shall be determined during construction. These signs may be attached to handrail or similar uneven surfaces with stainless steel hardware and miscellaneous straps or appurtenances as required.

STANDARD SPECIFICATION
FOR
MODULAR PRECAST CONCRETE BUILDING

SECTION 5

I. PART 1 - GENERAL

A. SUMMARY

1. The building manufacturer shall design and manufacture a Modular Precast Concrete Building meeting all the requirements of this specification. This building will serve as the Water Resource Recovery Facility's VFD Electrical Building and will contain critical electrical and VFD equipment that must be properly and fully protected from rain, excessive heat, wind, and other environmental conditions so that it can function properly. If the equipment in this building is not adequately protected, it could fail and result in the discharge of improperly treated wastewater.
2. The specifications contained herein encompass the labor, equipment and materials for the fabrication of a transportable, prefabricated, pre-engineered, vandal resistant concrete building.
3. Compliance with BOCA, SSBC, UBC and the IBC is required. Design shall be comprehensive to cover placement of shelters in all 50 states.
4. See Contract Drawings for dimensional, layout, and other requirements.
5. See the "Shop Drawings, Submittals, and O&M Manuals" requirements in the Specifications. These contain important requirements regarding these items that are not repeated in this section. A failure to comply with the shop drawing or submittal or O&M manual requirements will delay the processing of the document and may result in a complete rejection without engineer review comments.

B. RELATED SPECIFICATIONS

1. Electrical Specifications

C. REFERENCES

Codes and Standards: The building shall comply with the most recent versions of the following codes and standards:

1. ACI-318-08, "Building Code Requirements for Reinforced Concrete". Concrete Reinforcing Institute, "Manual of Standard Practice".
2. ANSI/ASCE-7-05 "Building Code Requirements for Minimum Design Loads in Buildings and Other Structures".
3. Florida Building Code – 2010
4. UL-752 Test Method Level Four (4) for Bullet Resistance certified by an Independent Structural Engineer.
5. Concrete Reinforcing Institute, "Manual of Standard Practice".
6. PCI Design Handbook – 6th Edition.
7. International Building Code – 2012.
8. National Electrical Code – 2011.
9. Manual of Steel Construction – LRFD AISC – 13th Edition.
10. Manual of Steel Construction – ASD AISC – 13th Edition.
11. Local Building Codes of the AHJ.

D. QUALITY ASSURANCE

1. Manufacturing shall occur in a National Precast Concrete Association (NPCA) Certified Plant.

2. Manufacturer shall be a member of the Modular Building Institute (MBI).

3. Manufacturer shall have at least 5 Years of extensive and proven experience of similar scope and of the same or greater complexity. The experience shall be satisfactory to the Owner.

4. Manufacturing shall occur in an Environmentally Controlled Facility.

5. Manufacturer shall provide fully Pre-Engineered Building Submittals including, but not limited to, Full Electrical, Structural and Production Drawings. In addition, manufacturer shall provide an Architectural Package with the submittals including all color and finishes available for all building components (i.e., interior and exterior walls, doors, A/C units, roof, etc.) for the Owner to select from.

6. Manufacturer shall provide Engineering Documentation demonstrating compliance with the Proposed Wind Loading. The Manufacturer shall have a professional engineer with Alabama registration stamp the drawings.

E. RECOMMENDED MANUFACTURERS

Modular precast concrete buildings shall be as designed by and manufactured by AES Precast Co., Inc. (Northport, AL), Modular Connections, LLC (Bessemer, AL), or Equal.

F. DESIGN LOADING

Precast Building shall be designed by the building manufacturer for the following loading as a minimum:

1. Floor: N/A
2. Roof: Per ASCE 7-05 Roof/Snow Load Specification of 60 lbs. per square foot.
3. Wind: Per ASCE7-05 Basic Wind Speed Specifications of 150 MPH
4. Category "C" Seismic Rated Construction

The building manufacturer shall design and shall be solely and fully responsible for the design and fabrication of the complete building including but not limited to all its joints, connections, details, and accessories. The building manufacturer shall retain a registered professional structural engineer to perform the design. The criteria stated herein shall be considered as minimum requirements.

II. PART 2 – BUILDING CONSTRUCTION AND STRUCTURAL

A. Structural design and manufacturing shall conform to requirements of ACI 318-89.

B. MATERIALS

1. Concrete: Steel reinforced, polypropylene fiber reinforced 6000 PSI. Minimum 28 days compressive strength, air entrained (ASTM C260)

2. Reinforced Steel: ASTM A615, Grade 60 unless otherwise indicated. Reinforcing steel shall be steel bars rigidly held in correct place during concrete placement. Welded wire fabric or similar shall not be used.

3. Reinforced Fiber: Polypropylene Fiber, Fortafiber @ 1.5 pounds per cubic yard or equal.

4. Roof and wall panels must each be produced as single component monolithic panels. No roof or vertical wall joints will be allowed, except at corners. Wall panels shall set on top of prepared concrete foundation (prepared by installation contractor).

5. Panel Connections: All panels shall be securely welded together with 1/4" minimum thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A283, Grade C. Cast-in anchors used for panel connections to be Dayton-Superior F-63, or equal.

6. The roof and wall panels shall be designed, assembled, and connected by the Building Manufacturer.

C. FLOOR SECTION: FLOORLESS

1. Reinforced concrete floor slab shall be poured-in-place in field by the Contractor.

2. Building manufacturer shall design and provide all connection assemblies (including stainless-steel anchor bolts) required to properly connect/anchor the precast building to the poured-in-place slab.

3. Coordinate as required with Contractor prior to bidding and during submittal process.

4. See Contract Drawings (including Electrical drawings) and other sections of this specification for required penetrations through floor slab.

5. See Contract Drawings for the recess around the perimeter of the poured floor slab. This recess is provided to increase the permanent watertightness of the wall to floor joints. The building manufacturer shall show this recess on his submittal drawings and shall include details clearly showing how the door frames, doors, and insulation system are handled at the recess. Note that the minimum required clear door opening must be provided above the main non-recessed slab.

D. ROOF SECTION

1. 4” thick (minimum at thinnest part of roof) solid steel reinforced concrete construction

2. Roof shall extend a minimum of 2.5" beyond the wall panels on each side.

3. Roof must slope 2” (min.) from center.

4. Roof and wall panels must each be produced as single component monolithic panels. No roof or vertical wall joints will be allowed, except at corners.

5 The building shall be watertight and shall not leak or seep.

6. Interior Ceiling Finish shall be smooth concrete finish painted with Epoxy Paint (white, off-white, gray, or other color selected by Owner).

7. The building manufacturer shall apply a permanent waterproofing coating to the roof. The coating shall be light colored to reduce heat gain due to sunlight. If the coating is best applied after installation, the manufacturer shall apply the coating at that time.

8. See Wall Section for roof insulation requirement.

E. WALL SECTION

1. Wall panels shall be 4" minimum solid reinforced concrete. Each of the four walls shall be cast in one piece to minimize joints. Wall panels shall set in recesses on top of prepared concrete foundation. Carefully coordinate the walls with the recess, especially at the doors.

2. Interior Wall Finish shall be smooth concrete finish painted with Epoxy Paint (white, off-white, gray, or other color selected by Owner.

3. Exterior Wall Finish shall be Simulated Splitface Block Painted Light Tan with Dark Bronze Trim (or either finish as selected by Owner prior to submittal preparation). Color selection shall be by the Owner during the submittal process. If Form/Mold Liners are used to create the simulated brick pattern, the resulting pattern shall be seamless, without wave, and completely uniform. Form/Mold Liner splices shall be avoided. Buildings with a non-uniform pattern, or with waves or seams, shall not be acceptable. All finishes shall be free from rust, other distractions, and irregularities, etc.

4. See the Floor Section requirements regarding the recess around the perimeter of the floor slab. The recess shall support the walls.

5. The walls and roof shall be insulated with a Prodex 5M insulation system (0.20" nominal thickness, R15) covered by 1.5" Styrofoam (R7.5) that is selected and installed by the Building Manufacturer. Insulation shall be covered by ½" OSB laminated with white textured fiberglass reinforced plastic (Structoply FRP). The insulation system shall be installed in a permanent manner with a pleasing appearance. Studs shall be installed by the Building Manufacturer to assist in securing the insulation to the walls and roof and to provide bracing and support for electrical panels. The Building Manufacturer shall carefully coordinate the location of the studs with the panels. Coordinate the wall insulation with the recess around the perimeter of the poured floor slab. The Building Manufacturer shall have a long-term proven and successful history of using the insulation system to be utilized.

6. The walls shall be anchored to the floor with attachments as designed, provided, and installed by the building manufacturer. The building manufacturer shall provide adhesive (epoxy) stainless steel anchor bolts of sufficient size and length to withstand all specified building loads, including but not limited to wind loads and their associated uplift. Because of the proximity of the anchor bolts to the recess in the bottom slab, the depth of the recess shall not be utilized in calculating the required embedment length of the anchor bolts.

7. The exterior wall surfaces shall be treated with a permanent waterproofing membrane.

F. FINISHES

1. Interior of Building: Walls and Ceiling – Smooth Concrete Finish, Sealed with Epoxy Paint (white, off-white, gray, or other color selected by Owner

2. Exterior of Building: Simulated Splitface Block or river gravel (or other finish as selected by Owner prior to submittal preparation). Painted Light Tan with Dark Bronze Trim (All colors are to be selected by Owner during submittal process). Exterior surfaces of walls and roof shall be sealed with two coats of recommended sealer in strict conformance with manufacturer's instructions, unless otherwise noted.

3. Roof to have smooth trowel finish sealed with a liquid applied roofing system, White.

G. SEALING/MOISTURE MANAGEMENT

1. The building manufacturer shall be fully responsible for designing and providing a watertight building.

2. All joints shall be carefully and effectively sealed by the building manufacturer with a compressible, resilient sealant.

3. There shall be no exposed roof to wall or wall to floor joints with roof capping walls and walls overhanging floor.

4. Reserved.

5. Interior sealant between panels shall be a dual continuous seal creating a dual layer moisture barrier as well as an escape channel for trapped moisture.

H. DOORS

1. Doors shall be provided by Building Manufacturer. Size of doors shall be as indicated on the Contract Drawings. Doors and Frames shall be extra heavy duty aluminum, insulated, and installed flush with door check. Door shall be manufactured by Alutech and designed for a +95 psf and for -95 psf.
2. Astragal required on double doors.
3. Heavy Duty Stainless Steel Hydraulic Door Closer required on each door
4. Neoprene weather stripping required.
5. Locksets: Mortise Lock with 6 pin removable core.
6. Deadbolt lockset required and shall be of the same manufacturer as the normal lockset. The deadbolts shall have interior thumb latches to unlock the deadbolt.
7. Hinges: Stainless Steel Vandal Proof (primed with non-removable hinge pins), minimum 4 per door on standard size doors to 7'0" high and 5 minimum on taller doors.
8. Aluminum threshold with neoprene seal. The threshold shall also incorporate a low dam to positively prevent windblown rain from entering the building even if the seal deteriorates with age. Additionally aluminum door sweeps with nylon brushes shall be provided with the doors.
9. Aluminum Drip Cap – 2.5" minimum overhang required. Attach with stainless steel hardware.
10. Door color shall be dark bronze.
11. All doors shall have panic hardware. The double doors shall have 3'0" opening each (6'0" total opening), shall open outward, and shall have panic hardware that unlocks the door. The door opening clear height

shall be a minimum of 7'0" to allow electrical equipment to be installed and removed.

12. All door locksets, deadbolts, and other hardware shall be 316 stainless steel suitable for installation in a damp and corrosive environment.
13. The door locks shall be keyed to match the Owner's existing locks.

I. DOOR FRAMES

1. Door frame shall be heavy duty aluminum.
2. Frame shall be cast into the wall panel.
3. Door Frame color shall match door.
4. The door frames shall be "held up" at the recess (around the perimeter of the concrete floor slab) that supports the walls. This will allow the recess around the perimeter of the concrete floor slab to be omitted at the doors (thereby avoiding a sudden low step up to the non-recessed main floor slab) and allow the full net clear door opening to be achieved. The Building Manufacturer shall carefully coordinate the door frames and doors with the General Contractor to ensure that the recesses are properly accounted for. The details shall be clearly shown in the building submittal.

J. RESERVED

K. RESERVED

L. AIR CONDITIONING UNITS

The Building Manufacturer shall provide the complete air conditioning systems. This shall include providing all air conditioning equipment and appurtenances as well making provisions to install and mount all components (including wall mounting of interior components) and to route all air conditioning piping and wiring, etc. Provide all needed penetrations. The air conditioning shall consist of two completely independent systems. One system is a complete spare (i.e. "redundant" system) so that if one system fails for any reason, the other system can independently (by itself) provide the entire specified cooling capacity. The air conditioning capacity specified must be provided to keep the electrical gear and VFDs inside the building at the required temperature. If the cooling is not adequate, the VFDs could fail and this would result in the overflow of wastewater that does not comply with state and federal requirements.

The interior air conditioning components must be mounted on the end walls so as not to intrude on clearance requirements (above electrical gear) contained in the National Electrical Code.

The air conditioning systems shall have independent thermostats set so that if one system fails, when the building temperature rises a few degrees to the on setpoint for the backup unit, the backup unit will automatically start. The WWTP operators shall be able to adjust the thermostat setpoints to cause the duty air conditioner to become the standby air conditioner and vice versa so that the "standby" air conditioner will be regularly exercised.

Each of the two Air Conditioning System must have a cooling capacity of 3 tons. Therefore the total installed capacity must be 6 tons: 3 tons for the unit in operation plus 3 tons for the standby unit. The units must operate off the power provisions (circuit breakers and wiring, etc.) shown in the electrical drawings. The building manufacturer shall notify the engineer in writing during the bid phase of the project if there are any potential issues or concerns in fully complying with the specifications.

Each of the two air conditioners shall be a 36,000 BTU / 3-ton ductless Mitsubishi Mr. Cool Mini Split 4 generation unit with a gold fin corrosion resistant compressor. The SEER rating shall be a minimum of 21.5. The units shall provide heating as well as cooling. Provide all required electrical circuits and control circuits including to both outside and indoor units. Each air conditioner may require 2 indoor units for a total of 4 indoor units. Provide for concealed coolant lines, number as required.

M. RESERVED

N. GROUND INSERT CONNECTORS

The precast building shall be provided with two copper inserts (or grounding lugs) located in opposite corners of each of the building wall panels (8 total) (or as shown on the Contract Drawings) to allow the building walls to be connected to the building grounding system. The inserts/lugs shall be embedded into the concrete, and bonded to the building wall steel. The bare copper grounding system shall be bolted or cadwelded to the building ground inserts.

O. ELECTRICAL

The Contractor/ Building Manufacturer shall see the Contract Drawings for all electrical items required on and in the precast building.

The Building Manufacturer shall provide and install all conduit and wiring (control and power) required between the items indicated herein and on drawings. The Building Manufacturer shall make allowance for any power wiring, control wiring, and conduit required for the inside and outside A/C components and controller. Make allowance for coolant tubing between the exterior units and the interior units. Building manufacturer shall review the electrical drawings to determine the electrical components being provided by the Contractor and provide all other electrical items required. Building manufacturer shall advise if there are any conflicts between the building design and the proposed Electrical Work. Building Manufacturer shall advise and provide recommendations regarding mounting and placement of electrical panels components. The walls must be capable of securely bracing the electrical panels.

Building manufacturer shall coordinate with the general contractor, electrical subcontractor, and engineer during the submittal process and ensure all required components are provided. Building manufacturer shall note on the building submittals any conflicts with proposed electrical components. Electrical conduits and appurtenances shall be aluminum or stainless steel.

P. SCADA RADIO, TEMPERATURE SENSOR, AND OTHER WALL PENETRATIONS

The building manufacturer shall coordinate carefully with the Contractor and the Owner's SCADA provider and make recommendations to the Engineer regarding the preferred location and method for penetrations for the radio from the SCADA system to its exterior antenna(s) and the temperature sensor. The building manufacturer shall provide the needed facilities to accommodate the radio, the temperature sensors, and their appurtenances without any threat of compromising the watertightness of the building. Seal the penetration(s) as needed for watertightness.

Air conditioning facilities including coolant lines, power wiring, and central wiring shall be installed in concealed conduits (i.e., below the floor slab and below the exterior sidewalk) to avoid interference with walk paths.

Q. MISCELLANEOUS

Miscellaneous metal components and fasteners, etc., shall be aluminum or stainless steel to prevent corrosion and rusting, etc.

III. PART 3 – EXECUTION

A. SHIPPING & INSTALLATION

1. The building manufacturer shall be fully responsible (to the Contractor) for properly and safely shipping the building to the project site.
2. Items extending beyond the shelter which will exceed legal shipping widths and/or heights, shall be prefitted and packed inside the building for shipment. These items shall be installed in the field by others unless otherwise indicated. A/C units shall be shipped inside the building and installed in the field for a weatherproof installation.
3. Off loading building from shipping equipment shall be the responsibility of the building manufacturer.
4. All installation and assembly of the modular building shall be performed by experienced and qualified personnel who are knowledgeable about the proper installation procedures for this type of building. The building manufacturer shall provide detailed clearly written instructions for all

installation and assembly. The building shall be installed in strict accordance with those instructions.

5. All welding shall be performed by an experienced and certified welder. All welding shall be in accordance with written instructions provided by the building manufacturer.
6. The air conditioning system shall be installed, started, and checked by a company that specializes in such work. The installer shall sign a certification form provided by the Owner that the air conditioning and heating equipment has been properly installed and started, and is ready for normal operation.
7. Perform any supplemental sealing and other minor items of work that may be needed for a properly functioning end product.
8. Any voids remaining in the recess between the walls and the floor slab shall be filled with iron-free non-staining grout.
9. Paint any ceiling, wall, or appurtenances not concealed by insulation.
10. The building shall be thoroughly cleaned in accordance with the cleaning requirements for the project. When placing concrete outside the installed building, cover the lower walls during concrete placement to prevent inadvertent splashing onto the walls.

B. BUILDING FOUNDATION AND SITE PREPARATION

1. Building manufacturer shall review and approve foundation design and dimensions (by others) included in the Contract Drawings prior to submittals. Building manufacturer shall provide all foundation recommendations or any requested changes during the submittal process. The building manufacturer shall make a site visit to review the site preparation and foundation prior to delivery of building.
2. Installing Contractor shall ensure foundation tolerances are within the Building manufacturer's requirements.

C. PRODUCT / FIELD SUPPORT/COORDINATION

1. Manufacturer shall provide field support and supervision for building installation, A/C unit installation, Exhaust fan installation, etc.
2. Contractor, Electrical Subcontractor, and Building Manufacturer shall coordinate all work required for power feeds, conduits, wiring, SCADA signals and all electrical work required. Contractor shall verify all items of work are included in the Bid Price.

D. SITE ACCESS

1. Building manufacturer shall coordinate with the Contractor to determine suitable access for delivery and off-loading of the building.

E. MANUFACTURER'S GUARANTEE

1. Building manufacturer shall address and correct any and all defects resulting from the manufacturing process, transportation, off-loading, installation, and all other construction activities.
2. Manufacturer shall provide a full 1-year warranty from the date of acceptance by the Owner for the entire building, its installation, and its components.

STANDARD SPECIFICATIONS

PIPING, VALVES, AND GATES

STANDARD SPECIFICATION
FOR
PIPE MATERIALS (EXCLUDING HDPE)

SECTION 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 ANSI/ASTM Standard Specification D1248. The material requirement, if not shown on the Plans, shall be either 8 mil, low density polyethylene or 4 mil, high density, cross laminated polyethylene. Material and installation methods shall be in accordance with the requirements of AWWA C105 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 top coat 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 service 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. Gates 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

The Contractor shall determine/confirm the type tapping sleeve and corresponding gaskets/seals required for accommodating the pipe material and pipe outside diameter before

ordering the sleeve. No special tools shall be required for assembly other than a standard socket wrench.

Tapping sleeves for use with ductile iron, gray iron, cast iron, and C-900 PVC pipe shall be bolted split type of ductile iron construction meeting ASTM A 536 Grade 65-45-12, have mechanical joint ends, and have a rated working pressure of 250 psi (unless indicated otherwise). Sleeves shall be heavy-duty. All MJ style end joint accessories (i.e., gaskets, split follower glands, etc.) necessary to assemble sleeve to pipe shall be provided. Side flange seals shall be 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 and the Specifications herein. Coatings shall be in accordance with the Specifications herein for ductile iron piping and fittings based on the application. Surfaces in contact with potable water shall have an NSF-61 approved coating and be in accordance with AWWA C550 as recommended by the sleeve manufacturer.

Tapping sleeves for use with ductile iron, gray iron, cast iron, and C-900 PVC pipe as discussed above shall be as manufactured by Mueller, American, or equal. For large diameter tapping sleeves (i.e., >18") with large flanged outlets (i.e., >12") to be used on these same type pipes, lighter weight tapping sleeve assemblies constructed of all stainless steel or fabricated steel may be considered by the Contractor depending on the specific application if approved by the Engineer and at no additional cost to the Owner. Stainless steel tapping sleeves for such applications shall be type 304 SS with all SS hardware (coated to prevent galling) and with permanent provisions/protection from contact with dissimilar metals. Fabricated steel tapping sleeves for such applications shall have bodies conforming to ASTM A285 Grade C, ASTM A-36 steel, or equal and have heavy factory coatings of fusion bonded epoxy in accordance with ANSI/AWWA C-213 and the manufacturer's recommendations for harsh conditions. Surfaces in contact with potable water shall have an NSF-61 approved coating, be in accordance with AWWA C550, and be as recommended by the sleeve manufacturer. All such stainless steel and fabricated steel tapping sleeves shall have MJ ends (with all required gaskets, split follower glands, accessories, etc. as required) and be JCM Industries 414 series or equivalent. Full submittal documentation shall be provided to demonstrate compliance with all project requirements.

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 – POTABLE WATER

Check valves shall have ductile iron or cast steel bodies and bronze mounted construction, and shall be swinging disc type, with a resilient seated disc mounted on a clapper arm. Disc, body seat, clapper arm, 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, American or equal.

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:

A. <u>Pipes Less than 18 Inches Diameter</u>

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 EPOM 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 is 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
DUCTILE IRON SEWER PIPE
INTERIOR COATING

SECTION 2

1.0 GENERAL

All ductile iron pipe and fittings supplied for gravity sewer shall have a high build protective lining on the interior and a bituminous coating on the exterior except for 6 inches back from the spigot end. The bituminous coating shall not be applied to the first 6 inches of the exterior of the spigot ends. All ductile pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining.

2.0 LINING MATERIAL

The material used for lining the pipe and fittings must have a successful history of protecting pipe lines in sewer service. The material must be a high build multi-component Amine cured Novalac Epoxy lining. The standard of quality is Protecto 401 Ceramic Epoxy. Any request for substitution must be approved by the engineer, meet the following criteria and be accompanied by the following data.

1. The permeability rating when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 42 days as reported by an independent laboratory.

2. A statement from the manufacturer of the submitted material attesting to the fact that at least 20% of the volume of the lining contains ceramic quartz pigment.

3. A laboratory report containing test data for Immersion in Acids, Bases, and Deionized Water at elevated temperatures using ASTM-D 714-56 (1974) for the rating method. The report should also contain data on ASTM D-2794 Direct Impact and ASTM-G 53-77 Moisture and Ultraviolet Light Exposure.

4. A statement concerning recoatability and repair to the lining.

3.0 APPLICATION

The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings. Prior to abrasive blasting, the

entire area which will receive the protective compound shall be inspected for oil, grease, etc. Any areas with oil, grease, or any substance which can be removed by solvent shall be solvent cleaned using the guidelines outlined in SSPC-1 Solvent Cleaning. After the surface has been cleared of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering annealing oxide may be left on the surface. Any area where rust reappears before coating must be reblasted to remove all rust.

After the surface preparation and within 8 hours of surface preparation, the interior pipe shall receive 40 mils dry film thickness of the protective lining. No lining shall take place when the substrate of ambient temperature is below 40 degrees Fahrenheit. The surface also must be dry and dust free. If flange fittings of pipe are included in the project, the linings must not be used on the face of the flange with full face gaskets being used to protect the ends of the pipe. All fittings shall be lined with 40 mils of the protective lining. The 40 mils system shall not be applied in the gasket grooves.

Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum Protecto Joint Compound. This coating shall be applied by brush to ensure coverage. Care should be taken that the coating is smooth without excess buildup in the gasket groove or on the spigot end. All materials for the gasket groove and spigot end shall be applied after the application of the lining.

The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The time between coats shall never be less than the time recommended by the lining material manufacturer. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

Protecto Joint Compound shall be used for touch-up or repair. Procedures shall be in accordance with manufacturer's recommendations.

4.0 INSPECTION AND CERTIFICATION

All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating. The interior lining of all pipe and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Each pipe joint and fitting shall be marked with the data of application of the lining system and with its numerical sequence of application on that date.

The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified, and that the material was applied as required by the specification.

5.0 PROCEDURE FOR FIELD REPAIR OF COATING

All coatings damaged in field whether from cutting edges or from handling shall be repaired as follows:

1. Remove burrs caused by field cutting of ends or handing damage and smooth out the edge of the lining if rough.
2. Remove all traces of oil, grease, asphalt, dust, dirt, etc.

3. Remove any damaged lining caused by field cutting operations or handling and clean any exposed metal by sanding or scraping. Sandblasting or power tool cleaning roughening is also acceptable. It is recommended that any loose lining be removed by chiseling, cutting, or scraping into well adhered lined area before patching. Be sure to overlap at least 1" of lining in the area to be repaired.

4. With the area to be sealed or repaired absolutely clean and suitably roughened, apply a coat of Protecto Joint Compound using the following procedure:

Mixing Procedure - Protecto Joint Compound is a seven-to-one (7:1) mix ratio. When mixed, it should contain 7 parts of the black activator and one part of the translucent blending resin. After blending resin is added to the activator, the mixture should be thoroughly agitated. All activated material must be used within 45 minutes of mixing.

Application of Material - After the material has been thoroughly mixed in a seven-to-one (7:1) ratio, it can be applied to the prepared surface by brush. Brushing is usually best, due to the fact that the areas are usually small. Practices conducive to a good coating are contained in the technical data sheet for Protecto Joint Compound.

It is important to coat the entire freshly cut exposed metal surface of the cut pipe end. To ensure proper sealing, overlap at least one inch of the lining with this repair material.

STANDARD SPECIFICATION
FOR
INSTALLATION OF PRESSURE PIPE (EXCLUDING HDPE)

SECTION 3

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:

Metal Pipe - Maximum Spacing		
Diameter (inch)	***Spacing (feet)***	***Maximum Hanger Diameter (inch)***
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

Schedule 80 - PVC - Maximum Spacing		
Diameter (inch)	***Spacing (feet)***	***Minimum Hanger Diameter (inch)***
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

Pipe Diameter	at 150 psi	at 200 psi	at 250 psi
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 SPECIFICATION
FOR
GRAVITY SEWER INSTALLATION

SECTION 4

1.0 PIPE LAYING

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.

The excavation, preparation, and backfilling of the trench shall be in accordance with the General Specifications and those Specifications covering excavation and sitework. The Contractor shall utilize the MUTCD to determine the minimum type of traffic control devices to be used on, and along all streets, including but not limited to City streets, County Roads, and State or Federal Highways. All sewers are to follow accurately the grade, alignment, type, size and location shown on the Plans unless otherwise approved by the Engineer. All pipe shall be inspected after unloading from the carrier. Rejected pipe shall be marked with paint and removed from the job site. The Contractor shall be responsible for locating and marking with guard stakes all underground obstructions. Where these obstructions could interfere with the sewer locations, the contractor shall notify the Engineer and the obstruction will be exposed to determine elevations and alignment of sewer in relation to the obstruction. All damages to obstructions will be repaired at the Contractor's expense.

The trench shall not be excavated any wider than necessary for safety and pipe installation. Mechanical excavation of trenches shall be stopped above the final invert grade elevation so that the pipe may be laid on a firm, undisturbed, native earth bed. The bottom of the trench shall be uniform so as to provide a firm and even bearing for the pipe. If the trench is over excavated, the disturbed material shall be replaced with compacted #57 crushed stone bedding or concrete installed at the Contractor's expense and as chosen by the Engineer. Pipe shall not be laid on rock but shall have a six inch cushion of compacted and approved bedding material, or shall be laid on concrete pads, as required. Each piece of pipe or fitting shall be cleaned and carefully examined for defects, and no defective pipe or fitting shall be laid in the trench. No blocking up with wood, rock, or other materials will be permitted. No load from adjacent spigot shall be transmitted to the bell with only the barrel of the pipe receiving bearing pressure from the trench bottom.

Spigots or hubs shall not be cut or chipped and shall be clean and dry. Whenever pipe is cut, it shall leave a smooth end at right angles to the axis. The laying of pipe in finished trenches shall be commenced at the lowest point, with the hub ends upgrade. Pipe shall be carefully centered and anchored before backfill to prevent movement. Preparatory to making pipe joints, all surfaces of the joints shall be clean and dry. Lubricants shall be used as recommended by the pipe or joint manufacturers.

Pipe shall be kept clean during construction with all excess debris being removed from sewers and appurtenances as work progresses. Sewers will be protected from debris entering lines after cleaning. A final cleaning will be made at time of acceptance if necessary. The ends of pipe shall be plugged when the work is left temporarily. When work resumes, the plug shall not be removed until the trench has been dewatered and all debris cleared away to prevent entry.

The length of the sewer trench to be opened or the area of the surface to be disturbed at any one time may be limited by the Engineer with regard both to expeditious construction and to the convenience of the public. The pipe laying shall be kept a safe distance from the excavation. The opening of new trenches will not be permitted when earlier trenches need backfilling or labor is needed to restore previous work. All blasting operations are to be conducted with due regard for the safety of persons, property, and utility and in strict compliance with ordinances and regulations governing blasting and the use and storage of explosives. Payment for the removal of rock shall be included in the Unit Price Bid for sewers and appurtenances unless otherwise specified. Trenches shall not be left open at night, weekends, holidays, or other periods when the work is unattended.

2.0 BACKFILLING

All trenches and excavations shall be backfilled immediately after pipe is laid, unless otherwise directed by the Engineer. Under no circumstances, shall water be permitted to rise in unbackfilled trenches after the pipe has been placed. Approved backfilling material shall be backfilled in layers of 8 inches maximum thickness, distributed evenly on both sides of the pipe, and shall be compacted to one foot above the top of the pipe and the remainder of the trench backfill being compacted and kept free from large rock and debris. All compaction shall be to 95% standard proctor density. PVC pipe shall be wrapped in #57 crushed stone to 12" above pipe. Use sand in lieu of crushed stone where indicated on drawings.

3.0 FITTINGS

Wye branches and other fittings shall be placed in the sewer lines as the work progresses or as directed by the Engineer. Wye branch openings shall be sealed with a vitrified clay cover which shall be secured in place before it is lowered into the trench. Wye branches shall not be backfilled until they have been located and recorded for future use. Sewer wyes, riser pipe and house service pipe shall be as shown. House service crossing state, federal or county highways shall be 4 inch ductile iron pipe.

4.0 ALIGNMENT AND ELEVATION CONTROLS

Control points and bench marks will be furnished to the Contractor for control of the work. The Contractor shall clear all right-of-ways or property prior to staking for sewers. It will be the Contractor's responsibility to maintain all bench marks and control points during clearing or construction. The contractor shall be responsible for checking all bench marks and control points prior to construction. The Engineer will provide alignment stakes and elevation

or grade stakes at each manhole. The Contractor shall prepare cut sheets and will submit them in duplicate to the Engineer for his approval prior to construction. No sewers will be installed or paid for without approval of cut sheets by the Engineer. Beginning points for construction will be designated by the Engineer.

5.0 MANHOLES

Unless specifically indicated in the Plans to be grouted, all manholes of precast concrete construction shall have flexible openings/connections to accept sewers entering and exiting the manhole. The Contractor shall be responsible for checking the sizes and orientations of manhole pipe openings before they are delivered to and unloaded at the job site. The Contractor shall be fully and solely responsible for all delays and/or damages resulting from his acceptance of incorrectly cast manhole sections. If the Contractor requests payment for stored material that include precast openings and/or flexible connections manhole sections, his request must be accompanied with a copy of the manhole section submittal indicating his field verified opening dimensions/orientation/elevations. These verifications shall take place before the manhole sections are unloaded on the job site. 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. Any repairs and plug holes in manholes will be sealed with nonshrink grout and made waterproof. Speedcrete will only be used to slow moving water, but final patch will be as described above. All repairs will be made on exterior of manhole.

6.0 ACCEPTANCE AND AIR TESTING OF LINES

All sewer construction shall be bedded and backfilled to prevent settlement in ditches and having tight joints with gaskets fully compressed. Sewers shall be watertight within the allowable limits, and shall have no visible leaks. Pipe shall be laid so when sighting from manhole to manhole in any section, the whole diameter of the pipe shall be visible throughout the section. Any visible leaks in any section of the sewer or appurtenances shall be repaired. The sewer shall be blocked off in sections totaling approximately 1,000 feet determined by the manhole spacing and tested for infiltration. No infiltration in excess of 200 gallons per mile per inch of pipe diameter per 24 hours will be permitted. Any section of sewer in which the infiltration is greater than that specified above shall be either repaired or replaced until it does meet the requirements specified.

Only lines tested after backfilling to final grade will be considered for acceptability. However, this test may also be used by the installer as a presumptive test to determine the condition of the line prior to backfilling. The Contractor shall furnish all the necessary equipment and be responsible for conducting all low-pressure air tests. In addition, the Contractor is responsible for any necessary repair work on sections that do not pass the test. No sealant shall be used in any newly installed sewer without the prior approval of the Engineer. Using sealant in a sewer is not the equivalent of a sound sewer pipe. Proper structural repair

work is much preferred and may be required by the Engineer or the Owner. The Engineer and/or a qualified inspector shall witness all low-pressure air tests and verify the accuracy and acceptability of the equipment utilized.

The infiltration quantities specified are those permissible when wet weather conditions prevail and the pipe is subject to a high water table. Further, the Contractor shall employ the low-pressure air testing procedure in order to determine the probable acceptability of the sewers when operating under wet weather conditions. The "low-pressure air test" shall generally conform to the procedure that is recommended for testing sanitary sewers and is as follows:

1. The section of pipe to be tested is cleaned and plugged at each end. The end of all branches, laterals and wyes are plugged. Either mechanical or pneumatic plugs (manufactured for the intended use of air testing) may be used. All plugs are to be braced to prevent blow-out. To facilitate test verification by the inspecting Engineer, all air used shall pass through a single, above ground control panel. The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to 10 psi. The continuous monitoring gauge shall be no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of ±0.04 psi. Two separate hoses shall be used to: (1) connect the control panel to the sealed line for introducing low-pressure air, and (2) a separate hose connection for constant monitoring of air pressure build-up in the line. If pneumatic plugs are utilized, a separate hose shall also be required to inflate the pneumatic plugs from the above ground control panel. Plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high groundwater situations. When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe, and this fault may be covered by the pipe plug.

2. Add air slowly to the plugged section of the sewer under test until the internal air pressure has been raised to 4.0 psig greater than the average backpressure of any groundwater. After the pre-set pressure has been obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain the pre-set pressure, then close air supply valve.

3. When the pressure decreases to a gauge reading equal to 3.5 psig, start stopwatch. Determine time in seconds marking drop of 1.0 psig of internal air pressure.

4. Refer to the appropriate table below to determine minimum permissible pressure holding time in seconds for particular section of sewer being tested if it contains one pipe size. If the time shown in Table I or Table II for the designated pipe size and length elapses before the air pressure drops 1.0 psig, the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even though the 1.0 psig drop has not occurred. If the pressure drops 1.0 psig before the appropriate time shown in Table I or Table II has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test.

TABLE I
MINIMUM TEST TIME FOR PVC OR D.I. PIPE

1 Pipe Diameter (in.)	2 Minimum Time (min: sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min:sec)						
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07

TABLE II

MINIMUM TEST TIME FOR VITRIFIED CLAY PIPE AND CONCRETE

Nominal Pipe Size, Inc.	T (time) Min/100 ft.
3	0.2
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8

If the section of line to be tested includes more than one pipe size, calculate the test for each size and add the test times to arrive at the total test time for the section. The Contractor will furnish all facilities and personnel for conducting the test in the presence of the Engineer. The acceptance air test shall be made only after backfilling has been completed and compacted. If any section of sewer tested should fail to meet the test requirements set forth hereinabove, the contractor shall determine the source or sources of leakage, repair or replace all defective materials, and correct all defective workmanship. Low-pressure air tests shall be repeated until the specified requirements have been met. Air testing of completed sections of sewers shall closely follow installation of the sewers in order that surface restoration work might be undertaken.

7.0 ACCEPTANCE AND DEFLECTION TESTING OF LINES

All installed PVC and Polyethylene gravity sewer shall be tested for deflection by the Contractor. The Contractor shall furnish all equipment, labor, and materials for making the test. Tests shall be made from manhole to manhole and performed in the presence of the Engineer. Deflection shall be tested by a "go", "no-go" mandrel or template which is sized to such dimensions that it will not "go" when encountering a deflection greater than permissible. This type of mandrel must be of such design as to minimize the possibility of its being hung up in the pipe by silt or other residues. A mandrel shall be sized to permit up to 5% deflection in pipe having typical maximum dimensional tolerances.

In order to use the mandrel, the line shall be completely flushed, making sure the pipe is clean of any mud or debris that would hinder the passage of the mandrel. A pull and retrieval rope is required on the mandrel with a marker attached on the rope at the end of the

pipe where the mandrel will exit to determine the location of the mandrel in the line. If the mandrel fails to pass through the line, it shall be assumed that the deflection exceeds 5% and the section or sections of pipe shall be corrected to the satisfaction of the Engineer.

If a section with excessive deflection is located, the Contractor shall uncover and inspect the pipe and replace any damaged pipe. If pipe is not damaged, replace and thoroughly tamp the haunching and initial backfill and replace remainder of backfill. If the section still fails to pass the deflection test, it shall be replaced with pipe which will pass the test. The cost of repair or replacement as well as acceptance retesting shall be borne by the Contractor.

8.0 ACCEPTANCE AND VACUUM TESTING OF MANHOLES

Only manholes tested after backfilling to final grade will be considered for acceptability. However, this test may also be used by the installer as a presumptive test to determine the condition of the manhole prior to backfilling. All main and service line connections which the manhole accommodates shall be 100% completed prior to testing of the manhole. Regardless of vacuum test results, no visible leaks will be allowed in a manhole.

1. Plug all manhole entrances and exits other than the manhole top access using suitably sized pneumatic or mechanical pipeline plugs. Plugs should be inserted a minimum of 12" beyond manhole wall. Make sure such plugs are properly rated for the pressures required for the test. The standard test of 10" Hg. (mercury) is equivalent to approximately 5 PSIG (.3 bar) backpressure. Unless such plugs are mechanically restrained, it is recommended that the plugs are used with a minimum two times (2x) safety factor or a minimum of 10 PSIG (0.7 bar) backpressure usage rating. All plugs are to be braced to prevent blow-out.

2. Install the vacuum tester head assembly at the top access of manhole. Adjust the cross brace to insure that the inflatable sealing element inflates and seals against the straight top section of the manhole or the ring assembly, if possible. (If using a "plate" style manhole tester, position the plate on the manhole ring assembly.)

3. Attach the vacuum pump assembly to the proper connection on the test head assembly. Make sure the vacuum inlet/outlet valve is in the closed position. Inflate sealing element to the recommended maximum inflation pressure. DO NOT OVER INFLATE!

4. Start the vacuum pump and allow pre-set RPM to stabilize. Open the inlet/outlet ball valve and evacuate the manhole to 10" Hg. (approximately negative 5 PSIG, 0.3 bar). DO NOT PRESSURIZE MANHOLE! THIS MAY RESULT IN MANHOLE DAMAGE AND/OR RESULT IN MANHOLE TEST HEAD DISLODGING FROM MANHOLE INLET!

5. Close vacuum inlet/outlet ball valve and monitor vacuum for specified test period (see Table). If vacuum does not drop in excess of 1" Hg., manhole is considered acceptable and the manhole passes the test. If manhole fails the test, complete necessary repairs and repeat test procedures until satisfactory results are obtained.

VACUUM TEST TIMETABLE
(24' MAXIMUM DEPTH)

DIAMETER (INCHES)	***ELAPSED TIME***	***ADDITIONAL TIME PER 2' OVER 24' DEEP***
48"	60 seconds	5.0 seconds
60"	78 seconds	6.5 seconds
72"	96 seconds	8.0 seconds

6. Repeat the above test procedure after backfilling manhole for final acceptance test.

Though the above is a general explanation of testing procedures, the Contractor is responsible for all testing procedures utilized. Testing procedures shall be modified as needed by the Contractor to insure a safe working environment.

STANDARD SPECIFICATION
FOR
VALVES AND ACCESSORIES

SECTION 5

1.0 GENERAL AND PAINTING

All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior. The inside of floor stands shall be painted. All anchor bolts shall be stainless steel.

2.0 CHECK VALVES WASTEWATER AND RETURN SLUDGE SERVICE

Check valves for wastewater, waste sludge, return sludge, and effluent water service shall have ductile iron or cast iron (ASTM A48, Class 40) bodies, stainless steel seats ASTM A276, Buna-N seat rings (80 Durometer), and extended stainless hinge pins (pivot shafts) Type 304, 309 or 316. Valve shall be gravity swing type, and shall be equipped with levers, weights, and air or oil cushion chamber (when indicated on the Drawings) adjustable for controlling closure. Valves shall be manufacture of APCO Model CVS-6000 Series; Golden-Anderson equivalent; Crispin SWC Series or other equivalent and be certified by the manufacturer for long term usage on sewage, sludge, and slurry applications. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

3.0 RUBBER CHECK VALVES

Check valves for use at the termination of drain lines or outfall lines shall be furnished as shown on the Drawings and shall be flexible, rubber type. Unless indicated otherwise, valves shall have a flanged connection. Inlet port area shall be 100% of the mating pipe port size. The port area shall contour down to a duckbill which shall allow passage of flow in one direction while preventing reverse flow. Valve construction shall be butyl rubber. Valve shall be Tide Flex Series 35 as manufactured by Red Valve, or equivalent. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

Rubber check valves for gravity sewer applications shall have a maximum headloss of 3 inches for a design flowrate capacity of the applicable line size and slope at 75% full flow.

4.0 FLAP VALVES

Flap valves shall be iron body construction with iron gates, bronze disc (gate) rings and bronze seats. Bushings and hinge pins shall be bronze. Flap valves shall be furnished with flanged frames, hub frames or spigot frames as required and/or as shown on the Drawings. Flap valves shall be as manufactured by Mueller Company, or M&H Valve Company, or American Valve & Hydrant Company. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

5.0 MUD VALVES

Mud valves shall be furnished and installed complete with stainless steel stems and (stainless steel) extension stems, stem guides and brackets, floor stands (provided with stainless steel stems) and benchstands where required, floor stand or bench-stand supports and operators. Mud valves shall be of the heavy duty flanged type designed to provide a positive seal under both seating and unseating head conditions. The valves shall be rising stem style. Frame, plug and yoke shall be cast iron (ASTM126B). Valve operating stem and lift nut shall be bronze (B421). The seat ring shall be bronze (B62) with a tapered, accurately machined seating face. The plug seat shall be seamless molded neoprene tapered to accurately mate with the seat ring for a positive seal. Each valve shall be complete with coupling for connecting valve stem to extension stem. Floor stands shall be provided where shown on the drawings. Floor stands shall be indicating, standard pattern. Provide stem guides for a maximum unsupported length of 5'. Provide floor stand brackets as required for application. Floor stand mounting to grating shall be as shown on the drawings. Mud valves shall be manufacture of Troy Valve, Mueller Company; M&H Valve Fittings Company; or equivalent. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

Mud valves shall be installed by attaching (with stainless steel hardware) to tapped flanges that are recessed below the top of the floor so that entire contents of the structure can be completely drained. The top of the mud valve flange shall not extend above the adjacent floor of the structure or tanks, etc.

6.0 BALL VALVES FOR CHEMICAL SERVICE

Ball valves for chemical service shall be manufactured from rigid polyvinyl compounds conforming to ASTM Specification Designation D-1784, latest revision, Type 1 Grade 1. Valves shall be suitable for 100 psi service, shall be approved by the National Sanitation Foundation, and shall be Hills-McCanna; Chemetron; or equivalent. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

7.0 SIGHT FLOW INDICATORS

Sight flow indicators shall be furnished and installed in all pressure feed lines (water) to water lubricated bearings or bushings; in all seal water lines to water sealed packing or stuffing boxes on waste pumps; in discharge lines from chemical feed pumps; and elsewhere as indicated on the Drawings.

Sight flow indicators shall be of the following styles and types:

1. For horizontal pressure pipelines and for vertical pressure pipelines with upward flow Jacoby-Tarbox Style 100-S, Flapper type; Johnson; or equivalent.
2. For horizontal and vertical pressure lines with upward or downward flow Jacoby-Tarbox Style 300-S, Rotary Type; Johnson; or equivalent.
3. For vertical pressure pipelines with upward flow at low flow rates - Jacoby-Tarbox Style 400-S, Ball Type; Johnson; or equivalent.

Bodies for sight flow indicators under water service shall be bronze or cast iron; and indicators shall be Teflon or Nylon.

Bodies for sight flow indicators under chemical feed service shall be PVC as specified in these Specifications or other materials resistant to the particular chemical, and indicators shall be of materials unaffected by the chemical solution.

8.0 AIR RELEASE VALVES-POTABLE WATER

See drawings for any specific brands/models of air release valves required for the project. Air release valves for pump discharge piping shall be air and vacuum type; and shall have cast iron body, bronze trim, stainless steel float, and heavy duty closed head tapped for discharge piping. All valves shall be installed complete with discharge piping from tapped head of valve, and with throttling valve in discharge line. Air release valve assemblies shall be furnished and installed complete with inlet piping, gate valve, discharge piping, and steel bracing or supports. Unless otherwise stated on the drawings, valves shall be APCO, sizes and series as indicated on the Drawings, and complete with surge check unit in sizes 4" and larger; or shall be similar combination as manufactured by Metraflex; Golden-Anderson; or equivalent. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

9.0 PRESSURE RELIEF VALVES

Cast iron hydrostatic pressure relief valves shall be installed in a vertical position in the concrete base slab of structures in locations shown on the Drawings. Valves shall have bronze body seat with resilient neoprene seat in the cover. Unless otherwise indicated on the drawings, valves shall be 4 inch diameter, body length as required, and shall be Model A2550 as manufactured by the Troy Valve; or equivalent. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard

Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

10.0 BACKFLOW PREVENTER

Backflow preventer shall have bronze body, bronze working parts, stainless steel springs, integral strainer, neoprene valve discs, neoprene coated cotton duck diaphragm; shall have a maximum working pressure of 175 psi, hydrostatic test pressure of 350 psi and temperature range of 32°F - 145°F. The device shall consist of two spring-loaded check valves and a spring-loaded, diaphragm actuated, differential pressure relief valve located in the zone between the check valves. All piping in backflow preventer box including backflow preventer shall be insulated with 1" thick fiberglass Micro Lok pipe insulation with weather protective jacket to prevent freezing. Backflow preventer shall be mounted above grade with fittings as required and an insulated housing as described below. Backflow preventer shall be Watts Model 909S, or equivalent. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

Fiberglass enclosure where shown on drawings shall be insulated and lockable, with provisions for drainage. Enclosure shall be mounted to 4" thick concrete pad. Suitably sized enclosure shall be the Lokbox as manufactured by Northeast Florida Enterprises, or equivalent.

11.0 EXTENSION STEMS

Extension stems and stem guides shall be furnished and installed where specified, indicated on the drawings, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the valve actuator shaft. Extension stems shall be connected to the valve actuator by a single universal joint water or grease filled protective boot. All stem connections shall be pinned and tack welded.

At least two stem guides shall be furnished with each valve requiring stem guides. Guide spacing shall be per the manufacturer's recommendations. Stem guides shall be of cast iron construction, bronze bushed and adjustable in two directional Stem guide spacing shall not exceed 100 times the stem diameter or 10 feet, whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall have a collar; the collar shall be pinned to the stem and shall bear against the stem thrust guide.

Extension stems shall be provided for buried valves when the valve actuator is 4 feet or more below finished grade. Each extension stem for a buried valve shall extend to within 6 inches of the ground surface, shall be provided with spacers which will center the stem in the valve box, and shall be equipped with a wrench nut.

Unless the stem is manufactured from stainless steel, all paint on the stem shall comply with the "Standard Specifications for Painting" for this project.

12.0 CHECK VALVES - SCUM, GRIT AND PRIMARY SLUDGE SERVICE

Checks valves shall be rubber flapper swing check with heavily constructed cast iron body and cover. The body shall be long pattern design (not wafer), with integrally cast-on end flanges. The flapper shall be Buna-N having an "O" ring seating edge and be internally reinforced with steel.

Flapper shall be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve. Flapper shall be easily removed without need to remove valve from line. Check valves to have full pipe size flow area. Seating surface to be on a 45□ angle requiring the flapper to travel only 35□ from closed to full open position, for minimum head loss and non-slam closure.

Buna-N flapper to have an elastic spring, molded internally, to assist the flapper to close against a slight head to prevent slamming. A manually operated backflow device shall be provided to create backflow through the check valve. Backflow device shall be constructed of cast bronze ASTM B-143 Alloy 922.

Materials of construction shall be certified in writing to conform to ASTM Specifications as follows:

Body and Cover	Cast Iron	ASTM A48, Class 30
Flapper	Buna-N	

Valve to be APCO series 100 rubber flapper swing check valve or equal. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

13.0 AIR RELEASE AND VACUUM VALVES - SEWAGE AND SLUDGE SERVICE

See drawings for any specific brands/models of air release and vacuum valves required for the project. Sewage and sludge service and vacuum valves shall allow unrestricted venting or re-entry of air, through it, during filling or draining of the force main, to prevent water column separation or pipeline collapse due to vacuum. Valves shall incorporate one upper and one lower stainless steel floats, connected by a common stainless steel float guide, thereby maintaining an air gap between the bottom float and top shut-off float. The air gap shall retard waste solids from fouling or clogging the top shut-off float. The internal baffle shall be fitted with a guide bushing and act to protect the shut-off float from direct air flow. The baffle shall retain the 45 Durometer Buna-N seat in place, without distortion, for tight shut-off. All internals shall be easily removed through the top cover without removing the main valve from the lines. Both floats shall withstand 1000 psi or more. Valve shall be fitted with blow off valves, quick disconnect couplings and minimum 6' of hose, to permit backflushing after installation without dismantling valve.

The valve inlet shall be 2" N.P.T. and the outlet 1" N.P.T. The valve manufacturer shall furnish installation and maintenance instruction manuals with each valve. The valve manufacturer shall be certified in writing to conform to ASTM specifications as follows:

Body, Cover and Baffle	Cast Iron	ASTM A48 Class 30
Internal Parts	Brass	ASTM B16
Float and Float Guides	Stainless Steel	ASTM A240
Seat	Buna-N	
Exterior Paint	Per Paint Spec FDA approved for	Potable Water Contact

Unless indicated otherwise on the drawings, valves to be APCO Series 400 Sewage Air and Vacuum Valves, or equal. All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

14.0 FLOOR BOXES

Where openings through concrete slabs are provided for key operation of valves with the operating nut being in or below the slab, such openings shall be provided with a cast iron floor box complete with cover. Each floor box shall be of the depth required for installation in the slab indicated on the Drawings. Where the operating nut is in the slab, the stem shall have a guide to maintain the nut in the center of the box; where below the slab, the opening in the bottom of the box shall permit passage of the operating key. Covers shall have cast theron designation of the service for which the valve is used.

Each floor box and cover shall be shop coated by dipping in asphalt varnish. Floor boxes in plants and pump stations shall either be painted in accordance with the "Standard Specifications for Painting" for this project, or, if allowed by the Owner, dipped in asphalt varnish.

15.0 BUTTERFLY VALVES - AIR SERVICE

Unless otherwise indicated or specified, air service butterfly valves shall be of the EPDM-seat tight-closing type. Except where other types are indicated or specified, butterfly valves shall have flanged ends above ground and MJ ends with megalugs below ground. All gaskets shall be rated for hot air with a temperature as stated below. Valve discs shall seat at 90 degrees with the pipe axis.

Flanged end valve shall be of the short-body type. Where mechanical joint ends are specified, either mechanical joint or push-on ends conforming to ANSI/AWWA C111/A21.11 will be acceptable. For buried or submerged service, shaft seals shall be O-ring type.

Each valve shall be provided with an actuator having a torque capability sufficient to seat, unseat, and maintain intermediate positions under the anticipated operating conditions. Lever actuators may be furnished for 6 inch and smaller valves, except where

electric, handwheel, or chain wheel actuators are indicated to be required. All 8" and larger valves shall have enclosed, geared, handwheel or chainwheel actuators with position indicator. Actuators shall be designed to produce the rated torque with a maximum pull of 80 pounds on the lever or wheel.

Each valve actuator, except actuators that are located in manholes, buried, or submerged, shall have a valve disc position indicator mounted on the end of the valve shaft. A disc position indicator shall also be provided on each operating stand or the actuator mounted thereon. Actuators in manholes, buried or submerged shall be suitable for submerged service.

Butterfly valves in air piping shall be industrial valves suitable for 15 psi air service, a maximum air velocity of 100 fps, and a minimum operating temperature of 225° F. Materials of construction shall be as follows:

Body	Cast Iron
Shaft	AISI Type 304 or 316 stainless steel
Disc	Bronze, or cast iron with corrosion-resistant metal plating
Seat	EPDM, or other elastomer with suitable temperature rating
Shaft Bearings	Upper and lower bearings, bronze or reinforced Teflon
Shaft Seal	Synthetic rubber rings with suitable temperature rating

Motor operated valves shall be furnished with electric valve actuators as specified in the Electric Valve Operator Section., or if called for in the drawings, or if specified elsewhere

All valves, except those buried in earth, floor stands, and all appurtenances shall comply with the "Standard Specifications for Painting" for this project unless the Engineer determines that the valve manufacturer's coating is superior.

16.0 FLEXIBLE COUPLINGS, REDUCERS AND FITTINGS

Flexible coupling, joint, increasers, etc. where indicated on the Drawings shall be constructed with high strength fabric and elastomer reinforced with metal rings. Flanges shall be integral with the body and utilize ductile iron retaining rings. Standard flange drilling mates with 125/150# flanges.

Flexible fittings for sewage or sludge service shall be supplied with a soft rubber arch filler to prevent the collection of solid materials in the arch. Multiple arches shall be provided as required for pipe misalignment and expansion or contraction.

Concentric and electric reducer connections shall connect unequal size pipes as indicated in the Plans and confirmed through the submittal process. Joints shall be provided with arches as described above and provide sound and vibration isolation.

A high strength synthetic fabric shall be used to reinforce the body. Flanges are drilled to standard ANSI dimensions and provided with ductile iron retaining rings. Control rods, gussets and compression sleeves shall be provided for all pressure applications.

Couplings shall be as manufactured by Metraflex, Chicago, IL; Mercer Rubber Company, Hauppage, NY; or equal.

STANDARD SPECIFICATION
FOR
PLUG VALVES

SECTION 6

1.0 GENERAL

Water and wastewater plug valves for raw water, raw wastewater, and sludge service shall be eccentric type, either non-lubricated or permanently lubricated. Valves shall have bodies of semi-steel, or of cast iron ASTM A126D, Class B or of ductile iron ANSI/ASTM A536, Grade 65-45-12. Discs or plugs shall be semi-steel or ductile iron ANSI/ASTM A536, Grade 65-45-12 and all bushings, bearings and journals shall be corrosion resistant. All wetted surfaces shall be made corrosion resistant by application of nylon or epoxy coatings, fusion bonded. All valves required for underground service shall be specifically designed for long-term underground service in all respects and be maintenance free.

All valves (non-wetted surfaces of valves), operators, floorstands, brackets, and appurtenances, etc., shall be prepared and painted in accordance with the Painting Specification for this project. Primer, intermediate coat, and top coat 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.

Valves shall be rated at not less than 150 psi working pressure, bi-directional. Valves shall operate from fully closed position to fully-open position with 90° turn, shall have full port openings of not less than 82% of connecting pipe area, and shall be equipped with position-indicating quadrants, pointers, adjustable stops and locks. Valve ends shall be flanged ANSI B16.1 Class 125, except when installed underground. Valves for underground service shall be equipped with mechanical joint ends. Valves shall be similar and equal to manufacture of DeZurik, Clow, Keystone or equivalent.

Each valve shall be equipped with operating device to suit the location of the particular valve. In general, all manual valves shall be equipped with handle (lever) wrenches; or supplied with handwheel or chainwheel operators for 8" or larger valves or floor stands where shown. Chainwheel operators will be equipped with stainless steel chain. Valves located in piping trenches shall be provided with extension socket wrenches of proper length so that the handle is 30 inches above the grating or floor. Openings in gratings shall be framed with 1/8-inch bar stock of same material as grating and of same depth as grating, and circular stem collars (split type) shall frame the openings. Collars shall have flanges bases for attachment (bolted) to grating and collar height shall be not less than 2" so as to maintain the extension stem in vertical position.

All 6" and larger valves and all valves installed at heights greater than 6'-6" above finished floor, without regard to size of valve, shall be equipped with worm-and-gear operators and chain wheels complete with chains of proper lengths. All worm-and-gear operators shall be enclosed in oil-tight and dust-proof cases.

Valve assemblies installed in typical underground applications shall be equipped with geared operator of traveling-nut type, sealed, gasketed and lubricated and rated for

underground service. The encased operators shall 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 service under 25' (minimum) of water submergence or as required by the application shown in the Contract Drawings. High-head extension boxes and extension stems for valves shall be provided for all underground, submerged, and other types of deep valve installations. Tops of extension stems shall be equipped with operating nuts, and bottom sockets of extension stems shall be robustly pinned to operating nuts of valves. Extend all valve operators as required for safe, convenient, and easy access for operation.

2.0 AIR SERVICE

Plug valves for air service shall be brass construction in sizes through 2" and be cast iron or semi-steel in sizes greater than 2" with all valves rated for a working pressure of 175 psi. Plugs shall be lubricated type, with close tolerances between plug and body sealing surfaces; and the plugs shall rotate easily in corrosion resistant bushings and journals and on corrosion resistant bearing surfaces. Valves shall operate from fully-closed to fully-open with 90° turn, and shall be equipped with indicating quadrants, pointers, adjustable stops and locks. Valves of sizes through 2" shall have full port openings (100% of connecting pipe area); but valves of sizes greater than 2" may be restricted port opening provided that port area is not less than 65% of connecting pipe area. Valve ends may be either screwed or flanged ANSI B16.1 Class 125 or ANSI B16.5 Class 150, as required or indicated on the drawings. Valves shall be similar and equal to Homestead Industries, AFC Industries, Inc., or Dresser Industries.

The Contractor shall furnish to the Owner one (1) lubricant gun and one (1) 25% container (full) of each type of lubricant required for each service condition specified.

STANDARD SPECIFICATIONS
FOR
MECHANICAL COUPLINGS

SECTION 7

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:

Type	Model
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 EBAA Iron 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 and be NSF 61 approved. The remaining components shall be fusion bonded flexi-coat epoxy per AWWA C213. The complete mechanical coupling assembly shall be suitable for its application and installation conditions.

STANDARD SPECIFICATION
FOR
MANUAL VALVE ACTUATORS

SECTION 8

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. Floors 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 ductile iron or cast iron base type as manufactured by Clow Corporation, Troy Valve, DeZurik, 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. Height of floor stands shall be at any ergonomic height (34" $\pm$). All components to be painted in accordance with the manufacturer's recommendations for a harsh outdoor environment.

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 SPECIFICATION
FOR
STAINLESS STEEL SLIDE/WEIR GATES

SECTION 9

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required to install, ready for operation and field test heavy duty, stainless steel gates and appurtenances as shown on the Contract Drawings and as specified herein.
B. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C561 Standard for Fabricated Stainless Steel Slide Gates as modified herein. The allowable leakage rate for the stainless steel gates in this specification shall be 1/2 the allowable leakage listed in the latest revision of AWWA C561.
C. Gates installed in drinking water or water treatment applications shall be NSF/ANSI 61 certified. Provide manufacturer certification of conformance to this standard.
D. Gates shall be non-self contained, self contained, surface mounted, and/or embedded as shown on the Contract Drawings.
E. Gate assemblies located in hazardous locations shall be designed to be non-sparking. Headworks structures at WWTPs shall be considered hazardous locations.

1.02 SUBMITTALS

A. Provide the following information to confirm compliance with the specification in addition to the submittal requirements specified in the General Specifications.
    1. Complete description of all materials including the material thickness of all structural components of the frame and slide.
    2. Installation drawings showing all details of construction, details required for installation, dimensions, and anchor bolt locations.
    3. Maximum bending stress and deflection of the slide under the maximum design head.
    4. The location of the company headquarters and the location of the principle manufacturing facility. Provide the name of the company that manufactures the equipment if the supplier utilizes an outside source.
    5. Maximum required operating force required.
    6. Certification that the allowed leakage rate shall be achieved.

1.03 QUALITY ASSURANCE/QUALIFICATIONS

A. Qualifications

1. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years' experience designing and manufacturing water control gates. The manufacturer shall have manufactured water control gates for a minimum of 100 projects.
2. The manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX or AWS D1.6 Structural Welding Stainless Steel.
3. Any gate imported into the United States must be fully shop tested at a test location within the US and shall be witnessed by a representative of the engineer. The cost of travel for the Engineer's representative shall be borne by the gate manufacturer.
4. In order to avoid contamination and maintain surface purity, the principle manufacturing facility must have a dedicated stainless-steel facility segregated and isolated from the facility where products of other materials such as carbon steel or cast iron are manufactured. The stainless-steel material must be kept separated from other materials beginning from acquisition and storage through handling, fabrication, assembly, and dispatch. Mechanical removal of free iron particle, oil, dirt, paint, welding flux, slag, heat tint and scales of oxides must be supplemented with glass bead blasting followed by in house chemical bath pickling and passivation. Spray passivation or pickling and passivation performed by a third party is strictly not permitted.
5. To prevent crevice corrosion and advocate long life of stainless-steel fabricated products, the principle manufacturer must only use continuous welding practices. To verify the quality of the welds, a dye penetration test shall be conducted on all weld joints and approved by a quality control inspector.
6. Gates shall be as manufactured by Whipps, Rodney Hunt, or equal.

PART 2 EQUIPMENT

2.01 GENERAL

A. Gates shall be as specified herein and have the characteristics and dimensions shown on the Contract Drawings.
B. The slide gates will be designed for water tightness for both seating and un-seating differential head per the actual site requirement as detailed in the Contract Drawings. Leakage shall not exceed 0.05 gpm/ft of wetted seal perimeter in seating head and unseating head conditions.
C. The gate shall utilize self-adjusting seals as its primary sealing mechanism. Due to the difficulty of accessing gates when they are in service, gates that utilize adjustable wedges, wedging devices or pressure pads as the primary sealing mechanism are not acceptable. All seals shall be suitable for their intended environment including corrosive environments such as raw wastewater and chemical feed locations/environments.
D. All structural components of the frame and slide shall be fabricated of stainless steel having a minimum thickness of 1/4-inch and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

E. Slide gate frames shall be shipped fully assembled with the invert member welded to the side frames and the slide installed in the frame unless the overall width of the slide gate exceeds 96 inches, or the overall height of the slide gate exceed 25 feet.
F. All welds shall be performed by welders with AWS D1.6 certification.
G. Finish: Mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale accompanied by passivation. All iron and steel components shall be properly prepared, and shop coated with a primer and finish painted, all in accordance with the Project's Painting Specifications.
H. Materials:

Components	Materials
Frame Assembly and Retainers	Stainless Steel, Type 316L, ASTM A240
Slide, Plates, and Stiffeners	Stainless Steel, Type 316L, ASTM A240
Bars and Shapes	ASTM A564
Austenitic Stainless Steel Pip	ASTM A312
Stem	Stainless Steel, Type 316, ASTM A276
Anchor Studs	Stainless Steel, Type 316, ASTM A276
Fasteners and Nuts	Stainless Steel, Type 316, ASTM F593/F594
Invert Seal (Upward Opening Gates Only)	Viton
Seat/Seals and Facing	Ultra-High Molecular Weight Polyethylene ASTM D4020 and Viton
Lift Nuts	Bronze ASTM B584
Pedestals and Wall Brackets	Stainless Steel, Type 316L, ASTM A240
Operator Housing	Cast aluminum

2.02 FRAME

A. The frame assembly, including the guide members, invert member and yoke members, shall be constructed of formed stainless steel plate with a minimum thickness of 1/4-inch.
1. Frame design shall allow for embedded mounting, mounting directly to a wall with stainless steel anchor bolts and grout or mounting to a wall thimble with stainless steel mounting studs and a mastic gasket material. Mounting style shall be as shown on the Contract Drawings.
2. All wall mounted or wall thimble mounted gates shall have a flange frame. Flat frame gates are not acceptable.
3. The structural portion of the frame that incorporates the seat/seals shall be formed into a one-piece shape for rigidity. Guide members that consist of two or more bolted structural members are not acceptable. Guide member designs where water loads are transferred through the assembly bolts are specifically not acceptable.
4. Gussets shall be provided as necessary to support the guide members in an unseating head condition. The gussets shall extend to support the outer portion of the guide assembly and shall be positioned to ensure that the load is transferred to the anchor bolts, or the wall thimble studs.

5. The frame shall extend to accommodate the entire height of the slide when the slide is in the fully opened position on upward opening gates or downward opening weir gates.
6. On self-contained gates, a yoke shall be provided across the top of the frame. The yoke shall be formed by structural members affixed to the top of the side frame members to provide a one-piece rigid assembly. The yoke shall be designed to allow removal of the slide. The Yoke shall be sized to withstand normal operating loads as well as the maximum hoist output. The Yoke deflection shall not exceed 1/360 of the gate width or a maximum of ¼" whichever is less at maximum operating load.
7. A rigid stainless steel invert member shall be provided across the bottom of the opening. The invert member shall be of the flushbottom type on upward opening gates.
8. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.
9. A rigid stainless-steel member shall be provided across the invert of the opening on downward opening weir gates.

2.03 SLIDE

A. The slide and reinforcing stiffeners shall be constructed of stainless-steel plate. All structural components shall have a minimum thickness of 1/4-inch.

1. The slide shall not deflect more than 1/720 of the span or 1/16 inch, whichever is smaller, under the maximum design head.
2. When the width of the gate opening in feet multiplied by the maximum design head in feet is greater than 80 square feet the portion of the slide member that engages the guide shall be 1/2" thick. When the width of the gate opening in feet multiplied by the maximum design head in feet is greater than 120 square feet, the portion of the slide that engages the guide members shall be of a "thick edge" design. The thick edge portion of the slide shall have a minimum thickness of 2.5 inches.
3. Reinforcing stiffeners shall be continuously welded to the slide and mounted horizontally. Vertical stiffeners shall be continuously welded on the outside of the horizontal stiffeners for additional reinforcement. When required to maintain proper plate stress and deflection intermediate vertical gussets shall be provided. Appropriate safety factors shall be applied to the ultimate tensile and yield strength of the material.
4. The stem connector shall be constructed of two angles or plates. The stem connector shall be continuously welded to the slide. A minimum of two bolts shall connect the stem to the stem connector.

2.04 SEALS

A. All gates shall be provided with a seal system that has self-adjusting and adjustable features to restrict leakage in accordance with the requirements listed in this specification. The manufacturer shall thoroughly review the space limitations for

each gate installation to ensure the sealing system selected does not result in a gate assembly that is too big or creates conflicts at its installation location.

1. All gates shall be equipped with UHMW polyethylene or other suitable seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide. Seat contact pressure shall not exceed 600 psi at the design head. Seats/seals shall be suitable for their intended environment including corrosive environments such as raw wastewater and chemical feed locations/environments (e.g., chlorine contact chambers).
2. The seat/seals shall extend to accommodate the 1-1/2 x the height of the slide when the slide is in the fully closed or fully opened position.
3. All upward opening gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member, or the bottom of the slide and it shall be held in place with stainless steel attachment hardware.
4. All downward opening weir gates shall be provided with UHMW polyethylene or other suitable seat/seals across the invert member.
5. The seal system shall be durable and shall be designed to accommodate high velocities and frequent cycling without loosening or suffering damage.
6. All seals must be bolted or otherwise mechanically fastened to the frame or slide. Arrangement with seals that are force fit or held in place with adhesives are unacceptable.
7. The seals shall be mounted so as not to obstruct the water way opening.
8. A resilient sealing system separate from the seat shall be provided to ensure watertightness of the gate assembly. "J" seals, "P" seals, crown seals, cord seals, etc. may be used for this purpose if recommended by the gate manufacturer and approved during the submittal process.
9. The overall seal system shall have been factory tested to confirm negligible wear (less than 0.01") and proper sealing. The factory testing shall consist of an accelerated wear test comprised of a minimum of 25,000 open-close cycles using a well-agitated sand/water mixture to simulate fluidized grit.

2.05 STEM

A. A threaded operating stem shall be utilized to connect the operating mechanism to the slide. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator or motor actuator. On non-rising stem gates, the threaded portion shall engage the nut on the slide.

1. The threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches. Stem extension pipes are not acceptable.
2. The stem shall be constructed of solid stainless-steel bar for the entire length, the metal having a tensile strength of not less than 75,000 psi.
3. The stem shall be threaded to allow full travel of the slide unless the travel distance is otherwise shown on the Contract Drawings.
4. Maximum L/R ratio for the unsupported part of the stem shall not exceed 200.

5. The operating stem shall be designed to transmit in compression at least 2 times the rated hoist output with an effort of 40 lb on the crank or handwheel. The Euler column formula shall be utilized. Where a hydraulic or electric actuator is used, the stem design load shall not be less than 1.25 times the output thrust of the hydraulic cylinder with a pressure equal to the maximum working pressure of the fluid supply or 1.50 times the output thrust of the electric actuator at the stalled condition.
6. The stem shall be designed to withstand the tension load caused by the application of a 60 lb effort on the crank or handwheel without exceeding 1/5 of the ultimate tensile strength of the stem material.
7. The threaded portion of the stem shall have machine rolled threads of the full Acme type with a 16-microinch finish or better. Stub threads are not acceptable.
8. Stems of more than one section shall be joined by stainless steel or bronze couplings. The coupling shall be bolted to the stems.
9. Stems, on manually operated gates, shall be provided with adjustable stop collars to prevent over closing of the slide.

2.06 STEM GUIDES

A. Stem guide shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.
   1. Stem guide brackets shall be fabricated of stainless steel and shall be outfitted with UHMW or bronze bushings. For submerged applications, the bushing material shall be selected based on the application (e.g., chemical environments such as chlorine contact chambers)
   2. Adjustable in two directions.

2.07 WALL THIMBLES

A. Wall thimbles shall be provided when shown on the Contract Drawings.
   1. The wall thimble depth shall be equal to the thickness of the concrete wall in which the thimble is to be mounted.
   2. Wall thimbles shall be fabricated stainless steel construction of adequate section to withstand all operational and reasonable installation stresses.
   3. Wall thimbles shall be constructed of 1/4-inch minimum thickness stainless steel and the front face shall have a minimum thickness of 1/4–inch.
   4. The fabrication process shall ensure that the wall thimble is square and plumb, and the front face is sufficiently flat to provide a proper mounting surface for the gate frame.
   5. The face of the wall thimble shall only be machined if recommended by the gate manufacturer. If the wall thimble is to be machined, the front face shall have a minimum thickness of 1/4-inch after machining.

6. A water stop shall be welded around the periphery of the thimble. Wall thimbles shall be designed to allow thorough and uniform concrete placement during installation.
7. Studs and nuts shall be stainless steel. Water stop may be stitch welded.
8. A suitable gasket or mastic shall be provided to seal between the gate frame and the wall thimble.

2.08 MANUAL OPERATORS

A. Unless otherwise shown on the Drawings, gates shall be operated by a manual handwheel or a manual crank-operated gearbox. The operator shall be mounted on the yoke of self-contained gates or on the pedestal of non-self-contained gates. All operators and gearboxes for gates in hazardous locations shall be non-sparking.
   1. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated with no more than a 40 lb. effort when the gate is in the closed position and experiencing the maximum operating head. The force required to operate the gate shall be such that the gate is easy to open and close when under the maximum head. The gate shall remain easy to open and close as the gate components age.
   2. An arrow with the word "OPEN" shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate.
   3. Handwheel operators shall be fully enclosed and shall have a cast aluminum housing. Handwheel operators shall be allowed only for small gates with low operating force.
      a. Handwheel operators shall be provided with a threaded cast bronze lift nut to engage the operating stem.
      b. Handwheel operators shall be equipped with roller bearings above and below the operating nut.
      c. Positive mechanical seals shall be provided above and below the operating nut to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.
      d. The handwheel shall be removable and shall have a minimum diameter of 15 inches. The operator hub shall be suitable for allowing a portable motorized operator to be used to operate the gate.
   4. Crank-operated gearboxes shall be fully enclosed and shall have a cast aluminum. All gearboxes for gates in hazardous locations shall be non-sparking.
      a. Gearboxes shall have either single or double gear reduction depending upon the lifting capacity required.
      b. Gearboxes shall be provided with a threaded cast bronze lift nut to engage the operating stem.
      c. Bearings shall be provided above and below the flange on the operating nut to support both opening and closing thrusts.
      d. Gears shall be steel with machined cut teeth designed for smooth operation.
      e. The pinion shaft shall be stainless steel and shall be supported on ball or tapered roller bearings.

f. Positive mechanical seals shall be provided on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.
g. The crank shall be cast aluminum or cast iron with a revolving nylon grip.
e. The crank shall be removable. The operator hub shall be suitable for allowing a portable motorized operator to be used to operate the gate.

5. All downward operating weir gates and all gates having widths equal to or in excess of 72 inches shall be provided with two gearboxes connected by an interconnecting shaft for simultaneous operation.
   a. Interconnecting shafting shall be constructed of aluminum or stainless steel.
   b. Flexible couplings shall be provided at each end of the interconnecting shaft. Couplings shall be stainless steel or non-metallic.
   c. One crank shall be provided to mount on the pinion shaft of one of the gearboxes.
   d. If the operating assembly is motorized, a stainless-steel enclosure shall be provided over the interconnecting shaft to comply with OSHA regulations.
6. An extended operator system utilizing chain and sprockets shall be furnished by the manufacturer when the centerline of the crank or handwheel, on a non-geared operator, is located over 48-in above the operating floor. Chain wheels are not acceptable.
   a. A removable stainless steel or aluminum cover shall be provided to enclose chain and sprockets.
   b. The extended operator system shall lower the centerline of the pinion shaft to 36-in above the operating floor.
   c. A handwheel may be utilized in conjunction with a gearbox in lieu of the extended operator system if the centerline of the pinion shaft is 60-in or less above the operating floor.
7. Pedestals shall be constructed of stainless steel. Aluminum pedestals are not acceptable.
   a. The pedestal height shall be such that the handwheel or pinion shaft on the crank-operated gearbox is located approximately 36-in above the operating floor.
   b. Wall brackets shall be used to support floor stands where required by the application and/or shown on the Drawings and shall be constructed of stainless steel. Offset pedestals (in lieu of pedestals with wall brackets) shall only be used when dictated by the application, specifically shown on the Contract Drawings, and/or approved by the engineer during the submittal process.
   c. Wall brackets shall be reinforced to withstand in compression at least two times the rated output of the operator with a 40 lb. effort on the crank or handwheel.
   d. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and included in the submittals. The gate manufacturer shall supply the bracket, anchor bolts and accessories as part of the gate assembly.

8. Operators shall be equipped with aluminum or stainless-steel stem covers with a narrow slot to allow observation of the stem position.
    a. The top of the stem cover shall be closed.
    b. The bottom end of the stem cover shall be mounted in a housing or adapter for easy field mounting.
    c. Stem covers shall be complete with permanent indicator markings (1" graduation) to indicate gate position. For rising stem applications, a full height scale shall be mounted on the side of the stem cover and an indicator nut mounted on the rising stem to show gate position. For non-rising stem applications, a gate opening indication shall be provided on the stem cover.
9. When shown on the Contract Drawings, provide 2-inch square nut, mounted in a floor box, with a non-rising stem.
    a. The square nut shall be constructed of bronze.
    b. The floor box shall be constructed of stainless steel or cast iron and shall be set in the concrete floor above the gate as shown.
    c. Provide one aluminum or stainless-steel T-handle wrench for operation.
10. All manually operated gates shall have provision to allow a portable electric operator to be easily connected to the gate.

2.09 ELECTRIC MOTOR ACTUATORS

A. See Standard Specification for "Electric Valve and Gate Actuators/Operators". Actuators located in hazardous locations shall be rated as explosion proof.

2.10 POSITION INDICATION SIGNAL

The actuator shall utilize gearing feedback or other appropriate signal source to indicate precise gate position to the SCADA system. The position indication method and logic shall be as designed by the gate manufacturer. The gate position signal must be accurate and dependable as it will be used to remotely control plant operations during critical periods. The baseline for measurement shall be coordinated with the SCADA system and Engineer during construction. Coordinate with the SCADA supplier for the 4-20 mA and power sources for gate position indication to SCADA.

2.11 ANCHOR BOLTS

A. Anchor bolts shall be provided by the gate manufacturer for mounting the gates and appurtenances.
    1. Quantity and location shall be determined by the gate manufacturer.
    2. If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.
    3. Anchor bolts shall have a minimum diameter of 1/2-inch.

2.12 GATE SCHEDULE

See the "Slide and Weir Gate Schedule" at the end of this Specification for gate designations and additional requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Where multiple weir gates are set in the same structure, set all weir gate frame inverts at the exact same elevation so that the gate position feedback signals are based on the same datum.

B. Installation of the gates and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.

C The CONTRACTOR shall review the installation drawings and installation instructions prior to installing the gates.

D The gate assemblies shall be installed in a true vertical plane, square and plumb.

E. The CONTRACTOR shall fill the void in between the gate frame and the wall with non-shrink grout as shown on the installation drawing and in accordance with the manufacturer's recommendations. Fully comply with all instructions of the grout manufacturer and the gate manufacturer to ensure the grout is correctly and permanently installed. Cure grout properly.

F. The CONTRACTOR shall add a mastic gasket and or other sealant material (suitable for the application) between the gate frame and wall thimble (when applicable) in accordance with the manufacturer's recommendations.

G. Remove and replace the gates at no cost to the Owner if needed for the ease of operation.

3.02 FIELD TESTING

A. After installation, all gates shall be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured and shall not exceed the maximum operating effort specified herein. Electric motor actuators shall function smoothly and without interruption. Each gate shall be water tested by the CONTRACTOR, at the discretion of the ENGINEER and OWNER, to confirm that leakage does not exceed the specified allowable leakage. If the leakage exceeds the specified leakage, it shall be corrected in a permanent manner at the Contractor's expense and to the Owner's satisfaction.

Slide and Weir Gate Schedule

Notes:

1. All gates shall have top closure.
2. All gates shall have electric actuators provided by the gate manufacturer. See "Standard Specification For Electric Valve And Gate Actuators/Operators".
3. All gates shall be furnished with a Gear Counter to reliably track & send the precise weir position to SCADA system.
4. Coordinate carefully with SCADA provider to ensure compatibility of all controls and all signals.
5. Provide a permanent engraved easily readable name tag approximately 4" x 2" showing the Gate Designation for each gate. Attach tags to the gates with a stainless steel chain or in some other permanent non- corrodible manner. The tag shall be designed for long life in direct sunlight and extreme weather conditions. All components shall be corrosion proof.
6. See Drawing SB/F-3 for plan view of gate locations in Splitter Box.
7. See Drawing SB/F-4 for gate sizes and inverts.

Gate Name:	Gate Designation:	Operator:
Disk Filter #1 - Influent Weir Gate	DF #1 – IWG	Electric
Disk Filter #2 - Influent Weir Gate	DF #2 – IWG	Electric
Traveling Bridge Filters – Influent Weir Gate #1	TBF – IWG #1	Electric
Traveling Bridge Filters – Influent Weir Gate #2	TBF – IWG #2	Electric

STANDARD SPECIFICATION
FOR
ELECTRIC VALVE AND GATE ACTUATORS/OPERATORS

SECTION 10

1.0 GENERAL

Electric valve and gate operators shall be provided by the valve supplier for (1) modulating, (2) throttling, and (3) open/close applications as indicated on the Drawings and as specified herein. The valve operators shall be an integral unit and shall consist of motor, gearing, limit switches, torque switches, handwheel, declutch lever, electrical control connections, motor electrical connection, motion assurance circuit, relays, and other components required to perform properly and as described herein. Actuators shall conform without exception to this specification and to the requirements of AWWA C540, latest edition. Any deviation from this specification must be approved in writing by the Engineer prior to the bid date.

See Contract drawings for applications where electric valve and gate operators are to be suitable for Class 1, Division 2, Groups C and D hazardous locations/applications.

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.

Electric valve and gate actuators/operators shall be as manufactured by EIM, AUMA, or equal. For control circuit consistency, ease of maintenance and spare availability, the same manufacturer shall supply all actuators.

2.0 DESIGN

A. GENERAL

Actuators shall be designed by the actuator manufacturer for trouble free service. Actuators shall be sized by the valve supplier for the application shown and shall be factory mounted and fully tested prior to shipment. Motors shall be sized by the valve and actuator manufacturers to produce a minimum of 1 ½ times the maximum torque rating and pull rating of the valve/gate. Stall torque of the motor shall not exceed the torque capacity of the valve. For actuators being retrofitted on existing valves/gates, the manufacturer shall consider all factors when sizing the actuators to ensure the actuators are not undersized and will operate satisfactorily and trouble-free.

The most adverse conditions to be encountered shall be considered when sizing actuators. Drive motor shall be sufficient to open, close, or modulate valves against maximum differential pressure when supply voltage is 90% of the nameplate rating, without loss motion considered and designed for intended service.

All gearing shall be designed to withstand the full stall torque of the motor.

Motor assemblies and all electrical appurtenances shall be designed and assembled for their intended service. See Contract drawings for applications where electric valve and gate operator assemblies are to be suitable for Class 1, Division 2, Groups C and D hazardous locations/applications. Submittal documentation shall clearly show all installation requirements for hazardous locations as well as all other locations.

Motors shall be specifically designed for actuator service. Motors shall be squirrel cage induction type, totally enclosed, non-vented. Insulation shall be Class F, tropicalized and suitable for temperatures of up to 310 degrees F. Motor shall be of the "thermally protected" type, with three (3) thermal switches imbedded in motor windings one hundred twenty (120) degrees apart. Motors shall be powered by 460 volt - 3 phase - 60 hertz power. Motors for open-close service shall be minimum 30 minute duty rated at the full output rating of the motor. Motors for modulating and throttling service shall be minimum 30 minute duty rated at the full output rating of the motor. De-rating of the motors is unacceptable. Motor housing shall be aluminum die cast with cooling fins.

Motors shall be sized for continuous duty. Motors for standard rotary valves (i.e gate valves, butterfly valves, plug valves, etc.) shall operate from fully closed to fully open or vice versa in 60 seconds minimum. Motors for devices such as telescoping valves and gates, shall move the valve/gate linearly at a minimum rate of 24" per minute. Motors for actuators in throttling or modulating service on quarter turn valves shall be designed and sized for a minimum of 1200 starts per hour. Actuators for throttling service shall be specifically suitable for and compatible with valve controllers provided by other equipment manufacturers. Actuator manufacturer shall coordinate as required.

Actuators shall be permanently lubricated by the manufacturer and shall be capable of operating in any position, vertical or horizontal.

Actuator enclosures shall be furnished with space heaters. The space heater power shall be derived from the main 460 V power to the valve. All motors, gearing switches, wiring terminals and electrical connections shall be completely sealed against the environment and protected against the ingress of water, humidity, and dust. Enclosure shall be rated NEMA 4X/6, watertight. For safety, no exposed wiring or terminals shall be allowed in the switch compartment. Switches (limit and torque) shall be in IP 68 enclosure such that no dirt, dust water, etc. may interfere with the contacts when limit switch compartment is removed. Actuators shall be supplied with a watertight seal between external wiring connection and the actuator housing. This seal shall prevent water ingress due to moisture penetration into conduit or external wiring connections. Enclosure shall not be sacrificed when covers or plugs are removed for field wiring. All external fasteners shall be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss with covers removed.

Actuator service shall be as indicated in the actuator schedule and/or as shown on the Drawings.

Actuator controls shall be integral. Remote mounted control modules/packages for remote monitoring, control, display, diagnostics, E.C. shall be provided when specified on the plans or when the actuator is inaccessible from the floor or a plateform. For open/close service, and as applicable to others, actuators shall be furnished with reversing motor contactors, electrically and mechanically interlocked, equipped with auxiliary contacts, control transformer, monitor relay for alarm, red and green high-intensity LED indicating lights. Contactor shall

be completely wired to the electrical control assembly shall be contained in a minimum NEMA 4X/6 rated housing integral to the operator. Control power transformer shall be grounded with fused secondary and capable of transforming 460 V, 3 ø, 60 Hz to regulated 24 VDC. A minimum of three (3) threaded hubs for electrical conduit entry in controller compartment shall be provided, one (1) for primary power and two (2) for control circuits. All internal wiring in the housing shall be to terminal strips or plug assembly and all switches shall be wired to these terminals. Integral controls to be field separable from actuator gearcase by means of plug and socket electrical connection. Integral pilot device station must be capable of repositioning at 90 degree increments so the pushbuttons, indicating lights and selector switch are accessible to the operator. Open-stop-close controls shall be by means of a three (3) push buttons and two (2) lights, Green for Open, Red for Closed. Local-Off-Remote control shall be by means of a three (3) position selector switch, padlockable in three positions. Auxiliary contacts shall be provided on the Local-Off-Remote selector switch to facilitate remote indication of switch position. Padlocks shall be provided for each actuator and shall be common keyed with all actuators. Actuator control modules/packages shall be easily wall mountable remote from the actuator if required on plans. If control packages are to be mounted remotely, the actuator manufacturer shall provide adequate length of all wiring/cable required to fully interface between the control package and the actuate (coordinate during submitter process). Controls modules/packages shall be supplied with internal phase discriminator, monitor relay for collective fault signal and surge protection to 10KV exceeding IEEE 587. An internal phase correction device shall be provided to prevent incorrect phase rotation of three phase actuators. Local valve position shall be accomplished via limit switch contact as well as indication via dial type mechanical position indicator (MDPI). Modulating valves and gates shall meet the above requirements, and shall include solid state starters and solid state comparator circuit (positioner) to accept 4-20 mA command signal, with adjustable controls for span, signal differential, zero and response delay for signal change to eliminate seeking due to signal noise. The position comparator circuit shall be of solid state printed circuit board design and shall include (but not limited to) separate controls for a zero, span and deadband adjustment. LED lamps shall be furnished for indication of control status and shall include as a minimum, indications for open, close and fault. Positioner shall be field adjustable to fail in the open, closed, or last position on loss of signal. One (1) watt mylar potentiometers shall be used and shall be capable of providing linearity of +/- 1% and shall be rated for up to 250 degrees F. Internal power supply shall provide regulated 24VDC power to power solid state comparator circuit (positioner) and shall have the capability to supply power to internal, solid state 4-20 mA feedback device. For throttling service, actuators shall be provided with a local and remote momentary contact circuit such that the appropriate actuator contact must be "maintained" in order for the actuator to move in either the open or close direction. Actuator control logic shall be provided to allow simple dip switch changes inside the actuator control housing that will facilitate separate selection of local and/or remote open and close momentary or latching control circuits while in the field.

Remote control contacts and relays shall be powered from the actuator and shall be 120 VAC. When in the remote mode, 120 VAC circuits powered by the actuator shall be closed or opened at the remote location to operate the valve. Separate 120 VAC power, produced elsewhere for limit switch interrogation, shall be routed through the auxiliary (dry) limit switch contacts and other alarms or switches, to sense valve position, etc.

Provide optical isolators to separate incoming voltage signals from internal motor controls. Provide other appurtenances as required to protect from surges.

Provide limits switches at each end of travel. Limit switches with a minimum of twelve (12) contacts rated 5A to 250VAC shall be provided for each operator (3 N.O & 3 N.C for opening and 3 N.O. & 3 N.C for closing- one pair of which shall be dry contacts available for remote voltage interrogation). Limit switches shall be of the DPDT, double break type. Limit switch drive to be of counter gear design and shall be "in step" with the output drive at all times in both the motor drive and manual (handwheel) modes. Limit switches shall be adjustable to change state at any point between or beyond the fully open and fully closed positions, with easy set declutch. Limit switches shall either be non-intrusively adjustable and/or be capable of quick adjustment requiring no more than five (5) revolutions of the limit switch adjustment spindle. Limit switch compartment to have no exposed electrical connections. Limit switch adjusting shall be clearly marked as to direction of adjustment. All contacts on the limit switch assembly to be sealed in minimum IP 66 enclosure to maintain the integrity of the contacts and to eliminate shorting out. Indicating lamp circuitry shall include motion assurance to indicate when the operator is in motion, and direction in which it is traveling. Motion assurance shall be wired into lamps on operator, and available for remote light circuits when specified. Position indication shall be accomplished by means of an indicator dial in full step at all times with valve travel, whether in power or manual operation. Limit switch gearing shall be grease lubricated. The drive mechanism shall be totally enclosed to prevent entrance of foreign matter. Metallic gears shall be used. The use of any non-metallic gearing is unacceptable.

Each operator shall have a separately adjustable opening torque switch and closing torque switch. Adjustment range shall be responsive to opening or closing loads such that switches operate to protect valve and operator from damage when there is over-torque during opening or closing. All contacts shall be sealed to insure the integrity of the contacts and to eliminate shorting out. When required, opening torque switch shall be able to control predetermined back seating thrust of a valve. Closing torque switch shall control predetermined seating thrust required for torque seating of wedge gate or globe valves. Seating torque shall be constant and independent of wear in valve disc or seat. Torque switches shall be of the SPDT, double break type with contacts rated 5A to 250VAC.

Provide with manual over-ride handwheel. Manual operation shall be via gearing to facilitate easy changeover from motor to manual operation when the actuator is under load. Return from manual to electric mode shall be automatic upon motor operation. Declutching mechanism shall allow valve operation by means of permanently attached auxiliary handwheel, meeting O.S.H.A. requirement of no more than forty (40) pounds rim pull effort. The design of the declutch mechanism shall be such that an internal shear mechanism shall prevent damage to the actuator housing due to excessive input torque being applied to the handwheel. Actuation of motor automatically returns the operator to the electric mode. Operation of the motor shall not cause the handwheel to rotate, and operation of the handwheel shall not cause the motor to rotate. Should power be returned to the motor while the handwheel is in use, the design of the unit shall prevent transmission of the motor torque to the handwheel. The handwheel shall have an arrow and the word "OPEN" indicating required rotation. The handwheel shall operate in the clockwise direction to close. External declutch lever will be padlockable in the motor mode.

Quarter turn actuator shall be provided with mechanical stops to restrict valve and/or actuator travel.

Provide actuators with aluminum or stainless-steel stem covers with a narrow slot to allow observation of the stem position. Provide permanent indicator markings in 1" maximum increments.

Power gearing in modulated actuators shall have zero backlash between motor and actuator.

The actuators shall include adequate internal circuitry to provide control voltage protection for switches and electronic modules from external voltage surges. Control requirements such as modulating control, 2-wire control, interposing relays etc. shall have gold- or silver-plated contact connectors. Unless otherwise specified, all PC boards must be temperature rated -20° C to 70° C.

B. POSITION INDICATION SIGNAL

The actuator shall utilize gearing feedback or other appropriate signal source to indicate gate position to the SCADA system. The position indication method and logic shall be as designed by the gate manufacturer. The gate position signal must be accurate and dependable as it will be used to remotely control plant operations during critical periods. The baseline for measurement shall be coordinated with the SCADA system and Engineer during construction.

3.0 ACTUATOR COORDINATION

Fully coordinate actuators and controls with all related and controlling equipment. Fully coordinate actuators with equipment manufacturers and SCADA system manufacturer prior to making the first actuator submittal. Coordinate with the SCADA supplier for the 4-20 mA and power sources for gate position indication to SCADA. Provide additional equipment and functions at no extra charge as required to ensure a complete installation and trouble free operation. Fully coordinate all manufacturer's requirements for applications requiring ratings for Class 1, Division 2, Groups C and D hazardous locations/applications.

4.0 SUBMITTALS

Provide submittals in accordance with the requirements set forth in the General Specifications. In addition, provide the information required by Section 4.1 of AWWA C540, latest edition.

5.0 STORAGE

Actuators shall be stored in accordance with manufacturer's written storage instructions. As a minimum, valves with electric actuators shall be stored indoors and maintained at higher than ambient dew-point temperature. Keep actuators sealed and protected from moisture. Provide heat or connect power for heaters if needed to protect electrical components.

6.0 STARTUP

Provide manufacturer factory technician when needed and at startup to check, adjust and verify proper valve/actuator installation. A factory authorized service representative of the actuator manufacturer shall verify field wiring connections to the actuator prior to electrical power being sent to the actuators. The same service representative shall perform on-site assistance consisting of actuator installation supervision, pre-startup wiring verification, start-up assistance and post commissioning operator training. The technician shall have a minimum of five (5) years experience with the manufacturer starting up similar actuators.

STANDARD SPECIFICATIONS

STRUCTURAL

STRUCTURAL SPECIFICTION INDEX

Section Number:	Section Description:
01 4000	Structural Tests and Special Inspections
03 3000	Concrete

06/29/23

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including all EJCDC Documents and all Technical Requirements, apply to this Section.

1.2 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. Standard Specification for Sitework, Excavation, and Earthwork.
2. Section 033100 - “Cast-In-Place Concrete”

1.3 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.

1.4 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.

B. Qualifications of Special Inspector: The Special Inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the Building Official, for inspection of the particular type of construction or operation being inspected. The Special Inspector shall meet the legal qualifications of the building code having jurisdiction.

1. Duties and Responsibilities of the Special Inspector:

    a. The Special Inspector shall observe the work assigned to ascertain, to the best of his/her knowledge that it is in conformance with the approved design drawings and specifications.

    b. The Special Inspector shall furnish inspection reports to the Building Official, the Architect/Engineer, and the Owner. All discrepancies shall be brought to the immediate attention of the Architect/Engineer, Contractor, and Owner. A report that the corrected work has been inspected shall be sent to the Building Official, the Architect/Engineer, and the Owner.

    c. The Special Inspector shall create and maintain a log of all discrepancies throughout the duration of the project. This log shall include, but is not limited to, discrepancy date, description, drawing and/or detail reference, description of as-built condition, description of any remedial work performed, and status of discrepancy. This log shall be submitted to the Architect/Engineer on a periodic basis for the review and comment. Upon completion of the project, this log shall be submitted in its entirety as an attachment to the final signed report described below.

    d. The Special Inspector shall submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the approved plans and specifications and the applicable workmanship provisions of the building code.

1.5 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.

1.6 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.

1.7 PAYMENT OF TESTING LABORATORY

A. The Owner will pay for the initial laboratory services for the testing of materials for compliance with the requirements of the contract documents. The Contractor will be liable to the Owner for the cost for testing and retesting of materials that do not comply with the requirements of the contract documents and shall furnish and pay for the testing and inspection of other items as specified in these Specifications.

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.

3.4 SCHEDULES AND FORMS – ATTACHED OR IN CONSTRUCTION DOCUMENTS

A. STATEMENT OF SPECIAL INSPECTIONS

B. SCHEDULE OF SPECIAL INSPECTIONS (ON STRUCTURAL DRAWINGS)

C. FINAL REPORT OF SPECIAL INSPECTIONS

END OF STRUCTURAL TESTS AND SPECIAL INSPECTIONS

STATEMENT OF SPECIAL INSPECTIONS

Project:
Project Address:
Permit Applicant:
Applicant Address:
Owner:
Owner Address:

Registered Design Professionals (RDP):

Architect:
Geotechnical Engineer:
Structural Engineer:
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_____.

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.

FINAL REPORT OF SPECIAL INSPECTIONS

Project:
Project Address:
Testing / Inspection Agent:
Testing / Inspection Agent Address:
Scope of Testing / Inspections:

(To be completed by Testing / Inspection Agent)

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. The following discrepancies that were outstanding since the last interim report dated
have been corrected:

_____

_____

(Attach 8 1/2" x 11" continuation sheet(s) if required to complete the description of corrections)

Prepared By:

_____
Type or print name

_____
Signature Date

Special Inspector's Seal

(Licensed Professional Engineer)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formwork.
2. Reinforcing.
3. Cast-in place concrete including mix design, placement procedures, and finishes.

B. Cast-in-place concrete includes the following:

1. Foundations and footings.
2. Slabs-on-grade.
3. Equipment pads and bases.

C. Related Documents: Drawings and general provisions of Contract, including all EJCDC documents and all technical requirements, apply to this Section.

D. Related Sections: The following Sections contain requirements that relate to this Section:

1. Standard specification for sitework, excavation, and earthwork.
2. Standard specifications for piping, valves, and gates and standard specifications for electrical.

1.2 SUBMITTALS

A. General: Submit the following according to Standard General Conditions of the Contract and other Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others if requested by Engineer.

C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures.

D. Samples of materials as requested by Engineer, including names, sources, and descriptions, as follows:

1. Normal weight aggregates.
2. Reglets.
3. Waterstops.
4. Vapor retarder/barrier.

E. Laboratory test reports for concrete materials and mix design test.

F. Minutes of pre-installation conference.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301, "Specifications for Structural Concrete for Buildings".
2. ACI 302, "Guide for Concrete Floor and Slab Construction".
3. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
4. ACI 305, "Hot Weather Concreting".
5. ACI 306, "Cold Weather Concreting".
6. ACI 309, "Guide for Consolidation of Concrete".
7. ACI 311, "Recommended Practice for Concrete Inspection".
8. ACI 318, "Building Code Requirements for Reinforced Concrete".
9. ACI 347, "Recommended Practice for Concrete Formwork".
10. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
11. American Welding Society, AWS D1.4 "Structural Welding Code - Reinforcing Steel".

B. Concrete Testing Service: Engage a testing agency acceptable to Engineer to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and retesting at any time during progress of Work. Tests, including retesting of rejected materials for installed Work, shall be done at Contractor's expense.

D. Preinstallation Conference: Conduct conference at Project site to comply with project requirements and the following:

1. At least 35 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to, the following:

a. Contractor's superintendent.
b. Agency responsible for concrete design mixes.
c. Agency responsible for field quality control.
d. Ready-mix concrete producer.
e. Concrete subcontractor.
f. Primary admixture manufacturers.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.

2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches to the plane of the exposed concrete surface.

E. 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.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

D. Deformed-Steel Welded Wire Fabric: ASTM A 497.

E. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

F. Threaded Dowels: Continuous threaded high-strength steel bars equal to "Lasstud" by Richmond Screw Anchor Co., Inc. Provide inserts compatible with dowels, designed for ultimate pull-out force indicated on the drawings.

G. Steel Shapes, Plates and Rods: Conform to ASTM A 36, "Specification for Structural Steel".

H. Do Not Weld Reinforcing Steel: Unless specifically noted on drawings. If welding is shown, conform to latest revision of AWS D12.1, "Reinforcing Steel Welding Code of the American Welding Society". Perform all welding with certified welders qualified per AWS.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II or ASTMC 595 Type IL MS.

1. Use one brand of cement throughout Project unless otherwise acceptable to Engineer.

B. Fly Ash: ASTM C 618, Type F or C.

1. Limit use of fly ash to not exceed 20 percent of cement content by weight.

C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Engineer.

D. Water: Potable.

E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Air-Tite, Cormix Construction Chemicals.
   b. Air-Mix or Perma-Air, Euclid Chemical Co.
   c. Darex AEA or Daravair, W.R. Grace & Co.

d. MB-VR or Micro-Air, Master Builders, Inc.
e. Sealtight AEA, W.R. Meadows, Inc.
f. Sika AER, Sika Corp.

G. Water-Reducing Admixture: ASTM C 494, Type A.

1. Products: Subject to compliance with requirements, provide one of the following:
a. PSI N, Cormix Construction Chemicals.
b. Eucon WR-75, Euclid Chemical Co.
c. WRDA, W.R. Grace & Co.
d. Pozzolith Normal or Polyheed, Master Builders, Inc.
e. Plastocrete 161, Sika Corp.

H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Eucon 37, Euclid Chemical Co.
b. WRDA 19 or Daracem, W.R. Grace & Co.
c. Rheobuild or Polyheed, Master Builders, Inc.
d. Sikament 300, Sika Corp.

I. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Accelguard 80, Euclid Chemical Co.
b. Daraset, W.R. Grace & Co.
c. Pozzutec 20, Master Builders, Inc.

J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

1. Products: Subject to compliance with requirements, provide one of the following:
a. Eucon Retarder 75, Euclid Chemical Co.
b. Daratard-17, W.R. Grace & Co.
c. Pozzolith R, Master Builders, Inc.
d. Protard, Prokrete Industries.
e. Plastiment, Sika Corporation.

2.4 RELATED MATERIALS

A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217-inch-thick (26-gage) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Vapor Barrier:

1. Vapor Barrier, General Use (except as indicated below):

a. Product: Plastic vapor barrier. Include manufacturer's recommended adhesive or pressure-sensitive tape for sealing joints, laps and penetrations, preformed boots for penetrations, and all other components required for a complete, proper and vaporproof installation in accordance with ASTM E1643.
   1) Classification: Must exceed ASTM E 1745 Class "A".
   2) Permeance: ASTM E96: 0.02 perms or less.
   3) Thickness: Not less than 15 mils.

b. Manufacturer/Product:
   1) "Moistop Ultra 15 mil", Fortifiber Building Systems Group.
   2) "Perminator 15 mil", W.R. Meadows
   3) "Griffolyn Type-105", Reef Industries, Inc.
   4) "Stego Wrap 15 mil", Stego Industries, LLC.
   5) "VaporBlock VB15", Raven Inc.
   6) "Husky Yellow Guard 15 mil", Poly-America, L.P.

c. "Locations for Use: Continuous below all new and opened building slabs, and other structural slabs, porches, stoops, pads, covered (below roofs) areas, etc., on grade, and turned-down to tops of footings.

C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

D. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

E. Liquid Membrane-Forming Curing Compound: Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Spartan-Cote, The Burke Co.
   b. Day-Chem Cure and Seal, Dayton Superior Corp.
   c. Eucocure, Euclid Chemical Co.
   d. Horn Clear Seal, A.C. Horn, Inc.
   e. L&M Cure R, L&M Construction Chemicals, Inc.
   f. Masterkure, Master Builders, Inc.
   g. CS-309, W.R. Meadows, Inc.
   h. Kure-N-Seal, Sonneborn-Chemrex.

F. Water-Based Acrylic Membrane Curing Compound: ASTM C 309, Type I, Class B.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Sealco - VOC, Cormix Construction Chemicals.

b. Safe Cure and Seal, Dayton Superior Corp.
c. Aqua-Cure, Euclid Chemical Co.
d. Dress & Seal WB, L&M Construction Chemicals, Inc.
e. Masterkure 100W, Master Builders, Inc.
f. Vocomp-20, W.R. Meadows, Inc.

G. V.O.C. Compliant Acrylic Curing and Sealing Type (30 Percent): Liquid type membrane-forming curing compound complying with ASTM C 309, Type 1, Class A and B. Provide 30 percent solids minimum, for surfaces indicated to be sealed.

H. Safe Cure and Seal: 30 percent (J-19), Dayton Superior Inc.

I. Evaporation Control:

1. Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1. Eucobar, Euclid Chemical Co.
      2. E-Con, L&M Construction Chemicals, Inc.
      3. Confilm, Master Builders, Inc.

J. V.O.C. Compliant Evaporation Control: Sure Film (J-74), Dayton Superior Inc.

K. Underlayment Compound: Free-flowing, self-leveling, pumpable, cement-based compound for applications from 1 inch thick to feathered edges.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. K-15, Ardex, Inc.
   b. LevelLayer II, Dayton Superior Corp.
   c. Flo-Top, Euclid Chemical Co.
   d. Gyp-Crete, Gyp-Crete Corp.
   e. Levelex, L&M Construction Chemicals, Inc.
   f. Underlayment 110, Master Builders, Inc.
   g. Thoro Underlayment Self-Leveling, Thoro System Products.

L. Bonding Agent: Polyvinyl acetate or acrylic base.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Polyvinyl Acetate (Interior Only):
      1. Superior Concrete Bonder, Dayton Superior Corp.
      2. Euco Weld, Euclid Chemical Co.
      3. Weld-Crete, Larsen Products Corp.
      4. Everweld, L&M Construction Chemicals, Inc.
      5. Ready Bond, Symons Corp.
   b. Acrylic or Styrene Butadiene:

1. Acrylic Bondcrete, The Burke Co.
2. Day-Chem Ad Bond, Dayton Superior Corp.
3. SBR Latex, Euclid Chemical Co.
4. Daraweld C, W.R. Grace & Co.
5. Hornweld, A.C. Horn, Inc.
6. Everbond, L&M Construction Chemicals, Inc.
7. Acryl-Set, Master Builders Inc.
8. Intralok, W.R. Meadows, Inc.
9. Sonocrete, Sonneborn-Chemrex.

M. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Resi-Bond (J-58), Dayton Superior.
   b. Euco Epoxy System #452 or #620, Euclid Chemical Co.
   c. Epoxtite Binder 2390, A.C. Horn, Inc.
   d. Epabond, L&M Construction Chemicals, Inc.
   e. Concresive Standard Liquid, Master Builders, Inc.
   f. Rezi-Weld 1000, W.R. Meadows, Inc.
   g. Sikadur 32 Hi-Mod, Sika Corp.

N. Interior Epoxy Sealer: Use a maximum 35 percent type.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Epoxy-Plus; Dayton Superior Inc.
   b. Eucopoxy 1; Euclid Chemical
   c. Oauerseal 30E; Non-Crete, Inc.
   d. Rescon R117; Symons Corp.
   e. Son-No-Mar; Sonneborn, Div./Chem Rex Inc.
   f. Super Seal 35; L & M Const. Chem. Co.

O. V.O.C. Compliant Urethane Sealer:

1. Day Chem Urethane V.O.C. (J-39); Dayton Superior Inc.

P. Waterstops: Provide strip applied, flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.
1. Flexible Butyl Rubber Strip Applied Waterstops:
   a. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
      1. Swellstop, as manufactured by Greenstreak.
      2. Synkoflex.
2. Rubber Waterstops: Corps of Engineers CRD-C 513.
   a. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. The Burke Co.
2. Progress Unlimited.
3. Williams Products, Inc.

3. Polyvinyl Chloride Waterstops: Corps of Engineers CRD-C 572.

a. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. The Burke Co.
2. Greenstreak Plastic Products Co.
3. W.R. Meadows, Inc.
4. Progress Unlimited.
5. Schlegel Corp.
6. Vinylex Corp.

Q. Waterproofing

1. Waterproofing materials of the paint and/or membrane types shall be applied concrete structures at the locations shown on the plans.
2. Waterproofing paint and its application shall be as shown on the plans or as specified in the Special Conditions.
3. Membrane type waterproofing shall consist of four coats of hot applied waterproofing pitch and three layers of No. 15 tarred felt, or one coat of cold applied setting cement and one layer of synthetic sheeting. Pitch and felt shall be as manufactured by the Barrett Division, Allied Chemical Corp.; the Flintkote Co.; Johns-Manville; or equal. Cold applied cement shall be Nerva-Plast and synthetic sheeting shall be Nervastrol Seal-Pruf H-D, as manufactured by Rubber & Plastics Compound Co.; comparable materials as manufactured by Carlisle Tire & Rubber Division, Carlisle Corp.; Building Products Division, America Cyanamid Co.; or equal. Membrane waterproofing shall be applied in accordance with the manufacturers' recommendations and as authorized by the Engineer.

2.5 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial mixtures or field experience methods as specified in ACI 318-89 Section 5.3. If trial mixtures method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing, unless otherwise acceptable to Engineer.

B. Trial mix designs and strength tests, made by qualified independent material laboratory, in accordance with ACI 318-89 Section 5.3 are required for the following types of concrete:

1. Normal weight concrete with specified strength in excess of 4000 psi.
2. All concrete designs for which a suitable experience record is not available.

C. Mix design based on a record of past performance in accordance with ACI 318-89 Section 5.3, may be provided by qualified concrete supplier or precast concrete manufacturer for concrete designs. Mix design shall be certified by an independent testing laboratory.

D. All concrete mix designs shall include the following information:

1. Proportions of cement, fine and coarse aggregate and water.
2. Water/cement ratio, design strength, slump and air content.
3. Type of cement and aggregates. Provide mix using #67 coarse aggregate.
4. Type and dosage of all admixtures.
5. Type, color and dosage of integral coloring compounds, where applicable.
6. Special requirements for pumping.
7. Any special characteristics of the mix which require precautions in the mixing, placing or finishing techniques to achieve the finished product specified.

E. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.

F. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios as follows:

1. Subjected to freezing and thawing: W/C 0.45.
2. Subjected to deicers/watertight: W/C 0.40.
3. Subjected to brackish water, salt spray, or deicers: W/C 0.40.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps and sloping surfaces: Not more than 3 inches.
2. Reinforced foundation systems: Not less than 1 inch and not more than 3 inches.
3. Concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8 inches after adding admixture to site-verified 2-to-3-inch slump concrete.
4. Other concrete: Not less than 3 inches and not more than 5 inches.

2.6 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

B. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg.F (10 deg.C).

C. Use high-range water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs, exposed concrete, parking structure slabs, concrete required to be watertight, and concrete with water-cement ratios below 0.50.

D. Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the

following limits:

1. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure:
   a. 4.5 percent (moderate exposure); 5.5 percent (severe exposure) for 1-1/2-inch maximum aggregate.
   b. 4.5 percent (moderate exposure); 6.0 percent (severe exposure) for 1-inch maximum aggregate.
   c. 5.0 percent (moderate exposure); 6.0 percent (severe exposure) for 3/4-inch maximum aggregate.
   d. 5.5 percent (moderate exposure); 7.0 percent (severe exposure) for 1/2-inch maximum aggregate.
2. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 4 percent air.

E. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg.F (30 deg.C) and 90 deg.F (32 deg.C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg.F (32 deg.C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

1. Provide Class A tolerances for concrete surfaces exposed to view.
2. Provide Class C tolerances for other concrete surfaces.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers,

blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER/BARRIER INSTALLATION

A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.

B. Lap vapor barrier over footings and/or seal to foundation walls.

C. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape.

D. Seal all penetrations (including pipes) per manufacturer’s instructions.

E. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.

F. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.

3.4 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for

"Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.

1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Engineer.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Engineer.

B. Provide keyways at least 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.

D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

E. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Joint fillers and sealants are specified in Section 07900, "Sealants and Joint Fillers".

F. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/8 inch wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.

1. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
3. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
4. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants."

3.6 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

B. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

C. Install dovetail anchor slots in concrete structures as indicated on drawings.

D. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.7 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.8 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
3. Maintain reinforcing in proper position on chairs during concrete placement.

F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

G. When air temperature has fallen to or is expected to fall below 40 deg.F (4 deg.C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg.F (10 deg.C) and not more than 80 deg.F (27 deg.C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg.F (32 deg.C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineer.

3.9 FINISHING FORMED SURFACES

A. All permanently exposed concrete surfaces which are above water level, except slabs, shall be given a rubbed finish consisting of filling small voids and two rubbings. In addition, all walls inside process basins shall be given a rubbed finish. Plastering and steel troweling of surfaces will not be permitted.

B. The initial rubbing of concrete shall begin immediately after concrete surfaces have been floated smooth and the pointing has set. The initial rubbing shall be with No. 16 carborundum stone which shall be continued until all burrs form marks, and irregularities have been removed. The concrete shall be cured for a minimum of seven (&) days, beginning immediately after the initial rubbing. After at least seven (7) days curing, the final rubbing shall be with a No. 30 carborundum stone which shall be continued until all swirl marks and surplus materials have been removed from the surface and the surfaces show a uniform, smooth finish and uniform color.

C. No special concrete or cement mortar topping course shall be used for slab finish unless shown on the plans. The base slab shall be brought to a true and even finish by power or hand floating. Where a trowel finish is required as shown on the drawings, it shall be done with steel trowels in such a manner as to produce a dense, smooth, impervious surface, free from blemishes.

D. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

E. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed

and smoothed.

F. Smooth-Rubbed Finish: Provide smooth-rubbed finish on scheduled concrete surfaces that have received smooth-formed finish treatment not later than 1 day after form removal.

1. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

G. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.

1. After placing slabs, finish surface to tolerances specified in Section 3.11. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Finish surfaces to tolerances specified in Section 3.11. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances specified in Section 3.11. Grind smooth any surface defects that would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.11 MISCELLANEOUS CONCRETE ITEMS:

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.12 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. No curing agents or sealers are to be applied to the concrete slab where Resilient Athletic Flooring is scheduled.

C. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

D. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.

1. Provide moisture curing by the following methods:

a. Keep concrete surface continuously wet by covering with water.
b. Use continuous water-fog spray.
c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.

2. Provide moisture-retaining cover curing as follows:
   a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
   a. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
   b. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

E. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

F. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.

1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.13 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg.F (10 deg.C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

D. Immediately after the removal of forms and steel ties, small voids shall be filled with mortar (one (1) part cement, two (2) parts sand), pressed into holes, and floated smooth. Imperfect surfaces shall not be patched but shall be removed and replaced.

3.14 REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Engineer.

3.15 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Engineer.

B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.

2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, containing defects that affect the

concrete's durability. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Engineer.
4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar.

F. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.16 HYDROSTATIC TESTING

A. Concrete structures that are to contain water, sludge, or other liquids, such as settling or digestion tanks, coagulation basins, reservoirs, filter basins and similar structures shall be hydrostatically tested for leakage. Testing shall consist of filling each structure with water so that the Engineer can inspect and observe any leaks when the structure has been full of water for 72 hours. Such tests shall be made before backfill is placed around the structure. All leaks in the structure are to be repaired in an approved manner. Patching or covering or any other method of repair on the outside or dry walls will not be permitted. Damp areas or spots on permanently exposed walls, such as in filter galleries will be considered leaks.

3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. General: The Owner will employ a testing agency to perform tests and to submit test reports.

B. The Contractor shall provide a proper insulated concrete cylinder storage box on site to be

coordinated with the Special Inspector.

C. Sampling and testing for quality control during concrete placement may include the following, as directed by Engineer.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
   a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
   b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
   c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg.F (4 deg.C) and below, when 80 deg.F (27 deg.C) and above, and one test for each set of compressive-strength specimens.
   d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.

D. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 25 cu. yd. of each concrete class placed in any one day, or for each 5000 sq ft of surface are placed; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

1. Any additional cylinder required by the Contractor for early strength gain tests for form stripping or post-tensioning are Contractor’s responsibility and shall be paid for by Contractor.
2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
3. When total quantity of a given class of concrete is less than 50 cu. yd., Engineer may waive strength testing if adequate evidence of satisfactory strength is provided.
4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
6. Test results will be reported in writing to Engineer, Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix

proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests.

7. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
8. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

END OF CONCRETE

STANDARD SPECIFICATIONS

ELECTRICAL

JRA PROJECT NO. 222159
North Shelby WRRF 2023 Filter Improvements
Alabama Water Utilities
Shelby County, Alabama
CLIENT JOB NO. -
BASED ON CLIENT TEMPLATE: "Municipal Consultants.docx"
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ELECTRICAL SPECIFICATION INDEX:

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27 60 05 .....SCADA INSTRUMENTATION

DIVISION 26/27
ELECTRICAL

6/2/2023

SECTION 26 05 00 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

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

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

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

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

B. Remove all existing electrical equipment and wiring made obsolete by this project and remove or relocate all electrical services located on or crossing through the project property, either above or below grade, which would obstruct the construction of the

project or conflict in any manner with the completed project or any code pertaining thereto. Dispose of salvageable materials as directed by the Engineer. Contractor shall schedule meeting to review scope of electrical demolition and to confirm scope and phasing of proposed demolition with the owner in the presence of the prime consultant prior to start of any electrical demolition.

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

D. Furnish and install complete variable frequency drives and associated devices for motors as shown on drawings and/or specified herein.

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

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

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

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

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

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

K. Furnish and install a complete Surge Protection System as shown on drawings and/or specified herein.

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

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

N. Unless specifically indicated or required otherwise, terminate all circuitry/cabling provided within this contract at associated equipment/devices/etc. in accordance with all

applicable codes, standards and supplier requirements, whether associated equipment/device/etc. is furnished within this contract or by others.

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

PART 2 - PRODUCTS

2.1 APPROVED MATERIALS AND DEVICES

A. Where not otherwise specified, provide only new, standard, first-grade materials/systems throughout, conforming to standards established by Underwriter's Laboratories, Inc., and so marked or labeled, together with manufacturer's brand or trademark. All equipment/systems subject to approval of Engineer before installation. All like items and associated equipment/systems shall be of one manufacturer.

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

C. To ensure commonality of spare parts, it is required that the electrical contractor provide the same brand for all circuit breakers, starters, power equipment, etc. provided under the following divisions of these specifications:
   1. SECTION 26 05 73: POWER DISTRIBUTION SYSTEM ELECTRICAL STUDIES
   2. SECTION 26 22 00: DRY TYPE TRANSFORMERS
   3. SECTION 26 24 17: LIGHTING PANELBOARDS
   4. SECTION 26 24 19: MOTOR CONTROL CENTERS
   5. SECTION 26 28 16: SAFETY SWITCHES AND FUSES

2.2 SUBMITTALS

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

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

C. Submit to Engineer promptly after award of Contract and prior to purchasing, the number of copies required by the contract. All drawings of a specific item or system shall be made in one submittal, and within thirty (30) days after award of Contract. Shop drawings of all power equipment shall contain exact details of device placement, phasing and numbering, in form of elevations, for each major piece of equipment. Shop drawings shall be submitted on the following:
   1. SECTION 26 05 73: POWER DISTRIBUTION SYSTEM ELECTRICAL STUDIES

2. SECTION 26 22 00: DRY TYPE TRANSFORMERS
3. SECTION 26 24 17: LIGHTING PANELBOARDS
4. SECTION 26 24 19: MOTOR CONTROL CENTERS
5. SECTION 26 28 16: SAFETY SWITCHES AND FUSES
6. SECTION 26 29 00: MANUFACTURED CONTROL PANELS
7. SECTION 26 29 01: TRAVELING BRIDGE FILTER MUDWELL PS CONTROL PANEL
8. SECTION 26 29 23: VARIABLE FREQUENCY DRIVES
9. SECTION 26 43 00: SURGE PROTECTIVE DEVICES
10. SECTION 26 44 00: ELECTRICAL HEAT TRACING SYSTEMS
11. SECTION 26 50 00: LIGHTING MATERIALS AND METHODS
12. SECTION 27 10 00: STRUCTURED CABLING SYSTEM
13. SECTION 27 60 00: SCADA SYSTEM
14. SECTION 27 60 05: SCADA INSTRUMENTATION
15. ALL POWER DISTRIBUTION EQUIPMENT (i.e. SWITCHBOARDS, PANELBOARDS, DRY TYPE TRANSFORMER, ETC.)
16. ALL ELECTRICAL AND TELECOMMUNICATION EQUIPMENT LAYOUTS - Submittals shall include ¼" = 1'-0" CAD drawings (hand drawn sketches will not be accepted) of each electrical room, IT room, electrical equipment stand, generator area, or any other similar area with electrical equipment. Drawings shall indicate all panelboards, transformers, switchboards, generators, equipment racks, control panels, HVAC equipment, etc. that are located in each electrical/IT area. Layouts shall show that each piece of electrical equipment has the clearances, working space and dedicated equipment space required by applicable codes. No conduits to equipment within these areas shall be installed until submittals have been provided and returned without exception by the design team.
17. ALL CONTROL ITEMS & SYSTEMS

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

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

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

G. Material proposed for substitution shall be of the same quality, perform the same functions, conform to such physical dimensions and appearance as are required by the Engineer. All material proposed for substitution is subject to the approval of the Engineer

and his authority for approval is final. No material proposed for substitution will be considered unless all submittal data complies with the drawings and specifications of Section 16 as to time of submission, number of copies of submittal, and detail requirements.

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

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

PART 3 - EXECUTION

3.1 SITE VISIT

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

3.2 WORKMANSHIP

A. All work shall be in accordance with the latest editions of NFPA 70 (National Electrical Code), NFPA 101 (Life Safety Code), National Electric Safety Code, International Building Code, applicable NECA standards and the rules and regulations of State and Local Authorities Having Jurisdiction.

B. All work shall be executed in a workmanlike manner and shall present a neat and mechanical appearance upon completion.

C. All equipment, devices, etc. shall be installed in accordance with manufacturer's recommendations.

D. All items shall be installed straight and plumb in a workmanlike manner and care shall be exercised so that like items are mounted the same position, heights and general location.

E. Keep site clean of accumulation of cartons, trash and debris.

3.3 SAFETY

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

3.4 CONTRACT DOCUMENTS

A. Contract documents indicate diagrammatically, extent, general character and approximate location of work. Where work is indicated but minor details omitted, furnish and install it complete so as to perform its intended functions. For details and

mechanical equipment, follow drawings provided by other disciplines (Architectural, Mechanical, Structural, Civil, etc.) and fit electrical work thereto.

B. Contract documents consist only of the hardcopy documents issued by the Prime Engineer. Electronic documents issued directly by the electrical engineer to the contractor and/or its sub-contractors/vendors are issued for convenience only (electronic documents are not formal contract documents).

C. If the contractor and/or one of its suppliers require a one-time transfer of electronic files of the current electrical construction documents to prepare shop drawings (or for another similar purpose), it shall:
   1. Sign a waiver prepared by the electrical engineer prior to the transmittal of these files.
   2. Agree to pay the electrical engineer a fee of $50.00 per drawing, up to a maximum of $400 per transfer, payable upon receipt of the files.
   3. To the fullest extent permitted by law, indemnify, hold harmless, and defend JRA from all claims, damages, losses and expenses, including attorneys' fees arising out of or resulting from the use of the CAD files.

D. Take finish dimensions at job in preference to scaled dimensions.

E. Except as above noted, make no changes in or deviations from work as shown or specified except on written order of Engineer.

3.5 UNDERGROUND UTILITY/EQUIPMENT COORDINATION

A. Prior to commencement of work, verify exact locations of all existing or proposed underground utilities and/or underground equipment and verify that proposed electrical installation does not conflict with these items. Notify Engineer immediately if any conflict is found.

3.6 EQUIPMENT STORAGE

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

3.7 EXCAVATION, CUTTING AND PATCHING

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

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

3.8 PENETRATIONS

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

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

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

3.9 INSTALLATION OF EQUIPMENT - GENERAL

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

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

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

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

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

F. All relays, starters, push-button and other control devices shall be cleaned and if necessary, lubricated with CRC 2-26 to assure free operation.

3.10 MOTORS, STARTERS AND CONTROLS

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

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

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

3.11 CIRCUITS AND BRANCH CIRCUITS

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

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

3.12 LUG/TERMINAL RATINGS

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

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

3.13 EQUIPMENT FAULT CURRENT RATINGS

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

3.14 OUTLET LOCATION

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

3.15 IDENTIFICATION

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

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

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

3.16 GROUNDING

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

3.17 PAINTING

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

3.18 ACCEPTANCE TESTING

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

B. The electrical sub-contractor shall include in bid price start-up assistance and training from a certified representative of the manufacturer for the following systems:
   1. SECTION 26 29 23: VARIABLE FREQUENCY DRIVES
   2. SECTION 26 44 00: ELECTRICAL HEAT TRACING SYSTEMS
   3. SECTION 27 10 00: STRUCTURED CABLING SYSTEM
   4. SECTION 27 60 00: SCADA SYSTEM
   5. SECTION 27 60 05: SCADA INSTRUMENTATION

3.19 OPERATION AND MAINTENANCE DATA

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

3.20 GUARANTY-WARRANTY

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

END OF SECTION 26 05 00

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

PART 1 - GENERAL

1.1 DESCRIPTION

A. Power Wires and Cables

B. Low Voltage Wires and Cables

PART 2 - PRODUCTS

2.1 POWER WIRES AND CABLES - 600 VOLT

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

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

C. VFD Cabling
   1. Wiring/Cabling installed between each VFD (Variable Frequency Drive) and the associated motor shall be multi-conductor shielded VFD power cable with the following characteristics:
      a. Multi-conductor cable with three (3) power conductors and three (3) ground conductors
      b. Soft annealed flexible stranded copper conductors.
      c. 1kV cross-linked polyolefin insulation (to resist the potential reflected voltages experienced in 600VAC VFD applications).
      d. Metallic shielded providing 100% shield coverage
      e. Oil, abrasion, chemical & sunlight resistant thermosetting compound outer jacket.

f. Flexible TC-ER rated, UL listed for use in cable trays.
g. Equal to AmerCable #37-108VFD cable.

D. Class 1 Control Cabling (120VAC Control Circuits, Etc.)
1. Unless specified otherwise, Class 1 control cabling shall:
a. Be rated for exposed cable tray installation.
b. Be plenum rated (Class 1 Control cabling and Instrumentation cabling installed in conduit or exposed in cable tray in non-plenum areas is not required to be plenum-rated).
c. Be UL-rated for the proposed application.
d. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation. Conductors with green insulation shall not be used for conductors other than ground.
e. Utilize copper conductors.
f. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
g. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
h. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.
i. Be rated for 600V.
j. Be industrial grade.
k. Have stranded conductors.
l. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.
2. Control cabling shall be as manufactured by Belden, AlphaWire or General Cable.

E. Fixture Wiring
1. Conductor Types:
a. Type TFFN or XFF.
2. Minimum Sizes:
a. For fixtures up to 300 watts: #16.
b. For fixtures over 300 watts up to 1500 watts: #14.
c. For fixtures over 1500 watts: as required.
d. Conductors to concrete pour fixtures: #12.
3. Fixture wire shall extend only from fixture to first junction, and not over 6 feet, except for concrete pour units.

2.2 WIRE CONNECTIONS:

A. All connector types:
1. Shall be properly rated for the proposed application by UL and per the manufacturer.

B. At Motor Connections (within motor terminal boxes):

1. On Unshielded Wire:
    a. Single conductor per phase: shall be made with insulated set screw connectors or 3M 5300 Series 1kV Motor Lead Connections kits with mechanical lugs as required.
    b. Multiple conductors per phase: shall be made with insulated mechanical lugs, rated for the associated motor cable types, by Polaris or Ilsco.
2. On Shielded Power Wire:
    a. The braided shields and internal grounding conductors of shielded power (not instrumentation) cables shall be grounded at BOTH ends (at VFD/starter and at motor) with a termination kit provided by the cable supplier. This termination kit shall include a connection ring that makes contact around the full circumference of the braided shield, and connects all internal grounds to a common external ground point.

C. Other Dry locations:
1. On Wire larger than #10: shall be made with solderless, non-insulated compression-type connectors meeting requirements of Federal Specification WS-610e for Type II, Class 2 and shall be covered with Scotch #33 electrical tape so that insulation is equal to 150% of conductor insulation.
2. On Wire #10 and smaller: shall be made with one of the following:
    a. Ideal Wing Nuts or equal by 3M .
    b. Ideal Push-In Wire Connectors (for #12 and smaller only).

D. Other Wet/Damp locations:
1. On Wire larger than #10: shall be made with underground/direct-burial, waterproof rated EPDM or TPE-insulated connectors by Ilsco, Burndy or T&B.
2. On Wire #10 and smaller: shall be made with one of the following:
    a. Ideal Weatherproof or Underground Wire Connectors pre-filled with 100% silicone sealant as required by the application.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. All wires and cables shall be installed in conduit unless specifically noted otherwise.

B. All joints and splices on wire shall be made with solderless connectors, and covered so that insulation is equal to conductor insulation.

C. No splices shall be pulled into conduit.

D. No conductor shall be pulled until conduit is cleaned of all foreign matter.

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

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

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

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

3.2 POWER WIRE AND CABLE INSTALLATION:

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

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

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

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

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

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

3.3 WIRE CONNECTIONS

A. See Part 2 above for material types.

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

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

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

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

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

3.4 SHIELDED CABLE INSTALLATION

A. Shielded VFD (power) cables:
   1. The braided shields and internal grounding conductors of shielded VFD (power) cables shall be grounded at BOTH ends (at VFD and at motor) with a termination kit provided by the cable supplier. This termination kit shall include a connection ring that makes contact around the full circumference of the braided shield, and connects all internal grounds to a common external ground point.
   2. Contractor shall coordinate the necessary size of conduit with the outer diameter of the proposed cable type to verify that the raceway loading does not exceed NEC requirements prior to rough-in of the conduit system.

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

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

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

3.6 CIRCUITS AND BRANCH CIRCUITS

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

3.7 LABELING AND COLOR CODING OF WIRE AND CABLE

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

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

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

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

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

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

3.8 TESTING

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

END OF SECTION 26 05 19

SECTION 26 05 26 – GROUNDING

PART 1 - GENERAL

1.1 GENERAL

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

1.2 GENERAL REQUIREMENTS

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

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

PART 2 - PRODUCTS

2.1 CONDUCTORS

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

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

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

2.2 GROUNDING ELECTRODES

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

2.3 CONNECTIONS

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

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

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

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

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

2.4 MANUFACTURERS

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

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

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

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

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

PART 3 - EXECUTION

3.1 TRANSFORMER GROUNDS

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

3.2 EXPOSED NON-CURRENT-CARRYING METAL PARTS

A. General: Ground connections to equipment or devices shall be made as close to the current carrying parts as possible, that is, to the main frame rather than supporting structures, bases or shields. Grounding connections shall be made only to dry surfaces

that are clean and dry. Steel surfaces shall be ground or filed to remove all scales, rust, grease, and dirt. Copper and galvanized steel shall be cleaned to remove oxide before making welds or connections. Code size ground conductors shall be run in all power conduits and properly terminated at each end.

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

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

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

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

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

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

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

3.3 ACCEPTANCE DOCUMENTATION AND TESTING

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

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

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

END OF SECTION 26 05 26

SECTION 26 05 33 – RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

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

PART 2 - PRODUCTS

2.1 CONDUITS

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

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

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

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

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

E. HDPE Innerduct
    1. Shall be composed high density polyethylene and shall be orange in color, unless noted otherwise.
    2. Shall be corrugated unless noted otherwise.
    3. Shall be manufactured by Carlon, Ipex or equal.

F. Flexible Metallic Conduit:
    1. Shall be continuous spiral wound and interlocked galvanized material, code approved for grounding.

G. Liquidtight Flexible Metallic Conduit:
    1. Shall be galvanized steel-core sealtite, code approved for grounding.

2. Shall have an outer liquidtight, nonmetallic, sunlight-resistant jacket over an inner flexible metal core.
3. Shall be as manufactured by Electric-Flex, Anaconda or equal.

2.2 FITTINGS, COUPLINGS & CONNECTORS

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

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

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

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

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

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

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

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

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

2.3 BUSHINGS

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

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

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

2.4 HARDWARE, CONDUIT CLAMPS AND SUPPORTS

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

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

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

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

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

2.5 WATERTIGHT ENTRANCE SEAL DEVICES

A. For new construction, seal devices shall consist of oversized sleeve and malleable iron body with sealing rings, pressure rings, sealing grommets and pressure clamps as required (O-Z/Gedney type FSK/WSK or equal).

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

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Minimum Diameter: 3/4-inch.

B. Raceway Type: Raceway types shall be as specified below, unless indicated otherwise on drawings:
1. Exterior, Exposed: Rigid Aluminum unless otherwise noted.
2. Exterior, Used for Instrumentation Circuits: See Below.

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

top of slab). Exposed portions of these coated conduits shall extend a minimum of 6" above floor level, and shall be installed at uniform heights.

3.2 RACEWAY INSTALLATION

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

B. Routing/Locating:
1. Exposed conduit runs shall be run level and plumb and shall, on interior of buildings, be run parallel and/or at right angles to building walls and/or partitions.

2. Conduit with an external diameter larger than 1/3 the thickness of a concrete slab shall not be placed in the slab. Conduits in slab shall not be spaced closer than 3 diameters on center.
3. Conduit run in ceiling spaces shall be run as high as possible, all at same level, and shall be supported from building structure. Do not support conduit from any other installation.
4. Conduit run within exterior CMU, concrete or other similar walls shall be run within the CMU cells / concrete structure / etc. Conduits shall not be run on the outside surface of CMU cells / concrete structure / etc. underneath exterior veneers / etc., which could cause a thermal break in the wall insulation or a future water intrusion problem.
5. Install conduit runs to avoid proximity to steam or hot water pipes. In no place shall a conduit be run within 6" of such pipes except where crossing is unavoidable, then conduit shall be kept at least 3" from the covering of the pipe crossed.
6. Before installing raceways for motors, HVAC equipment and other fixed equipment, check location of all equipment connections/terminal boxes with equipment supplier and locate and arrange raceways appropriately.
7. No conduit for instrumentation shall be run closer than 12 inches to parallel power conduits.
8. A minimum of 12" of clearance (or more as required by associated utility companies) shall be provided between the finished lines of exterior, underground conduit runs and exterior, underground utilities (gas, water, sewer, etc.).
9. Where any portion of raceway is installed in a wet environment (such as below grade) and located at a higher elevation than the raceway termination point in a dry environment, install watertight compound inside raceway at termination around cabling to prevent transfer of water through conduit system. Watertight compound shall be rated for the potential water head pressure, based on the assumption that ground water level would be at grade level.

C. Bends:
1. Do not make bends (in any raceway, including flexible conduits) that exceed allowable conductor bending radius of cable to be installed or that significantly restrict conductor flexibility.
2. All bends within concrete-encased ductbanks installed in exterior locations shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
3. All bends in raceways containing multi-conductor power cables (such as shielded VFD cables) shall be long radius bends (24" minimum bending radius – varies with conduit diameter).
4. Where numerous exposed bends or grouped together, all bends shall be parallel, with same center and shall be similar in appearance
5. All PVC elbows, bends, etc., shall be either factory bends or made with an approved heat bender.

D. Support:
1. Anchor conduit securely in place by means of approved conduit clamps, hangers, supports and fastenings. Arrangement and methods of fastening all conduits shall be subject to Engineer's direction and approval. All conduits shall be rigidly

supported (wire supports may not be used in any location). Use only approved clamps on exposed conduit.

2. Rigid Aluminum Conduits shall be supported at intervals not to exceed 5' on center.
3. Conduit in riser shafts shall be supported at each floor level by approved clamp hangers.
4. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameters of conduits.
5. Where installed in seismic zones, suspended raceways shall be braced in two (2) directions as required to prevent swaying and excessive movement.
6. Raceways installed on top of flat roofing shall be supported a minimum of 3 ½" above roof with rubber block supports (Cooper B-Line Dura-Blok or equal). Installation shall be in strict accordance with support manufacturer's instructions and recommendations.

E. Terminations:

1. All conduit connections to sheet metal cabinets or enclosures located in exterior or wet locations shall terminate by use of rain tight (Meyers) hubs.
2. In wet, exterior or process areas, conduits shall NOT enter tops of enclosures. All conduits shall enter enclosures from bottom, left or right sides of the enclosure (utilizing rain-tight Meyers hubs as indicated above).
3. Where rigid or I.M.C. conduits enter sheet metal boxes, they shall be secured by approved lock nuts and bushings.
4. Where metal conduits enter outdoor pull boxes, manholes, under freestanding electrical equipment or other locations where direct metal-to-metal contact does not exist between enclosure and conduit, grounding bushings shall be installed. Each grounding bushing shall be connected to the enclosure ground and all other grounding bushings with properly sized grounding conductors.
5. Where PVC enters outdoor pull boxes, manholes or under freestanding electrical equipment, PVC end bells shall be installed.
6. Contractor shall be responsible for coordinating required conduit sizes with equipment hubs/conduit entry provisions (such as at motor tap boxes) prior to installation of conduit systems. Contractor shall field adjust final conduit sizes at terminations where so required (only as allowed by code) from those indicated on plans to coordinate with equipment hubs/conduit entry provisions.
7. Where conduit terminates in free air such that associated cabling/circuitry becomes exposed (such as at cable trays, etc.), conduit shall generally terminate in a horizontal orientation (to prevent dust/debris/etc. from entering conduit system). Where vertical conduit termination is necessary, the termination shall be provided with cord-grip conduit terminations to seal the conduit system.
8. Conduit ends shall be carefully plugged during construction.
9. Permanent, removable caps or plugs shall be installed on each end of all empty raceways with fittings listed to prevent water and other foreign matter from entering the conduit system.

F. Penetrations:

1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly. Refer to drawings and other specifications for additional requirements.
2. All penetrations shall be at right angles unless shown otherwise.

3. Structural members (including footings and beams) shall not be notched or penetrated for the installation of electrical raceways unless noted otherwise without specific approval of the structural engineer.
4. Dry-packed non-shrink grout or watertight seal devices shall be used to seal openings around conduits at all penetrations through concrete walls, ceilings or aboveground floors.
5. All raceways entering structures, or where water is otherwise capable of entering equipment/devices through the raceway system, shall be sealed (at the first box or outlet) with foam duct sealant to prevent the entrance of gases or liquids from one area to another or into equipment/devices.
    a. Where the elevation of the raceway penetration (into the structure) is no more than 15’ below the other (higher) end of the same raceway, Polywater FST sealant (rated to hold back up to 22’ of continuous water head pressure), or pre-approved equal, shall be used.
    b. Where the elevation of the raceway penetration (into the structure) is between 15’ and 75’ below the other (higher) end of the same raceway, Polywater PHRD Custom Mechanical Seals (rated to hold back up to 36psi or 83’ of continuous water head pressure), or pre-approved equal, shall be used.
    c. Where the elevation of the raceway penetration (into the structure) is more than 75’ below the other (higher) end of the same raceway, the contractor shall propose a custom solution designed to hold back or to drain the possible water within the associated raceway. Submittals shall be provided to the engineer for review/approval, including a summary of the anticipated elevations/PSIs, details of the proposed installation, cut-sheets of devices/materials, etc.
6. Additionally, where necessary to ensure that water does not enter equipment/devices through the raceway system (where raceways extend to equipment/devices from wet areas), junction boxes with drain assemblies in bottom shall be located at low point of raceway system near equipment/devices (to drain water out of raceway system before it enters equipment/devices). Contractors shall provide drains in raceway systems where so necessary to prevent water entry into equipment/devices. In special applications (such as to instruments, etc.,), where cabling rated for exposed application is provided, contractor may propose short air gaps (approximately 6” or less) between the end of the conduit system and the equipment/device cable entry (to be made with cable gland connectors) to prevent water in conduit system from entering equipment/devices in lieu of drained junction boxes.
7. All raceways passing through concrete roofs or membrane-waterproofed walls or floors shall be provided with watertight seals as follows:
    a. Where ducts are concrete encased on one side: Install watertight entrance seal device on the accessible side of roof/wall/floor as directed by equipment manufacturer.
    b. Where ducts are accessible on both sides: Install watertight entrance seal device on each side of roof/wall/floor as directed by equipment manufacturer.
8. All raceways passing through walls of rooms containing/storing noxious chemicals (chlorine, ammonia, etc.) or through hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS or equal).

9. All raceways terminating into electrical enclosures/devices/panels/etc. located in hazardous locations shall be sealed with conduit seals (Crouse-Hinds type EYS, EZS or equal) within 18" of the termination.

G. Exterior Electrical Ductbanks:
   1. Where exterior electrical concrete-encased ductbanks are indicated on drawings, conduit runs between buildings or structures shall be grouped in concrete-encased ductbanks as follows:
      a. A minimum of 3" of concrete shall encase each side of all ductbanks.
      b. A minimum of 1 ½" of separation shall be provided between each conduit within ductbanks. PVC spacers shall be installed at the necessary intervals prior to placement of concrete to maintain the required spacing and to prevent bending or displacement of the conduits.
      c. Top of concrete shall be a minimum of 30" below grade. A continuous magnetic marking tape shall be buried directly above each ductbank, 12" below grade.
      d. Exact routing of ductbanks shall be field verified and shall be modified as necessary to avoid obstruction or conflicts.
      e. Underground electrical raceways shall be installed to meet the minimum cover requirements listed in NEC Table 300.5. Refer to drawings for more stringent requirements.

END OF SECTION 26 05 33

SECTION 26 05 34 – OUTLET BOXES, JUNCTION BOXES, WIREWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Outlet and Junction Boxes

B. Pull Boxes

C. Wireways

PART 2 - PRODUCTS

2.1 OUTLET BOXES & JUNCTION BOXES (THROUGH 4-11/16")

A. Sheet Metal: Shall be standard type with knockouts made of hot dipped galvanized steel as manufactured by Steel City, Raco, Appleton, Bowers or equal.

B. Cast: Shall be type FS, FD, JB, GS, or SEH as required for application as manufactured by O-Z/Gedney, Appleton, or equal.

C. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal.

2.2 JUNCTION AND PULL BOXES (LARGER THAN 4-11/16")

A. Oil-Tight JIC: Shall be Hoffman Type CH box or approved equal.

B. Galvanized Cast Iron or Cast Aluminum: Shall be O-Z/Gedney or approved equal.

C. Stainless Steel: Shall be as manufactured by O-Z/Gedney, Hoffman or approved equal. Boxes shall have continuous hinges, seamless foam-in-place gaskets and screw-down clamps.

D. Nonmetallic: Shall be type Polycarbonate/ABS construction as required for application with non-metallic quick-release latches as manufactured by Hoffman, O-Z/Gedney, Appleton, or equal. Boxes shall have hinged covers and screw-down clamps.

E. Wireways: Shall be standard manufacturer's item as manufactured by Hoffman, Square "D", Burns, B & C or equal. Wireways shall have hinged covers and screw-down clamps.

F. Above-Grade Padmounted Low Profile Pull Boxes:
   1. Construction:
      a. 12Ga. stainless steel base with 12Ga aluminum top with brushed finish, and structural bracing as required.
      b. Continuous base frame with open bottom and eight (8) ½" x 1" slots for securing box to concrete pad below and a center support member.

c. Two (2) full-size swing-open lids with full-length, stainless steel continuous hinges, lifting handles, key-locking provisions and provisions for latching lids in open position (with stainless steel chain or approved equal).
d. Guides on lid and base frame as required to insure proper closing of box and to provide increased security.
e. Aluminum or stainless steel barrier between power & instrumentation areas within box if box is used for both power and instrumentation wiring.
f. Other stainless steel hardware as required.

2. Minimum Dimensions:
a. Power: 40 inches square x 18 inches high.
b. Instrumentation: 24 inches square x 18 inches high.

3. Manufacturer:
a. Electrical Enclosure Mfg. (Pell City, AL).
b. Ebox (Pelham, AL).
c. Approved Equal.

G. Above-Grade Padmounted Transclosure Pull Boxes:
1. Construction:
a. 12Ga.aluminum with brushed finish.
b. Continuous top and bottom support frames with open bottom and slots as required for securing box to concrete pad below and a center support member.
c. Roof with 1" crest on each unit and gutters between each unit.
d. Vents (with screens) on top and bottom around perimeter of box.
e. Full-size swing-out doors on two (2) opposing sides with weld-on barrel hinges (minimum of two per door) and key-locking "L"-handles with roller rods.
f. Stainless steel barrier between power & instrumentation areas within box if box is used for both power and instrumentation wiring.
g. Other stainless steel hardware as required.

2. Minimum Dimensions:
a. Power: 42 inches square x 42 inches high.
b. Instrumentation: 42 inches square x 42 inches high.

3. Manufacturer:
a. Electrical Enclosure Mfg. (Pell City, AL).
b. Ebox (Pelham, AL).
c. Gilbert Electrical Systems
d. Approved Equal.

PART 3 - EXECUTION

3.1 APPLICATION

A. General
1. All boxes and wireways shall be of sufficient size to provide free space for all enclosed conductors per NEC requirements. Fill calculations shall be performed by contractor per NEC requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16")
a. Sheet metal boxes shall be used on concealed work in ceiling or walls.

2. Cast boxes shall be used wherever Rigid or I.M.C. conduits are installed.
3. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
4. Except when located in exposed concrete block, switch and receptacle boxes shall be 4" square for single gang installation. Appropriate gang boxes shall be used for mounting ganged switches.
5. When installed in exposed concrete block, switch and receptacle boxes shall be square type designed for exposed block installation.
6. Ceiling outlet boxes shall be 4" octagon 1-1/2" deep or larger required due to number of wires.
7. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.

C. Junction & Pull Boxes (larger than 4-11/16")
1. For all below grade exterior use and elsewhere as shown:
   a. In areas subject to future vehicular traffic: shall be galvanized cast iron (rated AASHTO H-20 Loading unless noted otherwise).
   b. In areas not subject to vehicular traffic: shall be galvanized cast iron or pre-cast polymer concrete (rated for Tier 15 Loading unless noted otherwise).
2. All boxes installed exposed in exterior or wet areas shall be stainless steel (NEMA 4X).
3. All boxes installed exposed in corrosive areas shall be stainless steel (NEMA 4X).
4. All boxes installed in extremely corrosive areas (such as chlorine and fluoride storage rooms) where non-metallic raceways are used shall be non-metallic.
5. Padmounted Pull Boxes shall be installed as shown on Plans or as required by project conditions. Transclosure-style Padmounted boxes shall be installed wherever required by the quantities and sizes of conductors. Contractor shall submit all Padmounted Pull Box types prior to ordering for engineer's review and comment.
6. Boxes installed in hazardous locations shall be explosion-proof rated for the associated application, constructed of copper-free cast aluminum.
7. All others shall be oil tight JIC box not less than 16 gauge.

3.2 INSTALLATION

A. General
1. All boxes and wireways shall be securely anchored.
2. All boxes shall be properly sealed and protected during construction and shall be cleaned of all foreign matter before conductors are installed.
3. All boxes and wireways shall be readily accessible. Contractor shall be responsible for furnishing and installing access panels per architect's specifications. Locations shall be as directed by the architect as required to make boxes, wireways, electrical connections, etc. accessible where above gypsum board ceilings or in other similar locations.
4. All metallic boxes and wireways shall be properly grounded.
5. Refer to Specification Section 26 05 53 for identification requirements.

B. Outlet Boxes & Junction Boxes (through 4-11/16")

1. Boxes shall be provided with approved 3/8" fixture studs were required.
2. Recessed boxes for wiring devices, surface fixtures, or connections, shall be set so that the edge of cover comes flush with finished surface.
3. There shall be no more knockouts opened in any sheet metal box than actually used.
4. Any unused opening in cast boxes shall be plugged.
5. Back to back boxes to be staggered at least 3 inches.
6. Under no circumstances shall through-the-wall boxes be used.

C. Junction & Pull Boxes (larger than 4-11/16")
1. Pull boxes shall be installed as indicated on plans and/or as required due to number of bends, distance or pulling conditions.
2. Boxes to be imbedded in concrete shall be properly leveled and anchored in place before the concrete is poured.
3. All pull boxes and/or junction boxes installed exterior below grade, shall have their tops a minimum of 1-1/2 inches above surrounding grade and sloped so that water will not stand on lid. A positive drain shall be installed, to prevent water accumulation inside.
4. Above grade pull boxes shall be installed on concrete anchor bases as shown on Plans.

D. Wireways and/or wall-mounted equipment
1. Mount each wireway to channels of the same metal type as the wireway.
2. Conductors serving a wireway shall be extended without reduction in size, for the entire length of the wireway. Tap-offs to switches and other items served by the wireway shall be made with ILSCO type GTA with GTC cap.

END OF SECTION 26 05 34

SECTION 26 05 53 – ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wire and cable identification.

B. Pullbox & Junction Box Identification

C. Electrical distribution & utilization equipment identification.

D. Emergency and Standby Power receptacle identification.

E. Instrument and control device identification.

F. Raceway identification.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE IDENTIFICATION

A. Intermediate Locations:
1. Wires and cable labels shall be white, thermal transfer, halogen-free, flame-retardant marker plates (sized to accommodate three lines of text) permanently affixed to the associated cable with UV-resistant plastic wire ties. Labels shall be Panduit #M200X/300X series or equal.

B. Circuit/Cable Termination Locations:
1. Wires and cable labels shall be non-ferrous identifying tags or pressure sensitive labels unless noted otherwise.

2.2 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. Labels on electrical distribution & utilization equipment shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment with rivets or silicone adhesive unless noted otherwise.

2.3 INSTRUMENT AND CONTROL DEVICE IDENTIFICATION

A. Instruments and control device labels shall be black-on-white engraved Bakelite nameplates permanently affixed to the equipment or the adjacent, visible mounting surface with silicone adhesive or stainless steel wire ties.

2.4 RACEWAY IDENTIFICATION

A. Raceway labels shall be white thermal transfer marker plates permanently affixed to the associated raceway with stainless steel wire ties, with two wire ties (one on either end of marker plate to provide a flush installation) where possible. Labels shall be Panduit #M300X series or equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Any proposed deviation in identification methods and materials from those described herein shall be submitted to Engineer for review and comment prior to installation.

B. Contractor shall provide all labeling or identification required by applicable local, state and national codes. These specifications do not intend to itemize all code-required labeling or identification requirements.

C. All labels/identification shall be positioned such as to be readable from the normal perspective without adjusting wiring/cables/labels. For example, labels/identification of wires/cables within cable trays shall be positioned to point towards the viewer (typically downward for overhead cable trays, or upward for cable trays within trenches).

D. All labels/identification (except for handwritten labels on concealed pullbox/junction box covers as noted below) shall be typewritten/printed/engraved in a neat, workmanlike, permanent, legible, consistent and meaningful manner. Labels shall not be handwritten unless specific approval is granted by engineer.

3.2 WIRE AND CABLE IDENTIFICATION

A. General:
   1. Where cabling is exposed (such as within cable trays), provide two wire ties per cable (one on either end of marker plate to provide a flush installation). Where cabling is concealed (such as within pullboxes/wireways), one wire tie per cable will be acceptable.

B. Intermediate Locations:
   1. Thermal transfer labels shall be securely fastened to all wiring and cabling in the following locations:
      a. Wireways
      b. Pullboxes/Junction boxes larger than 4-11/16”
      c. Pullboxes/Junction boxes through 4-11/16” where wires and cables are not easily identifiable via the color coding and box labeling
      d. Vaults & Manholes
      e. Approximately every 50 feet within cable trays (especially at locations where cables exit or diverge). Labels within cable trays shall be grouped (rather than being pre-labeled on cables and pulled into cable trays).
      f. Other similar intermediate locations.
   2. Labels shall be stamped or printed with the following data so that the feeder or cable can be readily identified and traced:
      a. From where the circuit originates (including panel designation and circuit number):
         1) Ex: “FROM: PP-A CIR. 3 (IN MAIN ELEC ROOM)”
      b. To where the circuit extends (using the common name of the equipment):
         1) Ex: “TO: RTU-6 (ON ROOF)”
      c. The purpose of the circuit:

1) Ex: “POWER”

d. The set number (If parallel power feeds are used).
1) Ex: “SET NO. 3 OF 4”

C. Circuit/Cable Termination Locations:
1. Where multiple termination points exist within a circuit origination point (panelboard, switchboard, MCC, starter, etc.) or other similar circuit endpoint (control panel, etc.), labels shall be securely fastened to all ungrounded and neutral conductors to clearly identify the terminal and/or circuit number associated with each conductor. For example, within lighting panels, each phase and neutral conductor shall be labeled near the terminals at a clearly visible location with the associated circuit number(s), so that if all conductors were unterminated, the labels would clearly indicate which conductor was associated with each circuit.

D. Refer to Specification Section 26 05 19 for all color-coding requirements of wires and cables.

3.3 PULLBOX & JUNCTION BOX IDENTIFICATION

A. Concealed pullboxes/junction boxes:
1. Front surface of all pullbox/junction box covers in concealed areas (such as above lay-in ceilings) or within mechanical/electrical rooms (and other similar areas where appearance of boxes is not an issue) shall be neatly marked with the ID of circuits/cables contained with permanent black marker on cover of box (Ex: “RP-1A Cir. 1, 2 & 3”). Additionally, front surface of box shall be painted red where box contains fire alarm system cabling.

B. Exposed pullboxes/junction boxes:
1. Interior surface of all pullbox/junction box covers in exposed areas shall be labeled “Power”, “Telecommunications”, “Fire Alarm” or with other similar general text neatly with permanent black marker to indicate function of box. Circuit/cable labeling within box (see above) shall identify specific cables contained. Additionally, interior surface of cover shall be painted red where box contains fire alarm system cabling.

C. Where pullboxes/junction boxes are named on contract documents (Ex:”PULLBOX #3”), an engraved nameplate shall be installed on the front surface of the box to identify the name.

3.4 ELECTRICAL DISTRIBUTION & UTILIZATION EQUIPMENT IDENTIFICATION

A. General:
1. All new and existing equipment modified by this project shall include arc-flash warning labels in accordance with NEC article 110.16.

B. All Panels, Motor Control Centers, Switchboards, Switchgear, Transformers, Etc.:
1. Engraved nameplates identifying name of equipment, nominal voltage and phase of the equipment and where the equipment is fed from shall be installed on front

surface of all panels, motor control centers, switchboards, switchgear, transformers, etc.:
    a. Ex: First Line: “NAME: RP-A”, Second Line: “120/208V-3Ø-4W”, Third Line: “FED FROM: PP-A CIR. 4 (IN MAIN ELEC ROOM)”
2. Refer to Panelboard Specification Sections for additional labeling requirements (circuit directory cards, permanent circuit labels, permanent circuit numbers, etc.) required inside panelboards.

C. Safety/Disconnect Switches and Utilization Equipment (HVAC Equipment, Pumps, Powered Valves, Control Panels, Starters, Etc.)::
1. Engraved nameplates identifying equipment being fed and where the equipment is fed from shall be installed on front surface of all disconnect switches (including both visible blade type switches and toggle-type switches) and on utilization equipment (where not clearly identified by immediately adjacent local disconnect switch):
    a. Ex: First Line: “RTU-6”, Second Line: “FED FROM: PP-A CIR. 5”
2. Where safety/disconnect switches are installed on the load side of variable frequency drives, the safety/disconnect switch shall be furnished with an additional engraved nameplate to read: “WARNING: TURN OFF VFD PRIOR TO OPENING THIS SWITCH”.
3. Safety/Disconnect switches feeding equipment that is fed from multiple sources (such as motors with integral overtemperature contacts that are monitored via a control system) and Utilization Equipment fed from multiple sources shall be furnished with an additional BLACK-ON-YELLOW engraved nameplate to read: “WARNING: ASSOCIATED EQUIPMENT FED FROM MULTIPLE SOURCES – DISCONNECT ALL SOURCES PRIOR TO OPENING COVER”.

3.5 INSTRUMENT AND CONTROL DEVICE IDENTIFICATION

A. New Instruments and control devices (whether furnished by contractor or not) shall be labeled with black-on-white engraved nameplates permanently affixed to the equipment or to the adjacent, readily-visible mounting surface with silicone adhesive or stainless steel wire ties.
1. Instruments and process control devices (float switches, etc.) shall be labeled with instrument name and, where available, instrument ID number.
2. Pushbutton stations shall be labeled with equipment being controlled. Labels shall be installed on front surface (or adjacent mounting surface) of all pushbutton stations.
3. Thermostats and other similar HVAC control devices installed in process areas shall be labeled with equipment being controlled. Labels shall be installed on front surface (or adjacent mounting surface) of all thermostats and other similar HVAC control devices.

3.6 RACEWAY IDENTIFICATION

A. Each exposed raceway shall be labeled at the point where it becomes concealed, such as where it enters a concrete floor slab, a concrete wall, the ground, etc.

B. Each raceway entering in-grade or on-grade pullboxes/junction boxes, where the conduits are only visible inside the box, shall be labeled within the box at the point where the raceway becomes concealed.

C. Raceway nameplates shall identify:
   1. The location of the other end of the raceway ("TO MCC-1" or similar). If the other end of the raceway is at an intermediate, named pullbox ("INSTRUMENTATION PULLBOX #4" or similar), that pullbox name shall be labeled rather than the endpoint of the circuitry.

3.7 OTHER IDENTIFICATION

A. Factory-engraved coverplates identifying functions of light switches and other similar devices shall be installed where so required by plans/specifications.

END OF SECTION 26 05 53

SECTION 26 05 73 – POWER DISTRIBUTION SYSTEM ELECTRICAL STUDIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
   1. Power Distribution System Electrical Studies.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Short Circuit Studies, Protective Devices Evaluation Studies, Protective Device Coordination Studies and Arc Flash Hazard Studies shall be performed by the same entity, which shall be a Professional Engineer registered in the state where the equipment will be installed. The studies shall be per the requirements set forth in the latest edition of NFPA 70E-Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E, Annex D.

B. The studies shall be submitted to the Engineer prior to shipment of any electrical distribution equipment.

C. The studies shall include all portions of all electrical systems affected by the project (including any existing systems/equipment) from the utility service to any existing equipment at the facility (including all existing equipment fed from the same service point as any new equipment) and to all new equipment installed under this contract. All induction motors 50 HP or below and fed from the same bus may be grouped together. All induction motors greater than 50 HP shall be included individually with associated starters and feeder impedance. See individual study sections below for additional scope requirements.

D. The studies shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) or EasyPower software program.

E. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

F. The contractor shall be responsible for collecting data on any existing or proposed electrical equipment, devices, conductors, etc. as required to prepare the study, and shall supply pertinent electrical system conductor, circuit breaker, generator, and other component and system information in a timely manner to allow the studies to be completed prior to shipment of equipment.

G. The Power Distribution System Electrical Studies shall be performed by Square 'D' or Cutler Hammer; or a third-party vendor if specifically approved by the engineer prior to preparation of the studies.

H. The proposed vendor shall have completed a minimum of five (5) equivalent Arc-Flash Hazard Studies in the past three (3) years.

2.2 SHORT CIRCUIT STUDY

A. The Short Circuit Study shall be performed with aid of a computer program. The study input data shall include the power company's short circuit contribution, resistance and reactive components of the branch impedances, X/R ratios, base quantities selected, and other source impedances.

B. Short circuit momentary duty values and interrupting duty shall be calculated on each individual basis with the assumption that there is a three-phase bolted short circuit at the respective switchgear bus, switchboard, low voltage motor control center, distribution panelboard, and other significant locations throughout the system.

C. The short circuit tabulation shall include symmetrical and asymmetrical fault currents, and X/R ratios. For each fault location, the total duty on the bus, as well as the individual contributions from each connected branch, including motor back EMF current contributions shall be listed with its respective X/R ratio.

2.3 PROTECTIVE DEVICE EVALUATION STUDY

A. The Protective Device Evaluation Study shall be performed to determine the adequacy of circuit breakers, switches, transfer switches, and fuses by tabulating and comparing the short circuit rating of these devices with the calculated fault currents. Appropriate multiplying factors based on system X/R ratios and protective device rating standards shall be applied.

B. Any problem areas or inadequacies in the equipment due to short circuit currents shall be promptly brought to the Engineer's attention.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. The Protective Device Coordination Study shall be performed to provide the necessary calculation and logic decisions required to select or to check the selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low voltage breaker trip characteristics and settings. The objective of the study is to obtain optimum protective and coordination performance from these devices.

B. The coordination study shall show the best coordination attainable for all breakers down through the largest breaker at each piece of distribution equipment. Coordination study shall demonstrate selective coordination where required by applicable codes or contract documents.

C. Phase and ground overcurrent protection shall be included as well as settings of all other adjustable protective devices. Where ground fault protection is used, coordination of the ground fault protection with the first downstream overcurrent phase protection device shall be demonstrated.

D. All restrictions of the National Electrical Code shall be adhered to and proper coordination intervals and separation of characteristic curves be maintained.

2.5 ARC-FLASH HAZARD STUDY

A. The Arc-Flash Hazard Study shall be performed with the aid of computer software intended for this purpose in order to calculate Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances.

B. The Arc-Flash Hazard Study shall be performed in conjunction with a short-circuit Study and a time-current coordination Study.

C. The Arc-Flash Hazard Study shall be performed for the following equipment:
   1. All Distribution Equipment – This includes but is not limited to the following:
      a. Switchgear
      b. Switchboards
      c. Motor Control Center
      d. All Lighting and Power Panelboards
      e. Fused Disconnect Switches rated greater than 100A
   2. Separately enclosed devices fed from protection device rated greater than100A - This includes but is not limited to the following:
      a. Control Panels
      b. VFD's
      c. RVSS

D. A generic Arc-Flash label shall be applied to other electrical equipment that has not been included in the study. This includes but is not limited to the following equipment:
   1. Non-fused Disconnect Switches
   2. Fused Disconnect Switches rated 100A or less
   3. Transformers
   4. Control Panels, VFD's, RVSS, etc. rated 100A or less

E. Where a main protective device is provided, the study shall be performed on the line side and load side of the main. The worst-case result shall be used for the study result and label.

F. The Study shall be performed under worst-case Arc-Flash conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

G. Where incident energies are calculated to fall within the high marginal region of a given Hazard/Risk Category Level, the Hazard/Risk Category Level shall be increased one level.

H. The Arc-Flash Hazard Study shall be performed in compliance with the latest IEEE Standard 1584, the IEEE Guide for Performing Arc-Flash Calculations. Where IEEE 1584 does not have a method for performing the required arc-flash calculations (such as for single phase equipment), calculations shall be performed and system shall be modeled using modules/methods as recommended by the arc flash software supplier (for

example, using SKM Unbalanced/Single Phase Studies module for modeling single phase systems).

I. Equipment labels to identify AFIE and appropriate Hazard/Risk Category in compliance with NFPA 70E and ANSI Z535.4 (latest version of these requirements) shall be provided to the Electrical Contractor. The Electrical Contractor shall affix the labels to the distribution equipment devices as directed by the equipment manufacturer. These labels shall, at a minimum, include the following:
   1. WARNING label.
   2. Hazard/Risk Category.
   3. Arc Flash Boundary Distance.
   4. Incident Energy (in cal/cm2) at Working Distance.
   5. Shock Hazard Voltage.
   6. Limited Approach Boundary Distance.
   7. Restricted Approach Boundary Distance.
   8. Prohibited Approach Boundary Distance.
   9. Equipment Name.
   10. Name of Firm who prepared the Study.
   11. Project Number of the Firm who prepared the Study.
   12. Date that the Study was prepared.
   13. Method for calculating analysis data.
   14. Statement to read: “Any system modification, adjustment of protective device settings, or failure to properly maintain equipment will invalidate this label” (or equivalent).

PART 3 - EXECUTION

3.1 SUBMITTAL REQUIREMENTS

A. The results of the studies shall be summarized in a final report. The report shall include the following sections:
   1. General:
      a. Description, purpose, basis and scope of the studies
      b. Single line diagram of the portion of the power system which is included within the scope of the work. The single line diagram shall fit on one sheet of paper (size as required) unless approved otherwise by engineer. The following information shall be shown on the single line diagram:
         1) Device Name
         2) Branch Fault Currents with directional indicators
         3) General Location (for busses only)
         4) Other basic component information such as cable type, cable length, breaker rating, buss short circuit rating, transformer voltages, transformer size, fuse size, etc..
   2. Short Circuit Study:
      a. Tabulation of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding same.
   3. Protective Device Evaluation/Coordination Study:

a. Protective devices time versus current coordination curves**,** tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
b. Fault current calculations including definitions of terms and a guide for interpretation of computer printout.
c. Documentation from utility company on their letterhead showing their anticipated values of available short circuit currents X/R ratios and protective devices with which the power distribution system will coordinate.
d. Time-current characteristics of the respective protective devices shall be plotted on log-log paper. Plots shall be printed in color with a dedicated color and pattern for each curve for clear identification.
e. Plots shall include complete titles, respective single line diagrams and legends, and associated power company's relay or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breakers trip curves and fuses.
f. The coordination plots shall indicate the type of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, transformer magnetizing inrush and ANSI transformer withstand parameters, cable thermal overcurrent withstand limits and significant symmetrical and asymmetrical fault currents.
g. The coordination plots for phase and ground protective devices shall be provided on a system basis.
h. A sufficient number of separate curves shall be used to clearly indicate the coordination achieved.

4. Arc-Flash Hazard Study:
a. Tabulation of device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, personal-protective equipment classes and AFIE levels.
b. Recommendations for reducing AFIE levels and enhancing worker safety.

B. Furnish all labor, materials, calculations, electrical equipment, technical data and incidentals required to provide a complete short circuit study, coordination study and arc flash hazard study of protective devices, busses, etc. from the utility service to any existing equipment at the facility and all new equipment installed under this contract.

C. The study shall comply with the following applicable provisions and recommendations of the latest revisions of the following: ANSI C37.5, IEEE Standard No. 399, and IEEE Standard No. 141.

D. Submit calculations and results of the short circuit, protective device evaluation and coordination and arc flash hazard studies prior to submitting shop drawings for new equipment. Contractor shall verify that all proposed equipment is properly rated per the short circuit and protective device evaluation portions of the study prior to releasing equipment for manufacturing.

E. Submit a copy of a sample typical arc flash label layout (meeting requirements outlined above) that will be used for the project.

F. Submit final electronic copies of all SKM program files/models/input data/etc. used to perform the study to the owner with final close-out documents. These files shall be complete as required to allow future users to recreate the study.

3.2 INSTALLATION

A. Contractor shall adjust all breaker settings as recommended by the coordination study prior to energizing equipment.

B. Contractor shall affix arc flash hazard notification labels (as determined by the results of this study) to each piece of distribution equipment prior to energization of equipment. A generic arc-flash warning label shall be affixed to any electrical equipment not included in the analysis as outlined above.

C. Where short circuit rating of equipment is dependent on setting of upstream overcurrent device, provide and install label for equipment indicating the required settings of the associated device.

END OF SECTION 26 05 73

SECTION 26 22 00 – DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 GENERAL

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
   1. Dry Type Transformers

1.2 GENERAL REQUIREMENTS

A. Voltage for 3 phase units shall be 480V to 120/208V, three phase, four wire unless shown otherwise. Voltage of single phase units shall be 480V to 120/240V single phase, three wire unless shown otherwise.

B. Where isolation transformer is indicated on drawings, furnish K-13 rated transformer with dual-faraday electrostatic shield.

PART 2 - PRODUCTS

2.1 INSULATION

A. Transformers shall be ventilated with insulation to withstand a minimum of 150 degree Celsius temperature rise (Class 220 insulation) unless specifically shown otherwise on the drawings.

2.2 ENERGY EFFICIENCY

A. Transformers shall comply with the latest applicable DOE energy efficiency requirements and latest edition of NEMA standard TP-1 and shall be labeled for the EPA Energy Star Program.

2.3 SOUND RATING

A. Sound level design may not exceed the following:

	KVA	DESIGN SOUND LEVEL
2.	0-45	40 db
3.	46-112.5	44 db
4.	113-150	47 db
5.	151-300	49 db
6.	301-750	58 db

B. Sound levels shall be determined in accordance with NEMA and ASA Standards. Core and coils shall be mounted on vibration isolator pads.

2.4 ENCLOSURES

A. Transformers mounted in dry, interior locations shall be furnished with NEMA 1 enclosures unless shown otherwise.

B. Transformers mounted outdoors or in wet locations shall be furnished with NEMA 3R enclosures with drip shields unless shown otherwise.

C. Transformers installed inside motor control centers or other similarly enclosed equipment may be “open” units not requiring additional enclosures.

2.5 CLEARANCE REQUIREMENTS

A. Transformer construction/efficiency/ventilation shall allow 3” (or less) clearance from rear and sides.

2.6 TAPS

A. All units shall be equipped with a minimum of two (2) 2 ½% taps above nominal (FCAN) and a minimum of four (4) 2 ½% taps below nominal (FCBN) as required to allow adjustment of the turns ratio of the transformer to account for site voltage adjustments.

2.7 LUGS

A. Lugs shall be AL/CU compression type suitable for the quantities and sizes of conductors required.

2.8 MANUFACTURER

A. Transformers shall be Square 'D' or Cutler Hammer.

PART 3 - EXECUTION

3.1 GENERAL

A. Minimum clearances shall be provided on all sides of transformers per manufacturer’s and code requirements.

B. Where site voltages so require, transformer taps shall be adjusted to maintain nominal voltage on secondary side of transformer. Adjustment of dry-type transformer taps shall not be made until all upstream voltage adjustments (such as voltage tap adjustments at service transformers) are finalized.

C. Refer to Specification Section 26 05 26 for transformer grounding requirements.

D. Refer to Specification Section 26 05 53 for transformer identification requirements.

3.2 MOUNTING

A. Transformers shall be mounted as indicated on plans. No units shall be wall mounted unless shown or directed otherwise.

B. Floor mounted transformers:
1. Shall be installed on a minimum of four (4) double-deflection neoprene vibration isolators (by Amber/Booth, Korfund Dynamics or Mason Industries - size as required

– with seismic restraint capability ratings as required by the associated seismic zone).

2. Shall be installed on four-inch thick concrete pads unless specifically shown otherwise. Pad shall have beveled edges.

END OF SECTION 26 22 00

SECTION 26 24 17 – LIGHTING PANELBOARDS

PART 1 - GENERAL

1.1 GENERAL

A. The work under this section includes but is not limited to the following:
   1. Lighting Panelboards
   2. Circuit Breakers

PART 2 - PRODUCT

2.1 PANELBOARDS

A. Enclosure:
   1. Panelboards shall be dead front type and shall be in accordance with Underwriter's Laboratories, Inc., standard of panelboards and enclosing cabinets and so labeled.
   2. Panelboards installed in dry locations shall have enclosures fabricated from sheet steel and shall be finished in ASA #49. Panelboards installed in corrosive, exterior or wet locations shall have NEMA 4 stainless steel enclosures.
   3. The door shall have a cylinder type lock. Lock shall be held in place by concealed screw to a captive nut, welded to inside of door. All locks shall be keyed alike.
   4. A metal framed circuit directory card holder with clear plastic covering shall be factory-mounted on the inside of door.
   5. Panels for 20 or more circuits, including spares and spaces, shall be 20 inches wide.
   6. Panelboards enclosures shall be as shown on panel schedule on plans for surface, flush or motor control center mounting.
   7. Provide hinged trim with piano-hinge down full length of one side to allow access to wiring without complete removal of outer trim.
   8. Each section of multi-section panelboards shall be of matching heights and depths.

B. Bussing/Lugs:
   1. Ampacity and service voltage of main buss, lugs or main breakers and branch circuit breakers shall be as shown on drawings.
   2. All bussing and associated connectors shall be tin-plated copper.
   3. All panelboards shall contain ground buss.
   4. Entire panelboard shall be capable of withstanding a short circuit not less than the interrupting capacity of any breaker in the panel. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. Interrupting ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.
   5. Buss connectors shall be for distributed phase arrangement.
   6. Main and sub-feed lugs shall be provided with AL/CU compression lugs suitable for the quantities and sizes of conductors required.
   7. Top/bottom feed arrangement and lug sizes/quantities shall be coordinated by the contractor.
   8. Entire panelboard assembly, including all bussing, shall have SCCR ratings meeting or exceeding the minimum AIC ratings listed on the plans for the panel. When a

power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. All ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.

9. Service entrance panelboards shall be provided with barrier such that no uninsulated, ungrounded service busbar or service terminal is exposed to inadvertent contact by persons or maintenance equipment while servicing load terminations

C. Breaker arrangement and numbering:
   1. Panelboards shall be factory assembled with branch breakers arranged exactly as indicated on plans.
   2. Breakers shall be numbered vertically beginning top left. Multi-section panelboards shall be numbered consecutively through all sections.
   3. Breaker numbers shall be permanently attached to trim.
   4. Main breakers shall be vertically-mounted (branch-mounted or back-fed main breakers will not be acceptable unless specifically so shown on plans).

2.2 CIRCUIT BREAKERS

A. Circuit breakers shall be quick break, quick make, thermal magnetic type, for alternating current. Breakers shall trip free for the handle and tripping shall be indicated by the handle assuming a position between OFF and ON.

B. Circuit breakers shall be of the bolt-on type.

C. Multi-pole breakers shall be internal common trip with single operating handle; external handle ties are not acceptable, unless specifically noted otherwise (such as for multi-wire branch circuits described below).

D. Circuit breakers feeding multiwire branch circuits (as defined by NEC) consisting of separate single phase loads sharing a common neutral shall be provided with multi-pole breakers or handle ties to simultaneously disconnect all ungrounded conductors per NEC Article 210.4(B). The necessary locations of these multi-pole breakers or handle ties shall be coordinated by the contractor. Where necessary, the contractor may rearrange circuit breakers (as minimally as possible) as required to meet this requirement.

E. All breakers shall meet the minimum RMS symmetrical interrupting capacity ratings shown on plans for the associated panel. All interrupting ratings shall be full ratings. Series ratings will not be allowed unless shown otherwise on drawings.

F. All branch circuit breakers shall be listed to UL489 or shall be specially-tested to be HACR listed.

2.3 SPECIAL REQUIREMENTS

A. Any special requirements on the drawings, such as for increased interrupting rating, ground fault protection, etc., shall supersede these specifications, but only insofar as that particular requirement is concerned.

B. Lighting panels larger than 400A shall conform to the requirements for power panels.

2.4 MANUFACTURER

A. Panelboards shall be as manufactured by Square 'D' or Cutler Hammer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All panelboard dimensions and clearances shall be carefully checked and coordinated with the proper trades to insure proper mounting space and support prior to roughing in equipment. In no case shall any circuit breaker be located above 6’-7” A.F.F..

B. Wiring in panelboard wireways shall be done in a neat and workmanlike manner. Wiring shall be grouped into neat bundles and secured with approved tie wraps.

C. For all flush-mounted panelboards, a minimum of three (3) one-inch empty conduits shall be stubbed out above the nearest accessible ceiling space for future use.

3.2 PANEL IDENTIFICATION

A. Refer to Specification Section 26 05 53.

END OF SECTION 26 24 17

SECTION 26 24 19 – MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes requirements for motor control centers (MCC's) and all required control devices as shown on the drawing and specified to be part of the MCC equipment. The MCC shall be 277/480 V, 3-Phase, 4-Wire, 60 Hz unless otherwise indicated.

1.2 SUBMITTALS

A. Submittals shall be furnished in accordance with Specification Section 26 05 00.

B. Submittals shall show separate views of the elevation, profile and conduit openings. The elevation shall show the section identification and the unit identification. The drawings shall give dimensions of size and location of the following:
   1. Vertical section height, width and depth
   2. Mounting channels
   3. Conduit openings top and bottom
   4. Wireway openings in sides
   5. Horizontal buss
   6. Ground buss

C. The submittals shall contain a summary of the design specification containing but not limited to the following:
   1. NEMA type enclosure and class of wiring
   2. Rated buss voltage
   3. Current ratings for horizontal buss, vertical busses and ground buss
   4. Buss material and plating

D. Buss bracing and sheet circuit rating

E. The submittals shall contain a listing of all modifications, options and special equipment.

F. The submittals shall contain a listing of each unit containing but not limited to the following:
   1. Unit Location
   2. Nameplate
   3. Major contents of unit (fuse starter, CB switch, M.C.P., etc.) complete with NEMA size and heater rating or current rating.
   4. Size of load served (H.P. KVA, KW, etc.).

G. Provide the following for each starter/controls unit:
   1. A job-specific, custom wiring diagram
      a. The wiring diagram shall clearly show all control components (whether the components are mounted internal or external to the MCC 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.

H. Submittals shall be complete and electrical contractor shall review and approve all accessories required for control wiring prior to submittal

1.3 REGULATORY REQUIREMENTS

A. The MCC shall conform to Underwriters Laboratory (UL) 845, current revision, CSA, EEMAC, NEMA ICS-2, the latest version of the National Electrical Code, and the Canadian Electrical Code. The MCC shall be manufactured in an ISO 9001 certified facility.

1.4 WARRANTY

A. An eighteen-month warranty shall be provided on materials and workmanship from date of owner acceptance/substantial completion after completion of startup.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. Square 'D' or Cutler Hammer.

B. Additions to existing MCCs shall be the same as the original manufacturer.

2.2 MATERIALS

A. Steel material shall comply with UL 845 and CSA requirements.

B. Each MCC shall consist of one or more vertical sections of heavy gauge steel bolted together to form a rigid, free-standing assembly. A removable 7 gauge structural steel lifting angle shall be mounted full width of the MCC shipping block at the top. 10 gauge bottom channel sills shall be mounted underneath front and rear of the vertical sections extending the full width of the shipping block. Vertical sections made of welded side-frame assembly formed from a minimum of 12 gauge steel. Internal reinforcement structural parts shall be of 12 and 14 gauge steel to provide a strong, rigid assembly. The entire assembly shall be constructed and packaged to withstand normal stresses included in transit and during installation.

C. Each entire MCC assembly (including all sub-components) shall be rated to withstand (and provide proper breaker functionality within) the fault current ratings listed on the plans. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. The fault current ratings listed shall be assumed to be at the input terminals of the associated MCC.

2.3 MCC FINISH

A. All steel parts shall be provided with UL and CSA listed acrylic/alkyd baked enamel paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.

B. Pre-treatment shall include:
   1. Hot alkaline cleaner to remove grease and oil.
   2. Iron phosphate treatment to improve adhesion and corrosion resistance.

C. The paint shall be applied using an electro-deposition process to ensure a uniform paint coat with high adhesion.

D. The standard paint finish shall be tested to UL 50 per ASTM B117 (5% ASTM Salt Spray) with no greater than 0.125 in (3 mm) loss of paint from a scribed line.

E. Paint color shall be #49 medium light gray per ANSI standard Z55.1-967 (60-70 gloss) on all surfaces unless specified otherwise. Paint color of additions to existing MCCs shall match that of the existing MCC. Control station plates and escutcheon plates shall be a contrasting gray.

2.4 STRUCTURES

A. Structures shall be totally enclosed, dead-front, free-standing assemblies. Structures shall be capable of being bolted together to form a single assembly.

B. The overall height of the MCC shall not exceed 90 in (2286 mm) (not including base channel or lifting angle). Lifting angles, of 3 in (76 mm) in height, shall be removable. The total width of one section shall be 20 in (508 mm); (widths of 25 in (630 mm), 30 in (760 mm), and 35 in (890 mm) can be used for larger devices). The total depth of each section shall be 20 in (508 mm) unless shown otherwise.

C. Structures shall be NEMA/EEMAC type 1 unless shown/specified otherwise.

D. Each 20 in wide standard section shall have all the necessary hardware and bussing for modular plug-in units to be added and moved around. All unused space shall be covered by hinged blank doors and equipped to accept future units. Vertical bus openings shall be covered by manual bus shutters.

E. Each section shall include a top plate (single piece or two-piece). NEMA/EEMAC type 12 shall also include a bottom plate. Top and bottom plates shall be removable for ease in cutting conduit entry openings.

F. All MCC components, terminations, wiring, etc. shall be fully accessible from the front of the MCC unless noted otherwise.

2.5 WIREWAYS

A. Structures shall contain a minimum 12 in (305 mm) high horizontal wireway at the top of each section and a minimum 6 in (152 mm) high horizontal wireway at the bottom of

each section. These wireways shall run the full length of MCC to allow room for power and control cable to connect between units in different sections.

B. A full-depth vertical wireway shall be provided in each MCC section that accepts modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireway. The vertical wireway shall be 4 in (102 mm) wide minimum with a separate hinged door. There should be a minimum of 80 in^2 (516 cm^2) of cabling space available for 20-inch-deep sections. Access to the wireways shall not require opening control unit doors. Structures that house a single, full section control unit are not required to have vertical wireways. Those control units shall open directly into the MCC horizontal wireways.

C. All wireway doors shall be hinged and shall be held shut by captive hardware.

2.6 BARRIERS

A. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be mounted onto a glass filled polyester support assembly that braces the bus against the forces generated during a short circuit. The horizontal bus shall be isolated from the top horizontal wireway by a two-piece rigid non-conductive barrier. The barrier design shall allow qualified personnel to slide the barriers both left and right, to allow access to the bus and connections for maintenance without having to remove the barrier. Barrier sliding shall occur via an upper and lower track system.

B. The vertical bus shall be housed in a molded glass-filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 in (75 mm) for unit stab-on connections. Each opening shall be provided with a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the MCC.

C. Barriers shall be provided in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.

2.7 BUSSING

A. All bussing and connectors shall be tin-plated copper.

B. The main horizontal bus shall be rated as indicated on plans and shall extend the full length of the MCC. Bus ratings shall be based on 65° C maximum temperature rise in a 40° C ambient. Provisions shall be provided for splicing additional sections onto either end of the MCC.

C. The horizontal bus splice bars shall be pre-assembled into a captive bus stack. This bus stack is installed into the end of the MCC power bus to allow the installation of additional sections. The main bus splice shall utilize four bolts, two on each side of the bus split, for

each phase. Additional bolts shall not be required when splicing higher amperage bus. The splice bolts shall secure to self clenching nuts installed in the bus assembly. It shall be possible to maintain any bus connection with a single tool.

D. A neutral bus and/or neutral lugs (with amperage rating equal to that of the main horizontal bus) shall be provided for all 4-wire motor control centers.

E. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of copper and plating as the main bus, and shall be rated 300 A or 600 A continuous based on UL standards (and the associated loads connected to the bus). The vertical bus shall be connected directly to the horizontal bus stack without the use of risers or other intervening connectors. It shall be possible to maintain the vertical to horizontal bus connection with a single tool. "Nut and bolt" bus connections to the power bus shall not be permitted. When a back-to-back unit arrangement is utilized, separate vertical bus shall be provided for both the front and rear units.

F. A tin-plated copper ground bus shall be provided that runs the entire length of the MCC. The ground bus shall be rated for 25% (minimum) of the main horizontal bus amperage. Compression lugs shall be provided in the MCC for a ground cable, sized to accommodate the grounding connections shown on plans. The ground bus shall be provided with six (6) holes for each vertical section to accept customer-supplied ground lugs for any loads requiring a ground conductor.

G. Each vertical section shall have a tin-plated copper vertical ground bus that is connected to the horizontal ground bus. This vertical ground bus shall be installed so that the plug-in units engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected upon removal of the plug-in unit.

H. The system shall be rated for an available short circuit capacity as indicated on plans. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. Interrupting ratings shall be full ratings. Series ratings will not be allowed unless specifically shown otherwise on drawings.

2.8 TYPICAL UNIT CONSTRUCTION

A. Units with circuit breaker disconnects through 400 A frame, and fusible switch disconnects through 400 A, shall connect to the vertical bus through a spring reinforced stab-on connector. Units with larger disconnects shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus.

B. All circuit breakers rated (or able to be adjusted to) 1200A or higher 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.

C. All circuit breakers shall have adjustable magnetic trip settings. Provide a field adjustable breaker to allow for one breaker for each NEMA size starter. The adjustment range shall

include current range to encompass the entire range of each size starter. There shall also be adjustments to select either standard or high inrush magnetic settings, from 6 times to 13 times motor full load current. If a standard, non adjustable, magnetic only trip breaker is furnished for a combination starter unit, the manufacturer shall include in the bid cost to furnish and install replacement breakers at jobsite if equipment changes dictate.

D. All conducting parts on the line side of the unit disconnect shall be shrouded by a suitable insulating material to prevent accidental contact with those parts.

E. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal. All plug-on units shall use a twin-handle camming lever located at the top of the bucket to rack in and out the plug-on unit. The cam lever shall work in conjunction with the hanger brackets to ensure positive stab alignment.

F. A lever handle operator shall be provided on each disconnect. With the unit stabs engaged onto the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit. All circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door. Clear indication of disconnect status shall be provided, by adhering to the following operator handle positions:
   1. Handle "On" position shall be up or to the left and within 45 degrees of being parallel to the face of the equipment.
   2. Handle "Off" position shall be down or to the right and within 45 degrees of being parallel to the face of the equipment.
   3. The minimum separation between the "On" and "Off" positions shall be 90 degrees.
   4. On Circuit Breaker disconnects, the handle "Tripped" position shall be perpendicular to the face of the equipment +/- 30 degrees. Minimum separation between "On" and "Tripped" shall be 30 degrees. Minimum separation between "Tripped" and "Off" shall be 45 degrees.

G. A mechanical interlock shall prevent the operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent the operator from placing the disconnect in the ON position while the unit door is open. It shall be possible for authorized personnel to defeat these interlocks.

H. A non-defeatable interlock shall be provided to prevent installing or removing a plug-in unit unless the disconnect is in the OFF position.

I. The plug-in unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.

J. Provisions shall be provided for locking all disconnects in the OFF position with up to three padlocks.

K. Handle mechanisms shall be located on the left side to encourage operators to stand to the left of the unit being switched.

L. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.

M. All unit doors shall be hinged and shall be held shut by captive hardware.

N. Interiors of all units shall be painted white.

2.9 COMPONENTS FOR TYPICAL UNITS

A. Main Lugs
1. Main and sub-feed lugs shall be provided with AL/CU compression lugs suitable for the quantities and sizes of conductors required.

B. Circuit Breakers
1. 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.
2. Circuit breakers shall be quick-make and quick-break, whether actuated automatically or manually. Circuit breakers shall have inverse time tripping characteristics with automatic release which shall trip free of the handle. Circuit breaker handles shall be three distinct positions—"OFF", "ON", and "TRIPPED". When a circuit breaker opens on overload or short circuit, the operating handle shall automatically assume the "TRIPPED" position.

C. Combination Starters
1. All combination starters shall utilize a unit. 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).
2. 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:
   a. Overload.
   b. Phase Unbalance.
   c. Phase Loss.
   d. Ground Fault (Class II detection).
3. Unless specifically shown otherwise, each combination starter shall be furnished with a control circuit transformer including two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads (including motor space heaters and other similar loads where specified). The transformer rating shall be fully visible from the front when the unit door is opened. Unless otherwise indicated, control voltage shall be 120V AC. Control power shall be provided by individual unit control power transformers.
4. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.

5. Auxiliary control circuit interlocks shall be provided where indicated. Auxiliary interlocks shall be field convertible to normally open or normally closed operation.
6. 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.
7. Each starter shall be equipped with a minimum of the following control devices:
    a. Door-mounted reset button.
    b. Two (2) field-reversible (N.O./N.C.) auxiliary contacts
    c. For reversing and two-speed starters: Four (4) field-reversible (N.O./N.C.) auxiliary contacts
    d. Additional control devices as indicated on plans.

D. Terminal Blocks
1. Wiring within all units shall be type B, with unit-mounted control terminal blocks for each field wire.
2. Terminal blocks shall be the pull-apart type 600 volt and rated at 25 amps. All current carrying parts shall be tin plated. Terminals shall be accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail mounted with the stationary portion of the block secured to the unit bottom plate. The stationary portion shall be used for factory connections, and shall remain attached to the unit when removed. The terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.

E. 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.

F. Wiring
1. All wiring shall be identified on each end with hot stamped or shrink tube type permanent wire markers to correspond with numbering shown on wiring diagrams.

G. Wiring Diagram
1. A job-specific, custom wiring diagram for each unit 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 each unit (whether the components are mounted internal or external to the soft start 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 unit.

H. Control Components:
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.
2. All pilot lights to be cluster LED type & push to test.

3. Relays:
    a. Control relays shall have the following characteristics, unless noted otherwise:
        1) General purpose, plug-in type.
        2) Minimum mechanical life of 10 million operations.
        3) Coil voltage as indicated or required by application.
        4) Single-break contacts rated 12 amperes, resistive at 240 volts.
        5) 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.
        6) Furnished with RC transient suppressor to suppress coil-generated transients to 200% of peak voltage.
        7) LED on/off indicator light and manual operator.
        8) Industry standard wiring and pin terminal arrangements.
        9) Equal to Square D 8501KP series with matching plug-in socket.
    b. Interposing/isolation relays used to isolate input/output field wiring from PLC inputs/outputs shall be terminal-block style. Terminal-block style relays shall have the following characteristics, unless noted otherwise:
        1) Minimum mechanical life of 10 million operations.
        2) Single-break contacts rated 6 amperes, resistive at 120 volts.
        3) One (1) N.O. contact per relay.
        4) Furnished with integral transient protection.
        5) LED on/off indicator light.
        6) DIN-rail mounted.
        7) Equal to Square D type Zelio RSL.
    c. Timer relays shall be electronic, adjustable plug-in devices meeting the following characteristics, unless noted otherwise:
        1) General purpose, plug-in type.
        2) Minimum mechanical life of 10 million operations.
        3) Single-break contacts rated 10 amperes, resistive at 240 volts.
        4) 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.
        5) Rotary-thumbwheel adjustments for time value, timing range and function.
        6) Time value adjustments from .05 seconds to 999 hours
        7) Selectable Timing Functions, including the following:
            a) On Delay
            b) Interval
            c) Off Delay
            d) One Shot
            e) Repeat Cycle-Off
            f) Repeat Cycle-On
            g) On/Off Delay

h) One Shot Falling Edge
i) Watchdog
j) Trigger On Delay

8) Accuracy shall be ± 2% and repeatability shall be ± 0.1%.
9) Furnished with integral transient protection.
10) LED indicator light(s) for “timing” and “on/off status”
11) Held in place with hold-down spring
12) Equal to Square D type JCK with matching plug-in socket.

2.10 VARIABLE FREQUENCY DRIVES

A. Refer to Section 26 29 23.

2.11 QUALITY CONTROL

A. The entire MCC shall go through a quality inspection before shipment. This inspection shall include:
   1. Physical Inspection of:
      a. Structure.
      b. Electrical conductors, including:
         1) bussing.
         2) general wiring.
         3) units.
   2. Electrical Tests
      a. General electrical tests include:
         1) power circuit phasing.
         2) control circuit wiring.
         3) instrument transformers.
         4) meters.
         5) ground fault system.
         6) device electrical operation.
      b. AC dielectric tests shall be performed on the power circuit.
   3. Markings/Labels, include:
      a. instructional type.
      b. Underwriters Laboratory (UL)/Canadian Standards Association (CSA).
      c. inspector's stamps.
   4. The manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the MCC meets operating specifications.

B. The motor control center design shall be in accordance with the latest applicable standards of NEMA and Underwriters Laboratories.

2.12 SPECIAL REQUIREMENTS

A. Where the schedules and diagrams show deviations from these Specifications, the schedules and diagrams shall take precedence, but only for the particular feature.

PART 3 - EXECUTION

3.1 PACKING/SHIPPING

A. The MCC shall be separated into shipping blocks no more than three vertical sections each. Shipping blocks shall be shipped on their sides to permit easier handling at the jobsite. Each shipping block shall include a removable lifting angle, which shall allow an easy means of attaching an overhead crane or other suitable lifting equipment.

3.2 STORAGE

A. If the MCC cannot be placed into service reasonably soon after its receipt, store it in a clean, dry and ventilated building free from temperature extremes. Acceptable storage temperatures shall be determined by the manufacturer. Anti-condensation space heaters shall be provided during equipment storage as directed by the manufacturer.

3.3 LOCATION

A. Motor control centers shall not be placed in hazardous locations. The area chosen shall be well ventilated and totally free from humidity, dust and dirt. Where the minimum temperature of the area is less than 0° C (32° F), space heaters shall be provided within the motor control center. Where the minimum temperature of the area is greater than 40° C (104° F) ventilation fans and/or air conditioning units shall be provided within the motor control center as required to provide adequate cooling for each unit. For indoor locations, protection shall be provided to prevent moisture entering the enclosure .

B. Motor control centers shall be located in an area with a minimum of 4 ft (1219 mm) of free space in front of front-of-board construction. This free space shall give adequate room to remove and install units. A minimum of 0.5 in (13 mm) space should be provided between the back of front-of-board MCCs and a wall, 6 in (152 mm) required for damp locations.

C. The MCCs shall be assembled in the factory on a smooth level surface so that all sections are properly aligned. A similar smooth and level surface shall be provided for installation. An uneven foundation will cause misalignment of shipping blocks, units, and doors. The surface under a MCC shall be of a non-combustible material unless bottom plates are installed in each vertical section.

3.4 INSTALLATION

A. Motor control centers shall be installed on six inch thick concrete pads unless specifically shown otherwise. Pad shall extend a minimum of four inches to all sides and shall have beveled edges.

B. Orientation of motor control centers shall be as shown on the Engineer's drawings. Space requirements are critical on this project and therefore special care shall be taken to insure that equipment will fit in the designated space. To insure proper coordination, the MCC manufacturer shall submit with shop drawings a 1/2"=1'-0" scale floor plan of each electrical room showing all columns, doors, walls and proposed equipment. Manufacturer shall not bid equipment that will not fit in available space.

C. All motor control center dimensions and clearances shall be carefully checked and coordinated with the proper trades to insure proper mounting space and support prior to roughing in equipment.

D. Motor control centers shall be grounded in two places as specified on drawings.

E. Verify all accessories as shown on drawings. Perform all necessary additions and modifications to make the motor control center to the Engineer's drawings.

F. A job-specific, custom wiring diagram for each unit 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 each unit (whether the components are mounted internal or external to the soft start 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 unit.

G. Operations and Maintenance Manuals and a listing of the nearest and most convenient source of replacement parts and service shall be provided to the owner for all MCC components, control wiring, etc.

H. Operations and Maintenance Manuals shall include hardcopy printouts of all device settings and programming.

I. For safety, reliability, and continuity of warranty, any modifications, alterations, etc. required to conform to the requirements of this specification shall be performed by the MCC manufacturer only. Distributor modifications, third party packaging, etc. of a manufacturer's standard product are specifically disallowed.

J. Services shall include a minimum of eight (8) hours of field/classroom training for owner's personnel on routine operation and maintenance of the specified units.

3.5 SPARE PARTS

A. The following spare parts shall be provided at no extra cost to the Owner:
   1. One of each type and size of control fuse.

END OF SECTION 26 24 19

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wiring Devices

B. Plates

C. Finishes

PART 2 - PRODUCTS

2.1 WIRING DEVICES AND PLATES

A. Switches shall be AC type, extra-heavy duty industrial grade (unless otherwise shown) of ratings shown on drawings. Switches shall be as manufactured by Hubbell, P & S, Sierra, Bryant, GE, Arrow Hart or equal.

B. Receptacles shall have blade configuration and shall be heavy duty industrial grade (unless otherwise shown) of current and voltage rating as shown on drawings. Receptacles shall be as manufactured by Hubbell, P & S, Sierra, Bryant, GE, Arrow Hart or equal.

C. All GFCI-type receptacles shall continuously self-test and shall trip/deny power if the receptacle does not provide proper GFCI protection or if the line/load terminations are miswired and shall provide visual indication of power status, trip conditions, ground fault conditions and end-of-life status.

D. Each wiring device shall have a plate (see “Finishes” section below for specific requirements).

2.2 FINISHES

A. All wiring devices (switches, receptacles, etc.) shall be colored to match the coverplates described below. For instance, all items covered by stainless steel, aluminum or malleable iron plates shall be gray in color.

B. Coverplates for recessed, wall-mounted electrical items (switches, receptacles, telephone outlets, etc.) shall be stainless steel unless shown otherwise.

C. Coverplates, trim rings, etc. for recessed, floor-mounted electrical items (floor outlets, underfloor duct junctions, etc.) shall match finish of building hardware (302/304 stainless steel, brass, etc.) in area installed.

D. Coverplates for exposed electrical items (switches, receptacles, telephone outlets, etc.) shall be of same material as exposed boxes (see Outlet Box Specification for required material type) and shall have beveled edges.

E. Coverplates for receptacles in wet locations shall be metallic, in-use type, rated for wet locations per NEC requirements unless noted otherwise.

F. See “Electrical Identification” specification section for coverplate labeling requirements.

PART 3 - EXECUTION

3.1 GENERAL MOUNTING

A. Symbols on drawings and mounting heights are approximate. The exact locations and mounting heights shall be determined on the job, and it shall be the Contractor's responsibility to coordinate with all trades to secure correct installation. For example, Contractor shall coordinate exact mounting heights over counters, in or above backsplashes, in block walls, and at other specific construction features.

B. Verify all door swings with Architectural. Locate boxes for light switches within four inches of door trim on swing side (not hinge side) of door.

C. Devices and associated plates shall not be used as support; outlet boxes shall be rigidly supported from structural members.

D. Mount all straight-blade receptacles vertically with ground pole up, unless specifically noted otherwise.

E. Unless otherwise shown or required by local handicap codes, outlet boxes shall be the following distances above the finished floor unless otherwise noted.
   1. Receptacles and telephone outlets in offices and other finished areas: 1’-6” to the center of the box.
   2. Receptacles and telephone outlets in equipment rooms and other unfinished areas: 4’-0” to the center of the box.
   3. Receptacles over counters: As Noted
   4. Switches, general: 4’-0” to the top of the box.
   5. Push-button, etc., general: 4’-0” to the top of the box.
   6. Other device types: verify with engineer prior to rough-in.

END OF SECTION 26 27 26

SECTION 26 28 13 – FUSES

PART 1 - GENERAL

1.1 GENERAL

A. THE WORK UNDER THIS SECTION INCLUDES BUT IS NOT LIMITED TO THE FOLLOWING:
1. Fuses

PART 2 - PRODUCTS

2.1 FUSES

A. Fuses - 600 volts and less - shall be furnished and installed by electrical contractor who will maintain fuses in original new condition until installed. Fuses shall not be installed until equipment is ready to be energized.

B. Fuses 601 to 6000 amperes shall be time-delay, Class L type with an "O" ring to provide seal between the end bells and the glass melemine fuse barrel. Terminals shall be penned. Fuses must hold 500% rating for a minimum of 4 seconds and clear 20 times rated current in .01 seconds or less. Fuses shall be current-limiting and be listed by Underwriters Laboratories, Inc. with an interrupting rating of 200,000 amperes r.m.s. symmetrical. Bussmann Hi-Cap, time-delay, Class L fuses.

C. All other fuses for power, light and motor circuits shall be dual-element, Class RK5 type with separate overload and short-circuit elements. The overload element shall incorporate a spring activated thermal unit having a 284 Degree Fahrenheit melting point alloy and with a heat sink that will provide time-delay of a minimum of 10 seconds at 500% rating. Fuses shall be current-limiting and be listed by Underwriters Laboratories, Inc. with an interrupting rating of 200,000 amperes r.m.s. symmetrical. Bussmann Low-Peak, dual-element, Class RK5 fuses.

D. Fuses shall be installed in fluorescent fixtures on the line side of the ballast by the fixture manufacturer who will size the fuses for each application. Bussmann GLR fuses installed in HLR fuseholder.

E. Fuses for all other ballast-controlled lighting fixtures shall have fuses installed on the line side of the ballast either in the housing or handhole of lighting standards for easy access. Bussmann FNQ fuse with HPF holder for all applications. Bussmann FNQ fuse with HPF holder for all applications except lighting Standards where Bussmann HEB-JJ holder with FNQ fuse will be used.

2.2 MANUFACTURER

A. Fuses shall be as manufactured by Bussmann Manufacturing or approved equal. Approved substitutions will be allowed that provide required electrical safety overload and short-circuit performance. Electrical contractor shall submit one copy each of fuse and fuse holder manufacturers bulletins that fully describe performance for substitution approval consideration. The bulletins shall be submitted to the Electrical Design Engineer at time of bid submittal.

PART 3 - EXECUTION

3.1 SPARE FUSES

A. Spare fuses shall be provided by the electrical contractor. 10% (minimum of 3) of each size and type will be placed in a Spare Fuse Cabinet mounted on the wall of the electrical room.

END OF SECTION 26 28 13

SECTION 26 28 16 – SAFETY SWITCHES AND FUSES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Safety Switches

B. Fuses

C. Branch Feeders

D. Feeders

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

A. Safety switches shall be quick-make, quick-break, NEMA heavy duty type HD, fused or nonfused as shown. Switch blades shall be fully visible in the off position.

B. Safety switches shall be furnished with transparent internal barrier kits to prevent accidental contact with live parts. Barriers shall provide finger-safe protection when the switch door is open and shall allow use of test probes and removal of fuses without removing barrier.

C. Fused switches shall have provisions for class R, rejection type fuses.

2.2 FUSES (600V)

A. Fuses for all branch switches shall be Bussman Mfg. Co., Dual Element, Class “R” Fusetron.

B. Fuses for main switch/switches shall be Bussman Mfg. Co. Hi-Cap.

2.3 MANUFACTURER

A. Safety switches shall be as manufactured by Square 'D' or Cutler Hammer.

B. Fuses shall be as manufactured by Bussman Mfg. Co. or equal.

PART 3 - EXECUTION

3.1 SAFETY SWITCHES

A. Safety switches shall be installed as shown on the plans and in accordance with N.E.C.

B. Locations shown for safety switches on plans are diagrammatical only. Exact locations shall be field coordinated by contractor as required to provide code-required clearances.

C. Switch enclosures shall be rated NEMA I indoors in dry locations and NEMA 4X stainless steel outdoors and in wet or process areas.

D. Adequate support shall be provided for mounting safety switches. Safety switches shall not be mounted to the associated equipment (unless the safety switch is furnished with the equipment).

3.2 FUSES

A. Fuses shall be sized as shown on drawings, unless a smaller size is required by the associated equipment supplier, in which case the contractor shall provide fuses sized as directed by the associated equipment supplier at no additional cost.

B. Provide not less than one spare set of fuses for each size used. Provide an additional spare set for each five sets of same size fuses used.

END OF SECTION 26 28 16

SECTION 26 29 00 – MANUFACTURED CONTROL PANELS

PART 1 - GENERAL

1.1 SCOPE

A. This section describes control stations, PLC panels, motor control panels, manufactured control panels, and other similar panels specified herein. Specifications herein are intended as an extension of requirements in other Divisions of these specifications where reference is made to Electrical Specifications.

1.2 DEFINITIONS

A. “Control Stations”: Enclosures (with all required accessories) containing only door-mounted pushbuttons, indicator lights and/or selector switches (no electronic components or starter/controller equipment).

B. “Control Panels”: Enclosures (with all required accessories) containing equipment/devices other than door-mounted pushbuttons, indicator lights and/or selector switches (such as electronic components, starter/controller equipment, etc.).

1.3 SUBMITTALS

A. Provide the following for each control panel:
   1. A job-specific, custom wiring diagram
      a. The wiring diagram shall clearly show all components (whether the components are mounted internal or external to the control panel enclosure).
      b. All wires and terminal blocks shall be clearly labeled.
      c. Diagram shall be in accordance with NEMA/ICS standards.
   2. Size, type and rating of all system components.
   3. Unit frontal elevation and dimension drawings.
   4. Internal component layout diagrams.
   5. Manufacturer’s product data sheets for all components.

B. A Bill of Materials shall be included with catalog information on all components.

C. Information shall be included on any proprietary logic component sufficient to demonstrate its ability to perform the required functions.

D. The following calculations shall be submitted:
   1. Thermal calculations showing amount of air conditioning or ventilation and heating required for each control panel, per ambient requirements listed below and operating temperature limitations of all equipment/devices within each control panel. Where possible, forced air ventilation shall be utilized rather than air conditioning. Panel shall be oversized, interior equipment/devices shall be derated, and solar shielding shall be provided as required to allow the use of forced air ventilation as the cooling method. Air conditioning, ventilation, and/or heating equipment shall each have ratings/capacities at least 20% larger than required by calculations below unless noted otherwise:

a. Thermal calculations used for sizing cooling/ventilation systems for each control panel located in exterior or non-conditioned spaces shall assume:
   1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.
   2) Full solar contact where applicable (not applicable where enclosures are fully protected from solar contact using solar shields separated from panel enclosure with standoffs or similar).
   3) No wind.
   4) Heat loss from interior equipment (electronics, etc.) per equipment supplier's information.

b. Thermal calculations used for sizing heating systems for each control panel shall assume:
   1) Ambient exterior air temperature ranges of -5 degrees F to 105 degrees F.
   2) No heat loss by interior components of control panel.
   3) No solar gain on exterior of control panel.
   4) Doubling of heating wattage required to account for wind where control panels are located outdoors.
   5) Minimum temperature difference (due to heating) of 10 degrees F to prevent condensation, regardless of equipment temperature limitations.

2. Load calculations showing the sizing of all power supplies provided (with spare capacity as specified). Power supplies shall each have ratings/capacities at least 20% larger than required by load calculations unless noted otherwise.
3. Load calculations showing the sizing and anticipated runtime of all Uninterruptible Power Supply systems provided (with spare capacity as specified).

PART 2 - PRODUCTS

2.1 GENERAL

A. Control panels shall be Underwriters' Laboratories labeled by the panel manufacturer. Control panel manufacturers not capable of applying the U.L. label to their products are unacceptable.

B. All human interface equipment/devices (indicator lights, selector switches, pushbuttons, time switches, displays, keypads, and other similar items used for control, adjustments or monitoring) shall be mounted on the non-energized side of enclosure door(s) in such a way as to be accessible without exposing the user to energized parts.

2.2 RATINGS

A. All Control Panels shall have short circuit current ratings at least equal to the lesser of the following, unless noted otherwise on plans:
   1. The short circuit current rating of the electrical distribution equipment that feeds the Control Panel.
   2. 150% of the available fault current at the Control Panel as determined by a Short Circuit Current study prepared by a licensed professional electrical engineer.

B. All equipment/devices installed within control panels shall be rated to operate in ambient temperatures of 50 degrees C (122 degrees F) or higher.

2.3 ENCLOSURES

A. All enclosures (with any required accessories or auxiliary items) shall fit within the space shown on the Plans. Any costs associated with furnishing equipment which exceeds the available space shall be borne by the Contractor.

B. Enclosures (with any required accessories or auxiliary items) shall be suitable for the environment where installed.

C. Enclosure materials shall be as follows unless noted otherwise:
   1. Control Stations:
      a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
      b. Where located in other wet, process or outdoor areas: NEMA 4X of type 304 stainless steel construction (with stainless steel hardware).
      c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 of die cast zinc/aluminum construction.
   2. Control Panels:
      a. Where located in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.): NEMA 4X of non-metallic construction (with non-metallic hardware) compatible with the associated chemical(s).
      b. Where located in other wet, process or outdoor areas: NEMA 4X of type 316 stainless steel construction (with stainless steel hardware).
      c. Where located in dry, non-process, indoor areas (such as electrical rooms): NEMA 1 or 12.

D. Control Panel Enclosure Construction:
   1. Non-metallic control panel enclosure material, where specified, shall be reinforced polyester resin or equivalent, with a minimum thickness of 3/16 inch for all surfaces except those requiring reinforcement. Panels shall be precision molded to form a one piece unit with all corners rounded. Exterior surfaces shall be gel-coated to provide a corrosion-resistant maintenance-free satin finish which shall never need painting. Color pigments shall be molded into the resin. Color shall be grey.
   2. Metallic control panel enclosures, where specified, shall be fabricated using a minimum of 14 gauge steel for wall or frame mounted enclosures and a minimum of 12 gauge for freestanding enclosures. Continuously weld all exterior seams and grind smooth. Reinforce sheet steel with steel angles where necessary support equipment and ensure rigidity and preclude resonant vibrations.
   3. Use pan-type construction for doors.
   4. Door widths shall not exceed 36-inches.
   5. Mount doors with full length, heavy duty piano hinge with hinge pins.
   6. Provide gasket completely around each door opening.
   7. Mount and secure all internal components to removable back plate assembly.
   8. For NEMA 1 or 12 enclosures, provide handle-operated key-lockable three point stainless steel latching system for each door.
   9. For NEMA 4X enclosures, provide provisions for padlocking all doors and provide clamps on three (3) sides of each door.

E. Control panel enclosures (and associated backpanels and other similar accessories) shall be manufactured by Hoffman Engineering Co., or Saginaw Control & Engineering.

2.4 CONTROL PANEL ACCESSORIES:

A. Cooling systems shall be provided if so required by the application to maintain temperatures within the acceptable ranges of the interior equipment. In no case (regardless of temperature ratings of internal equipment) shall maximum temperatures within control panels be allowed to exceed 50 degrees C (122 degrees F). Thermostats shall be provided to control cooling without need of manual operation. Thermostat setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Cooling units shall be as manufactured by Hoffman Engineering Co., Rittal or approved equal and shall be thermostatically controlled.

B. Space heaters shall be provided for condensation and temperature control. Thermostats AND hygrostats (or combination hygrotherm controllers) shall be provided to control heating requirements (based on temperature and relative humidity within enclosure) without need of manual operation. Setpoints shall be as per recommendations of the equipment suppliers. See above for thermal calculation requirements. Space heaters and associated control devices shall be as manufactured by Hoffman Engineering Co., Rittal, Stego or approved equal.

C. NEMA 4X control panels shall be provided with vapor-phase corrosion inhibitor(s) (chemical combinations that vaporize and condense on all surfaces in the enclosed area, to protect metal surfaces/devices within the enclosed area from corrosion). Corrosion inhibitor shall be Hoffman #AHCI series (sized as required by the enclosure volume to be protected) or equal.

D. For outdoor panels, stainless steel solar shields for front, top and each side of panel, supported to associated panel face with standoffs as required (to allow free air flow between solar shield and panel enclosure), shall be provided where required to limit solar loading on panel to allow use of a ventilated panel design rather than an air-conditioned panel design.

E. Provide a sun shield over all LCD displays in exterior-mounted panels. Sun shield shall be collapsible to fully protect LCD display from UV light when not in use, shall provide side and top shielding when in use, shall be constructed of stainless steel and shall be installed such as to maintain NEMA 4X ratings of enclosures.

F. Provide a clear polycarbonate gasketted hinged door or window to encompass all indicators, controllers, recorders, etc. mounted on NEMA 4 and 4X enclosures.

G. Provide interior mounting panels and shelves constructed of minimum 12 gauge steel with white enamel finish. Provide metal print pocket with white enamel finish on inside of door.

H. Provide interior LED light kit, mounted at top of interior of panel, and switched to turn “ON” when door is opened for the following control panels:
   1. Control panels with outer dimensions greater than 20” wide or 30” high.

2. Control panels containing PLCs or other similar programmable devices.

I. Control panels containing VFDs or Reduced Voltage Soft Starters shall include a door mounted digital keypad for adjusting the starter parameters and viewing process values and viewing the motor and starter statuses without opening the enclosure deadfront door.

2.5 CONTROL COMPONENTS

A. General:
1. All pushbuttons, pilot lights, selector switches and other control devices shall be separate, standard size (full 30mm) and shape, heavy duty oil-tight units.
   a. Devices in extremely corrosive areas (chlorine rooms, fluoride rooms, etc.) shall be of non-metallic construction.
   b. Devices in other areas shall be of chrome-plated construction.
2. All components and devices so that connection can be easily made and so there is ample room for servicing each item.
3. Door-mounted indicators, recorders, totalizers and controllers shall be located between 48” and 72” above finished floor level.
4. Door-mounted indicator lights, selector switches and pushbuttons shall be located between 36” and 80” above finished floor level.
5. All devices and components shall be adequately supported to prevent movement. Mounting strips shall be used to mount relays, timers and other devices suitable for this type of mounting.

B. Pilot Lights:
1. All pilot lights to be cluster LED type & push to test.

C. Pushbuttons:
1. All STOP operators within control stations located at equipment shall be provided with lockout provisions and a minimum of two (2) sets of contact blocks.
2. Emergency shutoff pushbutton devices shall be as follows unless noted otherwise:
   a. 2 ¼” diameter, mushroom-style, maintained contact push buttons
   b. With a minimum of one (1) normally open dry contact and three normally closed dry contacts.
   c. Connections made such that pushing “in” the button will shutoff the associated equipment.
   d. Provided with a red engraved nameplate with ½” lettering to read “Emergency Shutoff”.

D. Relays:
1. Control relays shall have the following characteristics, unless noted otherwise:
   a. General purpose, plug-in type.
   b. Minimum mechanical life of 10 million operations.
   c. Coil voltage as indicated or required by application.
   d. Single-break contacts rated 12 amperes, resistive at 240 volts.
   e. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each individual relay

shall have 3PDT contacts. Where required, multiple control relays shall be provided (to provide the required quantities of contacts) for each "relay" function shown on plans/diagrams.

f. Furnished with RC transient suppressor to suppress coil-generated transients to 200% of peak voltage.
g. LED on/off indicator light and manual operator.
h. Industry standard wiring and pin terminal arrangements.
i. Equal to Square D 8501KP series with matching plug-in socket.

2. Interposing/isolation relays used to isolate discrete output field wiring (and where required for voltage translation for other discrete signals) to/from PLC inputs/outputs shall be terminal-block style. Terminal-block style relays shall have the following characteristics, unless noted otherwise:
   a. Minimum mechanical life of 10 million operations.
   b. Single-break contacts rated 6 amperes, resistive at 120 volts.
   c. One (1) N.O. contact per relay.
   d. Furnished with integral transient protection.
   e. LED on/off indicator light.
   f. DIN-rail mounted.
   g. Equal to Square D type Zelio RSL.
3. Timer relays shall be electronic, adjustable plug-in devices meeting the following characteristics, unless noted otherwise:
   a. General purpose, plug-in type.
   b. Minimum mechanical life of 10 million operations.
   c. Single-break contacts rated 10 amperes, resistive at 240 volts.
   d. Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each relay shall have DPDT contacts (2 N.O. & 2N.C.). Where required, multiple timer or control relays shall be provided (to provide the required quantities of contacts) for each "relay" function shown on plans/diagrams.
   e. Rotary-thumbwheel adjustments for time value, timing range and function.
   f. Time value adjustments from .05 seconds to 999 hours
   g. Selectable Timing Functions, including the following:
      1) On Delay
      2) Interval
      3) Off Delay
      4) One Shot
      5) Repeat Cycle-Off
      6) Repeat Cycle-On
      7) On/Off Delay
      8) One Shot Falling Edge
      9) Watchdog
      10) Trigger On Delay
   h. Accuracy shall be $\pm$ 2% and repeatability shall be $\pm$ 0.1%.
   i. Furnished with integral transient protection.
   j. LED indicator light(s) for "timing" and "on/off status"
   k. Held in place with hold-down spring
   l. Equal to Square D type JCK with matching plug-in socket.

2.6 CONFORMAL COATINGS

A. All printed circuit boards within electronic devices (PLCs, RTUs, controllers, I/O modules, power supplies, touchscreens, Ethernet switches, radios, etc.) installed in panels located in non-conditioned or exterior/process areas shall be conformal-coated for harsh environments.

2.7 DC POWER SUPPLIES

A. DC Power supplies shall be provided where specified elsewhere, or as required by design of system. Power supplies shall be industrial type, AC-to-DC switching, output voltage as required, 120vac input, size as required for the initial application plus 50% spare capacity.

B. Redundant power supplies with diode isolation shall be provided so that the loss of one power supply does not affect system operation. The back-up supply systems shall be designed so that either the primary or the back-up supply can be removed, repaired, and returned to service without disrupting the system operation.

C. Power supply output shall be protected by secondary overcurrent protection device(s).

D. The power distribution from multiloop supplies shall be selectively fused so that a fault in one instrument loop will be isolated from the other loops being fed from the same supply.

E. Each power supply shall meet the following requirements.
   1. Regulation, line: 0.4% for input from 105 to 132vac.
   2. Regulation, load: 0.8%
   3. Ripple/Noise: 15mV RMS / 200 mV peak to peak
   4. Operating temperature range: 0 deg C - 60 deg C
   5. Overvoltage protection
   6. Overload Protection
   7. Output shall remain within regulation limits for a least 16ms after loss of AC power at full load.
   8. Output status indicator.
   9. UL listing

F. Power supplies shall be manufactured by Puls, Sola, Phoenix Contact or equal.

2.8 UNINTERRUPTIBLE POWER SUPPLIES

A. Uninterruptible power supplies (UPSs) shall be provided where specified elsewhere, or as required by design of system. Power supplies shall be industrial type, size as required for the initial application plus 50% spare capacity unless noted otherwise.

B. Battery runtime shall be as specified elsewhere. If no other specification for battery runtime is specified, battery runtime shall be 12.5 minutes at full load.

C. UPSs shall be double-conversion, on-line type.

D. UPSs shall be rated for operation in -20 degrees C to 55 degrees C ambient temperatures.

E. UPS batteries shall be hot-swappable and 12-year rated when installed in 25 degrees C environment and 4-year rated when installed in 50 degrees C environment.

F. UPSs shall include dry contacts for the following alarm points:
   1. Loss of Input Power Alarm
   2. Low Battery Alarm

G. UPSs shall be manufactured by Falcon UPS or approved equal.

2.9 DISCONNECTS

A. A main disconnect switch or circuit breaker shall be supplied integral to all control panels. The main disconnect or circuit breaker shall be accessible/operable without exposing the operator to energized sections of the control panel(s), and shall be lockable in the open/off position.

B. Individual circuit breakers shall be provided integral to the manufactured control panel for each separate power circuit originating within the control panel.

C. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated (or can be adjusted to is 1200A or higher, breakers shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.

D. Manufacturers:
   1. Square 'D' or Cutler Hammer.

2.10 COMBINATION STARTERS

A. All combination starters shall utilize a unit disconnect. Magnetic starters shall be furnished in all combination starter units unless specifically shown otherwise. All starters shall utilize full NEMA/EEMAC rated contactors (size 1 minimum).

B. Starters shall be provided with a three-pole, external (door mounted) manual reset, solid state overload relay. Solid state overload relay shall have switch-selectable trip class and shall provide protection from:
   1. Overload.
   2. Phase Unbalance.
   3. Phase Loss.
   4. Ground Fault (Class II detection).

C. Unless specifically shown otherwise, each combination starter or each group of starters shall be furnished with a control circuit transformer including two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads (including motor space heaters and other similar loads where specified). The

transformer rating shall be fully visible from the front when the unit door is opened. Unless otherwise indicated, control voltage shall be 120V AC. Control power shall be provided by individual unit control power transformers.

D. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.

E. Auxiliary control circuit interlocks shall be provided where indicated. Auxiliary interlocks shall be field convertible to normally open or normally closed operation.

F. NEMA/EEMAC Size 1-4 starters shall be mounted directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger starters shall be arranged so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.

G. Each starter shall be equipped with a minimum of the following control devices:
   1. Door-mounted reset button.
   2. Two (2) field-reversible (N.O./N.C.) auxiliary contacts
   3. For reversing and two-speed starters: Four (4) field-reversible (N.O./N.C.) auxiliary contacts
   4. Additional control devices as indicated on plans.

H. Control Wiring Terminal Blocks
   1. Terminal blocks shall generally be:
      a. Feed-thru, screw-in type
      b. DIN rail mounted
      c. Furnished with the stationary portion of the block secured to the unit bottom plate
      d. Furnished with unit-mounted control terminal blocks for each field wire.
      e. Rated for the voltage and current of the proposed application per UL/NEC standards.
      f. Sized (by supplier) for the associated wire gauges/types/quantities.
      g. Phoenix Contact UT-4 series, Weidmuller WDU-4 series (or equivalent) unless required otherwise by application.

I. Nameplates
   1. Each unit shall be properly labeled with an engraved phenolic nameplate with a white background and black letters.
   2. Each pilot device shall be properly labeled with a legend plate or an engraved phenolic nameplate.

J. Manufacturers:
   1. Square 'D' or Cutler Hammer.

2.11 WIRING

A. Refer to Section 26 05 19 for all wiring types/applications.

B. All wiring shall be identified on each end with hot stamped, shrink tube type, or self-laminating vinyl permanent wire markers to correspond with numbering shown on wiring diagrams.

C. All connections shall be made on terminals with no splices.

D. All wiring runs shall be along horizontal or vertical routes to present a neat appearance. Angled runs will not be acceptable. Group or bundle parallel runs of wire in plastic wire duct where practical.

E. All wiring runs shall be securely fastened to the panel or wire duct by means of plastic wire ties. Adequately support and restrain all wire runs to prevent sagging or movement.

F. AC power wiring and instrumentation/analog wiring shall be run separate.

G. Color code all internal wiring (not field wiring) as follows:
   1. Line and load circuits: Black (B)
   2. AC control wiring: Red (R)
   3. Externally-Powered control wiring: Yellow (Y)
   4. Neutral wiring: White (W)
   5. Low voltage DC(+)pos: Blue (BL)
   6. Low voltage DC(-)neg: Blue/White Tracer (BL/W)
   7. Grounding: Green (G)

H. Terminal strips shall be provided for all input and output wiring. No more than two (2) wires shall be connected to one (1) terminal block.

2.12 ELECTRICAL SURGE AND TRANSIENT PROTECTION

A. General
   1. Function: Protect the system against damage due to electrical surges.

B. Application: As a minimum, provide surge and transient protection (with proper grounding) at the following locations as described below:
   1. Power Input High Frequency Noise Filtering:
      a. 120VAC Control panels with integral UPSs, PLCs, or other electronic/microprocessor equipment that is susceptible to failure or improper operation due to high frequency/harmonic input transients shall be provided with series-connected high-frequency noise filters on the line input (downstream of any panel main disconnects/breakers). Filters shall be as manufactured by Edco/Emerson/Islatrol or equal (exact type(s) as required by application).
   2. Power Input Surge Protection:
      a. Provide surge protection device at any connection of 120VAC power to panels containing programmable logic controllers, remote I/O equipment, UPS's, transmitters, radios, VFDs, Reduced Voltage Soft Starters or other electronic equipment. Device shall:
         1) Be mounted internal to the associated panel, with dedicated overcurrent protection.

2) Be of two-part (base and SPD), DIN-rail mountable construction.
3) Have 15kA total nominal discharge current per line (based on 8/20µs waveform).
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated circuit voltage.
5) Visually indicate operational status.
6) Be Dehn DEHNguard series or equal by MTL Technologies, or may be combined with the High Freqency Noise Filtering device required above.

b. Provide surge protection device at any connection of multi-pole AC power to panels containing programmable logic controllers, remote I/O equipment, UPS's, transmitters, radios, VFDs, Reduced Voltage Soft Starters or other electronic equipment. Device shall:
1) Be mounted internal to the associated panel, with dedicated overcurrent protection.
2) Provide protection for all phases.
3) Have 40kA (per phase) peak surge current rating.
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated circuit voltage.
5) Visually indicate operational status.
6) Be Square D SDSA or HWA series or equal.

3. Analog I/O Panel Terminations Surge Protection:
a. Provide surge protection device at the PLC (or similar) panel connection of each analog I/O signal. Device shall:
1) Be mounted internal to the associated panel.
2) Be of two-part (base and SPD), DIN-rail mountable construction.
3) Have 10kA total nominal discharge current per line (based on 8/20µs waveform).
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated signal.
5) Be Dehn Blitzductor XT series or equal by MTL Technologies.

4. Discrete I/O Panel Terminations Surge Protection:
a. Provide isolation relay at the PLC (or similar) panel connection of each discrete output signal (within the associated panel). See above for isolation relay requirements.

5. Low Voltage Power Supply Load Side Surge Protection:
a. Provide surge protection device at the PLC (or similar) panel on the load side of each low voltage power supply that has low voltage connections extending external to the panel. Device shall:
1) Be mounted internal to the associated panel.
2) Be of two-part (base and SPD), DIN-rail mountable construction.
3) Have 10kA total nominal discharge current per line (based on 8/20µs waveform).
4) Have maximum continuous operating voltage (MCOV) rating as required by the associated utilization voltage.
5) Be as manufactured by Dehn, MTL Technologies, or Phoenix Contact.

6. Network Panel Terminations Surge Protection:
a. Provide surge protection device at the PLC (or similar) panel connection of each network cable. Device shall:

1) Be mounted internal to the associated panel.
2) Be of DIN-rail mountable construction.
3) Have 1kA total nominal discharge current per line (based on 8/20µs waveform).
4) Be designed specifically for the associated network connection type (Ethernet, RS485, RS232, etc.).
5) Be MTL Zonebarrier series or equal.

7. Antenna Cable Terminations Surge Protection:
   a. Provide surge protection device at the connection of antenna cable to the radio panel. Device shall:
      1) Be mounted internal to the associated panel.
      2) Provide coarse protection via replaceable gas-filled surge voltage arrestor
      3) Be Phoenix Contact 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 INSTALLATION

A. Provide enclosure mounting supports as required for floor, frame or wall mounting. All supports in exterior, wet or process areas shall be stainless steel unless noted otherwise. All floor-mounted panels or other similar distribution equipment shall be mounted on 6" concrete housekeeping pads unless specifically shown otherwise.

B. All enclosures used outside shall be solid bottom unless otherwise specified. All cable and piping openings shall be sealed watertight. Cable and piping shall enter the enclosure as shown on drawings or specified herein.

C. All equipment and components shall be solidly grounded to the control panel. One grounded terminal unit shall be provided in each control panel for connection to plant ground system. Grounding digital and analog components shall be performed in accordance with the instrument supplier's installation recommendations. Signal ground shall be solidly connected to the ground system so as to prevent ground loops

3.2 PAINTING

A. For enclosures other than NEMA 4X stainless steel or fiberglass:
   1. Completely clean all surfaces so that they are free of corrosive residue. Then, phosphatize all surfaces for corrosion protection.
   2. Prime with two (2) coats and finish with one coat of factory finish textured polyurethane. Paint shall be Sherwin-Williams Polane "T' or approved equal.
   3. Color to be selected during shop drawing review phase.

3.3 IDENTIFICATION & DOCUMENTATION

A. Refer to specification section 26 05 53 for additional requirements.

B. Control panel power supply source, type, voltage, number or circuit ratings shall be identified inside control panels and on drawings.

C. All interior devices and components shall be identified with thermal transfer labels with black letters on white background. Labels shall be placed on the subpanel and not the component. Marking system shall be a Brother “PTouch II” or equal. Lettering shall be 1/4" high.

D. All front panel mounted devices such as push buttons shall be identified by the use of engraved bakelite nameplates or legend plates. Nameplates shall be 1/8” thick, white with black core.

E. Where a panel includes a PLC or other network-connected device that is intended to be connected to another system (such as a plant SCADA system) via a network connection, the panel supplier shall provide an Interface Control Document (ICD) to the other system supplier (such as the SCADA Integrator). This document shall itemize the following for each networked parameter that is capable of being monitored or controlled by the other system:
   1. Parameter Name/Function (ex: Pump No. 1 On/Off Status)
   2. Parameter Type (discrete or analog, input or output)
   3. Parameter register ID/location

F. Where a panel includes a touchscreen or other programmable HMI display and is to be monitored by another system (such as a plant SCADA system), the panel supplier shall provide copies of the HMI display code and screenshots of all proposed HMI screens to the other system supplier (such as the SCADA Integrator) for their use in duplicating the associated HMI.

G. A job-specific, custom wiring diagram for each control panel (not including control stations without relays) shall be provided to the contractor prior to installation for making the appropriate electrical connections. The wiring diagram shall clearly show all control components connected to the panel (whether the components are mounted internal or external to the enclosure). All wires and terminal blocks shall be clearly labeled. A laminated copy of the final wiring diagram for each unit shall be installed inside the door of the associated panel, and submitted to the owner with the as-built documentation.

3.4 OWNER TRAINING

A. Fully train the owner in the proper operation of all control panels/equipment, describing and demonstrating full operation, including function of each door-mounted device.

3.5 SPARE EQUIPMENT

A. Provide the following spare equipment:
   1. Fuses: 10% (minimum of 3) of each size and type utilized, mounted within a pocket within the associated control panel.
   2. Where control panel contains programmable controller (or similar equipment): Flash drive containing copies of all final programs utilized within the control panel,

with provisions/cable assemblies as required to connect the flash drive provided to the controller to download the programs. Flash drive shall be attached to retractable cord (long enough to reach the associated port) attached to the inside of the panel door.

END OF SECTION 26 29 00

SECTION 26 29 01 – TRAVELING BRIDGE FILTER MUDWELL PS CONTROL PANEL

PART 1 - GENERAL

1.1 SCOPE

A. This section describes the requirements for the new Traveling Bridge Filter Mudwell Pump Station Control Panel, and associated float switches. The associated existing pumps are existing. The supplier & contractor shall field-verify the existing pump provisions/requirements prior to bid. Specifications herein are intended as an extension of requirements in other Divisions of these specifications where reference is made to Electrical Specifications.

B. Refer to Specification Section 26 29 00 (“Manufactured Control Panels”) for additional control panel requirements. This specification section (26 29 01) is intended to summarize requirements that are unique to this panel only.

PART 2 - PRODUCTS

2.1 CONTROL PANEL

A. The Contractor shall furnish and install one duplex automatic, prewired pump control panel suitable for voltage shown on the drawings, 3 phase, 60 hertz, 3 wire (plus ground) power supply. It is the intention that this specification shall cover a complete two pump sanitary sewer lift station control system as hereinafter described and all necessary appurtenances which might normally be considered a part of the complete control system for this installation. The pump control panel provided shall utilize relay logic. This pump control panel shall be designed by the panel manufacturer to automatically operate the pumps as described herein. The pumps shall operate in a specified sequence, in response to variations in the liquid level.

B. The enclosure shall meet the requirements of NEMA construction, type 4X stainless-steel enclosure generously sized by panel manufacturer and designed specifically for mounting in direct sunlight. It shall have a gasketed, hinged, front door(s) with locking capability, all with three-point latches (no clamps allowed) and a locking hasp. The panel shall have an effective sunshield. All components necessary for standard operation of control panel shall be mounted on an interior dead front door of the panel so that all components normally actuated by operating personnel are accessible once exterior panel door is opened. A dead front plate shall be installed inside the outer door such that the circuit breaker handles, switches, lights and overload resets are easily accessible to the operator when the outer door is opened. The dead front plate shall be hinged to provide access to the interior components for service.

C. The panel shall have a main breaker, separate breakers for each pump, and a breaker for the control transformer.

D. For each existing 5HP-460V-3phase pump motor (HP/V/phase to be field-verified by contractor prior to bid), there shall be included an across-the-line NEMA-rated combination motor starter (with breaker-style MCP overload protection); and 120-volt control circuitry. Control circuitry shall consist of simple relay logic. A programmable

controller/relay is not acceptable. An automatic electric pump alternator for duplex stations shall be provided, providing alternating operation of pumps under normal conditions, or in case of high level, allowing both pumps to operate simultaneously. A terminal board for connection of level sensors shall be provided.

E. Provide the following additional inner deadfront-door-mounted devices:
   1. Elapsed time meters (for each pump as well as a third ETM for both pumps in simultaneous operation)
   2. Maintained-contact Hand/Off/Auto selector switch (for each pump)
   3. Momentary-contact Alarm Reset pushbutton (for each pump)
   4. Momentary-contact START pushbutton (for each pump)
   5. Momentary-contact STOP pushbutton (for each pump)
   6. GREEN pump run lights (for each pump)
   7. RED pump off lights (for each pump)
   8. AMBER pump fail overload alarm lights (for each pump)
   9. AMBER pump overtemp alarm lights (for each pump)
   10. AMBER pump leakage alarm lights (for each pump)

F. Provide the following features:
   1. Provide a phase failure relay to indicate improper power or loss of power.
   2. Provide 120VAC control power transformer.
   3. Provide timers to prevent immediate pump restart when power to the panel is transferred or restored, etc.
   4. Provide alarm and relay monitoring of remote-mounted submersible motor overtemp/leakage sensors/relays for each pump. There shall be provision on the dead front panel to bypass these sensors to allow for emergency operation.
   5. Provisions to monitor remote momentary-contact START and LOCK-OUT STOP pushbuttons at pump area (one control station per pump, START PB shall be active if H/O/A selector switch is in HAND position, STOP PB shall be active regardless of position of H/O/A selector switch).
   6. Provisions to monitor four (4) n.o. float switches (OFF, LEAD ON, LAG OFF, HIGH LEVEL ALARM) for station control. Provide intrinsically safe barriers and any associated components for all floats.

G. Provide output contacts for SCADA use for the following conditions:
   1. General Alarm
   2. Loss of Power (these contacts shall close even if the power is not available)
   3. HWL Level (these contacts shall close on HWL even if the power is not available)
   4. Pump 1 Running
   5. Pump 2 Running
   6. Pump 1 Fail (due to overload, overtemp, or leakage)
   7. Pump 2 Fail (due to overload, overtemp, or leakage)

H. The alarm circuit shall activate a high intensity flashing alarm light mounted on top of the enclosure. Capability shall be provided to allow the operator to select whether the lamp requires manual reset or whether it automatically resets when the HWL condition is corrected.

2.2 INSTRUMENTS:

A. Provide four (4) Teflon-coated stainless steel n.o. float switches within the existing wetwell for pump station level monitoring/control. These float switches shall be furnished by the control panel supplier, but shall meet all applicable requirements of specification section 27 60 05 (“SCADA Instrumentation”).

PART 3 - EXECUTION

3.1 GENERAL

A. See specification section 26 29 00.

B. The panel manufacturer shall perform a Functional Acceptance Test and this test shall be witnessed approved by the owner and engineer.

END OF SECTION 26 29 01

SECTION 26 29 23 – VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This section provides specification requirements for adjustable frequency drives, variable speed drives or herein identified as VFD's.

B. The manufacturer shall furnish, field test, adjust and certify all installed VFD's for satisfactory operation.

C. Any exceptions or deviations to this specification shall be indicated in writing and submitted to the engineer for approval a minimum of ten (10) days prior to bid.

1.2 REFERENCES

A. ANSI®/NFPA® 70 - National Electrical Code® (NEC®)

B. CSA® C22.2 No. 14-M91 - Industrial Control Equipment

C. IEC 61000 - Electromagnetic Compatibility

D. NEMA 250 Enclosures for Electrical Equipment

E. NEMA ICS7 - Industrial Control and Systems Adjustable Speed Drives

F. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Speed Drives

G. UL® 50 – Enclosures for Electrical Equipment

H. UL 98 – Disconnect Switches

I. UL 507 – Electric Fans

J. UL 508 – Industrial Control Equipment

K. UL 508C – Power Conversion Equipment

L. UL 991 – Safety Tests for Safety Related Controls employing Solid State Devices

M. OSHA® 1910.95 – VFD Controller Acoustical Noise

1.3 QUALITY ASSURANCE

A. The manufacturer of the VFD shall be a certified ISO 9001 facility.

B. The VFD and all associated optional equipment shall be UL Listed according to UL508C Power Conversion Equipment. A UL label shall be attached inside each enclosure as verification.

C. The VFD shall be designed constructed and tested in accordance with UL, CSA, NEMA and NEC standards.

D. Quality Assurance documentation shall be furnished to verify successful completion upon written request of the engineer.

1.4 SUBMITTALS

A. Submittals shall be furnished in accordance with Specification Section 26 05 00.

B. Provide the following for each VFD:
   1. A job-specific, custom wiring diagram
      a. The wiring diagram shall clearly show all control components connected to the starter (whether the components are mounted internal or external to the VFD 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. Enclosure frontal elevation and dimension drawings.
   4. Internal component layout diagrams.
   5. Available conduit entry and exit locations.
   6. Manufacturer's product data sheets for all components.

C. Standard catalog sheets showing voltage, horsepower, maximum current ratings and recommended replacement parts with part numbers shall be furnished for each different horsepower rated VFD shall be provided.

1.5 WARRANTY

A. An 18-month parts warranty shall be provided on materials and workmanship from the date of owner acceptance/substantial completion after completion of startup.

PART 2 - PRODUCT

2.1 MANUFACTURERS

A. The VFD equipment shall be:
   1. Square 'D' or Cutler Hammer.
   2. Or pre-approved equal meeting the detailed requirements of this specification. Note that all "named" Manufacturers are obligated to meet the detailed requirements of this specification. Any proposed exceptions shall be clearly stated at bid time, citing the reason for noncompliance, and the cost for providing a conforming product. Failure to provide a detailed list of proposed exceptions may cause a bid to be deemed non-responsive. The Engineer will be the sole determiner of the acceptability of a proposed exception.

B. Alternate control techniques other than pulse width modulated (PWM) are not acceptable.

2.2 GENERAL DESCRIPTION

A. The VFD shall convert the input AC mains power to an adjustable frequency and voltage as defined below and indicated on the drawings or motor control schedules.
   1. Where not specified otherwise, the VFD manufacturer shall use a 6-Pulse bridge rectifier design with line reactors for effective harmonic mitigation. The diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage. The power section shall be insensitive to phase rotation of the AC line. The line reactor ratings shall be as follows, unless specified otherwise:
      a. For drives without DC link chokes: 5% line reactor.
      b. For drives with DC link chokes: 3% line reactor.
   2. Where so specified on contract drawings, the VFD manufacturer shall supply a Low Harmonic Active-Front-End drive design equal to Square D Altivar ATV680, with the following characteristics:
      a. The VFD shall be a 3-level Active Front End (AFE) AC drive that is designed to comply with standard IEEE 519-2014 when installed in a system that is already in compliance with the standard. A 3-level design shall be used to provide a low harmonic current load to the power system and to avoid introducing additional common mode noise to the motor. Passive harmonic filters shall be acceptable for motors less then 150hp in size provided the TDD is shown to be less than limits established by IEE 519-2014. The 2-level type design shall not be acceptable due to the additional common mode noise output from the VFD to the motor. Input THDi of less than 5% at 80% load.
      b. “Stop and Go” function to de-energize active front end while not in use to reduce energy consumption and to provide isolation in standby mode
      c. Embedded power measurement and energy dashboard
      d. Performance Drift Monitoring
      e. The power section shall be insensitive to phase rotation of the AC line.

B. The output power section shall convert fixed DC voltage to adjustable frequency AC voltage. This section shall use insulated gate bipolar transistors (IGBT) or intelligent power modules (IPM) as required by the current rating of the motor.

C. The VFD shall be furnished with a long lead motor protection RCL filter system to reduce peak voltage spike conditions at the motor terminals. Filters shall be MTE Series A dV/dT Filters, TCI V1K filter or equal, with amperage rating equal to, or exceeding, that of the corresponding VFD. The exact filter type and ratings shall be selected to coordinate with the proposed VFD and the associated frequency range.

2.3 CONSTRUCTION

A. Refer to Specification Section 26 24 19 (Motor Control Centers) or Specification Section 26 29 00 (Manufactured Control Panels) as applicable for additional requirements (for enclosure, component types, etc.).

B. The VFD shall be provided complete with a main circuit breaker disconnect means for Type 1 short circuit overcurrent protection as follows:

1. Short circuit withstand rating shall be equal to or greater than the AIC rating listed on the plans for the distribution equipment (motor control center, panelboard, switchboard, etc.) that feeds the VFD.
2. Where the VFD installed within a motor control center, refer to Motor Control Centers Specification Section 26 24 19.
3. Sized by manufacturer per NEC requirements for corresponding motor load.

C. A mechanical interlock shall prevent an operator from opening the VFD door when the disconnect is in the on position. Another mechanical interlock shall prevent an operator from placing the disconnect in the on position while the VFD door is open. It shall be possible for authorized personnel to defeat these interlocks.

D. Provisions shall be provided for locking all disconnects in the off position with up to three padlocks.

E. Provisions shall be made for accepting a padlock to lock the enclosure door.

F. A seismic qualification label shall be provided for all wall and floor mount units to comply with the latest IBC and NFPA 5000 guidelines.

2.4 MOTOR DATA

A. Each VFD shall be sized to operate the AC motors defined to match load schedules and other specification documents as follows:
1. Motor Horsepower and voltage rating(s) – See electrical drawings and schedules.
2. Minimum full load amperage rating of VFD – See electrical drawings and schedules.
3. Motor full load amperes, RPM and service factor ratings - See individual motor specification documents.

B. The VFD manufacturer shall be responsible for verifying each exact motor amperage, horsepower, voltage, RPM and service factor with motor equipment supplier prior to submitting shop drawings.

2.5 APPLICATION DATA

A. The VFD shall be sized to operate either a Variable Torque or Constant Torque load (unless specifically stated otherwise on drawings). The exact load type shall be as determined by the motor supplier and shall be coordinated by the VFD supplier prior to submitting shop drawings.

B. The speed range shall be from a minimum speed of 0.1Hertz to a maximum speed of 60 Hertz.

2.6 ENVIRONMENTAL RATINGS

A. The VFD shall meet IEC 60664-1 and NEMA ICS-1 Annex A standards.

B. The VFD itself shall be designed to operate without derating in an ambient temperature from 0 to + 40 degrees C (+32 to 104 degrees F). Where temperatures exceed these

limitations, the VFD manufacturer shall properly derate the unit as required and shall clearly submit this derating calculation with the submittal package. See Specification Section 26 24 19 (Motor Control Centers) or Specification Section 26 29 00 (Manufactured Control Panels) as applicable for additional requirements (for thermal controls required within VFD outer enclosures).

C. The storage temperature range shall be -25 to +65 degrees C (-13 to +149 degrees F).

D. The maximum relative humidity shall be 95 percent at 40 degrees C non-condensing or dripping water conforming to IEC 60068-2-3.

E. The VFD shall be rated to operate at altitudes less than or equal to 3,300 feet (1000 meters) without derating. For altitudes above 3,300 feet, de-rating factors shall apply by the manufacturer.

F. The VFD shall conform to IEC 600721-3-3-3M3 amplitude for Operational Vibration Specifications.

2.7 ELECTRICAL RATINGS

A. The VFD shall be designed to operate from the rated input voltage plus or minus 10 percent.

B. The VFD shall operate from an input voltage frequency range of 57 to 63 Hertz.

C. The displacement power factor shall not be less than 0.95 lagging under any speed or load condition.

D. The efficiency of the VFD at 100 percent speed and load shall not be less than 96 percent.

E. The VFD unit amperage shall be the greater of the following:
   1. 110% of the NEC amperage rating associated with the horsepower rating shown on the plans (for constant torque loads).
   2. 100% of the unit amperage rating shown on the plans (for constant torque loads).

F. The rated VFD overcurrent capacity shall be 150 percent of the constant torque rating (or 110 percent of the variable torque rating where applicable) for one minute.

G. The VFD shall have a coordinated short circuit rating equal to or in excess of the minimum value listed on the piece of distribution equipment that feeds the VFD. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. This rating shall be listed on the nameplate.

H. The output carrier frequency of the VFD shall be randomly modulated depending on Drive rating for low noise operation. No VFD with an operable carrier frequency above 10 kHz shall be allowed.

I. The output frequency shall be from 0.1 to 200 Hertz.

J. The VFD shall be able to develop rated motor torque at 0.5 Hertz (60 Hertz base) in a sensorless flux vector (SVC) mode using a standard induction motor without an encoder feedback signal.

2.8 PROTECTION

A. Upon power-up shall automatically test for valid operation of memory, option module, loss of analog reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power and the pre-charge circuit.

B. Protection against short circuits, between output phases and ground; and the logic and analog outputs.

C. Minimum AC undervoltage power loss ride-through of 200 milliseconds. The VFD shall have the user-defined option of frequency fold-back to allow motor torque production to continue to increase the duration of the powerloss ride-through.

D. Selectable ride through function that shall allow the logic to maintain control for a minimum of one second without faulting.

E. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function shall provide programmable restart attempts. The programmable time delay before restart attempts shall be unlimited.

F. Deceleration mode programmable for normal and fault conditions. The stop modes shall include free-wheel stop, fast stop and DC injection braking.

G. Upon loss of the analog process follower reference signal, shall fault and/or operate at a user-defined speed set between software programmed low-speed and high-speed settings.

H. Solid state I^2t protection that is UL Listed and meets UL 508C as a Class 10 overload protection and meets IEC 60947. The minimum adjustment range shall be from 20 to 150 percent of the nominal output current rating of the VFD.

I. Thermal switch with a user selectable pre-alarm that shall provide a minimum of 60 seconds delay before overtemperature fault.

J. Use bonded fin heatsink construction for maximum heat transfer.

K. Fold-back function that shall automatically anticipate a controller overload condition and fold back the frequency to avoid a fault condition.

L. The output frequency shall be software enabled to fold back when the motor is overloaded.

M. There shall be three skip frequency ranges with hysteresis adjustment that can each be programmed independently, back to back or overlapping.

2.9 ADJUSTMENTS AND CONFIGURATIONS

A. The VFD shall self-configure to the main operating supply voltage and frequency. No operator adjustments shall be required.

B. Upon power-up, automatically send a signal to the connected motor. The stator resistance data shall be measured at rated current. The VFD shall automatically optimize the operating characteristics according to the stored data.

C. The VFD shall be factory pre-set to operate most common applications.

D. A choice of four types of acceleration and deceleration ramps shall be available in the VFD software; linear, S curve, U curve and custom.

E. The acceleration and deceleration ramp times shall be adjustable from 0.01 to 3,200 seconds.

F. The volts per frequency ratios shall be user selectable to meet variable torque loads, normal and high-torque machine applications.

G. The exact acceleration ramp time/type, current limitation, overload protection type and motor current shall be set in the field by the startup technician prior to equipment startup as recommended/approved by the motor supplier.

H. The memory shall retain and record run status and fault type of the past eight faults.

I. Slip compensation shall be adjustable from 0 to 150%.

J. The software shall have an “Energy Saving” function that shall reduce the voltage to the motor when selected for variable torque loads. A constant volts/Hertz ratio shall be maintained during acceleration. The output voltage shall then automatically adjust to meet the torque requirement of the load.

K. The VFD shall offer programmable DC injection braking that shall brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator. The level of current shall be adjustable between 10 and 110 percent of rated current and available from 0.1 to 30 seconds continuously. For continuous operation after 30 seconds, the current shall be automatically reduced to 50 percent of the nameplate current of the motor.

L. Sequencing logic shall coordinate the engage and release thresholds and time delays for the sequencing of the VFD output, mechanical actuation and DC injection braking in order to accomplish smooth starting and stopping of a mechanical process.

2.10 GRAPHIC TERMINAL DISPLAY INTERFACE

A. The graphic display terminal shall provide 8 lines of 240 by 160 pixels in plain English to control, adjust and configure the VFD. All electrical values, bar charts, configuration parameters, I/O assignments, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics. There shall be a standard selection of six additional languages built-in to the operating software as standard.

B. The VFD model number, torque type, software revision number, horsepower, output current, motor frequency and motor voltage shall all be listed on the drive identification display as viewed on the graphic display terminal.

C. As a minimum the selectable outputs shall consist of speed reference, output frequency, output current, motor torque, output power, output voltage, line voltage, DC voltage, motor thermal state, drive thermal state, elapsed time, motor speed, machine speed reference and machine speed.

D. The graphic display terminal shall consist of programmable function keys. The functions shall allow both operating commands and programming options to be preset by the operator. A hardware selector switch shall allow the graphic display terminal to be locked out from unauthorized personnel.

E. The graphic display terminal shall offer a simply smart to advanced user menu consisting of parameter setting, I/O map, fault history, and drive configuration. A software lock shall limit access to the main menu.

F. The navigation wheel shall provide the ability to scroll through menus and screens, select or activate functions or increase the value of a selected parameter.

G. An escape key shall allow a parameter to return the existing value if adjustment is not required and the value is displayed. The escape function shall also return to a previous menu display.

H. A RUN key and a STOP key shall command a normal starting and stopping as programmed when the VFD is in keypad control mode. The STOP key shall be active in all control modes.

I. A user interface shall be available that is a WINDOWS® based personal computer, serial communication link or detachable graphic terminal display.

J. The keypad and all door mounted controls shall be Type 12 rated.

2.11 CONTROL

A. External pilot devices shall be able to be connected to a terminal strip for starting/stopping the VFD, speed control and displaying operating status. All control inputs and outputs shall be software assignable.

B. 2-wire or 3-wire control strategy shall be defined within the software. 2-wire control allows automatic restart of the VFD without operator intervention after a fault or loss of

power. 3-wire control requires operator intervention to restart the VFD after a fault or loss of power.

C. The internal power supply shall incorporate an automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs shall be current limited and shall not be damaged if shorted or excess current is pulled. See below for external power supply requirements.

D. All logic connections shall be furnished on pull apart terminal strips.

E. There shall be (2) two software assignable analog inputs with interference filtering. The analog inputs shall be software selectable and consisting of user defined configurations: 4-20 mA or 0-10 V.

F. There shall be five software assignable logic inputs that shall be selected and assigned in the software. The selection of assignments shall consist of forward, reverse, jog, plus/minus speed (2 inputs required), setpoint memory, preset speeds (up to 8 inputs), auto/manual control, controlled stop, terminal or keypad control, output contactor when applicable (2 inputs required), motor switching, and fault reset.

G. There shall be a minimum of two (2) software assignable analog outputs with interference filtering (see plans for additional requirements). The analog outputs can be selected and assigned in the software. The analog output assignments shall be proportional to the following motor characteristics: frequency, current, power torque, voltage and thermal state. The output signal shall be user defined configurations: 4-20 mA or 0-10 V.

H. A minimum of two voltage-free Form C relay output contacts shall be provided. One of the contacts shall indicate VFD fault status. The other contact shall be user assignable. Refer to plans for additional requirements.

I. There shall be a hardware input/output extension module available that also provides interlocking and sequencing capabilities. The module shall be fully isolated and housed in a finger-safe enclosure with pull apart terminal strips. The module shall add logic inputs, analog inputs, relay outputs, and analog outputs as required by wiring diagrams shown on plans. All of the I/O shall be user assignable in the software as previously defined.

J. The VFD shall have a control power source from the 120V CPT. When an input isolation contactor is provided, the 120V CPT shall be powered from upstream of the input isolation contactor such that control power to the VFD is maintained when the input isolation contactor is opened.

K. The peripheral VFD control circuitry shall be operated at 120 Vac 60 Hz from a control power transformer included within the enclosure.

L. Operator devices shall be door mounted, functions/types as shown on drawings.

M. All operator devices shall be remote-mounted using supplied 120 Vac control logic. Clearly labeled terminals shall be provided for field installation.

N. All wiring shall be clearly identified on each end to match the wiring diagram(s) provided with the VFD.

O. Refer to Specification Section 26 24 19 (Motor Control Centers) or Specification Section 26 29 00 (Manufactured Control Panels) as applicable for all operator device and control component requirements (for pushbuttons, indicator lights, selector switches, relays, control wiring, etc).

2.12 COMMUNICATIONS

A. The VFD shall be able to be connected to communication network type(s) as indicated on plans or required by the SCADA Integrator (exact network/protocol type(s) required shall be as directed by the facility SCADA Integrator). Where no specific network connections are specified on plans or required by the SCADA Integrator, the VFD shall be provided with at least one of the following network communication options:
   a. Modbus RTU serial
   b. Ethernet TCP/IP
   c. Ethernet IP

B. The communication shall be able to provide access to the control, to the adjustment and to the supervision of the VFD.

C. No additional compensation will be granted to provide gateways, network components, etc. to properly communicate with the facility SCADA system. Equipment supplier is responsible for verifying all network connection requirements with the SCADA Integrator prior to bid.

2.13 INPUT SURGE PROTECTION

A. Each drive that does not have an upstream isolation contactor, and is not mounted within an MCC that has its own main bus surge protection shall be provided with a 3-phase, line-side surge protection device rated 80kA (per phase) or greater. The lead length between the surge protection device and the drive terminals shall be 12” or less. The surge protection device shall be designed / located / isolated such as to prevent / limit potential physical damage to other components within the enclosure if the surge protection device fails.

2.14 BYPASS CONTACTORS/STARTERS

A. Where specifically indicated on the contract drawings, a mechanically and electrically interlocked bypass contactor and bypass starter complete with a solid state overload relay shall be included to provide motor operation in the case of VFD failure. Bypass contactors (which are only used during bypass mode) may be NEMA or IEC rated. Bypass contactors shall fully isolate (on the line side and the load side) the VFD from the bypass starter.

B. Where specifically indicated on the contract drawings, a Reduced Voltage Soft Start bypass starter shall be provided for the emergency bypass mode.

C. Where a bypass is provided, the operator shall have full control of the bypass starter by operation of a VFD/BYPASS selector switch mounted to the front of the starter door.

D. Where a bypass is provided, neither starter shall be powered through the other starter (but each shall be wired to a common set of output terminals). Each starter (primary and bypass) shall have separate overload monitoring that does not cause the other starter to fault.

E. The horsepower/amperage ratings of all bypass starters/contactors shall match that of the proposed drive.

PART 3 - EXECUTION

3.1 TESTING

A. All incoming material shall be inspected and/or tested for conformance to quality assurance specifications.

B. All subassemblies shall be inspected and/or tested for conformance to quality assurance specifications.

C. Each completed unit shall be functionally tested prior to shipment to assure conformance to the specifications.

3.2 DELIVERY, STORAGE AND HANDLING

A. Handling and shipment of the equipment shall be in such a manner to prevent internal component damage, breakage, and denting and scoring of the enclosure finish.

B. Equipment shall be stored indoors in a clean, dry environment as directed by the equipment supplier. Energize anti-condensation space heaters if so required.
   1. Verify that the location is ready to receive work and the dimensions are as indicated.
   2. Do not install VFD equipment until the building environment can be maintained within the service conditions required by the manufacturer.

3.3 INSTALLATION

A. Installation shall comply with manufacturer's instructions, drawings and recommendations.

B. A job-specific, custom wiring diagram for each VFD unit 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 VFD (whether the components are mounted internal or external to the VFD 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 unit.

C. Operations and Maintenance Manuals shall be provided to the owner for all VFD components, control wiring, etc.

D. Operations and Maintenance Manuals shall include hardcopy printouts of all device settings and programming.

E. For safety, reliability, and continuity of warranty, any modifications, alterations, etc. required to conform to the requirements of this specification shall be performed by the VFD manufacturer only. Distributor modifications, third party packaging, etc. of a manufacturer's standard product are specifically disallowed.

3.4 START-UP AND TRAINING

A. The services of a qualified manufacturer's service representative shall be provided to install, test, and start up all VFD's furnished under this specification. The schedule of the startup(s) shall be determined by the contractor.

B. Services shall include a minimum of eight (8) hours of field/classroom training for owner's personnel on routine operation and maintenance of the specified units.

3.5 SPARE PARTS

A. The following spare parts shall be provided at no extra cost to the Owner:
   1. One of each type and size of control fuse.
   2. Three of each type and size of power fuse.

END OF SECTION 26 29 23

SECTION 26 43 00 – SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (<1000 V) power distribution and control equipment.

B. The specified unit(s) shall provide effective high energy transient voltage surge suppression, surge current diversion and high frequency noise attenuation in all electrical modes for equipment connected downstream from the facility's meter or load side of the main overcurrent device. The unit(s) shall be connected in parallel with the facility's wiring system.

C. The unit(s) shall be designed and manufactured in North America by a qualified manufacturer of suppression filter system equipment. The qualified manufacturer shall have been engaged in the commercial design and manufacturer of such products for minimum of ten (10) years.

D. All products that are submitted according to these specification will be required to meet this specification in it's entirety for both service and distribution TVSS systems. Any product that is submitted and does not comply with all parts of this specification will be subject to rejection.

1.3 DEFINITIONS

A. VPR: Voltage Protection Rating.

B. SPD: Surge Protective Device(s)

C. $I_{(n)}$: Nominal Discharge Current

1.4 SUBMITTALS

A. See specification section 26 05 00.

B. Product Data: For each type of product indicated. Include:
   1. Maximum Single Impulse Surge Current Rating.
   2. Surge Life (Repetitive Surge) Rating.
   3. UL1449 (Latest Edition) Voltage Protection Ratings (VPR).
   4. UL1449 (Latest Edition) Nominal Discharge Current (In).
   5. Product dimensions and weights.
   6. Furnished specialties and accessories.

C. Qualification Data:

D. Safety Agency File Number.

E. ISO 9001-2008 Certification.

F. ISO 1401-2001 Certification.

G. Operation and Maintenance Data: For SPDs to include all submittal data and any applicable operation and maintenance manuals.

H. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

B. The unit shall be UL 1449 Listed and CUL Approved as a Surge Protective Device and UL 1283 Listed as an Electromagnetic Interference Filter

C. Provide 2nd party certified data demonstrating SPD response to ANSI/IEEE C62.41.2-2002 standard waveforms when tested according to IEEE C62.45.

D. Comply with NFPA 70.

E. All SPDs provided within this project at the service entrance, distribution panels, and sub-panels shall be from the same manufacturer.

1.6 PROJECT CONDITIONS

A. Service Conditions: Rate SPDs for continuous operation under the following conditions unless otherwise indicated:
   1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
   2. Operating Temperature: 30 to 150 deg F.
   3. Humidity: 0 to 95 percent, non-condensing.
   4. Altitude: Less than 13,000 feet above sea level.

1.7 COORDINATION

A. Where field-mounted SPD's are specifically shown on plans, coordinate locations of field-mounted SPDs to allow adequate clearances for maintenance.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 10 years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Replaceable Protection Modules: 1 of each size and type installed, where field-replaceable modular SPDs are provided.
   2. Fuses: 1 of each size and type installed, where field-replaceable fuses are provided.

PART 2 - PRODUCTS

2.1 SURGE PROTECTIVE DEVICES

A. Manufacturer:
   1. Integral Devices: Surge Protective Devices shall be as manufactured by the distribution equipment manufacturer (Square D, etc.), or by Surge Suppression Inc. if all of the performance of this specification are met and all UL listing of the equipment manufacturer are met.
   2. External Devices (where specifically specified on plans): Surge Protective Devices shall be as manufactured by the distribution equipment manufacturer (Square D, etc.) or Surge Suppression Inc.

B. Each Surge Protective Device shall:
   1. Be internal to the associated distribution equipment (without violating any applicable UL listings) unless specifically shown otherwise on plans.
   2. Be UL 1449 (Latest Edition) listed.
   3. Have short-circuit current rating complying with UL 1449 (Latest Edition), that matches or exceeds the short-circuit rating of the associated distribution equipment.
   4. Be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.
   5. Have fuses, rated at 200-kA interrupting capacity.
   6. Have a minimum UL 1449 Nominal Discharge Current (I_n) Rating of 20kA.
   7. Be fabricated using bolted compression lugs.
   8. Provide suppression for all ten (10) modes of protection.
   9. Have LED indicator lights for power and protection status of each phase.
   10. Have audible alarm, with silencing switch, to indicate when protection has failed.
   11. Have form-C contacts rated at 2 A and 24-V ac minimum, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with facility monitoring and control system if monitoring by that system is required by plans or other specifications.
   12. Have six-digit transient-event counter, mounted to front of equipment door, set to totalize transient surges (externally mounted SPD's may have the transient –event counter monted on the visible face of the SPD).
   13. Meet all UL 96A requirements (for Lightning Protection Systems) where the device is installed at a service entrance of the facility. At a minimum, these devices shall:

a. Be marked as Type 1 or Type 2 SPDs with product Identity consisting of "Surge Protective Device" or "SPD", and identifying all ratings so required by UL96A and the 4 digit alpha numeric Control Number.
b. Have a minimum UL 1449 Nominal Discharge Current (I_n) Rating of 20kA.
c. Be UL listed and labeled with holographic label.

C. Peak Single-Impulse Surge Current Rating shall be meet the following minimums unless specifically shown otherwise on plans:

Application	**Per Phase**	**Per Mode**
Service Entrance Devices	240 kA	120 kA
Downstream Devices	160 kA	80 kA

D. The ANSI/UL 1449 voltage protection rating (VPR) in grounded wye circuits, the SPDs shall not exceed the following:

Modes	**208Y/120V**	**480Y/277V**	**600Y/347V**
L-N,L-G, N-G	800	1200	1500
L-L	1200	2000	2500

E. The ANSI /UL 1449 VPR for 240/120 V, 3-wire or 4-wire circuits with high leg shall not exceed the following:

Modes	**240/120V**
L-N,L-G, N-G	1200/800

2.2 ENCLOSURES

A. Where external units are specifically specified on plans, units not mounted within electrical distribution equipment (such as switchboards, MCC's, etc.) shall be provided in enclosures with NEMA enclosure ratings that match or exceed the NEMA enclosure ratings of the equipment from which the units are fed. For example, a unit fed from a NEMA 4X stainless steel panelboard shall also be mounted within a NEMA 4X stainless steel enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All SPD's shall be integrally-mounted within the associated distribution equipment unless specifically shown otherwise on plans.

B. Install SPDs at service entrance on load side, with ground lead bonded to service entrance ground.

C. Install SPDs downstream of the service entrance with conductors or buses between suppressor and points of attachment as short and straight as possible. The lead lengths between the TVSS unit and the equipment being protected shall not exceed fourteen (14) inches without approval from the engineer. Do not bond neutral and ground. Leads shall be as straight as possible with no sharp bends.

D. Where externally-mounted SPD's are specifically shown on plans, provide circuit breaker as directed by the SPD supplier as a dedicated disconnecting means for SPD unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

A. Ensure that interiors are free of foreign materials and dirt.

B. Check and test switches, pushbuttons, meters for proper operation.

C. Check and test indicating lights for proper operation and color.

D. Perform manufacturer's on site field test procedures.

3.3 STARTUP SERVICE

A. Do not perform insulation resistance (MEGGER) tests of the distribution wiring equipment with the SPDs installed. Disconnect all wires, including neutral, before conducting insulation resistance tests, and reconnect immediately after the testing is over.

3.4 SYSTEM WARRANTY

A. The SPD system manufacturer shall warranty the entire SPD system against defective materials and workmanship for a period of ten (10) years from the date of substantial completion. This warranty is in effect as long as the unit is installed in compliance with the manufacturer's installation, operation, and maintenance manual, UL Listing requirements, and any applicable national or local electrical codes.

B. Any SPD device which shows evidence of failure or incorrect operation, including damage as the result of lightning strikes, during the warranty period shall be replaced by the manufacturer at no charge to the owner. Warranty will provide for multiple exchanges of any inoperable devices at any time during the warranty period which starts at the date of substantial completion of the system to which the surge suppressor is installed.

C. The manufacturer is required to have a nationwide network of factory-authorized local service representatives for repair and service of this product. The manufacturer shall have a dedicated 1-800 telephone number for service problems and questions. This number shall be manned by a knowledgeable factory employee to ensure prompt response to any emergency situation that may arise.

END OF SECTION 26 43 00

SECTION 26 44 00 – ELECTRICAL HEAT TRACING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. This specification covers the requirements of materials and support services for heat-tracing systems. Heat tracing systems (including insulation and all accessories) shall be provided on all piping installed exposed in exterior locations or where otherwise indicated on plans unless noted otherwise.

1.2 CODES, APPROVALS, AND STANDARDS

A. The electric heat-tracing system shall conform to this specification. It shall be designed, manufactured, and tested in accordance with the applicable requirements of the latest edition of the following codes and standards.
   1. ANSI American National Standards Institute
   2. CEC Canadian Electrical Code
   3. CSA CSA International
   4. FM FM Approvals
   5. IEC International Electro-Mechanical Commission
   6. IEEE Institute Of Electrical and Electronics Engineers
   7. ITS Intertek Testing Services (Intertek ETL SEMKO)
   8. NEC U.S. National Electrical Code (NFPA 70)
   9. NEMA National Electrical Manufacturers Association
   10. NESC National Electrical Safety Code
   11. UL Underwriters' Laboratories, Inc.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Heat Tracing:
   1. Raychem/Tyco Thermal Controls.
   2. Thermon.
   3. Nelson Heat Tracing.
   4. Chromalox.

B. Insulation:
   1. Armstrong World Industries, Inc.
   2. Babcock & Wilcox; Insulationg Products Division
   3. CertainTeed Corporation
   4. Knauf Fiber Glass GmbH
   5. Manville Products Corp.
   6. Owens-Corning Fiber Glass Corp.
   7. Pittsburg Corning Corp.
   8. Rubatex Corp.

2.2 SELF-REGULATING HEATING CABLES

A. All heat-tracing applications with continuous exposure (maintain) temperatures from 150°F (65°C) to 250°F (121°C) or intermittent exposure temperatures from 185°F (85°C) to 420°F (215°C) shall use self-regulating cables.
   1. Self-regulating heating cable shall vary its power output relative to the temperature of the surface of the pipe or the vessel. The cable shall be designed such that it can be crossed over itself and cut to length in the field.
   2. Self-regulating heating cable shall be designed for a useful life of 20 years or more with "power on" continuously, based on the following useful life criteria:
      a. Retention of at least 75 percent of nominal rated power after 20 years of operation at the maximum published continuous exposure (maintain) temperature.
      b. Retention of at least 90 percent of nominal rated power after 1000 hours of operation at the maximum published intermittent exposure temperature. The testing shall conform to UL 746B, IEC 216-1 Part 1.
   3. A warranty against manufacturing defects for a period of 10 years shall be available.
   4. All cables shall be capable of passing a 2.5 kV dielectric test for one minute (ASTM 2633) after undergoing a 0.5 kg-m impact (BS 6351, Part 1, 8.1.10).

2.3 FREEZE-PROTECTION SYSTEMS

A. The heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable can be used directly on plastic or metallic pipes. Cables shall have a temperature identification number (T-rating) of T6 (185°F or 85°C) without use of thermostats.

B. The heating cable shall have a tinned copper braid with a resistance less than the heating cable bus wire resistance as determined in type test (ASTM, B193, Sec. 5). The braid shall be protected from chemical attack and mechanical abuse by a modified polyolefin or fluoropolymer outer jacket.

C. In order to provide rapid heat-up, to conserve energy, and to prevent overheating of fluids and plastic pipe, the heating cable shall have the following minimum self-regulating indices:
   1. Table K.1 Minimum Self-Regulating Indices

Heating cable	S.R. index (W/°F)	S.R. Index (W/°C)
3 W/ft	0.038	0.068
5 W/ft	0.060	0.108
8 W/ft	0.074	0.133
10 W/ft	0.100	0.180

D. The self-regulating index is the rate of change of power output in watts per degree Fahrenheit or watts per degree Celsius, as measured between the temperatures of 50°F (10°C) and 100°F (38°C) and confirmed by the type test and published data sheets.
   1. In order to ensure that the self-regulating heating cable does not increase power output when accidentally exposed to high temperatures, resulting in thermal runaway and self- ignition, the cable shall produce less than 0.5 watts per foot (1.64 watts per meter) when energized and heated to 350°F (177°C) for 30 minutes. After

this test, if the cable is reenergized, it must not have an increasing power output leading to thermal runaway.

2. In order to confirm 3.1B, the self-regulating heating cable shall retain at least 90 percent of its original power output after having been cycled 300 times between 50°F (10°C) and 210°F (99°C), allowing at least six minutes of dwell time at each temperature.
3. The heating cable shall be Raychem® BTV-CT or BTV-CR self-regulating heater, with continuous exposure (maintain) capability up to 150°F (65°C) and intermittent exposure capability up to 185°F (85°C), as manufactured by Tyco Thermal Controls.

2.4 SYSTEMS FOR DIVISION 1 HAZARDOUS LOCATIONS

A. The following requirements shall apply in addition to the criteria specified above:
   1. The self-regulating heating cable shall be specifically FM Approved or CSA Certified for use in Division 1 locations.
   2. A ground-fault protection device set at 30 mA, with a nominal 100 ms response time, shall be used to protect each circuit.
   3. The temperature identification number (T-rating) of the cable used shall comply with FM and CSA requirements as applicable.
   4. Connection methods used with the cable shall be compatible and approved as a part of the system manufactured and supplied by the heating cable vendor for use in the Division 1 location.
   5. For plastic pipe and vessel applications, the heating cable shall be Raychem HBTV-CT or Raychem BTV-CT self-regulating heaters, with continuous exposure capability up to 150°F (65°C) and intermittent exposure capability up to 185°F (85°C), as manufactured by Tyco Thermal Controls.
   6. The heating cable shall be Raychem HQTV-CT or Raychem QTVR-CT self-regulating heaters, for continuous and intermittent exposure capability up to 225°F (110°C), as manufactured by Tyco Thermal Controls.

B. Terminations for nonhazardous And hazardous class 1, div 2 locations
   1. All connection components used to terminate heating cables, including power connectors, splices, tees, and connectors shall be approved for the respective area classification and approved as a system with the particular type of heating cable in use. Under no circumstances shall terminations be used which are manufactured by a vendor other than the cable manufacturer.
   2. In order to keep connections dry and corrosion resistant, components shall be constructed of nonmetallic, electrostatic, charge-resistant, glass-filled, engineered polymer enclosure rated NEMA 4X. The component stand shall allow for up to four inches (100 mm) of thermal insulation.
   3. Terminals shall be spring clamp wire connection type to provide reliable connection, maintenance-free operation, and ease of reentry.
   4. Heating cable terminations shall use cold-applied materials and shall not require the use of a heat gun, torch, or hot work permit for installation.
   5. Components shall be rated to a minimum installation temperature of –40°F (–40°C), minimum usage temperature of –75°F (–60°C), and maximum pipe temperature of 500°F (260°C).

6. The component system shall be Raychem JBM-100-L-A connection kit complete with integral LED power indicating light to serve as complete power, splice, or tee connection for up to three Raychem BTV, QTVR, or XTV industrial parallel heating cables as manufactured by Tyco Thermal Controls.

2.5 THERMOSTATS AND CONTACTORS

A. Freeze protection systems shall operate using self-regulating control or with the DigiTrace AMC-1A or DigiTrace AMC-F5 thermostat and the DigiTrace E104-100A or DigiTrace E304-40A contactor in nonhazardous locations, and DigiTrace AMC-1H thermostat with Digitrace E307-40A contactor in hazardous locations, as supplied by Tyco Thermal Controls.

B. Where heat tracing is applied to emergency showers and/or emergency eye wash systems (or other systems where the heated piping system provides water that may be applied to persons in emergency or non-emergency situations), the sensor (that determines whether the heat tracing system is ON or OFF) shall be placed on the associated pipe or tank wall rather than in ambient air (such as to prevent the heat tracing system from overheating the associated liquid).

2.6 END SEAL

A. An above-insulation, lighted end seal kit shall be provided for each heat trace circuit termination as per the manufacturer's installation details. The kit shall be E-100-LBTV2 as supplied by Tyco Thermal Controls.

2.7 INSULATION

A. All components of the insulation, including covering, mastics and adhesives shall have a flame-spread rating of not over 25, and a smoke development rating of not over 50. Ratings shall be as established by tests in accordance with ASTM E 84 and Federal Specification standards. The integrated insulation assemblies shall also conform to the above specifications. Insulation shall be applied in strict accordance with the manufacturer's instructions.

B. Description:
1. This type of insulation shall be employed for process, cold-and hot water, steam, and condensate piping and equipment with surface temperatures up to 850 degrees F. Pipe insulation and jacketing shall be applied to piping where shown, and shall include fittings, flanges, and valves. Pipe insulation shall be molded-type pipe covering, made of fibrous glass with a minimum k-factor of 0.23 at 75 degrees F mean temperature. Unless otherwise specified the insulation thickness shall be 1" minimum.
2. The insulation shall be oversized for installation over electric heating cable. Insulation shall have a factory-applied white fire-retardant vapor-barrier jacket of kraft paper and aluminum foil laminated together and reinforced with fiberglass yarn. Fittings and valves shall be covered with the same material as the pipe, cut in segments to fit snugly without open spaces, held in place with copper wire or cement, and then covered with the same jacketing material as the pipe. Insulated

fittings adjacent to vapor-barrier insulation shall be sealed with an acceptable vapor-barrier cement before installation of the finish jacket. Pipe insulation and vapor-barrier shall be continuous through hangers and supports. Insulation shall be coordinated with the pipe hangers and supports and where insulation protection shields are provided the top half section of pipe insulation at support locations shall be of the same specified density, and the bottom half insulation segments provided between the pipe and the insulation protection shields shall have a density of not less than 6 lb/cu ft. All insulation shall be covered with smooth aluminum weatherproof metal or plastic preformed jacketing with a factory attached moisture barrier. The jacket for the fittings shall consist of precision-formed smooth-sided sections and shall be sized to cover and protect the insulated fitting. Each section shall be manufactured from aluminum or PVC, and all joints shall be sealed with silicon mastic or solvent welding, to provide a continuous, air and weathertight joint. Strapping shall be 1/2-inch wide, Type 3003 aluminum or stainless steel.

PART 3 - EXECUTION

3.1 GENERAL

A. Heat tracing shall be provided along full length of all exposed piping or vessels located outside of buildings or in other areas designated on plans (such as by insulated piping in areas subject to cold temperature). Insulation shall be provided over all heat traced pipes.

B. The vendor shall provide a detailed design utilizing standard heat-tracing design software, such as Tyco Thermal Controls TraceCalc® Pro design software or equal. At minimum, the design must provide the following:
   1. Circuit identification number
   2. Maintain temperature
   3. Line size and insulation
   4. Heat loss for pipe, valves, and supports
   5. Amount and type of heating cable required
   6. Spiral requirements
   7. Heating cable service voltage
   8. Heating cable power output at the maintain temperature
   9. Minimum and maximum maintain temperature vs. minimum and maximum ambient temperatures
   10. Circuit breaker and transformer sizing

C. A ground-fault protection device set at 30 mA, with a nominal 100-ms response time, shall be used to protect each circuit.

D. Install additional heating tape at bolted flanges, valves, pipe supports, and other fittings and fixtures as recommended by supplier, but not less than the following:
   1. Bolted flanges (per pair): Two times pipe diameter
   2. Valves: Four times valve length
   3. Pipe hanger or support penetrating insulation: Three times pipe diameter

E. The entire system shall be installed in compliance with the manufacturer's recommendations for a fully-functional, code-compliant system.

F. All insulation shall be installed by a qualified insulation contractor in strict accordance with the manufacturer's recommendations and the requirements of these specifications.

G. All piping insulation shall be installed following required testing and approval of piping.

3.2 IDENTIFICATION

A. Heat tracing systems shall be labeled at the field connection of power to the heat tracing equipment per the requirements for Utilization Equipment within Specification Section 26 05 53.

B. Heat traced piping, vessels, etc. shall be identified with appropriate caution signs or markings at intervals not exceeding 20 feet on center per NEC requirements.

3.3 TESTING

A. Factory inspections and tests for self-regulating, power limiting, series constant wattage and constant wattage (MI) heater cables shall include but are not limited to the following:
   1. Testing shall be done per the latest IEEE Std. 515 test section and applicable manufacturer's standards.
   2. In the field, all heater cables shall be meggered. The following separate field megger readings shall be taken on each self-regulating and each M.I. heater cable:
      a. Heater cable shall be meggered when received at jobsite before installation.
      b. Heater cable shall be meggered after installation, but before insulation is applied.
      c. Heater cable shall be meggered after insulation has been installed.
   3. All three of the above field megger readings shall be greater than 20 megohms. Otherwise, the heater cable is not acceptable and shall be replaced.
   4. Field megger tests shall be recorded for each heater cable, and certified reports shall be submitted to the user.

END OF SECTION 26 44 00

SECTION 26 50 00 – LIGHTING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Lighting Fixtures

B. Drivers

1.2 SUBMITTALS

A. Complete submittals shall be provided identifying all lighting fixture types and options, all lamp types (where applicable) and compliance with all contract requirements. The absence of clear submittal information specifically listing exceptions/deviations from detailed contract requirements will be understood to indicated that the contractor/supplier intends to meet all contract requirements. Refer to specification section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Lighting fixtures shall be furnished as shown on plans and specified herein. It shall specifically be the responsibility of Contractor to verify exact types ceilings, walls, etc. and recessing depth of all recessed fixtures and furnish the specific mounting trims and accessories of the specified and/or accepted fixture specifically for the ceiling, wall etc. in which each fixture is to be installed.

B. Base bid manufacturers are listed on the lighting fixture schedule. Manufacturers listed without accompanying catalog numbers are responsible for meeting the quality standards, efficiency, maximum wattages and photometric distributions set by the specified product.

C. All lighting fixtures shall be so designed and shall have drivers and other similar items so installed as to function without interruptions or failures when operating in the environment in which they are proposed to be installed. Special attention shall be given to environments with potentially high ambient temperatures such as attic spaces, exterior soffits, confined interior soffits, coves, unconditioned spaces, etc. and shall be addressed by providing fixtures with suitable high ambient temperature ratings, remote mounting of drivers/ballasts, providing approved ventilation, etc. as directed by fixture manufacturer and approved by engineer, at contractor’s expense.

D. All fixtures installed such as to create penetrations through fire rated ceiling or wall assemblies shall be labeled as suitable for that purpose or installed with covers, tenting or other means as required to maintain the fire rating of the assembly.

2.2 LED LUMINAIRES

A. For the purpose of these specifications, LED Luminaires shall be defined as the entire LED fixture assembly including LED array, drivers, housing, electronics, etc. that compose the lighting fixture.

B. Furnish and install LED Luminaire of proper size, type, efficacy, delivered lumen output, color temperature, distribution pattern, operational life, and CRI as shown on drawings.

C. LED Luminaires shall be tested in accordance with LM-79 and LM-80 standards.

D. LED drivers shall comply with NEMA 410 standards for inrush current, etc.

E. Exterior, pole mounted LED Luminaires shall be provided with an easily-serviceable, UL recognized surge protection device that meets a minimum 10kA Category C Low operation (IECC C62.41.2-2002). Device shall be wired in front of light engine(s) and driver(s) and shall fail "open" such as to prevent fixture operation after a surge protection failure.

F. LED Luminaires shall have a guarantee-warranty of at least five years unless specifically noted otherwise on contract documents.

G. LED Luminaire assembly shall comply with ambient temperature requirements specified in General section above.

2.3 STEMS/PENDANTS

A. Hangers shall be approved ball aligner type swivel, 30 degrees from vertical with swivel below canopy.

B. Stems/Pendants shall be rigid conduit unless specified otherwise on plans. Proposed stem/pendant types shall be submitted for review prior to shipment of light fixtures from factory.

C. Stems/Pendants shall be provided as required to prevent swaying of fixtures due to HVAC system airflow or other similar occurrences.

D. Shall be painted the same color as the fixture trim unless noted otherwise.

2.4 MANUFACTURER

A. Fixtures and stems shall be manufactured as shown in fixture schedule or approved equals.

B. Drivers shall be as manufactured by Philips/Advance, GE, Lutron, Magnatec, Motorola, EldoLED or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF LIGHTING FIXTURES

A. Support:

1. Support of all lighting fixtures shall be responsibility of electrical contractor. All lighting fixture supports shall be installed in accordance with lighting fixture supplier's recommendations.
2. Contractor shall coordinate installation requirements for all wall-mounted fixtures (especially for wall-mounted fixtures on uneven wall surfaces, etc.) as required to assure a level/flat mounting surface and level/plumb/secure finished installation. Contractor shall provide flat mounting plates or other mounting provisions where necessary. Any proposed mounting plates, etc. shall be submitted to and approved by project architect prior to ordering materials.
3. Fixtures shall be supported independent of ceiling from structural members of building.
4. Pendant mounted fixtures shall be directly supported from the structure above using a 9 gauge hanger wire or an approved alternate support without using the ceiling suspension system for direct support.
5. Tandem fixtures may utilize common hanger wires.
6. Contractor shall submit typical hanging detail to Engineer before installing any fixtures.

B. Row-Mounted fixtures:
   1. All stems on row-mounted fluorescent fixtures shall be installed as follows (except fixtures with slide grip hangers):
      a. One stem shall be installed in the first fixture knockout from end of row (on the first and last fixture of the row).
      b. One stem shall be installed between each two fixtures. Stem shall center joint where fixtures join and shall attach by use of "joining plates".
   2. All fixtures in continuous rows other than recessed grid type shall be connected by nipples with locknuts bushings.

C. Coordination:
   1. Contractor shall coordinate all dimensions & locations of light fixtures prior to rough-in to insure proper fit and coordination with other trades.
   2. Contractor shall verify exact ceiling types being installed and shall adjust fixture trim types accordingly (prior to submitting light fixture shop drawings).

END OF SECTION 26 50 00

SECTION 27 05 00 – AUXILIARY SYSTEM CABLES, 0-50V

PART 1 - GENERAL

1.1 DESCRIPTION

A. Cables rated for 0V-50V application

PART 2 - PRODUCTS

2.1 GENERAL

A. Unless specified otherwise, all cables within the scope of this specification section shall:
   1. Be rated for exposed cable tray installation.
   2. Be plenum rated (Class 1 Control cabling and Instrumentation cabling installed in conduit or exposed in cable tray in non-plenum areas is not required to be plenum-rated).
   3. Be UL-rated for the proposed application.
   4. Be multi-conductor with overall outer sheath as required by the application. The insulation of each conductor within the overall multi-conductor cable shall be uniquely color-coded. Ground conductors (when provided) within the multi-conductor cable shall have green insulation. Conductors with green insulation shall not be used for conductors other than ground.
   5. Utilize copper conductors.
   6. Have wire gauge as required to limit voltage drop to acceptable limits determined by the system supplier and to meet all applicable code requirements.
   7. Where installed underground, within slab-on-grade or in exterior locations, be rated for wet locations.
   8. Where required for specific systems, meet the specific requirements (conductor quantity, wire gauge, insulation type, shielding, etc.) of the system supplier.

2.2 INSTRUMENTATION CABLING

A. In addition to above requirements, and unless specified otherwise, Instrumentation cabling shall:
   1. Be #16awg minimum.
   2. Be rated for 300V.
   3. Have aluminum foil shielding.
   4. Have stranded, twisted conductors.
   5. Have PVC insulation/jacket with ripcord.
   6. Be manufactured by Belden, AlphaWire or General Cable.

2.3 CLASS 1 CONTROL CABLING (120VAC CONTROL CIRCUITS, ETC.)

A. In addition to above requirements, and unless specified otherwise, Class 1 control cabling shall:
   1. Be rated for 600V.
   2. Be industrial grade.
   3. Have stranded conductors.
   4. Have sunlight/oil-resistant PVC/Nylon insulation and jacket with ripcord.

5. Be manufactured by Belden, AlphaWire or General Cable.

2.4 CLASS 2 & 3 CONTROL CABLING (FED FROM CLASS 2 OR 3 POWER SUPPLIES)

A. In addition to above requirements, and unless specified otherwise, Class 2 & 3 control cabling shall:
   1. Be rated for 300V.
   2. Be shielded if so recommended by the system supplier/integrator.
   3. Have twisted conductors.
   4. Have plenum-rated insulation/jacket with ripcord.
   5. Be manufactured by AlphaWire, Belden, General Cable, Superior Essex or West Penn.

2.5 NETWORK CABLING

A. Furnish and install all Ethernet, Fiber Optic and Backbone Copper Telephone cabling in accordance with all BICSI requirements and in accordance with other applicable specification sections.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Routing:
   1. All wires and cables shall be installed in conduit unless specifically noted otherwise. Where conduit is not otherwise required by contract documents, 0-50V Cabling located within concealed, accessible ceiling spaces (such as above lay-in ceilings) may be run without conduit if the following requirements are met:
      a. Cabling is plenum-rated, multi-conductor.
      b. Cabling is supported by cable tray or with J-hook supports on intervals not to exceed 5’-0” on center. Cabling shall be supported solely from the cable tray or j-hooks supported from the building structure, without using piping, ductwork, conduit or other items as supports.
      c. Cabling is neatly formed, bundled and tied with plenum-rated Velcro straps on intervals not to exceed 30” on center.
      d. Properly-sized conduit(s) are provided wherever cabling enters an inaccessible or exposed area (such as above gyp board ceilings, within walls or through walls).
      e. Cabling is not a part of a Fire Alarm System, Smoke Control System, Emergency Generator Control System or other life-safety related system.
   2. End bushings shall be provided on both ends of all raceway terminations.
   3. No splices shall be pulled into conduit.
   4. No cabling shall be pulled until conduit is cleaned of all foreign matter.

B. Penetrations:
   1. All fire/smoke barrier penetrations shall be made in accordance with a U.L. listed assembly.
   2. For cabling not installed in conduit:

a. Fire/smoke barrier penetrations shall be sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.

3. For cabling installed within conduit from endpoint to endpoint:
   a. Fire/smoke barrier penetrations shall sealed utilizing fire caulk or other equivalent firestop systems around perimeters of conduits per UL requirements.
4. For cabling installed within cable trays:
   a. Fire/smoke barrier penetrations shall be sealed with one of the following methods:
      1) Continuous cable tray through the penetration, with a combination of large firestop pillows and small firestop pillows contained, supported and secured (to prevent unauthorized removal) on both sides by aluminum wire mesh and firestop putty. Firestop pillows shall be STI Series SSB or equal and Firestop putty shall be STI Spec Seal or equal.
      2) Cable tray broken at the penetration, with fire/smoke barrier penetrations sealed utilizing an enclosed fire-rated pathway device (STI EZ Path or equal) containing a built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed or retrofitted without the need to remove or reinstall firestop materials. The pathway shall be UL Classified and tested to the requirements of applicable ASTM/UL1479 standards.

C. Excess Cabling:
   1. Excess cabling shall be neatly coiled within all junction boxes, pullboxes, wireways, etc. and at all terminations as required to allow future re-termination of cabling.

D. Terminations:
   1. All conductors/cabling (including spare conductors) shall be properly terminated unless specifically directed otherwise. See below for general termination hardware requirements.
   2. Cabling shall be neatly formed, bundled and tied at all terminations.

3.2 SPLICES/CONNECTIONS/TERMINATIONS:

A. Network Cabling:
   1. Network and fiber optic cabling shall be continuous from endpoint to endpoint and shall not be spliced unless specifically noted otherwise.

B. Control Cabling:

1. Connections shall be made with T & B Sta-Kon wire joints EPT66M, complete with insulating caps. To be installed with WT161 Tool or C nest of WT11M Tool, Ideal Super - Nuts (not wire nuts), Ideal Wing Nuts, or Buchanan Elec. Products B Cap or Series 2000 Pressure connectors complete with nylon snap on insulators to be installed with C24 pressure tool.

C. Shielded cabling:
   1. Unless directed otherwise by the system supplier, 0-50V cable shielding shall be grounded at the PLC/control panel end only (not at the field device end) with a termination kit as directed by the PLC/control panel supplier.
   2. Shielded cabling shall be continuous from endpoint to endpoint and shall not be spliced without prior written approval from the Engineer.

3.3 LABELING

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

END OF SECTION 27 05 00

SECTION 27 10 00 – STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.1 SCOPE:

A. This document describes the products and execution requirements relating to furnishing and installing Telecommunications Cabling. Backbone and Horizontal cabling comprised of copper and fiber cabling, and support systems are covered under this document.

B. All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the structured cabling contractor as detailed in this document.

C. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities of telecommunications outlets, typical installation details, cable routing and outlet types are indicated on the plans. If the bid documents are in conflict, this specification shall take precedence.

D. Refer to Specification Section 26 05 53 (Electrical Identification) for additional identification requirements.

E. Refer to Specification Section 27 05 00 (Auxiliary System Cables, 0-50V) for additional material and installation requirements.

1.2 REGULATORY REFERENCES:

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association, the National Electrical Code, local ordinances and present manufacturing standards.

B. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. All modular jacks, patch cords, consolidation point, and patch cords shall be ETL Verified (not just tested) to be category 6 component and channel compliant.

D. The cabling system described in this specification is derived from the recommendations made in recognized telecommunications industry standards. The following documents are incorporated by reference:
   1. ANSI/TIA/EIA - 568-B.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements, April, 2001
   2. ANSI/TIA/EIA - 568-B.2, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components, April, 2001
   3. ANSI/TIA/EIA - 568-B.2-1, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted Pair Cabling Components, Addendum 1 – Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling

4. ANSI/TIA/EIA - 568-B.3, Commercial Building Telecommunications Cabling Standard Part 3: Optical Fiber Cabling Components, March, 2000
5. ANSI/TIA/EIA – 569-A, Commercial Building Standard for Telecommunications Pathways and Spaces, February, 1998
6. ANSI/TIA/EIA – 606-A, Administration Standard for Telecommunications Infrastructure of Commercial Buildings, February, 2002
7. ANSI/TIA/EIA – 607-AJ, Commercial Building Grounding and Bonding Requirements for Telecommunications, August 1994
8. ANSI/ TIA/EIA – 758, Customer-Owned Outside Plant Telecommunications Cabling Standard, April 1999
9. BICSI - TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM) 10TH edition.
10. National Fire Protection Agency (NFPA – 70), National Electrical Code (NEC) –2002
11. ANSI/TIA/EIA – 45-B, Test Procedures for Fiber Optic Connections.
12. ANSI/TIA/EIA – 526-14, Power Test for Fiber Runs.
13. FCC 47 CFR 68
14. NEMA 250
15. NEC Articles 770 and 800
16. ADA, Americans with Disabilities Act

E. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release.

F. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project. All local State and federal codes are to be followed.

1.3 APPROVED CONTRACTOR:

A. The Structured Cabling Contractor must meet the following requirements:
1. Contractor must have a certified RCDD on staff. The project manager for this project shall have an RCDD certification, and RCDD shall be responsible for reviewing all aspects of the design, submittals and installation of all products.
2. All required submittal information shall be stamped by the RCDD.
3. Contractor must have a minimum of 3 years experience with projects of similar size and scope to this project.
4. The company performing the work must have been in business for a minimum of 3 years.
5. The company must have an office within 75 miles of the job site.

B. The Structured cabling contractor is responsible for workmanship and installation practices in accordance with the requirements of the standards described in these specifications and manufacturer's requirements.

1.4 WORK INCLUDED:

A. The work included under this specification consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The structured cabling contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:
   1. Furnish and install a complete telecommunications wiring infrastructure.
   2. Furnish, install, and terminate all UTP and Optical Fiber cable
   3. Furnish and install all wall plates, jacks, patch panels, and patch cords at equipment racks and at work outlets (unless shown otherwise on plans).
   4. Furnish and install all required cabinets and/or racks as required and as indicated.
   5. Furnish any other material required to form a complete system.
   6. Perform channel testing (100% of horizontal and/or backbone links/channels) and certification of all components.
   7. Furnish test results of all cabling to the owner on disk and paper format, listed by each closet, then by workstation ID.
   8. Provide owner test results and documentation. (Testing documentation and As-built drawings)

1.5 SUBMITTALS:

A. Within thirty (30) days of notice to proceed the structured cabling contractor shall submit the following items:
   1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this spec.
   2. Submit proof from manufacturer of contractor's good standing in manufacturer's certification program.
   3. Submit copy of contractor's RCDD certification.
   4. Submit listing of five (5) projects of similar size and scope to this project that have been completed within the last five years. Include in this submittal owner's contact information for each project.
   5. Submit letter from the manufacturer stating that the manufacturer will provide a twenty-five year (25) warranty in accordance with the requirements paragraph 1.03 (B) of these specifications.
   6. Submit appropriate cut sheets and samples for all products, hardware and cabling.
   7. Submit 1/8" = 1'-0" drawings of floor plans indicating all work outlets and the labeling designation for each jack.
   8. Submit ½" = 1'-0" drawings of each MDF and each IDF showing all racks, patch panels, 110 blocks, etc.

B. Work shall not proceed without the engineer's approval of the submitted items.

C. The structured cabling contractor shall receive approval from the engineer on all substitutions of material. No substituted materials shall be installed except by written approval from the engineer.

1.6 DRAWINGS:

A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the structured cabling contractor in bidding the job. The structured cabling contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.

B. The structured cabling contractor shall verify all dimensions at the site and be responsible for their accuracy.

PART 2 - PRODUCTS

2.1 EQUIVALENT PRODUCTS:

A. Due to the nature and type of communications all products, including but not limited to faceplates, jacks, patch panels, racks, 110 blocks, and patch cords, for the purpose of this document, shall be manufactured by Hubbell, Ortronix, Panduit, Amp or Systimax. See below for acceptable cable manufacturers.

2.2 BACKBONE - FIBER:

A. Backbone Fiber Optic Cabling shall meet the following requirements:
   1. All optical fiber shall be Indoor/Outdoor,Tight-Buffered, All-Dielectric, Plenum rated (unless specified otherwise on plans) with Enhanced Multimode OM4-rated 50/125 Optical Fibers.
   2. Each Multimode Fiber shall:
      a. Be graded-index optical fiber wave-guide with nominal 50/125μm-core/cladding diameter.
      b. Comply with ANSI/EIA/TIA-492AAAC-A
      c. Have attenuation measured in accordance with ANSI/EIA/TIA-455-46, 53 or 61.
      d. Have information transmission capacity measured in accordance with ANSI/EIA/TIA-455-51 or 30.
      e. Have measurements performed at 23 degrees C +/- 5 degrees.
      f. Have Maximum attenuation dB/Km @ 850/1300 nm: 3.5/1.0
      g. Have bandwidth $\geq$ 4700 MHz-km @ 850nm. (EMB)
      h. Have bandwidth $\geq$ 500 MHz-km @ 1300nm.
      i. Be laser optimized and guarantee a 1 Gb/s distance of 1000 meters @ 850nm and 10 Gb/s at 600 meters @ 850nm.
      j. Terminate on fiber patch panel using SC Type fiber connectors.
   3. Each indoor/outdoor fiber optic cable shall:
      a. Be suitable for use in both outdoor and indoor applications without the use of a transition at the building entrance.
      b. Be suitable for use in risers, plenums and horizontal applications.
      c. Have a dry water blocking system for cable.
      d. Have a fiber strand count of 12 (unless shown otherwise on plans).
      e. Have a nominal 2.21 mm sub-unit diameter.

f. Have and be marked with an UL-OFNP Flame Rating (unless engineer specified otherwise on plans).
g. Comply with Bellcore GR-409 and GR20
h. Be independently verified to comply with ICEA S-104-696
i. Have strength members of FGE/Aramid yarn.
j. Be suitable for underground or above ground conduits.
k. (Where applicable) Have Tight Buffered fibers color coded in accordance with EIA / TIA 598 with an overall black jacket.
l. Be suitable for operation between -40° to +70° C
m. Be UV resistant
n. Be of an all dielectric design

4. Shall be manufactured by Berk-Tek, Corning, General Cable or Superior Essex.

2.3 PATCH CORDS:

A. The structured cabling contractor shall provide factory terminated and tested UTP and optical fiber patch cords and equipment cords for the complete cabling system. Patch cords shall be provided by the structured cabling contractor to connect patch panels to owner furnished electronics. The UTP patch cables shall meet the requirements of ANSI/TIA/EIA-568-B.2 and ANSI/TIA/EIA-568-B.2-1 for patch cord testing. Provide one set of optical fiber patch cables per fiber run that terminates on fiber patch panel and provide one category 6 patch cord for each category 6 work outlet that terminates on patch panel.

B. Fiber Optic patch cords shall:
1. Be furnished in the quantity of two (2) per IDF in each IDF and two (2) per IDF in each MDF.
2. Be manufactured by Panduit, Amp or Systimax.
3. Be multimode OM4 type.
4. Have connector type as directed by owner.
5. Have a performance marking indelibly labeled on the jacket (by the manufacturer).
6. Have the ability to accept color-coded labels and icons to comply with ANSI/TIA/EIA-606-A labeling specifications.
7. Be available in three standard colors
8. Be available in 3 foot, 5 foot, 7 foot, 10 foot, and 14 foot standard lengths

PART 3 - EXECUTION

3.1 PRE-INSTALLATION SITE SURVEY:

A. Prior to start of work, meet at the project site with the owner's representative and representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the General Contractor will be necessary to plan the crucial schedule completions of the equipment rooms and telecommunication closets.

B. Examine areas and conditions under which the system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.

3.2 OPTICAL FIBER TERMINATION HARDWARE:

A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

C. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

D. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.

E. A maximum of 12 strands of fiber shall be spliced in each tray

F. All spare strands shall be installed into spare splice trays.

3.3 BACKBONE CABLE INSTALLATION:

A. Raceways:
   1. All backbone cables shall be installed inside innerducts (see specification above) within conduits meeting specification requirements unless specifically noted otherwise.
   2. Backbone cables shall be installed separately (in separate innerducts/conduits) from horizontal distribution cables.
   3. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.
   4. Where backbone cables and distribution cables are specifically specified to be installed in a cable tray or wireway, backbone cables shall be installed first, within innerducts meeting specifications above, bundled separately from the horizontal distribution cables.

B. Support:
   1. Within Telecommunications Rooms or at Telecommunications Backboards, all backbone cables shall be securely fastened to the backboards on the walls.
   2. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
   3. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
   4. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

3.4 TESTING AND ACCEPTANCE:

A. General

1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-B. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
2. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the Panduit Certification Program Information Manual and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

B. Fiber Testing
1. All fiber testing shall be performed on all fibers in the completed end to end system. There shall be no splices unless clearly defined in an RFP. Testing shall consist of an end to end power meter test performed per EIA/TIA-455-53A. The system loss measurements shall be provided at 850 and/or 1300 nanometers for multimode fibers and 1310 and/or 1550 nanometers for single mode fibers. These tests also include continuity checking of each fiber.
2. Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for singlemode) in both directions.
3. Test set-up and performance shall be conducted in accordance with ANSI/EIA/TIA-526-14 Standard, Method B.
4. Where links are combined to complete a circuit between devices, the structured cabling contractor shall test each link from end to end to ensure the performance of the system. ONLY LINK TEST IS REQUIRED. The structured cabling contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above. The values for calculating loss shall be those defined in the ANSI/TIA/EIA Standard.
5. Attenuation testing shall be performed with an approved hand held tester from an industry recognized test equipment manufacturer.

3.5 SYSTEM DOCUMENTATION:

A. Upon completion of the installation, the structured cabling contractor shall provide three (3) full documentation sets to the owners for approval. Documentation shall include the items detailed in the sub-sections below.

B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor, etc.). This is inclusive of all test result and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. At the request of the Engineer, the structured cabling contractor shall provide copies of the original test results.

C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the

structured cabling contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.6 TEST RESULTS:

A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

B. Test results generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The structured cabling contractor must furnish this information in electronic form (CD-ROM).

C. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.7 WARRANTY:

A. The manufacturer shall provide a 25 year extended product warranty with a 25 year applications assurance warranty. Manufacturer shall provide the warranty directly to the end user.

B. An Extended Product Warranty shall be provided which warrants functionality of all components used in the system for 25 years from the date of registration. The Extended Product Warranty shall warrant the installed horizontal copper and the backbone optical fiber portions of the cabling system.

C. The Application Assurance Warranty shall cover the failure of the wiring system to support current or future applications that are designed for the link/channel specifications of ANSI/TIA/EIA–568-B.1. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, and 155 Mb/s ATM.

D. The contractor shall provide a warranty on the physical installation.

3.8 FINAL ACCEPTANCE & SYSTEM CERTIFICATION:

A. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a two week period will constitute acceptance of the system. Upon successful completion of the

installation and subsequent inspection, the end user shall be provided with a numbered certificate, from the manufacturer, registering the installation.

END OF SECTION 27 10 00

SECTION 27 60 00 – SCADA SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Modify the existing SCADA System with new PLCs, wirless LAN monitoring provisions, instrumentation and controls with appurtenant equipment and accessories as indicated, specified, and as necessary for a complete and proper operating system.
   1. Work includes, but not necessarily limited to, the following:
      a. New programmable logic controllers (PLCs), instruments, and other appurtenances as indicated and specified herein and as required by the process flow and instrumentation diagrams and descriptions.
      b. All engineering, hardware and software development, installation, startup, calibration services and supervision necessary.
      c. Testing and operational demonstrations as specified.
      d. Training programs as specified.
      e. Preparation of manuals.
      f. Programming of screens, alarms, historian, trending, etc. for the SCADA Computer system.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Specifications, Special Provisions, and all other related Sections.
   2. Refer to Specification Section 26 29 00 for additional control panel requirements.
   3. Refer to Specification Section 27 60 05 for instrumentation requirements.
   4. Refer to plans for point lists and additional device requirements.

1.2 QUALITY ASSURANCE

A. The qualifications and experience of key project personnel shall be acceptable to the Engineer. The System Integrator shall employ competent service personnel to service and troubleshoot the control and instrumentation systems and shall have at least 15 years of experience with similar work. References shall be provided upon request by the Engineer. The System Integrator shall maintain their own UL508 panel shop. The geographic location of a fully staffed office with Engineers, Service Personnel, and programmers shall be within a 150 mile radius of the project site. The System Integrator approved for this project is:
   1. Electric Machine Control, Inc. (“EMC”) – Birmingham, Alabama

B. The system integration duties shall be provided by a company qualified, experienced, and regularly engaged in designing, setting up, programming, and integrating complex process loop controls and instrumentation for process control and monitoring applications. Only qualified system integrators will be allowed to submit proposals for this project. In order to be considered qualified, integrator shall have completed a minimum of five (5) projects of similar type/scope and equal or greater magnitude and complexity within the last ten (10) years. Sub-contractors without qualifications will be rejected. Previous projects used to meet this experience requirement must have included similar (or greater) scopes of work for each of the following areas:

1. Process loop controls for the proposed processes
2. HMI graphics
3. Instrumentation
4. Control Panel/PLC panel construction

C. The System Integrator or its personnel engaged in this project shall have and shall maintain, at a minimum, the first three (3) certificates of ISA 62443 (for cybersecurity of industrial automation and control systems).

D. Contractor:
1. Shall be fully and solely responsible for the work of the systems supplier and solely responsible to the Owner for having supplied to the Owner the complete integrated SCADA system.
2. To provide personal superintendence and direction of the work, maintaining and supplying complete supervision over and coordination between all subcontractors employed by him and the Instrumentation and Control System Integrator.
3. To be responsible for defining the limits of his subcontractor's work.
4. To be responsible for setting of instruments (including alarms, etc. as provided under other sections).

E. Operation and Maintenance Manuals
1. Operating instructions shall incorporate a functional description of the entire system, including the system schematics which reflect “as-built” modifications.
2. Special maintenance requirements particular to the system shall be clearly defined along with special calibration and test procedures.
3. As part of the operation and maintenance manuals, provide one hard copy of the program used to program the programmable logic controller.

1.3 WARRANTY

A. Systems supplier shall furnish a hardware and software warranty for the system starting at substantial completion and ending one year from this date.

1.4 REFERENCES

A. Instrument Society of America (ISA) PR7. 1, Pneumatic Control Circuit Pressure Test, Tentative Recommendation Practice.

B. Instrument Society of America (ISA) S5.4, Instrument Loop Diagrams, standard.

C. National Electrical Manufacturers Association (NEMA) Publication, General Standards for Industrial and Control Systems, ICS 1 and Industrial Controls and Systems ICS2.

1.5 RADIO/WIRELESS SYSTEM PROPAGATION STUDIES

A. The successful bidder of this project will be responsible for modifying the existing wireless LAN communication network at the plant to provide a highly-reliable system to monitor new remote panels/devices as indicated on plans. The successful bidder shall provide these studies prior to preparing project submittals and shall implement

radio/wireless networks with components/antennae/radios/mounting poles/etc. accordingly as required for a fully functional system.

B. SCADA Integrator is fully responsible for all work associated with providing a complete system with proper coverage of the new equipment/devices.

C. The System Integrator shall obtain all necessary permits required for radio/wireless systems prior to ordering/procuring any associated system equipment/devices.

D. The propagation study will include running a computer model from topographical information. The propagation study will also include a site survey to test signal strength (with the actual equipment proposed) to confirm the computer analysis.

E. The goal of the study is to produce a report that will specify the equipment that a supplier/integrator will need to install at each radio/wireless-connected device/panel to achieve reliable communication for each radio/wireless link.

F. The propagation study report shall include the following information:
   1. Location of each new station.
   2. Type of wireless equipment/devices and wireless communication types proposed. Where applicable, frequencies used in system testing and proposed in final installation of radio systems shall specifically be noted..
   3. Tower/pole/mast mounting heights, types and installation requirements for all antennae.
   4. All antenna styles/types.
   5. Locations, types, mounting details, etc. for any required access points or repeaters required to achieve the required signal strengths. Note that, if possible, no intermediate access points or repeaters other than those specifically noted on contract documents should be provided. Any access points/repeaters required must be specifically approved by the engineer in writing prior to implementation. Any and all costs associated with furnishing or installing any required access points/repeaters (including material, power, mounting towers/poles, permitting, etc.) shall be fully included within the bid.
   6. Complete documentation from the computer analysis.

1.6 SUBMITTALS

A. General/System submittal requirements:
   1. Provide submittal (quantity as required by contract) of:
      a. Component manufacturing data sheets indicating pertinent data and identifying each component (including all components within PLC/control panel enclosures, instruments, computer systems, surge protection devices, antennae, radios, sun/rain shields, etc.) by tag number and nomenclature as indicated on drawings and in specifications.
      b. Component drawing showing dimensions, mounting, and external connection details,
      c. SCADA Network Diagram showing all major network equipment (including all PLCs, RTUs, Ethernet Switches, Computer System components, network cabling networked I/O, etc.).

d. List of all spare parts. All manufacturers recommended spare parts shall be provided in addition to required spare parts.
e. Shop test plan and results.
f. Propagation study results.

2. Identify any specification section where exceptions are being taken or an "or equal" piece of hardware is being proposed.
3. A Bill of Materials shall be included with catalog information on all components.
4. Information shall be included on any proprietary logic component sufficient to demonstrate its ability to perform the required functions.

B. Panel submittal requirements:
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. Instrumentation/Field Device submittal requirements:
1. Manufacturer's product data sheets
2. Job-specific model numbers for each instrument/field device
3. Job-specific ranges/setpoints/etc. proposed for each instrument/field device

D. Computer System submittal requirements:
1. Screen shots showing proposed layout of each specific or typical SCADA HMI screen.

E. Calculation submittal requirements:
1. Thermal calculations showing amount of air conditioning and heating required for each control panel, per ambient requirements listed below and operating temperature limitations of all equipment/devices within each control panel.
a. Thermal calculations used for sizing cooling 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.
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).
3. Load calculations showing the sizing and anticipated runtime of all Uninterruptible Power Supply systems provided (with spare capacity as specified).

1.7 DELIVERY, STORAGE AND HANDLING:

A. Packing and Labeling:
1. Prior to shipment, each component shall be tagged to identify its' location, tag number, and system function. Identification shall be prominently displayed on the outside of the package.
2. Firmly attach permanent, final labeling (as specified elsewhere) to all equipment, panels, instruments/field devices, etc. prior to installation.

B. Delivery:
1. Following completion of shop assembly, factory test, and approval of all equipment by the Engineer, the panels, cabinets, and consoles and equipment shall be shipped. Provide protection for equipment from handling and the environment.

C. Receiving:
1. The contractor is responsible for receiving and proper storage of equipment delivered to the job site.
2. All received items shall be protected from the elements and where required stored in a low humidity environment.
3. Protect materials and equipment against damage in storage and during construction.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Refer to Specification Section 26 29 00 (Manufactured Control Panels) for all control panel enclosure, control component, controller, surge protection device, etc. requirements.

B. Specifications below identify general intent and major system components only. System Integrator shall be responsible providing all system accessories, interconnections, installation, etc. and verifying compatibility of all system components as required to provide a fully-functional/coordinated system.

2.2 SCADA COMPUTER SYSTEMS

A. Modify existing SCADA workstation/server/etc. computer systems as required to accommodate new PLCs, I/O points, remote alarming, trending/historicizing, HMI displays/screens, etc.

2.3 SCADA SOFTWARE:

A. Modify existing SCADA HMI and Development Software systems as required for new I/O, PLCs, radios, etc. , Modify tag count licenses if so required by the project.

B. Modify existing SCADA Alarm Notification System/software as required for remote alarm notification as described in Part 3 below.

2.4 EACH SCADA PLC PANEL SHALL INCLUDE:

A. General construction/materials/devices per Specification Section 26 29 00 (Manufactured Control Panels).

B. 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.

C. Ethernet Switch:
   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) as required by application and/or as shown on network diagrams on plans.

E. Controller Devices
   1. Rockwell CompactLogix 5380 series 5069-L340ER processor, 4MB 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
   2. For PLC Panels at remote pumping/lift station and other similar remote sites:

F. Input/Output modules:
   1. 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:
      a. Discrete Input
      b. Discrete Output
      c. Analog Input

d. Analog Output

2. 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 .
3. 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, System Integrator 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. System Integrator shall provide programming/HMI for all networked points chosen by the owner/engineer for these systems.

G. Ambient Air Temperature Transmitter:
1. Each new SCADA PLC shall be provided with an ambient air temperature transmitter (per Specification Section 27 60 05 requirements) 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 SCADA Integrator.

H. Panel-mounted Thin Client PC and Touchscreen (provide where indicated on Plant Network Diagram on electrical plans):
1. Industrial panel-mounted thin client PC and touchscreen.
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. For PLC Panels at treatment facility sites:
      1) Programmed to match appearance/functionality of SCADA workstations
   b. For PLC Panels at remote pumping station and other similar remote sites:
      1) Programmed with screens as required to clearly display and provide control of parameters for the associated station/facility.
4. Touchscreen:
   a. 19.5” color touchscreen with LED backlight,
   b. NEMA 4X rating,
   c. Rated for operational temperatures of 0 degrees C to 50 degrees C.
   d. HD1080P with 3000:1 contrast ratio
   e. Connectors ars required to coordinate with associated PC/etc.
   f. NEMA 4X stainless steel front mounting bezel
   g. Where located in exterior environments, shall be covered by outer door of panel or fully-collapsible sun shield to fully protect LCD display from UV light when not in use, shall provide side and top shielding when in use. Sun shields

shall be constructed of stainless steel and shall be installed such as to maintain NEMA 4X ratings of enclosures.

h. Hope Industrial HIS-ML19.5-CTTA touchscreen with VB-20A mounting bracket, or equal

5. Industrial PC:
   a. Fanless design.
   b. Rated for operational temperatures of 0 degrees C to 50 degrees C.
   c. 2.1 GHz Dual Core processor with 4GB system memory
   d. Two (2) Mini-DisplayPorts, one (1) GB LAN Ethernet port and four (4) USB 3.0 ports
   e. Logic Supply ML100G-30 PC or equal.
6. Furnished with SCADA HMI and Windows operating system software as required
7. Furnished with wireless/Bluetooth keyboard and optical mouse (stored within pocket within door of PLC), and folding 18”x18” shelf on front of outer door of enclosure (shelf material to match that of enclosure, for example: provide foldable stainless steel shelf for stainless steel panels).

I. 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”.

J. 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. Wireless LAN-connected PLC Panels:
      a. WLAN Master Canopy PLC Panels:
         1) Provide WLAN canopy system including the following components: Phoenix FL WLAN 5101 Ethernet Client Radio, 2.5/5 GHz.
         2) Omni-directional antennae with cabling, grounding, surge protection, mounting kits, interconnections, etc. as required for a fully-functional system.
         3) System shall be capable of communicating on the existing wireless LAN network at the plant, and shall comply with IEEE 802.11g protocol using standard Ethernet TCP/IP protocol data.
      b. See Radio/Wireless System Propagation Studies submittal section above for additional requirements.

K. UPS: Provide UPS with battery-supplied power to operate the system for 10 minutes. Refer to Specification Section 26 29 00 for UPS specification requirements.

L. Provide 20A-120V-1Pole grounding-type GFI receptacle within inner door of panel for convenience (laptop charging, etc.). Receptacle shall be connected upstream of UPS power and shall be protected by a dedicated circuit breaker rated for 10A.

M. Panel surge protection, lighting, HVAC, auxiliary components, etc. shall be provided per Specification Section 26 29 00.

2.5 WIRING

A. Refer to Specification Sections 27 05 00, 26 05 19 and 26 29 00 for requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. SCADA System shall:
1. Measure and monitor discrete and continuous process and process equipment variables (see SCADA Point List on contract plans).
2. Effectively present the process and process equipment variables to the operators allowing them to accurately monitor the status of the processes. Screens/screen shots shall generally be detailed 2 dimensional (with shaded piping, and project-specific side/elevation views of major processes/tanks/equipment).
3. Provide a means for the operators to effectively control the treatment processes, both automatically and manually.
4. Provide historical data acquisition, storage, retrieval, processing, and report generation.

B. The SCADA software shall be developed to include graphics for the proposed project scope. Human-Machine Interface (HMI) software as specified shall be supplied and fully configured by the System Integrator. Reports, graphics displays, real-time trends, function blocks, PID loop control, historical trends, security, alarming, etc. shall be developed by the System Integrator through a collaborative effort between the Engineer, Owner, Contractor and Equipment Suppliers.

C. Where multiple SCADA computers (workstations or servers) are provided, each computer shall be configured as redundant historians (of each other) to provide native, redundant, synchronized historians for the facility.

D. The system shall include all provisions as necessary to provide alarm notification to off-site personnel. The system shall be configured to provide customizable alarm information via text-to-voice phone calls, SMS text messages, emails or pagers as directed/approved by the facility owner. The alarming system shall cascade alarms through a user-editable list of contacts, allowing each user to acknowledge the alarm (and to stop further notifications to other contacts).

E. In general, the operator interface to the system shall be via a hierarchy of graphics screens with “poke points” which will allow operators to navigate the plant facility by facility by simply “clicking” on the poke points with a mouse pointing device. All HMI conventions/graphics shall meet owner’s standards/conventions. Integrator shall fully

review proposed screen conventions with owner prior to submitting screen submittals. HMI standards shall match existing standards for this plant/owner.

1. A "Main Menu" shall be developed and will contain "poke points" to allow navigation to the following major subsystems:
    a. Overall detailed 2-D graphical screen of site(s), showing major structures/processes. Screen(s) shall show shaded piping, and project-specific side/elevation representations of the various equipment/facilities. Screen(s) shall indicate major system parameters such as significant flow/level measurements, system on/off statuses, etc. in a clear manner, but shall not be used for detailed parameter displays.
    b. Separate process-flow diagrammatical representations (with detailed 2-D graphics for each component) for each major process or structure. Screens shall indicate all relevant I/O statuses, and shall allow for control for the given process or structure.
    c. Pop-up style detailed component or process screens (for individual VFDs, analog instruments, PID or setpoint control systems, etc.). These types of component screens shall rely on graphical/diagrammatical displays rather than just text where possible.
    d. Real-time trend displays.
    e. Historical trend displays.
    f. Excel reporting subsystem.
    g. I/O diagnostics test displays.
    h. Current alarms.
    i. Equipment maintenance subsystem.
2. Where possible, real-time trends shall be embedded into the process-flow diagrammatical representations noted above. For example, graphical displays showing tank levels shall include an embedded trend line (within the tank image) to indicate the historical trend for the tank level. Typical/acceptable ranges and alarm ranges should be graphically indicated (by horizontal lines or colored bars as selected by owner) on the trend so that the user can quickly determine if the associated trend is within acceptable range(s). Similar embedded trending graphics shall be provided for other analog values where helpful to the plant operator.
3. The "Main Menu" shall contain dynamic symbols to depict the operational/communications status of each SCADA System panel/network device on the network (i.e. Normal or In Communications Failure).
4. Each new graphic display shall be designed so that an operator may "click" on "poke points" to gain access to any area of the facility (or to remote systems, where applicable) or to the Main Menu. The operator shall also be able to access the Current Alarms Display from any graphic display. Real-time and Historical Trend displays shall be made available from each plant process area via poke points.
5. All new graphics displays of plant areas shall be based upon detailed 2-D graphics as a basis for the display unless noted otherwise. For example, piping shall generally be drawn as grey-scale 2D pipes with fading (from center of pipe to outside edge of pipe), and with flow direction arrows. Motors, pumps, equipment images, etc. shall include similar detail.
6. Color conventions (for ON, OFF, OPEN, CLOSED, and various levels of alarms) used within the HMI shall be per the owner's standards (to be determined during the construction phase of the project). Consideration should be given to simplifying the

color schemes by using bolder colors for alarm conditions than for typical running/off/open/closed conditions.

7. Screen background color (black, grey, white, etc.) shall be as selected by owner. Consideration shall be given to black background color to minimize screen brightness for night operators.
8. Special graphics displays shall be developed by the System Integrator for each process control strategy. These graphics displays shall allow authorized operators to modify control parameters such as set points, operational sequences, etc. Passwords shall be utilized to determine the authorization level of operators.
9. All process alarms shall be categorized by "group" with each group representing a specific area of the plant or distribution system.
10. Graphics screens shall be developed for each major item of process equipment for which equipment runtime or equipment maintenance data is being collected. These graphics screens shall contain all data relative to the piece of equipment including runtime today, runtime since last serviced, total runtime between maintenance intervals. All runtime data shall be maintained by the various programmable logic controllers; not by the HMI software package.
11. All historical process data, such as average flows, hourly minimums and maximums, etc., shall be maintained by the various programmable logic controllers; not by the HMI software package.

3.2 TESTING

A. General
   1. All elements of the hardware and software shall be tested to demonstrate that the total system satisfies all of the requirements of this specification.
   2. As a minimum the testing shall include the following:
      a. Unwitnessed Factory Test (UFT)
      b. Operational Readiness Test (ORT)
      c. Functional Acceptance Test (FAT)
   3. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsection's producing the correct result (effect), the specific test requirement will have been satisfied.

B. Unwitnessed Factory Test (UFT)
   1. Prior to start of the witnessed Factory Demonstration Tests, the entire system shall be inspected and tested at the system supplier's factory to ensure that it is fully operational and ready for demonstration testing.
   2. All panels, consoles and assemblies of the System shall be inspected and tested to verify that they are in conformance with related submittals and these specifications.

C. Operational Readiness Test (ORT)
   1. General: Prior to start-up, the entire installed System shall be certified (inspected, tested and documented) that it is ready for operation. These inspections and tests shall include Loop/Component Inspections and Tests and a repeat of the Factory Demonstration Tests.

D. Functional Acceptance Test (FAT)

1. The entire SCADA System shall be tested on-site to demonstrate that it is operational and in conformance with these specifications.
2. Tests shall demonstrate specified functions, both hardware and software, to the satisfaction of the owner.

3.3 TRAINING

A. General
1. Provide an integrated training program for the owner's personnel at the jobsite. Tailor the training program to meet the specific needs of the Owner's personnel. Include training sessions, classroom and field, for managers, engineers, operators and maintenance personnel.
2. The training shall be carried out by technically competent and experienced instructors
3. The Owner shall have the right to make and reuse video tapes of all of the onsite training sessions.
4. One eight (8) hour day shall be provided on site for owner and or engineer selected attendees.

END OF SECTION 27 60 00

SECTION 27 60 05 – SCADA INSTRUMENTATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work included: Provide a complete system of instrumentation and controls with appurtenant equipment and accessories as indicated, specified, and as necessary for a complete and proper operating system.
   1. Work includes, but not necessarily limited to, the following:
      a. All engineering, hardware and software development, installation, startup, ranging, calibration services and supervision necessary.
      b. Testing and operational demonstrations as specified.
      c. Training programs as specified.
      d. Preparation of manuals.

B. Related work:
   1. Documents affecting work of this Section include, but are not necessarily limited to, General Specifications, Special Provisions, and all other related Sections.
   2. Refer to Specification Section 27 60 00 for additional SCADA System requirements.
   3. Refer to plans for point lists and additional device requirements.

1.2 QUALITY ASSURANCE

A. Where not specifically allowed or required otherwise by contract documents, all instrumentation and related equipment specified within this section shall be furnished by the SCADA Integrator for the project for proper system coordination.

B. Contractor:
   1. Shall be fully and solely responsible for the work of the systems supplier and solely responsible to the Owner for having supplied to the Owner the complete integrated SCADA system.
   2. To provide personal superintendence and direction of the work, maintaining and supplying complete supervision over and coordination between all subcontractors employed by him and the Instrumentation and Control System Integrator.
   3. To be responsible for defining the limits of his subcontractor's work.
   4. To be responsible for setting of instruments (including alarms, etc. as provided under other sections).

C. Provide Operation and Maintenance manuals
   1. Operating instructions shall incorporate a functional description of the entire system, including the system schematics which reflect “as-built” modifications.
   2. Special maintenance requirements particular to the system shall be clearly defined along with special calibration and test procedures.
   3. As part of the operation and maintenance manuals, provide one hard copy of the program used to program the programmable logic controller.

1.3 WARRANTY

A. Systems supplier shall furnish a hardware and software warranty for the system starting at substantial completion and ending one year from this date.

1.4 REFERENCES

A. Instrument Society of America (ISA) PR7. 1, Pneumatic Control Circuit Pressure Test, Tentative Recommendation Practice.

B. Instrument Society of America (ISA) S5.4, Instrument Loop Diagrams, standard.

C. National Electrical Manufacturers Association (NEMA) Publication, General Standards for Industrial and Control Systems, ICS 1 and Industrial Controls and Systems ICS2.

1.5 SUBMITTALS

A. General/System submittal requirements:
   1. Provide submittal (quantity as required by contract) of:
      a. Component manufacturing data sheets indicating pertinent data and identifying each component (including all instruments, surge protection devices, antennae, sun/rain shields, etc.) by tag number and nomenclature as indicated on drawings and in specifications.
      b. Component drawing showing dimensions, mounting, and external connection details,
      c. List of all spare parts. All manufacturers recommended spare parts shall be provided in addition to required spare parts.
   2. Identify any specification section where exceptions are being taken or an "or equal" piece of hardware is being proposed.
   3. A Bill of Materials shall be included with catalog information on all components.
   4. Information shall be included on any proprietary logic component sufficient to demonstrate its ability to perform the required functions.

B. Instrumentation/Field Device submittal requirements:
      a. Manufacturer’s product data sheets
      b. Job-specific model numbers for each instrument/field device
      c. Job-specific ranges/setpoints/etc. proposed for each instrument/field device

1.6 DELIVERY, STORAGE AND HANDLING:

A. Packing and Labeling:
   1. Prior to shipment, each component shall be tagged to identify its' location, tag number, and system function. Identification shall be prominently displayed on the outside of the package.
   2. Firmly attach permanent stainless-steel, or other durable non corrosive tag to the equipment. Mark tags with the instrument tag number shown in the Instrumentation Data Sheets and/or Instrument drawings.

B. Delivery:

1. Following completion of shop assembly, factory test, and successful submittal of all equipment information (without requirement for resubmittal), equipment shall be shipped. Provide protection for equipment from handling and the environment.

C. Receiving:
1. The contractor is responsible for receiving and proper storage of equipment delivered to the job site.
2. All received items shall be protected from the elements and where required stored in a low humidity environment.
3. Protect materials and equipment against damage in storage and during construction.

PART 2 - INSTRUMENTATION

2.1 GENERAL

A. All equipment and materials shall be new, unused and proved by previous use of similar products to be completely suitable for the service intended.

B. All of the equipment shall be the manufacturer's latest and proven design. Specifications and drawings call attention to certain features but do not purport to cover all details entering into the design of the system. All accessories, hardware, etc. shall be provided as required for a fully functional system. The completed system shall be compatible with the functions required and other equipment furnished by the Contractor.

C. All electrical components of the system shall be powered by 120V, single phase, 60 cycle current or 24VDC loop-powered from control panel, except as otherwise indicated or specified.

D. Cable lengths between sensors/elements and associated transmitters shall be as required by application. Contractor shall coordinate lengths and types of all sensor cables with the associated sensor supplier prior to bid and shall provide cable lengths/types as required.

2.2 RADAR LEVEL TRANSDUCERS WITH REMOTE TRANSMITTERS

A. General:
1. Scope -This section describes the requirements for a radar level transmitter with a remote, 4-wire (120V-powered) transmitter.
2. Basic System Description
a. The transducer shall utilize non-contacting 80GHz radar technology to determine the distance between the transducer(s) and monitored surface(s), as a basis for display, output, and digital communication.
b. The level/flow monitoring system shall consist of a remote, 120VAC-powered microprocessor-based level transmitter.

B. Technical Specifications:
1. Signal Processing - The level transducer/transmitter shall:

a. Employ a radar transceiver suitable for providing excitation to, and processing resultant signals from the attached radar transducer.
b. Create a digitized echo profile, and apply echo processing techniques to select and verify the echo representing the reflective surface monitored.
c. Calculate the distance between the transducer face and reflective surface based on the echo selected. The calculated distance shall be converted to represent material level.
d. Include configuration and calibration ability via integral keypad with non-volatile EEPROM memory to store user-programmed configuration.

2. Process Control Functions - The remote level transmitter shall provide an assortment of process control functions that may be user implemented in any allowable combination.
   a. Standard Process Control Functions
      1) Loop-powered 4–20 mA Hart output directly / inversely proportional to level.
      2) Loss of Echo or Cable Fault alarm
      3) Basic failsafe operation on measurement loss
3. User Interface - The remote level transmitter shall display measured variable (level) on the main backlit LCD display along with associated units, and shall enable user access to read only and read/write enabled data, using any of the following methods:
   a. Direct or scroll access to data stored in numerical parameters, using the graphic LCD display.
   b. Wireless connection via Bluetooth using free software/app from manufacturer.
4. Detailed Specifications:
   a. Transmitter Power:
      1) 120VAC
   b. Transducer Enclosure:
      1) PVDF wetted parts
      2) Shall be rated for hazardous areas (via either hazardous device rating and/or intrinsically safe wiring as applicable) per code requirements when installed in classified/hazardous areas.
   c. Remote Transmitter Enclosure:
      1) IP66/67, NEMA type 4X enclosure
   d. Transducer Process Temp.:
      1) -40 to 80°C
   e. Remote Transmitter Ambient Temp.:
      1) -20 to 60°C (readable)
   f. Remote Transmitter Display
      1) Back lit LCD, multi-line, 89mm x 56mm display
   g. Process Control I/O - The remote level transmitter shall provide:
      1) One (1) 4-20mA HART analog signal output, directly or inversely proportional and scalable to the configured process variables, (dependent upon the transmitter model), capable of driving a 500 ohm load.
      2) Three (3) 250VAC/60VDC dry contact relay outputs (can be configured for pump control, high level alarm, low level alarm, failsafe, etc.)
   h. Ranges: Up to 15m / 49.21ft unless required otherwise on plans or directed otherwise directed by Civil Engineer.

5. Accessories:
    a. Provide instrument/range as required by application and as recommended by manufacture for the proposed application (distance, material measured, mounting arrangement, etc.).
    b. Stainless steel mounting bracket/hardware or blind flange mounting assembly for transducer as recommended by manufacturer.
6. Execution:
    a. Supplier shall be responsible for verifying the suitability for the proposed application prior to submitting shop drawings.
    b. Maintain minimum separation between transducer and maximum process material level as recommended by manufacturer.
    c. Mount transducer to ensure a clear path from the transducer to the process material surface.

C. Manufacturer/ Model:
1. Vega VegaPuls C21 series radar transducer with remote Vega VegaMet 841 transmitter/controller with accessories/options as indicated above.

2.3 POLYPROPYLENE FLOAT SWITCHES

A. Standard Specifications:
1. Chemical Resistant polypropylene casing.
2. Suspended type unit with built-in weight.
3. Enclosed/encapsulated mercury SPST switch rated for 100VA at up to 250V. N.O. and N.C. contacts shall be provided, and shall be connected as indicated on wiring diagrams or required by application, coordinated by contractor and equipment supplier.
4. Complete with factory-installed PVC-jacketed STO cable designed for industrial duty, length as required to be extended to contractor-furnished termination point.

B. Execution:
1. Install float switches at heights as directed by civil engineer at locations that do not risk damage to the float switches.
2. Contractor shall provide corrosion resistant junction box or other termination point above high water level for splicing cables furnished with float switch(es) to cables furnished by contractor. Provide cord connectors at base of junction box (or similar) and stainless steel Kellems cord grips for proper strain relief of all float switch cables.

C. Manufacturer/ Model: Anchor Scientific Roto-Float Type S with hardware/accessories as described above, or equal. Normally-open/normally-closed contact types shall be coordinated by supplier and shall be as required by application.

2.4 AMBIENT AIR TEMPERATURE TRANSMITTERS

A. Interior/Dry Locations:
1. Standard Specifications:
    a. Panel-mounted to panel exterior (where on control panel/PLC panel), or outlet-box mounted.

b. 1000 Ohm platinum RTD
c. With integral transmitter for 4-20mA loop-powered output (2-wire instrument)
d. Display: 4 Digit LED
e. Labeling: Supplier/integrator shall provide engraved nameplate to read "AMBIENT TEMPERATURE TRANSMITTER"
f. Housing: Splash resistant faceplate with rear gasket seal
g. Temperature Range: -40 to 180 degrees F (scaled to 4mA = -13 degrees F and 20mA = 167 degrees F)
h. Accuracy: ±0.5 ºF (±0.3 ºC) at 77 ºF (25 ºC)

2. Acceptable Manufacturers: Devar d-RTTI

B. Wet/Process/Exterior Locations:
1. Standard Specifications:
a. NEMA 4X enclosure
b. 1000 Ohm platinum RTD
c. With integral transmitter for 4-20mA loop-powered output (2-wire instrument)
d. Display: 4 Digit LED
e. Labeling: Supplier/integrator shall provide engraved nameplate to read "AMBIENT TEMPERATURE TRANSMITTER"
f. Housing: Splash resistant faceplate with rear gasket seal
g. Temperature Range: -40 to 180 degrees F (scaled to 4mA = -13 degrees F and 20mA = 167 degrees F)
h. Accuracy: ±0.5 ºF (±0.3 ºC) at 77 ºF (25 ºC)
2. Acceptable Manufacturers: Devar d-RTTI-N4

2.5 SUN/RAIN SHIELDS

A. General:
1. Sun/Rain Shields shall be:
a. Furnished for all instruments that will be exposed to sun or rain (or where otherwise specifically noted).
b. Furnished by instrumentation supplier.

B. Standard Specifications:
1. Unless specified otherwise, sun/rain shields shall:
a. Have minimum dimensions of 24" wide X 24"high X 6" projection past front of associated instrument. Sun/Rain shields shall be sufficiently sized to accommodate instrument(s) plus associated surge protection device(s), power supplies, and other similar devices.
b. Have top and sides formed of single sheet 10 gauge aluminum.
c. Have back formed of single sheet 10 gauge aluminum tack-welded to top and sides to form a waterproof connection.
d. Have all exposed corners and edges grounded to be smooth and round.

C. Execution:
1. Sun/rain shields shall:
a. Be mounted corrosion resistant stainless steel mounting hardware

b. Include hardware as required to provide a minimum of ¾" separation between instrument (and other similar devices) and back of sun/rain shield.
c. Be mounted to wall, handrail, pipe or other similar supporting structure.

2.6 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 all field instrumentation connected to process piping or where part of circuitry extends outside building(s), as described below:
1. Analog Instruments::
a. Provide surge protection device(s) at power and analog circuit connections to the instrument equipment.
b. At 2-wire, loop-powered instruments, surge protection device shall:
1) Be of stainless steel, pipe-mounted, IP67 construction, nipple-mounted at the instrument as directed by the device supplier.
2) Have 10kA total nominal discharge current per line (based on 8/20µs waveform).
3) Have maximum continuous operating voltage (MCOV) rating as required by the associated signal.
4) Be Dehn DEHNpipe series or equal by MTL Technologies.
c. At 4-wire, separately-powered instruments, surge protection device(s) shall:
1) Be mounted within one (1) appropriately-sized NEMA 4X enclosure with viewing window at the field device.
2) Be of DIN-rail mountable construction.
3) Have 10kA total nominal discharge current per line (based on 8/20µs waveform) for the analog signal.
4) Have 15kA total nominal discharge current per line (based on 8/20µs waveform) for the power input.
5) Have maximum continuous operating voltage (MCOV) rating as required by the associated signal/power circuit(s).
6) Be one of the following:
a) Edco SLAC series
b) Dehn Blitzductor XT series (for the analog signal) plus Dehn DEHNguard series (for the power input), combined into (1) overall NEMA 4X enclosure.

C. Installation and grounding of suppressor: As directed by manufacturer. Provide coordination and inspection of grounding.

PART 3 - EXECUTION

3.1 INTERFACE REQUIREMENTS

A. The instrumentation supplier shall forward submittals clearly identifying all instrumentation interface requirements (inputs/outputs, network connections, register locations for network connections, loop power source requirements, etc.) to the supplier

of the associated control and monitoring system, or SCADA system, prior to construction of the associated control and monitoring panels, PLC's, RIO's, RTU's, etc.

3.2 IDENTIFICATION AND LABELING:

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

3.3 INSTALLATION

A. All equipment shall be installed in accordance with the manufacturer's recommendations.

B. All mounting hardware shall be of corrosion resistant material unless noted otherwise. In exterior or typical process areas, mounting hardware shall be type 316 stainless steel. In extremely corrosive areas (Chlorine rooms, Fluoride rooms, etc.), mounting hardware shall be of non-metallic construction as recommended by the equipment supplier.

3.4 CALIBRATION

A. All instruments provided, relocated or modified within the project shall be calibrated and ranged by a factory-trained representative to the range specified by the process engineer.

B. All calibration procedures shall be implemented using equipment meeting NIST standards.

C. Calibration sheets shall be used to record all applicable calibration settings and calibration equipment data, and to indicate certification of traceability to National Institute of Standards and Technology (NIST) standards.

3.5 TESTING

A. General
   1. All elements of the instrumentation system shall be tested to demonstrate that the total system satisfies all of the requirements of this specification.
   2. As a minimum the testing shall include the following:
      a. Operational Readiness Test (ORT)
      b. Functional Acceptance Test (FAT)
   3. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsection's producing the correct result (effect), the specific test requirement will have been satisfied.

B. Operational Readiness Test (ORT)
   1. General: Prior to start-up, the entire installed instrumentation system shall be certified (inspected, tested and documented) that it is ready for operation.

C. Functional Acceptance Test (FAT)
   1. The entire instrumentation system shall be tested on-site to demonstrate that it is operational and in conformance with these specifications.

2. Tests shall demonstrate specified functions, calibration and ranging to the satisfaction of the owner.

3.6 TRAINING

A. General
1. Provide an integrated training program for the owner's personnel at the jobsite. Tailor the training program to meet the specific needs of the Owner's personnel. Include training sessions, classroom and field, for managers, engineers, operators and maintenance personnel.
2. The training shall be carried out by technically competent and experienced instructors
3. The Owner shall have the right to make and reuse video tapes of all of the onsite training sessions.
4. A minimum of one eight (8) hour day shall be provided on site for training owner and or engineer selected attendees.

3.7 SPARES:

A. A quantity of spare surge protection devices for field instruments equal to 25% of the quantity specified of each type, or one of each type (whichever is greater) shall be provided. For example, a system with surge protection devices for two (2) loop-powered 2-wire field instruments and nine (9) 120V-powered 4-wire field instruments shall be provided with one (1) spare surge protection device for loop-powered 2-wire field instruments and three (3) spare surge protection devices for 120V-powered 4-wire field instruments.

3.8 SYSTEM DOCUMENTATION:

A. Upon completion of the installation, the instrumentation supplier shall provide full documentation sets (quantity as required by other specification sections) to the owner for approval. Documentation shall include:
1. A record set of all information submitted prior to installation.
2. Records of all calibration sheets described above.

3.9 FINAL ACCEPTANCE & SYSTEM CERTIFICATION:

A. Completion of the installation, in-progress and final inspections, receipt of the system documentation, and successful performance of the instrumentation system for a two week period will constitute acceptance of the system.

3.10 WARRANTY:

A. The contractor shall fully warrant the completed instrumentation system to be free from inherent mechanical and electrical defects for a period of one (1) year from the date of final acceptance.

END OF SECTION 27 60 05

EQUIPMENT SPECIFICATIONS

SPECIFICATION
FOR
ALL EQUIPMENT

SECTION 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.

Other 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. **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 manufacturer listed in the specification for the equipment. 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 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, uni-strut, hardware, components, and appurtenances, attachments, etc., shall be stainless steel or aluminum (unless specifically indicated otherwise) and shall be corrosion resistant for the application/environment. . Provide non-metallic components where noted and/or required based on the specific application (e.g., specific chemical environments). Coated steel components are only permitted where specifically noted.

All pipe hangers, uni-strut, hardware, components, and appurtenances, attachments, etc., shall be stainless steel or aluminum (unless specifically indicated otherwise) and shall be corrosion resistant for the application/environment. . Provide non-metallic components where noted and/or required based on the specific application (e.g., specific chemical environments).

Orient all flowmeters, pressure gauges, light, and other instrumentation, etc. such that is it 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.

The Contractor, the electrical subcontractor, and the equipment suppliers shall carefully coordinate in detail and fully cooperate with the SCADA system vendor/supplier during all phases including submittals, construction, wiring terminations, startup, and testing. Manufacturers of equipment control panels and the electrical subcontractor shall provide all termination point numbers and data registries as required to the SCADA system vendor during the submittal process and construction to allow complete coordination and integration into the SCADA system. The Contractor shall, with the assistance of the SCADA system vendor, completely test and clearly demonstrate that all equipment included in the project communicates properly with the SCADA system. This communication shall include, but not be limited to, receiving and sending all the intended information (including all inputs, outputs, and alarms) to and from the SCADA system and responding properly to all control signals sent from the SCADA system. The Contractor and Equipment Manufacturer shall simulate alarms and signals as necessary and to the satisfaction of the Owner during equipment startup and testing. The Contractor shall use his electrical subcontractor, equipment suppliers, and others as needed to demonstrate full compliance. Where any issues occur (regardless of whose fault), the Contractor shall perform re-testing as needed to demonstrate proper and reliable functionality. These requirements related to coordination with the SCADA system are in full effect regardless of whose scope includes the SCADA system work.

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 insure 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 will 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. Strictly adhere to anchor bolt installation instructions including but not limited to hole diameter, thorough and complete cleaning of anchor bolt hole, epoxy resin storage, and temperature of epoxy resin and the hole in which it will be installed.

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 the manufacturer's 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 insure 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 manufacturer 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.

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
SUBMERSIBLE SEWAGE PUMPS

SECTION 2

1.0 GENERAL

The Contractor shall furnish and install four (4) submersible non-clog sewage pumps specified below and as generally shown on the plans. Each pump assembly shall be furnished with an integral submersible 60 hertz electric motor suitable for operation on the voltage shown in the plans; a mating cast iron discharge elbow connection assembly with anchor bolts, dual 3" stainless steel guide bars, upper and intermediate (as required due to overall length) guide bar bracket(s), adequate length of properly rated 316 stainless steel lifting chain, monitoring relay(s)/base unit (mini-cas relays or other pump manufacturer equivalent), and adequate length of hypalon jacketed type SPC cable, P-MISHA approved and sized according to N.E.C. and ICEA standards; and all other appurtenances required for a complete pump installation in accordance with the plans and specifications. The cable shall be rated for continuous exposure to direct sunlight. Pump assemblies shall be manufactured by ITT-Flygt Company or equal.

The pump assemblies shall be as follows and shall be suitable for operation with variable frequency drives and shall be capable of producing the following at 100% speed:

Pump #1:

Flygt Model:	NP 3171 LT3~615 Explosion Proof
Primary Design Point	2800 GPM @ 18' TDH (75% Eff)
NPSHR @ Primary Design Point	17.8
Motor Voltage	460 Volt
Horsepower (minimum)	25 HP
Discharge Connection	10 inches
Maximum Pump Speed at 60 Hz	1160 RPM
Minimum Solid Passing Size	3.00 inches
Allowable Starts/Hour	30

The pump shall also be capable of producing the following conditions by changing only the speed of the pump motor utilizing a variable frequency drive.

<u>Reduced Speed Conditions (40 Hz +/-)</u>	
Secondary Design Point	1820 GPM @ 8' TDH (75% Eff)
Maximum Allowed Pump Dimension Perpendicular to Discharge Flange:	26-5/8”

Pumps #2, #3, & #4:

Flygt Model:	NP 3202 LT3~619 Explosion Proof

Primary Design Point	3880 GPM @ 22.2' TDH (75% Eff)
NPSHR @ Primary Design Point	21.6
Motor Voltage	460 Volt
Horsepower (minimum)	45 HP
Discharge Connection	12 inches
Maximum Pump Speed at 60 Hz	1170 RPM
Minimum Solid Passing Size	3.00 inches
Allowable Starts/Hour	30

The pump shall also be capable of producing the following conditions by changing only the speed of the pump motor utilizing a variable frequency drive.

Reduced Speed Conditions (40 Hz +/-)	
Secondary Design Point	2400 GPM @ 10' TDH (75% Eff)

Maximum Allowed Pump Dimension Perpendicular to Discharge Flange:	31-1/2”

Note that the “Maximum Allowed Pump Dimension Perpendicular to Discharge Flange” is an important parameter because the pumps must fit through existing openings whose widths cannot be increased. The pumps shall be suitable for operation in a wet well with widely varying flowrates and water levels. The pump performance must be acceptable over a wide range of hydraulic conditions. Drawings and performance curves shall be submitted to the Engineer for approval. The pumps shall be shipped fully assembled to the job site. The motors shall be megged before start-up. Any motor showing insulation weakness shall be promptly replaced at no additional cost to the Owner.

The pump supplier shall carefully coordinate the guide rail mounting bracket with the actual surface inside the hatch to provide the right dimensions such that the pump can be easily installed and slide straight down the guiderails and likewise be removed by simply pulling the pump straight up the guiderails.

The pump manufacturer's standard drawings shall show a minimum water level not exceeding 24-inches above the wet well floor.

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.

2.0 SUBMERSIBLE PUMP CONSTRUCTION

The pumps shall be capable of handling raw, unscreened sewage without clogging. The discharge elbow connection assemblies with sizes as shown in the drawings shall be permanently installed in the wet well, along with the discharge piping. The pumps shall be automatically connected to the discharge connection when lowered into place and shall be easily removed for inspection or service. There shall be no need for personnel to enter pump well. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. The entire weight of the pump unit shall be guided by no less than two guide bars and pressed tightly against the

discharge connection assembly to create a durable, watertight seal with metal-to-metal contact. A sliding guide bracket shall be an integral part of the pump unit. Sealing of the discharge interface by means of a diaphragm, 0-ring, or other devices will not be acceptable. No portion of the pump shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

The pump shall be designed for and suitable for use in raw sewage and be able to pass 3 inch solids. The pumps shall not clog when pumping raw sewage containing rags and other debris, etc., often found in unscreened sewage. Major pump components shall be of gray cast iron, Class 35B, with smooth surfaces devoid of porosity, blow holes, and other irregularities. Where watertight sealing is required, 0-rings made of nitrile rubber shall be used. All exposed nuts and bolts shall be of stainless steel 304. All metal surfaces coming into contact with the pumped media or sewage (other than the stainless steel components) shall be protected by an approved factory applied, sewage resistant coating. Pump exterior shall be sprayed with an acrylic dispersion zinc phosphate primer with polyester resin paint finish on the exterior of the pump equal to or better than Flygt's coating system. The pump paint system shall meet or exceed the requirements included in the Project's Painting Specifications.

Sealing design for the pump/motor assembly shall incorporate machined surfaces fitted with Nitrile (Buna-N) rubber O-rings. All critical mating surfaces where a watertight seal is required shall be machined and fitted with Nitrileor Viton rubber O-rings. Fitting shall be such that sealing is accomplished by metal-to-metal contact between machined surfaces. This will result in controlled compression of nitrile rubber o-rings without the requirement of a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical O-rings, grease or other devices shall be used.

The pump shall be equipped with an open stainless steel lifting hoop suitable for attachment of standard chain fittings, or for hooking from the wet well surface. The stainless-steel hoop shall be rated to lift a minimum of four times the pump weight.

The cable entry design shall not require a specific torque to insure a watertight and submersible seal. The cable entry shall consist of cylindrical elastomer grommets, flanked by stainless steel washers. A cable cap incorporating a strain relief and bend radius limiter shall mount to the cable entry boss, compressing the grommet ID to the cable while the grommet OD seals against the bore of the cable entry. The junction chamber shall be isolated and sealed from the motor by means of sealing glands. Electrical connections between the power cables and motor leads shall be made via a compression or post type terminal board, allowing for easy disconnection and maintenance. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.

Each unit shall be provided with an integral closed loop motor cooling system. A motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F. (40°C.). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

The motor shall be capable of operating, completely submerged, partially submerged, or unsubmerged. The motor shall utilize an integrated glycol-based cooling system that enhances heat transfer and allows the motor to operate at full rated power continuously without the need for de-rating or reduced duty cycle.

The factory installed closed loop cooling system shall be adequately designed to allow the motor to run continuously under full load while in an unsubmerged or minimally submerged condition. A cooling jacket shall surround the stator housing, and an environmentally safe non-toxic propylene glycol solution shall be circulated through the jacket by an axial flow circulating impeller attached to the main motor shaft. The coolant shall be pumped through an integrated heat exchanger in the base of the motor whenever the motor is running, allowing excess heat to be transferred to the process liquid. Cooling systems that circulate the pumped medium through the cooling jacket, or those that use a toxic cooling liquid shall not be acceptable. The use of external heat exchangers, fans, or the supply of supplemental cooling liquid shall not be required. The glycol cooling system shall allow these pumps to operate at low rpm and low wet well level – which is important for this application - without concern regarding overheating.

Each pump shall be equipped with a triple seal system consisting of tandem mechanical shaft seals, plus a radial lip seal; providing three complete levels of sealing between the pump wet end and the motor. The mechanical seal system shall consist of two totally independent seal assemblies operating in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The mechanical seals shall be of non proprietary design and shall be manufactured by a major independent manufacturer specializing in the design and manufacture of mechanical seals. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary industrial duty solid silicon-carbide seal ring and one rotating industrial duty solid silicon-carbide seal ring. The stationary ring of the primary seal shall be installed in a seal holding plate of gray cast iron ASTM A-48, Class 35B. The seal holding plate shall be equipped with swirl disruption ribs to prevent abrasive material from prematurely wearing the seal plate. The upper, secondary seal unit, located between the lubricant chamber and the sensing chamber, shall contain one stationary industrial duty solid silicon-carbide seal ring, and one rotating one rotating industrial duty solid silicon-carbide seal ring. Each seal interface shall be held in contact by its own spring system. A radial lip seal shall be positioned above the sensing chamber, preventing any liquid which accumulates in the sensing chamber from entering the lower bearing and motor. The seals shall not require routine maintenance, or adjustment, and shall not be dependent on the direction of rotation for proper sealing. Each pump shall be provided with a lubricant chamber for the shaft sealing system which shall provide superior heat transfer and maximum seal cooling. The lubricant chamber shall be designed to prevent overfilling, and to provide lubricant expansion capacity. The drain and inspection plug shall have a positive anti-leak seal and shall be easily accessible from the outside of the pump. The seal system shall not rely upon the pumped media for lubrication and shall not be damaged when the pump is run dry. Lubricant in the chamber shall be environmentally safe non toxic material.

The pump shaft and motor shaft shall be an integral, one piece unit adequately designed to meet the maximum torque required at any normal start-up condition or operating point in the system. The shaft shall have a full shutoff head design safety factor of 1.7, and the maximum shaft deflection shall not exceed .05 mm (.002 inch) at the lower seal during normal pump operation. Each shaft shall be stainless steel AISI 420 material and shall have a

polished finish with accurately machined shoulders to accommodate bearings, seals and impeller.

The impeller shall be of gray cast iron, ASTM A-48 Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design capable of passing a minimum 3 inch solid sphere. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft by a stainless-steel bolt which is mechanically prevented from loosening.

The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have integral spiral-shaped, sharp-edged groove(s) that is cast into the suction cover. The spiral groove(s) shall provide the sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute.

3.0 MOTOR DESIGN

The pump motor shall be premium efficiency motor housed in a water tight gray cast iron, ASTM A-48, Class 35B enclosure capable of continuous submerged operation underwater to a depth of 65 feet and shall have an IP68 protection rating. The motor shall be of the squirrel-cage induction design, NEMA type B, Premium Efficiency housed in an air filled, watertight chamber. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable.

The motor shall be rated for inverter duty and shall operate properly with a VFD. The motor shall be designed for continuous duty at widely varying or constant (minimum or maximum) speeds controlled by a VFD. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and intermittently up to 50°C (122°F). The motor shall be capable of handling up to 30 evenly spaced starts per hour without overheating. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board shall be sealed off from the motor and the stator housing by an elastomer compression seal (o-ring). Connections between the cable conductors, stator leads, power, and pilot sensor cables shall be made with threaded compression type binding posts permanently affixed to a terminal board and thus perfectly leak proof. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall have a NEMA Class A temperature rise, providing cool operation under all operating conditions. The Premium Efficiency Motor shall be FM and CSA approved for use in NEC Class I, Division I, Groups C & D hazardous locations. The surface temperature rating shall be T3C. The motor shall meet the requirements of NEMA MG1 Part 30 and 31 for operation on PWM type Variable Frequency Drives. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. The chart shall also include data on starting current and torque.

The pump power cable shall be shielded and fully rated for variable frequency drives. As a minimum, it shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without requiring splices. The outer jacket of the cable shall be oil, water, and UV resistant, and shall be capable of continuous submerged operation underwater without loss of watertight integrity to a depth of 65 feet. The pump cable will be exposed to sunlight and therefore superior UV resistance is important.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

Each phase of the motor shall contain a normally closed bi-metallic temperature monitor switch embedded in the motor windings. These thermal switches shall be connected in series and set to open at 140°C +/- 5°C (284°F).

A minimum of two thermal sensors shall be embedded in the stator winding end coils. These sensors shall be wired to the control panel to provide a high stator temperature shutdown signal in conjunction with the external motor overload protection.

A minimum of one float leakage sensors (FLS) shall be provided to detect the presence of water in the stator chamber and junction chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. Use of voltage sensitive solid state sensors shall not be allowed.

A solid-state relay (mini-cas or other pump manufacturers brand) shall be provided by the pump manufacturer and mounted in the pump control panel to send a low voltage, low amperage signal to the probe, continuously monitoring the conductivity of the liquid in the sensing chamber. If sufficient water enters the sensing chamber through the mechanical seal system, the probe shall sense the increase in conductivity and signal the solid state relay in the control panel. The relay shall then energize a warning light on the control panel, or optionally, cause the pump shut down. This system shall provide an early warning of mechanical seal leakage, thereby preventing damage to the submersible pump, and allowing scheduled rather than emergency maintenance.

The minimum L_{10} bearing life shall be 50,000 hours at any usable portion of the pump curve.

4.0 EXPLOSION PROOF CONSTRUCTION

All equipment installed in or exposed to the wet well (pump sump) environment shall be constructed to meet explosion proof requirements for use in hazardous locations defined as Class 1, Division 1, Groups C and D (gasses and vapors), Class 2, Division 1,

Groups E and G (dusts), Class 3, Division 1, (fibers and flyings). All equipment shall be approved and labeled by Factory Mutual Systems or other engineer approved firm.

5.0 ACCESSORIES

The Contractor/pump manufacturer shall furnish a stainless steel upper guide holder and level/float sensors cable holder. The upper guide holder shall be coordinated with the proposed opening. Provide a custom stainless steel holder or stainless steel adaptor if needed to provide the proper standoff from the concrete or hatch opening to the required location of the guiderails. Lower guide bar holders shall be integral with the discharge connection. Guide bars shall be of at least Schedule 40 stainless steel pipe of the size suggested by the manufacturer (3" diameter minimum) and shall not support any portion of the pump weight. The pump manufacturer shall provide the guide bars.

In order to minimize difficulty in removing the submersible pumps specified herein, the manufacturer shall provide a stainless lifting chain system. The system shall enable the operator to either remove the pump completely from the well in one lift or to remove it in a series of lifts. Short sections of stainless steel chain (not exceeding 4') connected by larger stainless steel intermediate tie off rings shall be provided by the pump manufacturer or the pump supplier in order to achieve a workable, tested system. The entire lifting system shall be stainless steel and shall be rated for overhead lifting. The rating working lifting capacity shall be at least three times the maximum weight of the pump and chain. All components shall be corrosion proof. The supplier shall furnish data to the Engineer verifying the design and satisfactory operation of the lifting system.

6.0 WARRANTY AND TESTING

The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory:

(a) Impeller, motor rating and electrical connections shall first be checked for compliance to all these specifications and the customer's purchase order.

(b) A motor and cable insulation test for moisture content or insulation defects shall be made.

(c) Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

(d) The pump shall be run for 30 minutes submerged, a minimum of six feet under water.

(e) After operational test d., the insulation test b. is to be performed again.

A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment upon request.

The service of a factory authorized technician with 10-years minimum experience satisfactory to the Owner shall inspect the installed equipment, start-up the equipment, train the operators, and issue a written Certification of Proper Installation and Start-Up on a form furnished by the Owner.

Drawdown testing shall be conducted to determine the pump capacity and performance. The Contractor shall provide the water for drawdown testing. The testing shall be performed in accordance with procedures established by the Engineer. The testing shall be repeated until consistent results satisfactory to the Engineer are achieved. If a pump does not produce its rated capacity and specified performance, it shall be replaced at no additional cost to the Owner.

The pump manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of five years or 10,000 hours. The manufacturer shall supply the required number of submittal drawings, operation and maintenance instruction manuals and parts list as required in the General Specifications.

The pump shall be tested at the site upon start-up and voltage, current, and other significant parameters (including but not limited to flow and head) shall be recorded. The manufacturer shall provide a formal test procedure and forms for recording data. Only factory certified service personnel shall perform start-up service. Proof of certification shall be required prior to equipment approval.

SPECIFICATION
FOR
TERTIARY PACKAGE CLOTH MEDIA DISK FILTER

SECTION 3

PART 1 GENERAL

1.01 CLOTH MEDIA DISK FILTER

A. The design, drawings, and specifications are based on two (2) Model ADFSP-54 x 14/10E-PC AquaDisk filters as offered by Aqua-Aerobic Systems, Inc., of Loves Park, Illinois. The filters shall be factory tested and ready for operation. The Contractor shall furnish all labor, materials, equipment and incidentals required for installation of the filter tanks as shown on the drawings, as specified herein, or as needed for a complete and properly operating system.

The Filter system manufacturer shall be solely responsible for the proper design and proper manufacturing of the entire Filter System including all equipment described in this specification and all required components, controls, and all miscellaneous items, etc. The Filter System shall be operator friendly, trouble-free, and safe to operate and maintain.

B. Each unit shall be provided with all components needed for proper operation and shall include the following general components as a minimum:

1. Tank Assembly
2. Drive Assembly
3. Centertube Assembly with Cloth Media Disks
4. Backwash System
5. Backwash/Waste Pump Assemblies
6. Valves
7. Pressure Transmitter
8. Float Switch
9. Vacuum Transmitter
10. Electrical Controls with Internal Components
11. Scum Removal Assembly

C. Each filter unit will be shipped fully assembled and wired from the factory, unless noted otherwise herein. All equipment, components, motors, pumps, and bearings shall be designed for continuous duty and long operating life in an outdoor, high humidity atmosphere fully exposed to the sunlight. All motors and pumps shall be 460-volt, 60 hertz, 3 phase. The Contractor shall be responsible for and provide and install all the wiring between the Filter Control Panels and the Filters and backwash pumps. The filter manufacturer shall factory-wire all equipment mounted on tank (drive motor, backwash valves, solids removal valves, scum

valve and all instruments) to a common termination junction box factory mounted on the effluent end of the filter so that the Contractor only has to make his field connections for that equipment and instruments from the filter control panel to that one point on the tank. The Contractor shall install conduit and wiring for the backwash pump power and casing heaters from the filter control panel directly to the backwash pumps. In other words, the backwash pump power and the backwash pump casing heater circuits shall not be routed through the filter mounted termination junction box. The termination junction box shall be located close to the remote mounted filter control panel. The termination junction box shall have a barrier to separate power wiring from low voltage and signal wiring. The termination junction box shall have termination blocks.

D. These plans, specifications, and dimensions are based on equipment as offered by Aqua Aerobic Systems, Inc. The filter shall be manufactured by Aqua Aerobic Systems, Inc., or equal. All equipment provided must meet these specifications. The project design has very limited hydraulic flexibility. Therefore, all equipment provided must meet the hydraulic capabilities of the design and specifications.

Space limitations for the filter are important. The filters must fit within footprint available. The gross out-to-out filter shall not exceed that indicated on the drawings. The out-to-out tank dimensions shall be approximately as follows and shall not exceed the following:

Total out-to-out length from face of influent flange to face of effluent flange:	224 9/16”
Total out-to-out width:	105 3/8”
Total height of the tanks to lip on top of wall:	138”

The filter influent weir shall be 9.32’ above the floor of the tank.

In addition to other dimensions, all these dimensions shall be clearly shown in the submittal.

The Control Panel dimensions shall not exceed an outside width of 36”. The panel air conditioner shall not increase this dimension by more than 12”.

1.02 ALL EQUIPMENT

The “All Equipment” specification in 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. In case of conflicts between the requirements of the “All Equipment” specification and other specification sections, the more stringent requirement, as determined solely by the Owner, shall prevail.

1.03 SERVICE

A. The equipment manufacturer shall furnish the services of a qualified factory trained representative to assist with and inspect the Contractor's equipment installation, start up and adjust the equipment, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance including safety, and provide process assistance. The representative shall make the minimum number of trips and days at the jobsite as described later in this specification.

B. If additional service is required due to the mechanisms not being properly installed or fully operational, at the time of service requested by the Contractor, the additional service days will be at the Contractor's expense.

C. The manufacturer shall have a free troubleshooting help line available 24 hours a day, 365 days per year for the life of the plant.

1.04 WARRANTY

A. The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the date the filter systems are fully accepted by the Owner and are put into continuous service.

1.05 MANUFACTURING QUALIFICATIONS

A. The filter supplier shall have experience in the design and manufacture of cloth media filters for a minimum of ten (10) years and shall be able to demonstrate a minimum of fifty (50) installations within the United States in municipal wastewater applications with cloth media. The manufacturer shall have data acceptable to the Owner demonstrating the achievement of the required total phosphorus performance. The data shall come from at least four full scale installations.

1.06 SUBMITTAL REQUIREMENTS

A. This submittal shall include the following as a minimum

1. Drawings. The drawings shall include, but not be limited to, all dimensions needed to allow installation of tanks, piping, elevated grating, and appurtenances. Provide a drawing that shows the (bottom) footprint of the filter tank along with dimensions to the centerline of and the face of the flanges on the connecting influent and effluent piping. This drawing shall be usable to set the tank in the correct location on the slab so that it will be properly placed with respect to the connecting piping.
2. Cut sheets
3. Media area calculations

4. Hydraulic loading rate calculations
5. Solids loading rate calculations
6. Hydraulic profile through the filter showing the following:
   a. Influent weir length
   b. Influent weir elevation
   c. Influent weir nappe at design and peak flow
   d. Effluent weir length
   e. Effluent weir elevation
   f. Effluent weir nappe at design and peak flow
7. Elongation and breaking strength test report from ISO certified textile laboratory
8. Title 22 Conditional Approval letter

B. This submittal shall also fully comply with all the requirements of the applicable sections of the General Conditions and the Specification for All Equipment.

PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN PARAMETERS

A. The disk filters shall be capable of filtering effluent from a secondary process. The design flows with 10 disks per filter shall be for:

1. 3 MGD Average Daily Flow for two filters (1.5 MGD Average Daily Flow per Filter)
2. 10 MGD Maximum Daily Flow for two filters (5.0 MGD Maximum Daily Flow per Filter)

B. Filter influent total suspended solids (TSS) concentration shall be 20 mg/l daily average and 20 mg/l maximum at average daily flow rate.

C. Filter effluent total suspended solids concentration shall not be greater than 5 mg/l based on a monthly average.

D. The filtration system shall be able to treat 50% of the maximum design flow to meet the above design conditions with one unit offline.

E. When the filter influent total phosphorus concentration is equal to or less than 0.60 mg/l on a monthly average, the filter effluent total phosphorus shall not be greater than 0.10 mg/l based on a monthly average.

F. The WWTP has limited hydraulic head available for use by the filters. Therefore if four disks are added per filter (for a total of 14 disks per filter) each filter must filter 7.0 mgd (peak flow) with the following hydraulic specifications:

Maximum Allowable Elevation Difference between Filter Influent Weir & Filter Effluent Weir: 2.00 feet

Maximum Allowable Elevation Difference (at 7.0 mgd) between Filter Influent Weir & Water Level on the Upstream Side of the Filter Influent Weir: 0.48 feet

2.02 FILTER DISK TANK

A. Each tank assembly shall be painted steel. Entire tank construction shall have a minimum thickness of 10 gauge. Each tank shall have a rounded bottom to ensure deposition of solids does not occur in the corners of the tank. Due to concerns with solids deposit, tanks without rounded bottoms shall not be accepted. Each tank shall be provided with an integral solids waste collection manifold. Waste manifolds that are not integral to the tank shall not be accepted. Each tank drain shall be provided with a manually operated brass ball valve. The drain shall be at the end of the tank as shown on the Drawings. If the drain location is not shown the Drawings, the filter manufacturer shall coordinate with the Engineer and show it in the preferred location in the first submittal. Valve shall be provided loose for installation by the installing contractor.

Painting: The tank shall be coated with a paint system that provides long-life in an outdoor installation exposed to direct sunlight, rainfall, and high humidity. The painting system shall be the following, as a minimum:

Interior: Near white sandblast (SSPC-SP10),
Painted with Tnemec N69 polyamide epoxy (color "safety blue")
2 coats 4-6 mils each, for a total 8-12 mils DFT.

Exterior: Commercial sandblast (SSPC-SP6),
Painted with Tnemec N69 Hi-Build Epoxoline II (color "safety blue") 2 coats 3-4 mils each, and
1 coat Tnemec 1095 Endura-Shield II, 2-3 mils, for a total 8-11 mils DFT.

For the Cloth Media Filter tanks, the above painting system specification supersedes the painting specifications required by the Painting section of the specifications.

B. The tank shall be furnished with appropriately sized holes in its base supports to allow it to be securely anchored to its concrete bottom slab to partially resist

flotation potential if major site flooding occurs when the tank is empty. The holes shall accommodate ¾" diameter anchor bolts or larger if the manufacturer deems it appropriate.

C. The tank shall have a 24" flanged influent pipe and a 24" flanged effluent pipe.

D. Accommodation for future tank cover: The filter tankage shall be designed and fabricated with a flange around the interior perimeter of the tank to accommodate a future aluminum cover that would be supported by the flange. The flange will need to be offset to allow a small blockout where the drive chain enters the tank. Should algal growth in the tank become a problem, the plant operators can install aluminum grating (2.5" deep) or aluminum planks to block the sunlight. The grating or planks will span the width of the tank and be supported by the angles on the interior walls of the tank. The horizontal bearing surface of the angles shall be 2.5 inches minimum.

E. The influent trough of the filter tank shall be furnished with a drain plug that shall be removable by reaching into the trough. When the drain plug is removed, it shall be possible to wash any solids that have accumulated in the influent trough into the main filter. The drain plug shall be located near the low end of the influent trough. The drain opening shall be flush with the bottom of the trough and shall be a minimum of 3.0" in diameter.

2.03 DRIVE ASSEMBLY

A. Each filter shall include an adjustable drive assembly with a gearbox, nylon drive sprocket, acetal drive chain with 304 stainless steel link pins, and a 304 stainless steel chain guard. The gearbox shall be parallel in-line helical type, AGMA Class 1 with a 1 HP drive motor rated for 460-volt, 3 phase, 60 Hz. Gear reducer shall be Nord or approved equal. Drive motor shall be Nord, WEG, Baldor, or approved equal.

Oil Drain: If the motor or gear box or any other components contain oil that must periodically be drained, provide a valve and a capped extension of sufficient length and oriented such that a container be placed beneath the oil drain pipe to allow easily draining oil without spillage. Use stainless steel for pipe, cap, and valve, etc.

B. The drive assembly shall rotate the disks only during backwash. Systems requiring constantly rotating disks during filtration will not be acceptable. Belt drive systems or systems with multiple drive units per filter will not be acceptable.

C. If motors and gearboxes require routine maintenance and are not accessible from the outside tank side walls, the equipment manufacturer shall provide an internal

access platform between the tank side walls and motors and gearboxes. The internal access platform shall be safe and convenient to use.

D. Accommodation for future tank cover. The drive assembly shall be selected and installed in a manner to facilitate the addition of a future cover that would rest on top of a flange on the interior walls of the tank.

2.04 CENTERTUBE ASSEMBLY

A. Each centertube assembly shall include a minimum 3/16", 304 stainless steel centertube weldment, driven sprocket, wheel assemblies, 304 stainless steel disk segment rods, and frame and cloth assemblies. Each centertube assembly shall also include a Viton v-ring effluent port seal which provides superior chlorine resistance. Materials other than Viton are not acceptable for seal materials. All components (including but not limited to any locking collars, lock rings, or similar or related components) that secure, or assist in securing, the port seal in position shall have long life and not be subject to failure due to corrosion or stress or other causes, etc. Any such components shall be made in the USA. Unless the manufacturer recommends otherwise in writing, such components shall be assembled with Locktite to ensure proper installation. Systems with swivel joints requiring routine lubrication are not acceptable. The driven sprocket shall be multi segment made of UHMW polyethylene. All fasteners shall be stainless steel.

2.05 CLOTH FRAME

A. Each cloth disk assembly shall be comprised of six (6) individual segments, each consisting of a cloth media sock supported by an injection molded glass filled polypropylene frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the WWTP where it is installed. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.

2.06 FILTER MEDIA

A. Each cloth disk assembly shall have a minimum of 53.8 square feet of effective submerged filtration area. Each disk shall be divided into no more than six (6) segments and shall be easily removable for service. If the wet weight of the filter disk segment is greater than 50 pounds, a lifting mechanism shall be designed by and provided by the filter manufacturer. The lifting device shall be safe and convenient to use.

B. Each of the two filter tanks shall be shipped with ten factory installed cloth disk assemblies. Each of the two filter tanks shall have space to add four additional disks in the future to result in fourteen total disks in each tank at the time. All

valves, piping, controls, and software, etc. shall be installed in the initial installation for the future four disks in each tank.

C. Each filter tank shall have an initial total of 538 square feet of minimum effective submerged filtration area per tank.

Future installation of four additional disks per filter tank shall result in a total of 753.2 square feet of minimum effective submerged filtration area per tank.

D. Cloths shall be of fiber pile construction having a nominal filtration rating of 5 microns. Granular media and screens having structured identical openings shall not be allowed. The cloth shall be unaffected by chlorine.

E. The cloth filter media must have obtained conditional acceptance under California Title 22 regulations. The approval letter associated with this acceptance must be included with the submittal.

F. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in the capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an acceptable headloss. Woven mesh or microscreen type media with no filtration depth are not acceptable.

G. Individual pile fibers shall be held in place by a support backing integral to the media. To facilitate proper flow of backwash water through the cloth, the medium's back side shall be of open construction consisting of 10% open area at least 50 times larger than the nominal filtration media in any direction. Media that uses sewn in support structures, which have the potential to prevent free flow through the media, shall not be allowed.

H. Cloth strength is critical to ensure long term performance of the media. Cloth media breaking strength and elongation shall be tested in accordance with ASTM Standard D5035 2R-E method by an ISO certified laboratory specializing in textile testing. Breaking strength shall be in excess of 200 lbf (890 N) in the warp and the weft direction. Elongation shall be less than 10% at 60 lbf (270 N) in the warp and the weft direction. Test reports shall be provided with the submittal to demonstrate compliance with this requirement.

I. To avoid excessive media movement, deformation and folding during backwash, the maximum distance between cloth restraints must not exceed 36 inches.

2.07 FILTER HYDRAULICS

A. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the

outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. During filtration, the filter flow path shall be from the outside of the cloth frame to the inside. Systems with flow paths during filtration from the inside to the outside of the cloth frame or that may have the potential to collect filtered solids and plastic debris on the interior surfaces of the cloth frame shall not be acceptable.

B. Only the media area below the effluent weir elevation will be considered in the filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.

C. Submittal information shall include calculations that verify the effective filtration surface area. Media surface fused directly to support structure such that water cannot pass through the media shall not be included in these calculations.

D. The operator shall be able to bring a drained filter on line by simply opening the influent isolation valve. If the filter design is such that it must be filled with water before the influent isolation device is opened to prevent damage to the filter media, an automated process that sequentially brings the filter back on line with a single switch shall be designed and provided by the filter manufacturer to prevent accidental media damage. The automated process shall activate a minimum 6" diameter motorized valve to fill the filter with effluent or other clean water source in not more than five minutes, verify that the filter is full, and open the motorized influent isolation device and shall be designed and provided by the filter manufacturer.

E. Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high pressure spray or a moving vacuum head as the sole means of solids removal will not be acceptable.

2.08 BACKWASH SYSTEM

A. The backwash function shall incorporate pumps that draw filter effluent through the cloth as the media rotates past the fixed backwash shoe, thereby removing accumulated solids from the cloth surface. The filter disks shall rotate only once during backwashing. Each disk shall be cleaned by a minimum of two backwash shoes, one on each side. The backwash shoes shall remain in a fixed position. Springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface.

B. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be acceptable.

C. Neither the cloth / support assemblies nor the backwash shoes shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.

D. The backwash system shall include 304 stainless steel backwash shoe supports with UHMW backwash shoes, 316 stainless steel spring reinforced PVC flexible hose with stainless steel hose clamps, and 304 stainless steel backwash manifolds.

2.09 BACKWASH/WASTE PUMP ASSEMBLIES

A. Each backwash/waste pump assembly on each filter shall include two (2) backwash/waste pumps, valves and gauges. In the external piping shall be backwash and solids waste valves, recirculation ball valve(s), 3" manually operated flow control gate valve for each pump, vacuum gauge(s), and pressure gauge(s).

B. The backwash/waste pump(s) shall have flanged connections and be shipped loose for field installation by the installing contractor. Backwash piping between the filter tank and pump(s) as well as piping following the pump(s) shall be supplied by the installing contractor. Installing contractor shall supply unions or flanges for service, wiring, and factory installed conduit shall be provided within 3 feet of the pumps.

C The backwash/waste pumps shall be Gorman Rupp model 12B20-B, externally mounted centrifugal pump. Pumps shall be provided with a 5 HP minimum, 460-volt, 3 phase, 60 Hz motor and operate at a variable speed. Pump shall be rated for 130 gpm at 60 ft TDH with 34 ft allowable discharge head after all suction losses in internal filter piping (including all suction losses through the filter and media) have been accounted for. The Filter Manufacturer shall field calibrate the backwash pump to determine the proper VFD settings during startup as no flowmeter will be provided. The Filter Manufacturer shall set the speed to achieve the backwash rate that it recommends. The motor shall be rated for inverter duty. The motor shall be TEFC and shall be manufactured by Baldor, TECO, WEG or approved equal. Backwashing shall be initiated by tank water level, timer, or manually through the operator interface. Operator shall have the ability to specify backwash time interval elapses through the operator interface. The backwash water shall be pressurized by the filter's backwash/waste pump for discharging from the filter system. Systems utilizing non-pressurized backwash flow will not be accepted. Backwash pumps using a belt drive shall not be acceptable due to routine tensioning and other maintenance requirements. The pump discharge casing shall be tapped for the pressure gauge provided by the filter manufacturer. If the pump or coupling or any other components contain oil that must periodically be drained, provide a valve and a capped extension of sufficient length and oriented such that a container be placed beneath the oil

drainpipe to easily allow draining oil without spillage. Use stainless steel for pipe, cap, and valve, etc.

D. Provide manually operated threaded gate valves on each backwash pump. The valves shall be class 125 bronze with screw in bonnet, non-rising stem, and solid wedge. Valves shall conform to MSS SP-80 and shall be Nibco or approved equal.

E. The 3 inch threaded ball valves shall be a two-piece, full port, with a brass body. Valves shall be Nibco or approved equal.

F. The vacuum gauges (2 per filter) shall have a minimum 2.5" dial with all stainless steel welded construction, 0-30" Hg vacuum range, liquid filled, ¼" NPT process connection, 316 stainless steel bourdon tube and tip material, and bronze socket material, manufactured by Ashcroft or approved equal. The manufacturer shall provide taps on the backwash suction for installation of vacuum gauges.

G. The pressure gauge(s) shall have a 2.5" dial with a black painted steel case, 0-15 psi, heat resistant polycarbonate window, ¼" NPT process connection, "C" shaped bronze bourdon tube, and brass socket material, Ashcroft or approved equal.

H. Filtering shall not be interrupted during normal backwashing and solids waste discharge.

I. The backwash pump shall be mounted on an aluminum or stainless steel pump stand of appropriate height to be provided by the Filter Manufacturer.

J. The Backwash Recycle Line shall be at the elevation shown on the drawings and suitable for the piping arrangement. This may be different from the elevation shown on the filter manufacturer's standard drawings. The elevation and other details relating to the location etc. of the backwash recycle line connection shall be carefully coordinated with the Contractor during the submittal preparation to ensure that the field piping will properly align with the connection on the tank. The Backwash Recycle Line connection to the filter tank shall be 3" diameter. The correct elevation and size shall be shown on the first submittal.

K. The pumps shall have casing heaters powered by and controlled by the Cold Weather Package.

L. COLD WEATHER PROTECTION

The ambient air temperature will periodically remain below freezing for several consecutive days. The filters are installed outdoors. A temperature sensor shall be mounted in the control panel for each basin. The sensor shall sense the

temperature outside the control panel and shall cycle the backwash pumps periodically during freezing conditions. All suction and discharge lines shall have flow moved through them during each cycle to prevent freezing of the piping contents. The solids valve and scum valve shall open at the end of the backwash triggered by sensor. The Cold Weather Package shall also power and control casing heaters in the backwash pumps.

2.10 VALVES

A. Each filter shall include seven (7) 2" (minimum) backwash valves. Valves shall be 3 piece, grooved end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, installed with painted cast iron Victaulic couplings, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

B. Because of fouling that can be caused by stringy material, non full port valves such as butterfly valves or plastic valves shall not be acceptable.

C. Each filter shall include two (2) 2" solids waste valve. Valve shall be 3 piece, grooved end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, installed with painted cast iron Victaulic couplings, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

D. Each filter shall include a solids waste removal system in the floor of the filter tank. The manifold shall be designed to siphon settled solids waste for discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.

E. Each filter shall include one 8" scum valve. The valve shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, assembled and tested with a RCEL 115 volt, single phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater, manual override, and limit switch feedback in the open and closed position.

F. Each filter shall have a manually-operated isolation valve in the suction header. This valve would normally be closed such that half of the suction header would be served by one backwash pump and the other half would be backwashed by the other backwash pump. If either backwash pump for a filter fails, it shall be

possible for an operator to manually open this valve and manually backwash the disks that ordinarily would be backwashed by the pump that failed.

G. The minimum rating of the actuators for water resistance shall be IP-67. The valves shall be capable of being manually opened or closed so that backwashing can be manually performed even if an actuator fails.

2.11 INDIVIDUAL FILTER ISOLATION

A. Each filter shall include isolation upstream provided by the installing contractor.

2.12 PRESSURE TRANSMITTER

A. The pressure transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 0 psi to 5 psi. Unit shall monitor the water level of each filter tank. Transmitter shall be flush mounted to the tank wall. Transmitter shall be an IFM Effector PX series or approved equal. The filter manufacturer shall provide one pressure transmitter for each filter.

2.13 FLOAT SWITCH

A. A float switch shall be furnished to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equal. The float shall contain a non-mercury switch, chemical resistant polypropylene casing hermetically sealed and a PVC #18 AWG three conductor cable. Switch rating shall be minimum 4.5 amps non-inductive at 120 VAC.

2.14 VACUUM TRANSMITTER

A. The vacuum transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of -30 to 0 inHg. Transmitter shall be an IFM Effector PX series or approved equal. The filter manufacturer shall provide one vacuum transmitter for each filter.

2.15 MISC/SPARE PARTS

The filter manufacturer shall provide the following parts as a minimum. Provide additional parts as recommended by the manufacturer.

A. (2) Frame and cloth assemblies.
B. (2) Backwash/solids waste valve and actuator.
C. (1) Viton V-ring effluent port/centertube seal.
D. At least 1 of each PLC I/O module(s), fuse(s), control relay(s), and indicating light replacement bulb(s).
E. 3 of each type of fuse used.

2.16 CONTROL SYSTEM

A. Refer to Specification Section 26 29 00 (“Manufactured Control Panels”) for additional control panel requirements.

B. The automatic and manual controls for operation of the filter system shall be fully designed by the Filter Manufacturer for reliable and proper performance. It shall be furnished fully assembled, wired and pre-programmed in a UL 508A Certified Industrial Control Panel. Panels shall have a UL 508 label and meet the requirements of the Shelby County, AL, electrical code. Controls shall be provided to control or monitor equipment as described in the contract drawings, in these specifications, and as needed for proper operation. The control system shall include the following control components and practices as a minimum:

2.17 CONTROL PANEL WIRING AND ASSEMBLY

A. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be a minimum of 14 kA RMS symmetrical @ 480VAC. The filter control panels will be powered by 460-volt, 3-phase circuits with three hot wires and one ground wire. (No neutral will be provided.)

B. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

2.18 CONTROL PANEL QUALITY ASSURANCE

A. All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

1. Point to point testing of all wiring prior to application of power
2. Intended supply voltage shall be applied to the enclosure
3. All components shall be tested for proper operation and calibration
4. The PLC and operator interface program shall be loaded and functionally checked
5. All components shall be checked to confirm proper mounting specifications have been followed
6 Enclosure shall be inspected for defects and repaired if necessary
7. All labeling of wires and devices are correct, properly installed and clean

B. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.

C. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e. finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure. Electronic copies shall be provided to the Engineer.

2.19 ALUMINUM CONDUIT

A. Refer to electrical plans for design intent of which conduits/circuitry is to be factory-wired by the disk filter system supplier (to a terminal box mounted to the disk filter system skid) vs field-wired by the electrical contractor. General design intent is for all equipment/devices/valves/instruments/etc. on the filter system skid to be factory-wired to the terminal boxes unless indicated otherwise on plans.

B. All wiring of pre-assembled and mounted external electrical components to control panels or junction boxes on the tank shall be aluminum metallic construction. Conduit shall be sized for adequate spare capacity. The aluminum conduit system shall be manufactured in accordance with UL6A and ANSIC80.5. All conduits shall be supported at maximum 3 foot intervals with support straps designed especially for installation of conduit. The clamp system shall allow the conduit to expand and contract freely, eliminating bowing caused by varying temperature changes. The aluminum conduit bodies shall be manufactured in accordance with UL514A, and Federal Military Specification WWC-586B. Conduit body hubs shall be threaded. Materials shall be copper free aluminum (max. 4/10 of 1% copper content), lightweight, shall be high corrosion resistance, be self-oxidizing, and self-renewing. Blank covers shall be domed for extra wiring space and shall be supplied complete with a neoprene or composition fiber gasket.

2.20 CONTROL ENCLOSURE

A. The automatic controls shall be provided in a UL listed, NEMA Type 4X 304 stainless steel (14 gauge minimum) floor mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. The enclosure shall have a white polyester powder paint applied by the enclosure manufacturer to increase the reflection of sunlight to assist with panel temperature. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316SS padlocking POWERGLIDE® handle shall be provided. Enclosures shall be white, with a smooth #4 brushed finish. Enclosure shall include a painted white mild steel (12 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

A 304 10-gauge stainless steel sun shield shall be included. A sunshield shall overhang the front of the panel a minimum of 10".

The control panel will be factory wired, tested, and then removed for shipping. The installing contractor shall mount the control panel and re-connect the wiring.

2.21 CORROSION INHIBITOR

A. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The

corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

B. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

2.22 AIR CONDITIONER

A. A thermostat controlled air conditioner with noise suppression shall be supplied to protect control components mounted inside the enclosure from high temperatures, humidity and ambient air contaminants. The air conditioner shall be constructed of brushed finish stainless steel 304 material and provide NEMA 4X Type protection from outdoor and hose-down applications. The air conditioner unit shall use CFC-free or environmentally safe refrigerant that is universally accepted. The air conditioner shall be manufactured by Hoffman or approved equal.

2.23 ELECTRIC HEATER AND COLD WEATHER PACKAGE

A. An electric heater shall be provided inside the control enclosure to protect sensitive mechanical and electrical components from the harmful effects of condensation, corrosion and low temperatures. The heater shall be a thermostatically controlled, fan-driven unit. The heater shall be manufactured by Hoffman or approved equal.

B. Provide a complete cold weather package: When the ambient air temperature drops below 36 degrees, the PLC shall trigger the backwash pumps and valves to make a cycle every hour to keep water moving. Also provide a backwash pump casing heater in each backwash pump that will operate when the ambient temperature drops to 36 degrees. The casing heaters shall be powered from the filter control panel.

2.24 MAIN DISCONNECT CIRCUIT BREAKER

A. A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosures. The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a padlockable door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/HDL, JDL, LDL, MDL, PDL or approved equal.

2.25 MOTOR STARTER

A. A full voltage non-reversing Integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection and monitoring functions for the motor. The starter shall be NEMA

rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

B. VFD: UL Listed Variable Frequency Drives (VFD) shall be provided to control the backwash pumps of the filters. The VFDs shall control motor speed via a manual setting. It functions only as a manual adjustment to the motor rpm so that the appropriate backwash rate is provided. The VFD output frequency shall be programmable. The VFD shall be provided in a NEMA Type 20 panel mount package and rated for an operating temperature of -4° to 122°F (-20° to 50°C). The VFD shall have a 65 kA maximum short circuit rating when protected with an Allen Bradley 140M motor circuit protector or Class CC/J fuse. The VFD shall be Allen-Bradley PowerFlex or approved equal. The VFD speed shall be set by the Filter Manufacturer at startup. Due to the importance of the filters on this project, the VFDs shall be selected by the Filter Manufacturer for reliable performance and shall provide reliable performance.

2.26 TRANSFORMER

A. A step-down multi-tap transformer shall be supplied to reduce incoming 3-phase power to 120 VAC single-phase. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish. Transformer shall be Square D 9070T or approved equal.

2.27 TRANSFORMER PRIMARY AND SECONDARY FUSES

A. Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

2.28 CIRCUIT BREAKERS

A. Appropriately sized branch circuit breakers shall be provided for the filter drive motor and the backwash pumps.

B. All single-phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC

maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

2.29 FUSES

A. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

2.30 OPERATOR DEVICES

A. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter. Transformer type push-to-test pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be super high intensity long life LED type lamps. Color coding shall be applied as required and is as follows:

1. Amber – Alarm active, caution
2. Green – Valve open, motor running
3. Red – Valve closed
4. White - Information

B. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Allen-Bradley or Square D, or approved equal. All switches shall be clearly identified as to what they control.

C. HOA switches for the backwash pumps shall be mounted in the same sequence (e.g. left-to-right) as the pumps when both are viewed from the same direction. The pump identification nomenclature shall be as selected by the Owner. Coordinate with the Engineer for Owner preferences prior to making the first submittal so that the first submittal will accurately reflect the Owner's preferences.

2.31 HIGH FREQUENCY NOISE FILTER

A. A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120/240VAC operating at 47 to 63 Hz. The unit shall reduce normal mode transients to plus or minus 2 volts, provide surge capacity of 45,000 amps and protect in all modes (Line to neutral,

line to ground and neutral to ground). The noise filter shall be an SolaHD STFV or approved equal.

2.32 UNINTERRUPTIBLE POWER SUPPLY

A. A UL listed uninterruptible power supply suitable for location in a UL 508 panel shall be provided to protect the HMI and PLC from short power outages by switching to an emergency battery backup without data loss or downtime. Nominal input voltage and output voltage shall be 120VAC with an autosensing input frequency of 47 to 63 Hz. The output power capacity shall be 650W / 1000VA. The UPS shall be provided with an audible alarm and LED status indicators and operate from 32° to 122°F (0° to 50°C). The UPS shall be an Allen Bradley 1609-B1000N.

2.33 GROUND FAULT DUPLEX RECEPTACLE

A. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

2.34 24 VOLT DC POWER SUPPLY

A. A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

2.35 THREE-PHASE TYPE 1 SURGE PROTECTIVE DEVICE

A. A UL Listed type 1 surge protective device shall be provided in the control enclosure to protect incoming three-phase power from external surges caused by lightning or power switching. The surge protector shall be a Surge Suppression Inc. Model CKLA3N4C1-LP-21 with indicating lights and with a dry contact that will close on failure of the SPD. If the panel manufacturer deems it advisable, it may provide a second 3-phase surge protection device (as selected by the panel manufacturer) for further protection.

2.36 SURGE PROTECTIVE DEVICE

A. A UL Recognized surge protective device shall be provided to protect electronic circuits from high voltage transients and temporary overloads on signal lines. The surge protector shall be an MTL Surge Technologies SD-32X (Analog Inputs and Outputs) and SD-150X (120 VAC digital inputs and outputs) or approved equal..

The filter manufacturer shall select the type surge protection to be used to provide the maximum protection for his equipment.

2.37 CONTROL RELAY

A. UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

2.38 TERMINAL BLOCK

A. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

2.39 PROGRAMMABLE LOGIC CONTROLLER

A. Automatic operation of the Filter shall be controlled through an Allen Bradley CompactLogix 1769-L30ER programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a backpanel, power supply, controller, base unit, expansion I/O modules, and memory network modules as required. All input and output points supplied (including unused) shall be wired to terminal blocks. The PLC user memory shall consist of a minimum of 1 MB of user memory and real-time clock. All PLC hardware shall be UL listed and operate at an ambient temperature of -4° to 140° F (-20° to 60° C).

B. Additionally, provide other equipment or upgraded equipment and features if needed for the PLC to properly communicate with the plant SCADA system. Refer to Plant Network Diagram on electrical plans for additional requirements. The filter manufacturer shall carefully coordinate with SCADA system supplier to ensure that the filter panel output provides communication and protocols (including but not necessarily limited to Ethernet TCP/IP) that can be utilized by the SCADA system. Provide a map of PLC registers for use by the SCADA system. Provide sufficient information to the SCADA system so that its screens will duplicate the filter control panel HMI screens. Provide capability so that, if the Owner allows, the filter manufacturer can temporarily access its control panel to assist in troubleshooting. Refer to Specification Section 26 29 00 for additional requirements.

C. Surge Protection: Refer to Specification Section 26 29 00.

2.40 ETHERNET SWITCH & SCADA COMMUNICATION

A. An Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation and provide for store and forward switching mode. The switch shall have a minimum of six (6) 10/100Base-T ports with RJ-45 sockets plus the fiber optic ports specified below, and shall support auto-crossing, auto-negotiation and auto-polarity.

B. The unit shall be DIN rail mounted and require 24VDC power. Diagnostic LEDs for power and connection status shall be included. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley/1783 or approved equal.

C. Fiber Optic Network Monitoring Provisions:

a. Provide OM4 multi-mode fiber optic port(s) within Ethernet switch and fiber optic patch panel within this control panel as required for remote SCADA monitoring. Exact termination/port type shall be coordinated with the structured cabling (fiber optic cabling) system installer prior to submitting shop drawings. Refer to Plant Network Diagram on electrical plans for additional requirements.

b. Coordinate with SCADA Integrator for configuration of IP addresses for PLC, etc.

2.41 HUMAN MACHINE INTERFACE OVERVIEW

A. The control system shall be equipped with a UL listed operator interface that provides control display screens. These screens shall be used by the operator to monitor and control filter status, setpoint and alarm information.

B. The Interface shall allow the Operator access to adjust the following operating parameters:

1. Backwash interval, Backwash duration, Solids Waste interval, Solids Waste duration, Number of Backwashes between Solids Waste interval. The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters:

Water level in the filter, Time since last Backwash, Time since last Solids Waste withdrawal, Elapsed time on the Drive Motor, Elapsed time on the Backwash/Waste Pumps, Total Backwash time and cycles, Total Solids Waste withdrawal time and cycles.

2. The operator interface shall allow the Operator to:
   a. Initiate Backwash
   b. Control all electric actuated valves

3. The interface shall display the alarm history. The alarm history shall include the time and date of the most recent 25 alarms along with the description of the alarm.
4. The interface shall also display current alarms, including the date, time and a description of the alarm.
5. As a diagnostic aid to the Operator, the interface shall display the time between Backwashes for the most recent 40 Backwashes.
6. Alarms shall be issued to the WWTP SCADA system for all conditions that may interfere with Filter performance. These shall include but not be limited to High Water Level in Filter, Equipment Failure, High Vacuum in Backwash Pump Suction, Low Water Level in Filter, and, Power Loss.
7. The status of all valves and pumps shall also be digitally communicated to the remote SCADA system. The Filter Manufacturer shall coordinate with the SCADA supplier to allow the remote SCADA HMI to provide the same screens and information that are available when the operator is standing at the filter panel.

2.42 HUMAN MACHINE INTERFACE

A. The operator interface shall be a NEMA Type 4X rated, 10.4" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 6 1000. Since the control panel shall be mounted outdoors in direct sunlight, the display shall be selected for maximum brightness and intensity. Additionally, the screen shall have an effective sun shield such as that manufactured by Smith and Loveless.

2.43 HUMAN MACHINE INTERFACE SUN SHIELD

A. A sun shield constructed of 304 stainless steel shall be mounted over the operator interface to provide protection and visibility of operator screens in outdoor applications.

2.44 MISCELLANEOUS REQUIREMENTS

A. PFAS: No PTFE tape shall be used in the assembly of the filter or any of its components, and no PTFE containing compounds shall be utilized in the filter or its components. The effluent from these filters enters a lake that is the source of much of the drinking water for the Birmingham Metro Area. Therefore the Filter Manufacturer shall take all practical measures to prevent its equipment from adding any per- and polyfluoroalkyl substances (i.e. "PFAS") to the flow passing through the filter. The Filter Manufacturer shall provide written notification to the Owner and Engineer of any known, suspected, and/or potential sources of PFAS from the equipment and components that it provides.

PART 3 EXECUTION

3.01 GENERAL

A. All components of the Specified system shall be handled with care during transportation, storage, and installation

B. The Contractor shall carefully follow all the Manufacturer's storage and handling instructions. All electrical and control panels shall be stored indoors until installed in its final location. Store in conditioned space if recommended by the manufacturer. The Contractor shall obtain or otherwise provide this space. All electrical and control equipment shall be stored above the maximum potential flood elevation. Unless recommended otherwise by the manufacturer, operate an incandescent light bulb inside electrical enclosures that have not been permanently energized. Use care in placement of the lightbulb not to overheat or damage any panel components. Once equipment has been set in its final location, properly protect it from dust and rain, etc. If a canopy is being provided over the equipment, do not set the equipment in place until the canopy installation is complete and grounding is complete.

C. The Specified system and all its appurtenances and components shall be installed in a manner that meets all the requirements of the manufacturer and all the requirements of the drawings and specifications

3.02 INSTALLATION

Prior to placing concrete, the Contractor shall carefully coordinate all concrete structure dimensions and details with the final equipment submittals. He shall make any changes that are necessary to properly accommodate the equipment actually delivered.

Concrete placement tolerance must be within that established by the Filter Manufacturer, or as needed for proper operation, whichever is more stringent.

Electrical power & control conduits must be installed in the correct locations to allow the equipment be properly accessed. No conduit shall be installed in a manner that creates a potential tripping hazard or a potential headroom hazard. The exact location shall be carefully planned and coordinated with the Manufacturer and the Engineer. They shall be installed accordingly.

The filter influent and effluent piping must be installed in the proper location for the filter tanks to properly connect to the filters and so that the filter tanks can be set in the correct location. The Contractor shall carefully coordinate the proposed pipe installation locations with the connections on the filter tanks as shown in the approved filter submittal.

The Contractor shall completely install all filter equipment and appurtenances, etc.. It shall be installed in full accordance with all the instructions of the manufacturer and in full accordance with all the requirements of the drawings and specifications.

The Contractor shall provide and connect all wiring not performed at the factory. The Contractor shall provide all wire and conduit for and make all wiring connections between the filter control panels and the backwash pumps and the valves and other equipment factory-mounted items on the filter tank. The Contractor shall coordinate with the manufacturer to clarify their responsibilities for wiring.

Prior to Startup, the Contractor shall use a level instrument to verify that the influent weirs on both filters are level and are set at the same elevation. He shall do this in the presence of the Engineer so that the Engineer can also verify that all weirs are the same elevation.

The Contractor shall use care throughout construction to keep all dust, dirt, mud, and debris, etc., from inside the filter tank. Cover the top of the tanks while being careful to maintain sufficient ventilation to the interior of the filters. Do not damage the tanks by the covering operation. If any material gets into the tank it shall be completely cleaned to the satisfaction of the Owner. The Contractor shall pay the manufacturer for the manufacturer to replace the cloth filter material if needed due to the original cloth material getting dirty. Personnel shall not be allowed to work on the top or inside of the tanks with muddy shoes, etc. If the Contractor allows dirt, debris, or mud, etc., to get into the filter tank, he shall hire the filter manufacturer to send factory personnel to the project site to remove sufficient filter disks to allow the Contractor to completely clean the contents of the filter tanks. After the cleaning has been inspected by the Engineer and is determined acceptable by the Owner, the Contractor shall pay the filter manufacturer to send factory personnel to the project site to reinstall the filter disks that were removed for cleaning access.

Keep all trash and debris etc. cleaned from filter tanks and upstream piping and processes to prevent damage to the cloth media. While the filter influent pipe is being installed, keep it plugged to prevent dirt and water etc. from getting into the pipe. Securely plug the opening to filter influent pipe until such time that it is ready to be placed into service to help reduce the opportunity of trash getting into filter.

The Contractor shall provide freeze protection until the filter system is formerly accepted by the Owner and all freeze protection equipment for the filters (including heat tracing by the Contractor and including casing heaters for the backwash pumps) is properly operational.

3.03 O &M MANUALS

The Manufacturer shall provide three (3) hard copies of the operation and maintenance manuals. Three (3) additional electronic copies shall also be provided. The O & M Manuals shall fully comply with all the requirements of the "Shop Drawings, Submittals, and O & M Manuals" Section of the General Specifications for this project and with the "All Equipment" specification. The manuals shall include thorough information advising personnel of potential safety hazards and instructions advising how to protect the personnel from the hazards. Non-applicable material and models shall be excluded from the manual or neatly lined-though to indicate that it is not applicable.

3.04 START-UP AND FIELD SERVICES

A. A qualified and experienced field service technician or qualified and experienced start-up engineer of the Manufacturer shall commission the equipment. He shall instruct representatives of the Owner and the Engineer on proper operation and maintenance. The instructions shall include thorough discussion of potential safety hazards and advising how to protect the personnel how to protect themselves from the hazards.

B. Local manufacturer's representatives are not acceptable to perform these tasks.

C. The field service technician shall certify that all equipment is properly installed and that the plant operators have been trained on proper operation, maintenance, and safety procedures.

D. The minimum recommended man-days / trips for installation assistance, installation inspection, system commissioning, and operator training shall be as follows:

1. Installation assistance, inspection of installation, and Start-up/system commissioning a minimum of six (6) man-days over a minimum of three (3) trips.
2. Operational training: a minimum of two (2) days over two (2) trips. The training trips shall be separated by a time period established by the Owner to allow its operators obtain actual hands-on operating experience after the first training trip.
3. The times stated above are actual effective time on site at the WWTP. Travel time to and from the site, etc., shall be in addition to the times stated.

3.05 TESTING

The Contractor, with the assistance of the Manufacturer, shall demonstrate that the installed System fully meets all contract requirements and all specified performance. All testing shall be performed in a manner that is acceptable to the Owner. Simulate flows as necessary to show that the performance is in accordance with the specifications. Make any corrections necessary to achieve compliance.

It may also be necessary to delay portions of the testing to await a varying flow condition. Testing shall be delayed as necessary to until flows increase sufficiently for a representative test under conditions satisfying the Owner. No additional time or money will be paid to the Contractor if it is necessary to delay portions of the testing; however, liquidated damages will not be assessed if the Contractor is fully complete with all the other parts of the contract. The Owner may also elect to transfer flow or pump flow from other tanks or other sources as necessary. Some clarifiers, etc. may be bypassed during this operation or partially used to obtain an effluent.

3.06. WARRANTY

The minimum warranty period shall be for one year beginning on the date of final acceptance by the Owner.

SPECIFICATION FOR REBUILDING
TRAVELING BRIDGE FILTERS
(AUTOMATIC BACKWASH FILTERS)
SECTION 4

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals required for rebuilding two existing approximately 12.5' wide x 42' long Traveling Bridge Filters (automatic backwash filters) with 8" wide cells, as shown on the drawings and as specified herein. The existing filter tanks, equipment, and components were provided by Agency Environmental Inc. and the new equipment shall be fully functional and compatible with the existing facilities. The Contractor shall require the Filter Manufacturer of the replacement equipment to provide all the equipment, materials, appurtenances, and miscellaneous items described in this section. During bidding the Contractor shall carefully coordinate with the filter manufacturer regarding the work that must be performed in the field by the Contractor (including but not limited to the final assembly of components shipped loose by the filter manufacturer) to insure that he includes money in his bid for all the work that he will be requred to do. The materials and equipment shall be installed, tested, and provided ready for normal operation.

B. ALL EQUIPMENT

The "All Equipment" specification in 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. In case of conflicts between the requirements of the "All Equipment" specification and other specification sections, the more stringent requirement, as determined solely by the Owner, shall prevail.

C. DESIGN RESPONSIBILITY OF FILTER MANUFACTURER

The manufacturer of the Traveling Bridge Filter equipment is solely responsible for the complete design of all equipment that it furnishes. He shall design and

manufacture all equipment so that it performs properly and reliably. The Filter Manufacturer shall have an understanding of the existing filters and tankage to allow him to properly design the equipment that must be installed in the existing tankage and structure.

Note that these filters are in a critical application since their discharge enters a lake providing much of the drinking water for the Birmingham, Alabama metro area. Thus, it is essential for the filters to provide high reliability and excellent performance.

The manufacturer shall have a proven history of satisfactorily rehabilitating at least 50 similar traveling bridge filters.

D. INTERRUPTION OF NORMAL PLANT OPERATIONS

These filters are extremely important to the performance of the existing WRRF and very significantly affect its capability to comply with its permit limits. The rebuilding of the existing filters shall require interruptions to normal plant operations. All work shall be performed in accordance with the "Special Provisions for Performing Work in Existing Facilities".

It will be necessary for the Contractor to take a filter out of service in order to rebuild a filter. Only one of the two filters may be taken out of service at any one time. A filter cannot be removed from service unless it is acceptable to the Owner to do so at that time. The Owner's approval to remove a filter from service shall be based on his opinion of the impact it will have on plant performance. The Owner's approval to take a filter out of service will be largely affected by the anticipated wastewater flowrate into the WRRF during the period when the filter will be out of service. The Contractor should not expect to receive approval to take a filter out of service during the period of November 25 through May 30 as flows are typically higher during that period.

The Contractor shall submit a detailed written plan and schedule to the Owner describing his plan for performing the work. The Contractor shall have all materials and equipment onsite before a filter can be taken out of service. This shall include but not be limited to the SCADA equipment, etc. needed so that the new filter equipment can be properly monitored as soon as the filter work is ready to return to service. The Contractor shall have spare installation equipment and tools onsite so that a breakage of the primary equipment or tools does not delay

the performance of the work. Once a filter is removed from service, the Contractor shall work expeditiously so that the filter can be returned to service as soon as practical. The Contractor shall provide adequate staffing for the filter work so that it can be completed as promptly as practical and once a filter is taken out of service shall not divert manpower or equipment away from the filter work if may delay the completion of the filter work. A filter's SCADA panel shall be tested and place into service when a filter is returned to service. Once a filter is returned to service, it must operate for a minimum of 10 continuous days without any problem before the Owner will consider allowing the second filter to be taken off line (subject to all the same considerations outlined above and in the Specification for "Performing Work in Existing Facilities") so that it can be rebuilt.

E. CONTRACTOR RESPONSIBILITIES

The following is a partial list of the Contractor's responsibilities. This is a general and partial listing of only some of the Contractor's responsibilities. It does not include all the work that is required be performed by the Contractor to provide complete and properly operational filters.

All removal shall be performed carefully so that the washwater troughs, cell dividers, SCADA panels, and other components being reused are not damaged. The Contractor shall fully coordinate with the filter manufacturer during bidding to ensure that his bid includes the cost of all required work. The Contractor shall have the filter manufacturer visit the site and field determine the actual filter dimensions, existing rail anchor bolt locations, and all other appropriate details prior to submittal preparation to ensure that all equipment is made to the correct dimensions so that the new equipment is suitable, will fit correctly, and will perform properly. The dimensions contained herein or shown on the drawings are approximate and it is required that filter manufacturer carefully determine the actual dimensions. The Contractor shall prevent influent flow to the filter during the work, and offload and store all equipment shipments in a dry location.

The filter rebuild shall include removal of all existing sand media above and below the porous plates, careful removal of the porous plates, removal of all hold down angles, spacer rods, hardware, and caulk.

The cell dividers shall be inspected and cleaned to be free of caulk. Remove the entire existing bridge assembly including but not limited to drive motor, gear box, shafts, bearings, and wheels. Remove existing bridges and appurtenances,

backwash arm, backwash shoe and tension assembly, washwater hood and piping, washwater and backwash pumps. Remove the existing wear strips (and the associated anchor bolts & hardware) near the bottom of the effluent channel walls. Remove the festoon system electrical cable, mooring cable, and trolleys. Remove existing rail system and grout. Cut off existing anchor bolts flush with the concrete.

Included as part of the rebuild are the following major work items: Complete cleaning of existing filter facilities after the completion of demolition, installation of new porous underdrain plates (including but not limited to caulking and hold down brackets, etc.) in strict accordance with the written instructions from the Filter Manufacturer. Install new SS spacer rods and hardware between cell dividers. Installation of new wear strips along the bottom of the wall in each of the effluent channels. Installation of a new 304 stainless steel bridge, floating vertex skimmer (with backwash pump), level sensing electrodes and holder. Installation of new rails (including but not limited to splices, hold down clamp assemblies, drilling and installing anchor bolts in concrete, and grout, etc.), bridge stops, indexing pegs, and limit switches. Installation of new festoon system, including cable tow mast, pulleys, electrical cable and trolleys. Installation of new filter media and complete bridges (preassembled with drive motor, gearbox, shafts, bearings and wheels). The rebuild will also include installation of a new backwash piping, shoe and backwash tensioning assembly, new backwash and washwater pumps. Install the new mooring and festoon cable. Wire the new pumps and festoon cables to the new control panel supplied as a part of the filter equipment. Perform wiring for other components attached to the bridge. The rebuild will include installing a new washwater hood, piping and scarifier blade. Prior to installation of new filter media, a light test will be performed to assure the porous plates are installed properly. The testing shall be performed in the presence of the Engineer and the Filter Manufacturer and in accordance with instructions provided by the filter manufacturer. Make adjustments as necessary. Before filtering water through the sand, the Contractor shall provide temporary pumps and piping to transfer filter effluent from the filter remaining in operation to the effluent channel of the new filter to allow thorough backwashing of the new filter sand.

This description of work is general in nature and does not describe or list all the work items that the Contractor is required to perform to provide the complete system. Field cutting, grinding, drilling, fitting, modifying, welding, and other such work will be required. It shall be the responsibility of the Contractor to

carefully coordinate with the Filter Manufacturer at bid time to ensure that his bid includes the complete cost of all assembly, installation, and miscellaneous work.

F. EXISTING ITEMS TO BE REUSED & PROTECTION OF SUCH ITEMS

The concrete tanks, influent and effluent ports, concrete festoon mooring posts, influent and effluent weirs, washwater troughs (the stainless-steel troughs to which the bridge backwash discharges), and cell dividers shall be reused. The Contractor shall protect these throughout demolition and construction, so they are not damaged. The Contractor shall be fully responsible for damage to any components intended to be reused. Note that the wear strips at the effluent ports in the effluent channels are not being reused and the Contractor shall remove and replace them with new wear strips provided by the Filter Manufacturer. The grating and handrail are being reused but will be modified by the Contractor.

G. OTHER FILTER WORK

See the plans for other work associated with the traveling bridge filters but not addressed by these specifications. This includes but is not limited to handrail and grating modifications, electrical modifications, SCADA modifications, influent and effluent piping modifications, and electrical and control modifications for the Mudwell (Backwash) Pump Station.

1.02 QUALIFICATIONS

A. To assure unity of responsibility, the backwash mechanism, the underdrain assembly, the filter media, the washwater hood and brackets, and the bridge rail and components (including anchor bolts) shall be furnished by a single manufacturer.

B. The Traveling Bridge Filter equipment (automatic backwash filter equipment) shall be manufactured by Aqua-Aerobic Systems, Inc., of Loves Park, Illinois, or equal (if approved by the Engineer).

1.03 WARRANTY

A. The Manufacturer shall provide a written warranty in accordance with the warranty requirements for this project.

1.04 OPERATING INSTRUCTIONS

A. Operation and maintenance manuals shall be furnished by the filter manufacturer. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to clearly instruct operation and maintenance personnel unfamiliar with such equipment. The manuals shall include thorough information advising personnel of potential safety hazards and instructions advising how to protect the personnel from the hazards.

B. A factory representative who has complete knowledge of proper operation and maintenance shall be provided for to instruct representatives of the Owner and the Engineer on proper operation and maintenance. The instructions shall include thorough discussion of potential safety hazards and advising how to protect the personnel how to protect themselves from the hazards. This work shall be conducted in conjunction with the inspection of the installation and test run as provided under PART 3.

C. See the "All Equipment" Specification for additional requirements regarding Operation and maintenance manuals and factory representatives.

PART 2: PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. All structural steel used in the fabrication of the equipment shall be stainless steel and conform to the requirements of "Specifications", ASTM Designation A-240. All welding shall conform to the latest standards of the American Welding Society. All manufacturing work shall be performed in a manner such that rust stains or specks, etc., are not formed.

B. All materials and equipment included in this specification shall be as recommended by and selected by the filter manufacturer. Unless specifically stated otherwise, all materials and equipment included in this specification shall be provided by the filter manufacturer. The stated requirements shall be the minimum requirements.

2.02 FILTER UNDERDRAIN SYSTEM

A. Filter Media Support System: The filter media support system shall be as recommended by the filter manufacturer and shall consist of HDPE porous underdrain plates that meet the following minimum requirements:

1. Porosity: 30% to 40%
2. Flexural strength: 1,000 P.S.I. minimum
3. Air Permeability: 170 to 190 C.F.M. per ft^2 per 1.0" thick plate at 2" water column pressure
4. Thickness: 1" (nominal)
5. Length: The plate lengths shall be such that it will not be necessary to have a spacer exceeding 1" in length. This is to provide as much effective area as possible.
6. The porous plates shall be selected by the Filter Manufacturer to provide the required strength for maximum loading and to provide the desired filtration characteristics and high-quality effluent.
7. The HDPE plates shall have NSF 61 certification.

B. The porous plates shall be completely sealed in place with a gasket-forming type sealant such as polyurethane. The sealant shall be as recommended by and provided by the filter manufacturer. The porous plates shall be held down by a fiberglass reinforced polyester retaining angle attached to the cell divider with 1/4" stainless steel fasteners (provided by the filter manufacturer) through factory pre-drilled holes.

C. The porous plates, sealants, and hold down brackets shall have NSF 61 approval for use with potable water.

2.03 GRANULAR MEDIA

A. The filter shall have a nominal sand media depth of 11". The depth specified shall be obtained when the filter is completely submerged and after thorough backwashing to remove all media fines. The filter backwashing to remove fines shall be in accordance with written instructions provided by the filter manufacturer. The sand media shall be a high-grade silica sand with a minimum of 85% silica dioxide complying with Sections 1, 2.2 and 5 of the Standard Specifications for Filtering Material (AWWA Designation: B100-09). The sand shall be well graded and materials showing abnormal grading will be rejected. The particle size distribution shall be determined by screening through standard

U.S. Series sieves. The percent size shall be determined from a plot of the percentages of the material passing each sieve, against the rated openings of the sieve. The 10% size or effective size shall be between 0.55 and 0.65 millimeters. The uniformity coefficient (ratio of 60% size to 10% size) shall not exceed 1.50.

B. The granular media shall be listed by NSF as being suitable for use in the production of drinking water.

2.04 RAILS AND ANCHOR PLATE ASSEMBLIES

A. Rails shall be 30 lb. ASCE with splice plates. 304 stainless steel anchor assemblies and 304 stainless steel bridge stops shall be included. A sufficient number of anchor plate assemblies to allow clamping the rail every 4 feet along its length shall be included. Each rail anchor assembly shall include two (2) stainless steel rail retaining clips. The Filter Manufacturer shall provide a site-specific layout for the location of the anchors to the concrete to avoid drilling into the remaining portion of the anchor bolts from the original rail installation.

B. Each anchor plate installation shall be Type 304 stainless steel consisting of two (2) anchor bolt assemblies, two (2) leveling nuts, and a floating leveling plate. The Contractor shall level and true the rail by the use of the nuts and leveling plate. Upon completion of this operation, the exposed anchor plate, nuts, leveling plates, and rail shall be grouted in place by the Contractor.

C. All rails and components, and anchor bolts, chemical anchors, and grout, etc. shall be as recommended by and provided by the filter manufacturer. The rail installation shall be in accordance with written instructions provided by the filter manufacturer.

2.05 BACKWASH MECHANISM ASSEMBLY

A. Bridges: Each of the two bridge mechanisms shall contain and support the drive mechanism, pumps, backwash piping and valves, washwater hood and controls. The bridge frame shall be welded 304 stainless steel construction allowing a maximum deflection of 1/720 of the span with a 100 lb./sq. ft. live load. The bridge shall be 48" wide minimum with a walkway of 1/4" aluminum check plate. The handrails shall be of 1.5" diameter aluminum pipe along each side of the bridge walkway for the full length of the walkway to the extreme far end of the bridge. The handrail shall turn and continue across the width of the bridge at the

far end of the bridge. The Filter Manufacturer shall coordinate and design the handrail to fully protect personnel while allowing for safe access to all components and avoiding conflict or interference with the festoon system or other components. The backwash pump valves shall be contained within the area protected by the handrail. It shall not be acceptable for the handrail to stop prior to the farthest end of the bridge. Removable SS chains with SS hardware shall be provided at the access end of the bridge.

The Filter Manufacturer shall coordinate and design the festoon system with the handrails (which extend for the full length of the bridge) to avoid any interference or other problems.

The vertical distance from the underside of the 2" of grout under the rail to the walking surface of the bridge walkway shall not exceed 15". In other words, the operator will not have to step higher than 15" to step onto the bridge.

The filter control panel shall be mounted on the bridge. The bridge width and mounting of the control panel shall be such that the Minimum Clear Working Space Distance between the front of the panel and the opposite handrail fully and clearly complies with the distance required by the current National Electrical Code. The minimum clear distance provided shall not be less than 42 inches.

B. Bridge Construction: The bridge weldment shall consist of two (2) parallel beams, formed from a minimum of 3/8" thick stainless-steel plate, and 1/4" thick cross supports. The beam formations shall be at least 14" high and have a flanged leg of 3-1/2" minimum. All other bridge supports welded to the frame shall be a minimum of 1/4" thick. All welded stainless steel shall be type 304.

C. Drive Mechanism: The bridge drive unit consists of one single speed, 1/2 HP minimum (T.E.F.C.) motor with a minimum 1.15 service factor, a gear reducer having minimum torque rating of 5100 inch-lbs., a drive shaft and self aligning, flanged bearings.

1. All gearing shall be fully enclosed in an oil-tight cast housing with the gears running in oil and all bearings of anti-friction type.
2. If the oil is recommended to be changed periodically, the oil drain port(s) shall have a SS valve with a SS pipe and a SS threaded cap that is extended

to a location where it is convenient for maintenance personnel to hold a bucket in order easily drain and contain the oil.

3. The steel drive shaft shall be a minimum diameter of 1-15/16", turned, ground, polished and shall have a rust inhibiting PVC covering.

4. The drive shaft shall be supported by self-aligning anti-friction ball bearings. All bearings shall have lubrication fittings easily accessible from the bridge walkway.

5. All bridge wheels shall be solid, double-flanged, 316 stainless steel. Both wheels on backwash end of the bridge shall be locked to the shafts to maintain proper alignment with backwash wear strip. The wheels on the influent end of the bridge shall be capable of compensating for minor misalignment of rails by sliding on the shafts.

D. Pumps: The backwash and washwater systems shall each be powered by submersible pumps that shall have mountings suspended from the filter bridge. The pumps shall be constructed of cast iron. A single pump system shall not be allowed.

1. Each pump shall be capable of a minimum pumping rate of 17 gallons per minute per ft^2 of cell area. The filter manufacturer shall provide pumps of higher capacity if he deems it will result in better filter performance. The pumps shall be equipped with stainless steel shafts and trim.

2. All motors shall be provided with sealed conduit boxes. Motors shall be designed for 3 phase, 60 hertz, 460-volt power supply, NEMA B design, single-speed with Class B insulation.

E. Backwash Frame and Shoe: A 304 stainless steel fabricated backwash frame shall be attached to the traveling bridge on the effluent channel side. The backwash shoe shall be mounted on the backwash frame such that it can independently follow any irregularities of the matching backwash wear strips, which will be replaced by the Contractor as part of the rebuild. This flexible movement shall be controlled by 300 series stainless steel springs and fasteners. The shoe shall attach to Schedule 80 PVC piping by means of a flexible hose. A pivoting backwash frame is not allowed.

F. Washwater Hood: The washwater hood shall be fabricated from 304 stainless steel. It shall be designed to permit the uniform expansion of the filter media. The hood width shall be 2.0 times the cell width. A stainless-steel manifold shall be an integral part of the upper portion of the washwater hood and shall connect with the washwater pump. The washwater hood shall contain two full-length scarifier blades constructed from high density polyethylene. Fiberglass hoods with PVC manifolds will not be allowed. The hood shall be capable of supporting the washwater pump without additional supports or hangers connected to the pump. Systems that utilize only one pump or hoods that seal on cell surfaces will not be allowed.

G. Skimmer: The automatic backwash system shall be fitted with a skimming device (a Floating Vertex Skimmer as designed by the filter manufacturer) integral with the bridge and washwater hood supports. The skimmer shall effectively remove floating material from the surface of the water in the filter and pump it to the washwater trough. All structural members shall be fabricated from 304 stainless steel. Skimmer guide blades shall be fabricated from polypropylene and factory assembled to a 304 stainless steel frame for ease of installation. These skimmer guide blades shall direct all floating scum, grease or oils to two (2) floating vertex collection points, from which it shall be pumped to the launder trough. Each collection point shall have direct piping to a submersible skimmer pump. Both floating vertex collection points shall skim in either direction and shall be capable of scum removal at a minimum rate of 50 GPM at a 20 foot TDH with a 460 volt, three-phase, 60 Hz., motor.

1. Skimmer controls shall be mounted in the control panel to operate during the backwash cycle. A selector switch, with indicator light, shall be provided to allow for selection between automatic and manual operation.

2. The skimmer pump shall be a heavy-duty cast-iron submersible type with a stainless-steel motor shaft, 1/2 HP, sealed with class B insulation.

H. Submersible Pumps: All submersible pumps shall be as manufactured by Flygt, unless the filter manufacturer recommends a different pump manufacturer in writing and the Owner agrees to accept the alternate manufacturer.

I. Wear Strips: The filter manufacturer shall provide new wear strips for the backwash shoes to press against. The filter manufacturer shall provide stainless steel hardware to be used by the Contractor in installing the wear strips to the concrete wall of the existing effluent channels.

J. Miscellaneous: This installation is outdoors so it will be exposed to high UV radiation. Accordingly, all components shall be designed for use in direct sunlight. Equipment will be submerged in or immediately above tanks containing wastewater. Therefore, all miscellaneous metallic components (hose clamps, brackets, hardware, and such, etc.) shall be stainless steel or aluminum for corrosion resistance.

2.06 STRETCH CABLE ELECTRICAL SYSTEM (Festoon System)

A. The electrical supply cable will be four-conductor, minimum #10-gauge cable. The supporting cable (which supports the electrical supply cable) shall be provided by the filter manufacturer and will be 3/8" diameter minimum x 7 x 19 stainless steel aircraft type stranded wire with stainless steel turnbuckle, stainless steel fittings, and stainless-steel hardware. The electrical cable will be supported every 8 feet for the length of the basin by nylon trolley carriers. Each carrier clamps and supports the electrical cable. All components shall be as recommended by the manufacturer and suitable for installation in direct sunlight in a humid environment. The existing concrete festooning posts shall be re-used. All metallic components of the festoon system shall be stainless steel.

B. Upon traveling to the end of the basin, the looped cable is extended to form a draped cable; as the cable returns, the loops are retracted by the action of the cable guide fastened to the bridge, towing the lead carrier.

C. The festoon system and supports shall be designed by the Filter Manufacturer to allow the bridge handrail to extend fully to the far end (i.e., the backwash pump end) of the bridge without causing any interference or other problems.

2.07 FACTORY PAINTING

A. Shop painting (prime and finish) shall be carefully done by the filter manufacturer and all coatings applied in a workmanlike manner in strict accordance with the paint manufacturer's published recommendation.

1. All ferrous metal purchase components including gear-motors, pumps, and bearings shall be given an additional topcoat of safety blue enamel over the manufacturer's original finish prior to assembly.

B. Rails shall be shop cleaned by sandblasting in accordance with the steel structures painting council specification (SSPC) SP-6 prior to priming.

1. Rails shall be prime coated only with Tnemec Series N69-1211 primer. One (1) coat of primer shall be applied resulting in a finished dry film thickness of 3.0 to 5.0 mils. The rails shall be properly prepared and top-coated in the field by the Contractor's painting subcontractor in accordance with the painting specifications for the project.

2.08 CONTROL SYSTEM

A. Refer to Specification Section 26 29 00 ("Manufactured Control Panels") for additional control panel requirements.

B. The automatic and manual controls for operation of the Traveling Bridge Filter system shall be furnished fully assembled, wired and pre-programmed in a UL 508A Certified Industrial Control Panel. The control system and all components shall be as designed by and provided by the filter manufacturer to provide reliable and trouble-free operation.

C. Included with the panel are control relays and PLC (Allen Bradley Compact Logix), and level sensing probes whereby the pump motors and drive motor may be actuated automatically by a predetermined increase in hydraulic head, or by a PLC to control the interval between each cleaning cycle automatically. The cleaning cycle is terminated by a signal from the level sensing probe signaling low water. The "off-time" of the cleaning cycle is controlled by the PLC with an adjustable range. When the PLC times out, the motors are actuated. During the "on-time", the PLC timer function resets for starting off-time at the end of the cycle. Should high water occur during off-time, the motors are started by a relay actuated from the high-water electrode signal, with a corresponding resetting of the PLC timer function.

D. The control sequence for the backwash mechanism shall be wired so the backwash mechanism stops at either end of the filter upon termination of the backwash cycle,

which will be at the low operating probe signal. A low water shutoff probe shall prevent pumping the filter tank below the minimum water level point.

E. Auxiliary E-Stop: In addition to the E-Stop mounted on the front of the Filter Control Panel, the Filter Manufacturer shall provide an auxiliary E-Stop to be mounted in a highly visible and readily accessible location on the access end of the bridge (i.e., the end where personnel step up onto the bridge). This shall allow personnel in that vicinity to immediately stop the bridge and all its equipment (pumps etc.) from that location should that become necessary. Provide a prominent and permanent "Emergency Stop" sign at that location. The Filter Manufacturer shall factory wire the E-stop to the Filter Control Panel and test it to verify that it functions properly.

F. Bridge Electrical Conduit: Any metallic conduit on the bridge shall be aluminum or SS. Any non-metallic conduit shall be designed for UV resistance and installation in direct sunlight. All attachment devices, hardware, or other electrical appurtenances, etc., shall be aluminum or SS.

G. The control system shall include the following control components and practices:

2.09 CONTROL PANEL WIRING AND ASSEMBLY

A. All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. The short circuit rating of the control panels shall be a minimum of 14 kA RMS symmetrical @ 480 VAC. The filter control panels will be powered by 460-volt, 3-phase circuits with three hot wires and one ground wire. (No neutral will be provided.)

B. All control panel wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation. All power wiring for all motors and pumps shall be 12 AWG minimum.

C. Wire colors are as follows:

208 VAC or higher	-	Black
120 VAC control power	-	Red
Neutral	-	White
Ground	-	Green with Yellow Stripe
Power from remote source	-	Orange

Neutral from remote source	-	White with Orange Stripe
24 VDC (+)	-	Blue
24 VDC (-)	-	White with Blue Stripe
Intrinsically Safe	-	Light Blue

D. All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or approved equal.

E. Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

F. Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

2.10 CONTROL PANEL QUALITY ASSURANCE

A. All Control panels shall be UL certified. The panels shall be completely tested, including all functionality, by the manufacturer's electrical engineer prior to releasing for shipment. Testing shall consist of the following as a minimum:
   a. Point to point testing of all wiring prior to application of power.
   b. 480-volt supply voltage shall be applied to the panel
   c. All components shall be tested for proper operation and calibration.
   d. The timer function and level controls shall be functionally checked.
   e. All components shall be checked to confirm proper mounting specifications have been followed.
   f. Enclosure shall be inspected for defects and repaired if necessary.
   g. Verify that all labeling of wires and devices is correct, properly installed and clean.
   h. The interior of the enclosure shall be clean and free from all debris, etc., of any type.

B. The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.

C. Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e., finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

2.11 CONTROL ENCLOSURE

A. The automatic controls shall be provided in a UL listed, NEMA Type 4X 304 stainless steel (12 gauge) floor mount enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. The enclosure shall have a white polyester powder paint applied by the enclosure manufacturer to increase the reflection of sunlight to assist with panel temperature. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316SS padlockable POWERGLIDE® handle shall be provided. Enclosures shall be white, with a smooth #4 brushed finish. Enclosure shall include a painted white mild steel (12 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

2.12 CORROSION INHIBITOR

A. Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.

B. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

2.13 AIR CONDITIONER & HEATER

A. A thermostat-controlled air conditioner with noise suppression shall be supplied to protect control components mounted inside the enclosure from high temperatures, humidity and ambient air contaminants. The air conditioner shall be constructed of brushed finish stainless steel 304 material and provide NEMA 4X Type protection from outdoor and hose-down applications. The air conditioner unit shall use CFC-free or environmentally safe refrigerant that is universally accepted. The air conditioner shall maintain acceptable and recommended panel temperature to protect all components including the PLC when installed in direct sunlight at the project site when the ambient air temperature is 120° F. The air conditioner shall be designed

for and shall provide dependable service and a long life. The air conditioner shall be manufactured by Hoffman or approved equal.

The air conditioner condensate shall be routed by the filter manufacturer such that it does not drip onto the bridge.

A control panel heater shall be provided to maintain the controls, UPS, and PLC at acceptable temperature and to prevent internal condensation in the panel.

2.14 MAIN DISCONNECT CIRCUIT BREAKER

A. A UL listed, automatic molded case 3-pole disconnect main breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. The breaker shall be padlockable in the "Off" position. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/HDL, JDL, LDL, MDL, PDL or approved equal.

2.15 MOTOR STARTER

A. A full voltage Integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection and monitoring functions for the motor. The starter shall be NEMA rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a minimum mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip, and phase imbalance trip.

2.16 TRANSFORMER

A. A step-down multi-tap transformer shall be supplied to reduce incoming 3-phase power to 120 VAC single-phase. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental

contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish. Transformer shall be Square D 9070T or approved equal.

B. Surge Protective Device: A UL listed surge protective device shall be provided on the secondary side of the 480v / 120v transformer to protect the circuits and equipment powered by the secondary size of the transformer.

2.17 TRANSFORMER PRIMARY AND SECONDARY FUSES

A. Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

B. Spares: A minimum of 3 spare fuses of each size and type installed shall be provided.

2.18 CIRCUIT BREAKER

A. All single-phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

2.19 FUSES

A. Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

B. Spares: A minimum of 3 spare fuses of each size and type installed shall be provided.

2.20 OPERATOR DEVICES

A. Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter. Super bright, long-life LED pilot lights (visible in direct sunlight) and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be push-to-test LED type lamps. Color coding shall be applied as required and is as follows:

   a. Amber – Alarm active, caution
   b. Green – Valve open, motor running
   c. Red – Valve closed.
   d. White - Information

B. All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and watertight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Square D 9001 or approved equal.

C. In addition to other devices, each panel shall have a large prominent E-stop button mounted on the front of the panel that will immediately stop the bridge and other equipment when it is depressed. Provide a label for the E-stop pushbutton.

D. Provide high-intensity long life LED indicator lamps to indicate the status of various pieces of equipment. All indicator lamps shall be wired to a single push button that will simultaneously test all lamps for operability.

2.21 UNINTERRUPTIBLE POWER SUPPLY

A. A UL listed uninterruptible power supply suitable for location in a UL 508 panel shall be provided to protect the HMI and PLC from short power outages by switching to an emergency battery backup without data loss or downtime. Nominal input voltage and output voltage shall be 120VAC with an autosensing input frequency of 47 to 63 Hz. The output power capacity shall be 650W / 1000VA. The UPS shall be provided with an audible alarm and LED status indicators and operate from 32° to 122°F (0° to 50°C). The UPS shall be an Allen Bradley 1609-B1000N.
B. Provide supplemental surge protection for the UPS in addition to the other SPDs in the panel.

2.22 GROUND FAULT DUPLEX RECEPTACLE

A. A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

2.23 THREE-PHASE TYPE 1 SURGE PROTECTIVE DEVICE

A. A UL Listed type 1 surge protective device shall be provided in the control enclosure to protect incoming three-phase power from external surges caused by lightning or power switching. The surge protector shall be a Surge Suppression Inc Model CKLA3N4C1-LP-21 with indicating lights and with a dry contact that will close on failure of the SPD. If the panel manufacturer deems it advisable, it may provide a second 3-phase surge protection device (as selected by the panel manufacturer) for further protection.

2.24 INDUCTION RELAY

A. An induction relay shall be provided for liquid level alarming and control of pumps and motors utilizing level sensing probes. The induction relay shall provide field convertible contacts rated for 25 amps at 120 VAC or 240VAC. Induction relay shall be B/W Controls 1500 or approved equal.

2.25 INDUSTRIAL RELAY

A. UL listed NEMA industrial relays shall be supplied for general control purposes. The relay shall be DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating at 600 VAC and 10 million mechanical life cycles. Relays shall be Allen Bradley 700-P, Square D, or approved equal.

2.26 TIME DELAY RELAY

A. A time delay relay shall be provided for control of the drive motor, wash water pump, and skimmer. The time delay relay shall have an on-delay time range of 0.3 seconds to 30 minutes. The time delay relay shall have a light emitting diode (LED) which is on during the time cycle and off at the end of timing. Contact type shall be DPDT (2 form C) with life rating of 50 million operations. Time delay relay shall be ATC 319 or approved equal.

2.27 TERMINAL BLOCK

A. Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point-to-point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

2.28 PROGRAMMABLE LOGIC CONTROLLER

A. Automatic operation of the Filter shall be controlled through an Allen Bradley CompactLogix 1769-L30ER programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a backpanel, power supply, controller, I/O modules, and network modules as required. All input and output points supplied (including unused) shall be wired to terminal blocks. The PLC user memory shall consist of a minimum of 1MB of user memory. All PLC hardware shall be UL listed and operate acceptably at an ambient temperature of -4° to 140° F (-20° to 60° C).

B. Additionally, provide other equipment or upgraded equipment and features if needed for the PLC to properly communicate with the plant SCADA system. Refer to Plant Network Diagram on electrical plans for additional requirements. The filter manufacturer shall carefully coordinate with SCADA system supplier to insure that the filter panel output provides communication and protocols (including but not necessarily limited to Ethernet TCP/IP) that can be utilized by the SCADA system. Provide a map of PLC registers for use by the SCADA system. Provide sufficient information to the SCADA system so that its screens will duplicate the filter control panel HMI screens. Provide capability so that, if the Owner allows, the filter manufacturer can temporarily access its control panel to assist in troubleshooting. Refer to Specification Section 26 29 00 for additional requirements.

C. Wireless LAN Network Provisions:

a. Provide WLAN canopy system including the following components:

i. Phoenix FL WLAN 5101 Ethernet Client Radio, 2.5/5 GHz.

ii. Three (3) omni-directional Phoenix 2885919 antennae with cabling, weather protection tape (Phoenix 2903182), coaxial cabling (L-Com CA3N060), coaxial surge protection (three Phoenix 2801057), Adapter cables (three Phoenix 2903263), grounding, interconnections, etc. as required for a fully-functional system.

b. System shall be capable of communicating on the existing SCADA wireless LAN network at the plant and shall comply with IEEE 802.11g protocol using standard Ethernet TCP/IP protocol data. Coordinate with the approved SCADA Integrator prior to submitting shop drawings to ensure that the proposed equipment/installation is fully compatible for a reliable wireless network monitoring system.

c. Coordinate with SCADA Integrator for configuration of IP addresses for PLC, radio, radio configuration parameters, etc.

D. Surge Protection: Refer to Specification Section 26 29 00.

2.29 ETHERNET SWITCH

A. An unmanaged Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. Maximum distance between devices shall be 100m.

B. The unit shall be DIN rail mounted and require 24VDC power. Diagnostic LEDs for power and connection status shall be included. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley 1783 or approved equal.

2.30 HUMAN MACHINE INTERFACE

A. The operator interface shall be a NEMA Type 4X rated, 6.5" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480-pixel resolution. The rated operating

temperature shall be 32° to a minimum of 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 7".

B: HMI Sunshield: A sun shield constructed of 304 stainless steel shall be mounted over the operator interface to provide protection and effective ease of visibility of operator screens in outdoor applications installed in direct sunlight.

C. Refer to "Wireless LAN Network Provisions" paragraph above for networking equipment/provisions/requirements.

2.31 INDEXING

A. 304 Stainless steel indexing pegs shall be provided at each filter cell. The indexing pegs shall be attached to an FRP channel strut. All components including attachment hardware shall be non-corrodible. Each filter bridge shall be provided with a limit switch that will activate a timer within the control panel. The timer shall allow an adjustable dwell time over each filter cell that is being backwashed. The panel shall provide flexibility to the operators for selection of continuous bridge movement if they prefer this mode of operation to indexing.

2.32 SUNSHIELD

A. A 304 SS sunshade shall be provided for the control panel. Note that these filters are in a critical application since their discharge enters a lake providing much of the drinking water for the Birmingham, Alabama metro area. Thus it is highly desirable for the filters to continue to operate properly even if the panel air conditioner fails.

2.33 MISCELLANEOUS

A. The Filter Manufacturer shall provide and install (with stainless steel hardware) appropriate and clearly readable permanent warning signs. These shall include but not be limited to "Danger – Equipment Starts Moving Automatically". The minimum size of the signs shall be 18" by 12". These shall be mounted in prominent locations on each side of the bridges (i.e. 2 per bridge) at the access end of the bridges so that they will be visible to a person approaching the bridge regardless of his approach direction. Install a similar sign on the guard chain at the access end of the bridge. The filter manufacturer shall install other warning signs that it deems appropriate or desirable.

B. The Filter Manufacturer shall provide and install clearly readable permanent equipment identification signs: “Traveling Bridge Filter #1” and “Traveling Bridge Filter #2”. These signs shall be mounted on each side of the bridge (i.e. 2 per bridge) as well as on the Filter Control Panels.
C. Install the signs in a manner such that they do not interfere with the ability to securely grasp the handrails.
D. Spare Parts: The Filter Manufacturer shall include all recommended spare parts for the equipment that it provides.
E. PFAS: No PTFE tape shall be used in the assembly of the filter or any of its components, and no PTFE containing compounds shall be utilized in the filter or its components. The effluent from these filters enters a lake that is the source of much of the drinking water for the Birmingham Metro Area. Therefore the Filter Manufacturer shall take all practical measures to prevent its equipment from adding any per- and polyfluoroalkyl substances (i.e. “PFAS”) to the flow passing through the filter. The Filter Manufacturer shall provide written notification to the Owner and Engineer of any known, suspected, and/or potential sources of PFAS from the equipment and components that it provides.

PART 3: SERVICES

3.01 FILTER MANUFACTURER SERVICES

A. The equipment manufacturer shall furnish the services of a competent field technician for a minimum of 21 full working days on site and a minimum of eleven (11) separate trips. These eleven trips shall consist of one (1) installation supervision trip, six (6) minimum mechanical supervision trips, and two (2) electrical supervision trips, and additional trips as needed to be confident that the plates and caulking are properly installed.

   If the Contractor is not ready for the filter manufacturer technician when he arrives, the required time or number of visits of the technician shall be extended at the Contractor’s expense.
B. The Contractor shall coordinate with the Filter Manufacturer in a timely manner so that a representative of the filter manufacturer can be onsite whenever recommended or required by the Filter Manufacturer.

C. See the “All Equipment” specification for further requirements for the field technician.

D. Note that the only one of the two traveling bridge filters on this project can be removed from service for rebuilding at any one time. The second filter must remain in service until the first filter is completed and in normal operation. Therefore, if the Filter Manufacturer feels it advisable to provide more trips and more days in order to ensure the maximum reliability for each filter, he shall do so. Further, the Filter Manufacturer shall add a trip to field determine actual filter dimensions and any other information that it needs to be able to properly perform the work.

3.02 INSTALLATION

Warning:

One traveling bridge filter must remain in operation at all times during both demolition of existing filter equipment and during installation of new filter equipment. Therefore, it will be necessary for the Contractor's personnel to work immediately adjacent to the traveling bridge of the filter remaining in operation both during demolition and during installation. The traveling bridges can begin moving silently at any time without any warning. The Contractor is responsible for safety and shall take all appropriate safety precautions throughout all work on the project.

A. This installation guidance is general. By no means is all required work described. The specifications and the drawings contain some, but by no means all, additional requirements. As noted previously, it is the responsibility of the Contractor to coordinate with the Filter Manufacturer at bid time to be certain he includes the full cost of all work in his bid.
B. The Contractor shall properly store all materials. The Control Panels shall be stored indoors in conditioned space. Caulking, sealants, resin for epoxy anchors, and grout, etc., shall be stored indoors and in accordance with the manufacturer's recommendations, including temperature considerations.
C. The Contractor shall schedule the installation of the plates and caulking during a period which no rain is predicted for seven days to minimize the potential for the installed plates or caulking becoming wet before the end of the 7-day curing period. Additionally, the Contractor shall erect a tent over the filter with sufficient overhang on all sides to keep the plates and caulking dry should unanticipated rain occur on the day of installation or within the 7-day period following the installation of all plates and caulk. The tent shall be sufficiently secured so that it will be effective even during periods of high winds. The tent shall also provide protection from sunlight to

minimize the potential for damage or for excessive temperatures before the caulk cures.

D. The filter manufacturer shall be onsite at whichever steps of construction he deems it advisable for him to be there. This shall include all important steps. As a minimum, the filter manufacturer shall be onsite to observe the installation of the porous plate underdrains and the associated sealant and hold down assemblies. The installation of the underdrains and sealants is especially important as improper installation can result in poor filter performance, permit violations, and shortened filter life. Carefully follow all written installation instructions provided by the Filter Manufacturer. Provide proper sealant and plate storage before installation. Do not use sealant or other products whose storage requirements have not been complied with or whose shelf life has expired. Do not apply sealant when ambient temperature or other conditions are not within recommended range or are not expected to remain within the recommended range during the cure period. Thoroughly clean and vacuum the entire area around and below the underdrains before installing the underdrain plates. Thoroughly re-clean and vacuum after the underdrain plates, retaining angles (plate hold-down brackets), and spacer rods have been installed but before sand is installed. Allow for a suitable curing period after installation of sealant (7 days minimum or longer if recommended by the Filter Manufacturer) before installation of sand.

E. Before filtering water through the new sand, the Contractor shall thoroughly clean the filter effluent channel (including but not limited to effective vacuuming) and shall provide temporary pumps and piping to transfer filter effluent from the traveling bridge filter remaining in operation to the effluent channel of the new filter to allow thorough backwashing of the new filter sand. The filter shall be backwashed in accordance with written instructions from the Filter Manufacturer until the onsite representative of the Filter Manufacturer advises the Owner and the Engineer that the backwashing is sufficient and that the filter startup may continue.

F. The filter manufacturer shall be required to sign a certification of proper installation form provided by the Owner at the completion of installation. See the All-Equipment specification for more information regarding this certification.

G. Carefully plan and schedule the rehabilitation of the existing filters to minimize the amount of time that they will be out of service. Only one filter can be removed from service at the time and the first filter removed from service must be totally completed, tested, and returned to service prior to removing the second filter. Neither filter may be removed from service unless acceptable to the Owner. Do not remove a filter from service for demolition until all new components are onsite and the required

manufacturer site visits have been coordinated with the filter manufacturer. Once a filter is taken out of service, the Contractor shall work expeditiously so that filter can be returned to service as soon as practical. Once a filter has been removed from service, the Contractor shall make returning that filter to service a priority and shall not allow his personnel to be used for other purposes when there is other work that can be performed to expedite returning the filter to full and proper operation in the intended mode. If the Contractor encounters delays or problems after a filter has been removed from service, he shall take all reasonable methods to mitigate the delay or problem. After the first rehabilitated filter is returned to service, it and the SCADA system serving it must operate for a minimum of 10-days with no malfunction or alarm or any other problem before the second filter can be removed from service. The SCADA system serving the filter must be properly operational during and following this 10-day period so that operators can be notified promptly of a problem with the filter. If the first filter or its SCADA system has any malfunctions, alarms, or any other issues within the 10-day demonstration period, the problem shall be corrected and the test shall be repeated for another 10-days until the filter and its SCADA system operates for 10 consecutive days without any issues. Highly reliable and dependable operation is important because the WRRF will not have any filtration if the first rehabilitated filter fails while the second filter is removed from service for rehabilitation. The filters are an important plant process in the Owner's ability to comply with his permit limits and thus the proper operation of both travelling bridge filters is essential.

H. During the removal of existing filter components that are being replaced, the Contractor shall use care to prevent any damage to any filter components that will be re-used. In addition to those components listed elsewhere, items such as grating, handrail (with some modification), and slide gates shall also be reused. The Contractor shall use care not to damage any components being reused and shall be fully responsible for any damage due to his work.

I. Install all equipment in full accordance with the detailed, clearly written instructions from the filter manufacturer which shall be included in the original equipment submittal. Install grout under the rails. Grout shall be non-shrink epoxy grout installed in accordance with the grout manufacturer's recommendations. Any spacers between the existing concrete and the new rails shall be stainless steel. Anchor brackets, hardware, bolts, and appurtenances, etc. shall be stainless steel. The manufacturer's installation instructions shall clearly show the exact location of the rails and other needed information so that the rails can be installed in the correct locations. Make any needed adjustments to equipment after installation to achieve proper performance.

J. There will be additional miscellaneous work that is not specifically described herein or shown on the drawings that must be performed by the Contractor to provide a complete and properly performing installation.

K. The completed installation shall perform reliably and trouble-free.

ATTACHMENTS

Geotechnical Section Contents

1. August 2, 2022 Geotechnical Engineering Exploration
2. September 29, 2022 Email From Atlas Technical Consultants
3. Controlled Structural Fill Requirements

August 2, 2022 Geotechnical Engineering Exploration

North Shelby WRRF Filter Improvements

Prepared By Atlas Technical Consultants LLC

53 pages

GEOTECHNICAL ENGINEERING EXPLORATION

NORTH SHELBY WRRF FILTER IMPROVEMENTS

Z003001227

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August 2, 2022

August 2, 2022

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Subject: **Geotechnical Engineering Exploration**
North Shelby WRRF Filter Improvements
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Dear Mr. Godfrey:

Atlas Technical Consultants LLC (Atlas) has completed the authorized Geotechnical Engineering Exploration for the subject project. This work was conducted in accordance with the agreement between Atlas and Municipal Consultants, Inc. (the "client"), which is detailed in Atlas Proposal No. 22-02673, dated March 18, 2022, and authorized March 24, 2022.

The purpose of our work was to evaluate general surface and subsurface conditions within the subject project site, and to gather and present data relative to the design and construction of the proposed construction referenced above. This report outlines the exploration procedures used, exhibits the data obtained, and presents our conclusions and recommendations.

Atlas appreciates this opportunity to provide these services and looks forward to working with you on future projects. Please contact us if you have any questions or require additional information.

Respectfully submitted,
Atlas Technical Consultants LLC

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Attachment: Geotechnical Engineering Exploration Report

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1. SCOPE OF WORK

The purpose of our analysis was to evaluate the general subsurface conditions within the proposed site, and to determine parameters for design and construction at the subject project site. This work was conducted in accordance with the agreement between Atlas and Municipal Consultants, Inc. (the "client"), which is detailed in Atlas Proposal No. 22-02673, dated March 18, 2022, and authorized March 24, 2022.

Our engineers evaluated the field exploration, laboratory tests, and substantiating data in order to provide recommendations for the design and construction of the proposed structures. Our analysis was made based on the conditions encountered by the test borings, laboratory tests on soil samples obtained from the borings, and our experience on similar projects. Our report includes the following:

- Field and laboratory test procedures and results;
- Area geology;
- Boring Location Plan;
- Recommendations for foundation design for the proposed structures; and
- Considerations and comments regarding site earthwork including subgrade preparation, excavation, and filling operations.

The scope of this geotechnical exploration did not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site evaluated, nor does it intend to address the potential for sinkholes or other deep geological phenomena related to karst activity. The scope of work did not include surveying services to locate the borings or to determine their ground surface elevations.

2. PROJECT AND SITE DESCRIPTION

The project site is located within an operating waste water treatment plant at 161 Village Street, Birmingham, Shelby County, Alabama. See Figures 1 and 2. Atlas understands that the proposed construction/demolition encompasses the following.

- The existing abandoned old Effluent Pump Station is to be demolished and a new Splitter Box and Disk Filters constructed in that area. Borings 1, 2, 3, 5, 6, 7, and 8 were drilled in this area.

- An elevated 4' wide aluminum walkway abutting the existing transfer pump station is to be constructed. This walkway is to support electrical gear and a canopy. The elevated aluminum platform is planned to be about 30'11" long. The concrete footing supporting the platform piers is to be 7'6" wide and 28'11" long. Boring 4 was drilled in this area.

Due to the demolition of the existing old Effluent Pump Station, the splitter box is to be constructed on newly placed fill. Figure 3 shows the current layout of the facility provided by the client. No additional information has been provided to Atlas including, grading or final elevations.

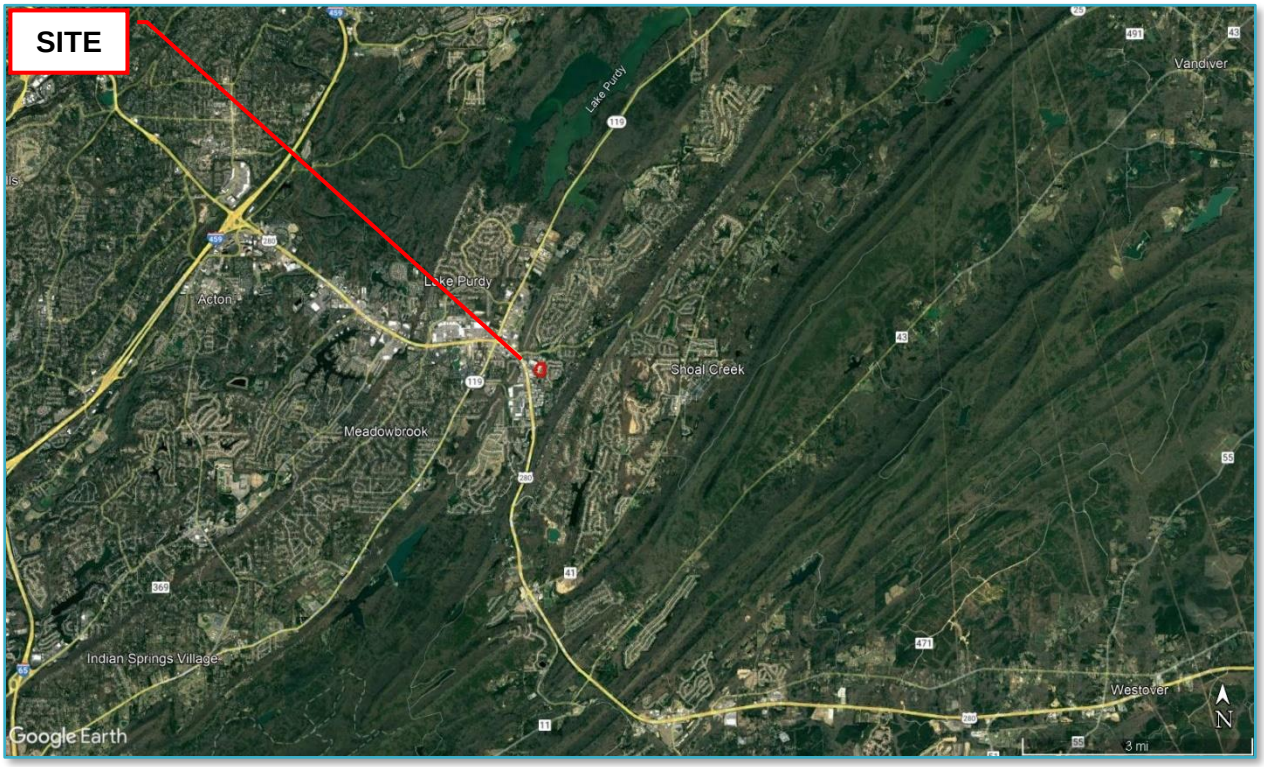

Figure 1 – Location Map (*Source: Google Earth*)

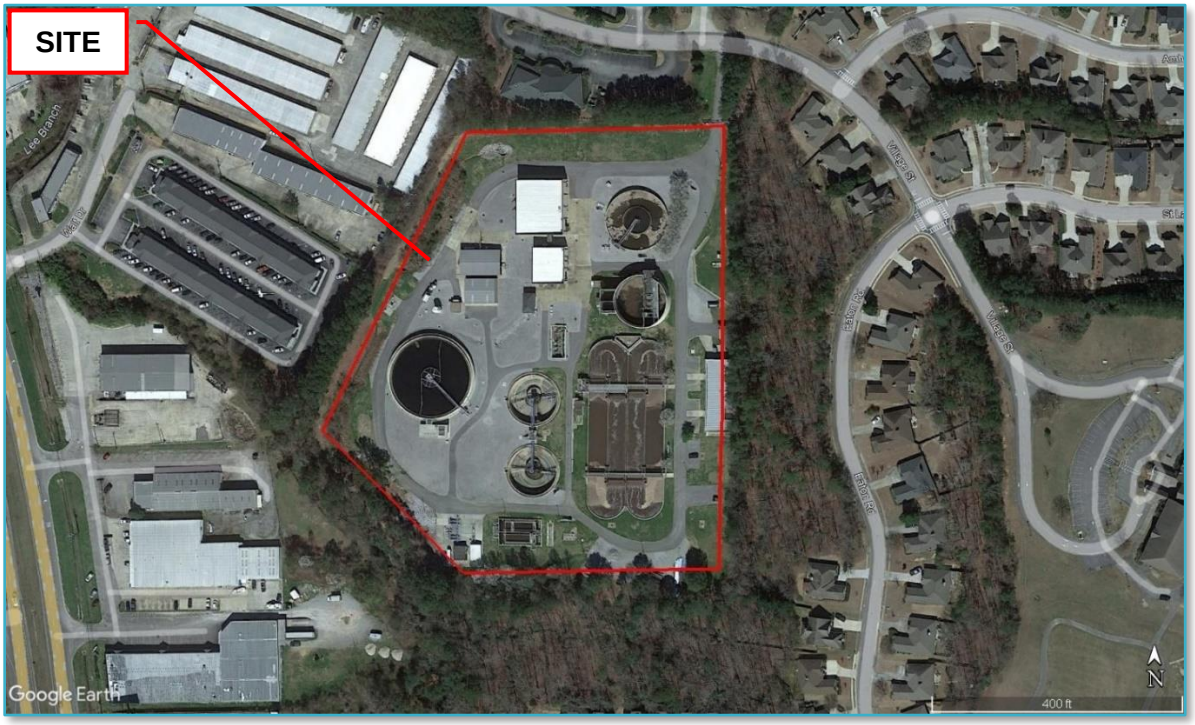

Figure 2 – Site Vicinity (*Source: Google Earth*)

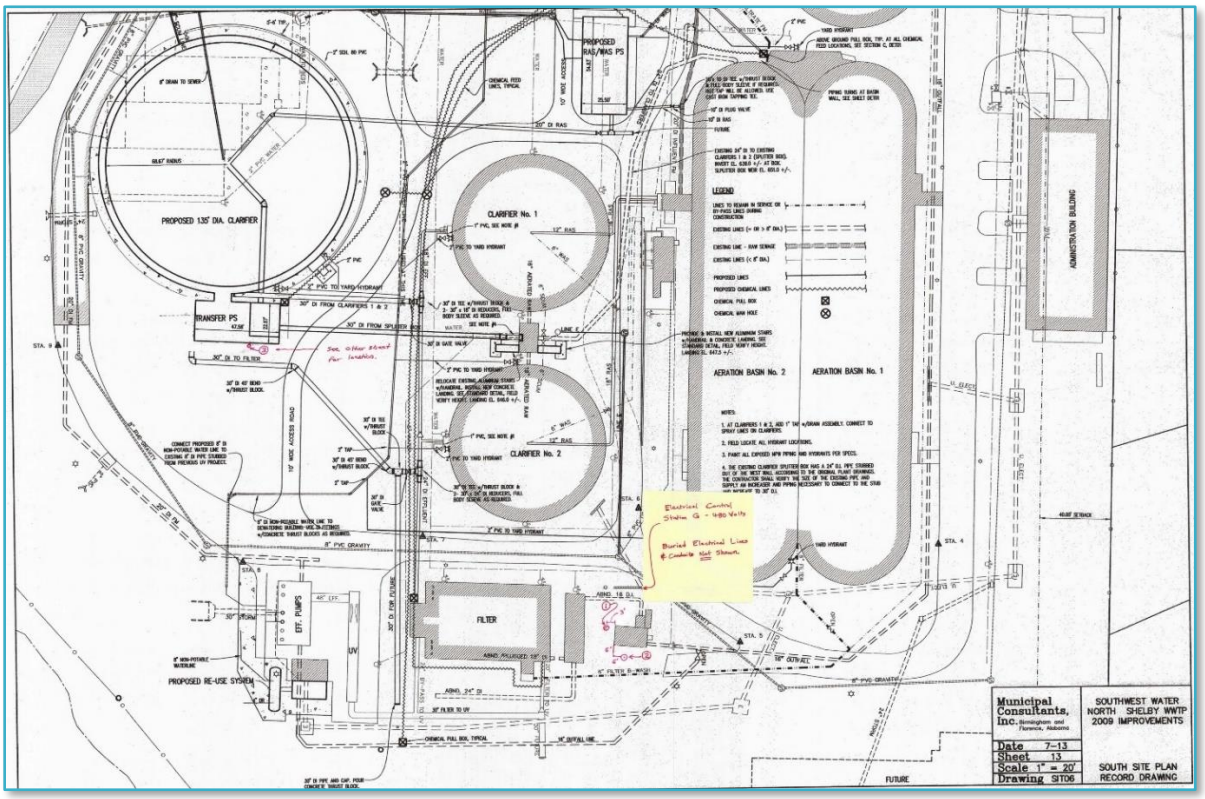

Figure 3 – Site Layout (*Source: Client*)

3. GEOLOGY

The project site is located within the southern portion of the Cahaba Valley of the Alabama Valley and Ridge Physiographic Section, which is one of Alabama's five physiographic sections. The Alabama Valley and Ridge physiographic section is the most southerly part of the Appalachian Plateaus province of the Appalachian Highlands Region. The Alabama Valley and Ridge section is identified by its pattern of relief features and landforms, which differ significantly from those of adjacent sections. It occupies about 15 percent of the state and occurs as a roughly northeast-oriented rectangular area in central and northeastern Alabama. The landscape consists of flat-topped, high-elevation plateaus separated by deep, steep-sided valleys. The plateaus slope gently from the northeast to the southwest.[1]

The project site is underlain by two geological formations: the Parkwood Formation (*PMpw*) and the Floyd Shale (*Mf*). The Parkwood consists of medium- to dark-gray shale containing intervals of light- to medium-gray lithic sandstone. The Floyd Shale is a dark-gray to black shale containing siderite (iron-rich) nodules. *Figure 4* below shows a generalized geological map of the site and vicinity.[2]

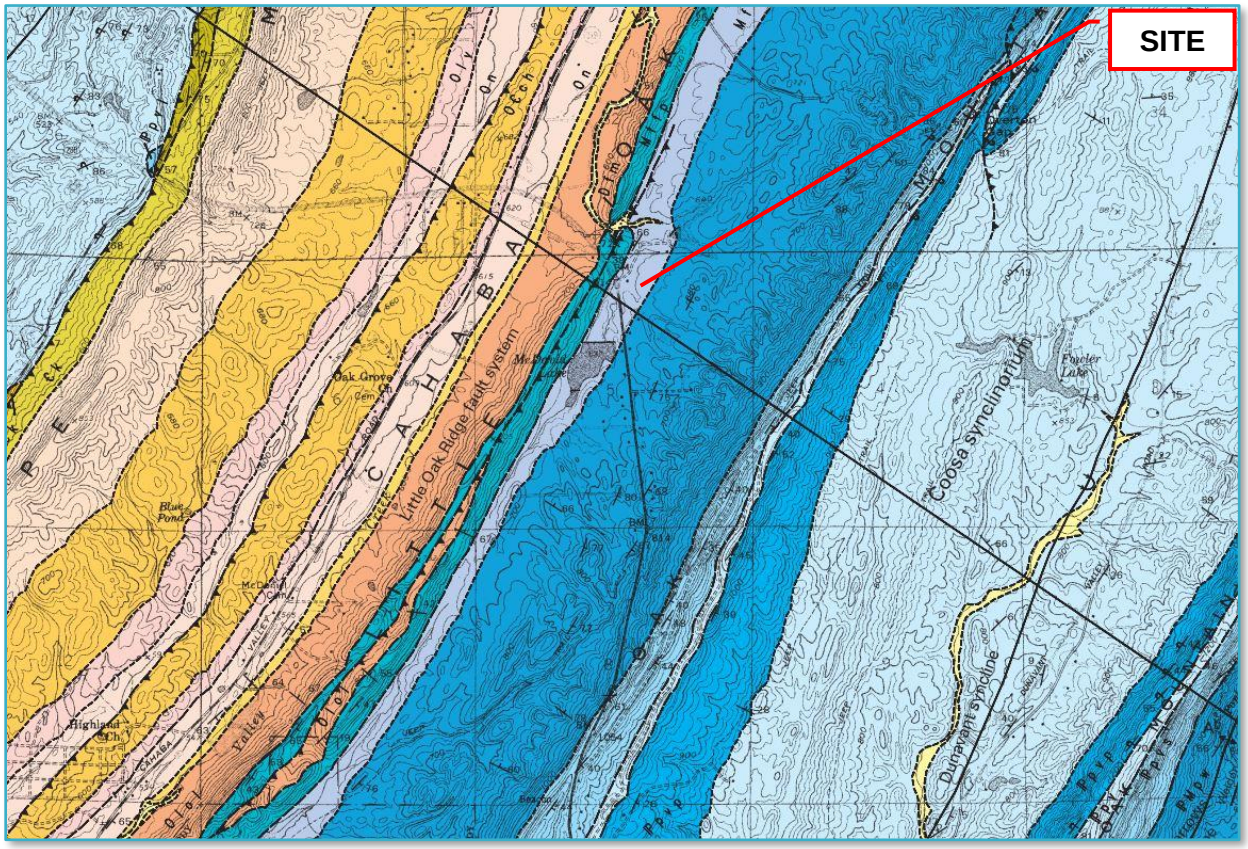

Figure 4 – Generalized Geological Map of the Site and Vicinity (*Source: GSA*)[3]

[1] Lineback, N.G., and Traylor, C.T. Atlas of Alabama. University of Alabama Press. 1973.
[2] Osborne, W.E. Geologic Map of the Cahaba Heights 7.5 Minute Quadrangle, Jefferson and Shelby Counties, Alabama. Plate 2. Geological Survey of Alabama. 2006.
[3] Osborne, W.E. Geologic Map of the Cahaba Heights 7.5 Minute Quadrangle, Jefferson and Shelby Counties, Alabama. Plate 1. Geological Survey of Alabama. 2006.

4. SUBSURFACE EXPLORATION

The field investigation consisted of eight (8) soil test borings ranging in depth from 10 to 22 feet below existing ground surface (*ft-begs*). The boring locations were estimated in the field by Atlas using a hand-held GPS device. Atlas completed the drilling operations on April 12, 2022, for borings B-1 through B-5, and on July 15, 2022, for borings B-5 through B-8. See *Figures 5* and *6* below for the Boring Location Plans.

Figure 5 – Overall Boring Location Plan (*Source: Google Earth*)

4.1 Soil Borings

Borings were advanced using a track-mounted Geoprobe 7822DT. The drilling procedures were in general accordance with ASTM D 1586, entitled "Standard Practice for Standard Penetration Tests" (SPT). SPT samples were obtained with a standard 1.4-inch I.D., 2.0-inch O.D., split-barrel sampler. The sampler was first seated 6 inches and then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final foot was recorded and is designated the “standard penetration resistance”, or “N-value.” Representative portions of each sample were selected and sealed in plastic bags to prevent loss of moisture. Sample depths and types are shown on the boring logs shown in the Appendix.

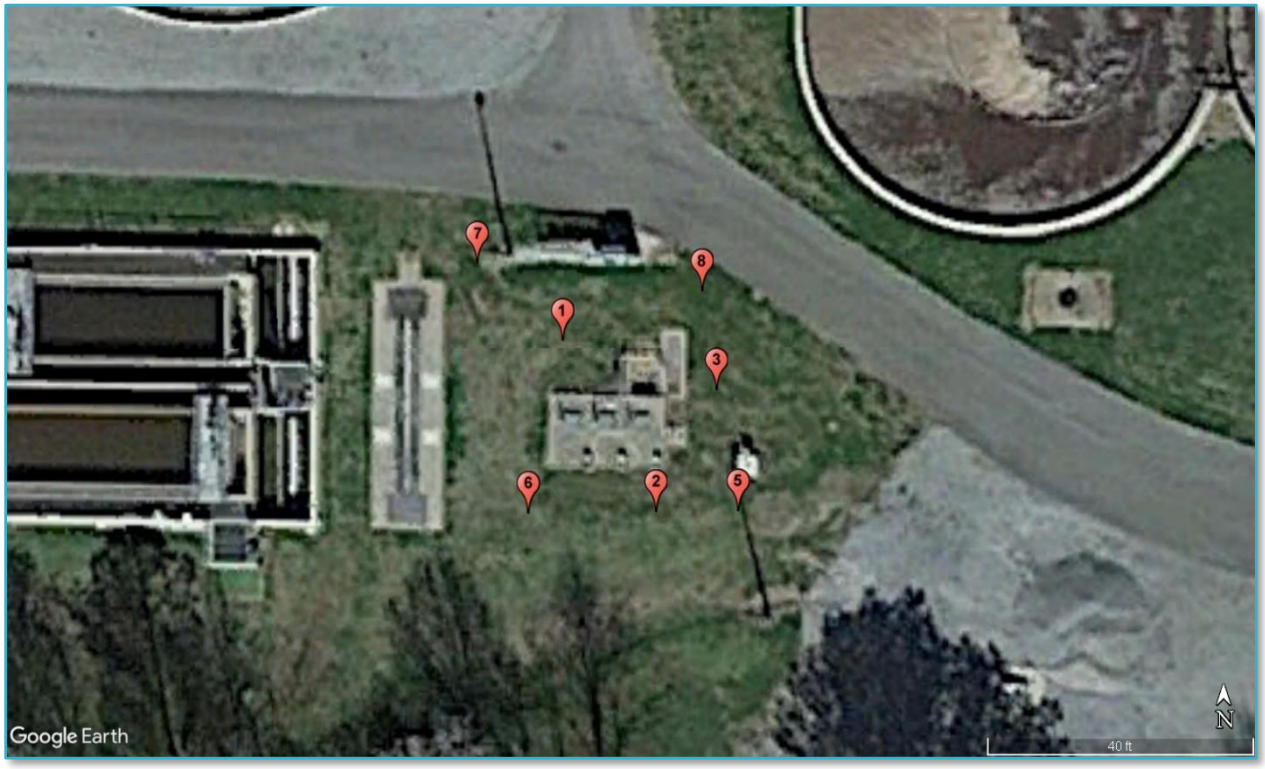

Figure 6 – Filter Area Boring Location Plan (*Source: Google Earth*)

Boring locations were estimated in the field with the assistance of a client's representative. Locations shown on the Boring Location Plans *(Figures 5 and 6)* above should be considered approximate. Borings were logged by an Atlas geotechnical engineer.

The boring logs represent the engineer's interpretations of the subsurface conditions based on the visual examination of samples and correlations made using the results of laboratory tests performed on selected samples. Lines designating the interface between various strata on the boring logs represent the approximate positions of soil changes. The actual transition between strata may be gradual. Subsurface water conditions shown on the boring logs are based on the field observations at the time the exploration was conducted. Upon completion of the drilling, borings were backfilled with the soil drill cuttings.

4.2 Surface and Subsurface Conditions

Details of the subsurface conditions encountered by the test borings are shown on the boring logs included in the Appendix. The stratification lines indicated on the boring logs represent approximate boundaries between soil types. However, the actual transition may be gradual. Conditions represented by the test borings should be considered applicable only at the test boring locations on the dates shown, and it should be assumed that the conditions might be different at other locations at other times. Samples are classified in general accordance with ASTM D2488 and the Unified Soil Classification System (USCS). Additional information regarding the soils is detailed in the borings included in the Appendix to his report.

4.2.1 Possible Fill Material

Fill material refers to any material, including soil, that was transported to its current location through manmade means. Fill material was visually identified in all borings, and ranged in thickness from about 1.5 feet below the existing ground surface (*ft-begs*) (*Test Boring B-8*) to approximately 19.0 *ft-begs (Test Boring B-1)*. The fill material generally consisted of sandy lean clay (CL), clayey sand (SC), and sandy silt (ML) with varying quantities of shale fragments. The consistency of the fill material varied considerably from very soft/loose to very stiff.

4.2.2 Residual Soils

Residual soils (also called residuum) are soils that are formed by the weathering of the bedrock immediately beneath it. The rate of rock decomposition is greater than the rate of erosion or transportation of weathering material and results in the accumulation of residuum. As the leaching action decreases with depth, there is a progressively lesser degree of rock weathering from the surface downwards, resulting in reduced soil formation, until unaltered (i.e., unweathered) rock is encountered. *Figure 7* below illustrates the various stages of formation of residuum.[4] Below the fill material, the test borings encountered residual soils. The residuum generally consisted of sandy lean clay (CL), clayey sand (SC), and sandy silt (ML) with varying quantities of shale fragments. The consistency of the residuum varied considerably from soft to hard. The residual soils extended to depths ranging from 6 to 20 *ft-begs*.

4.2.3 Weathered Rock

Weathered rock consists of rock that has been degraded from competent bedrock. Weathered rock will eventually degrade into residual soils. See *Figure 7* below. Underlying the residual soils, weathered shale layers were encountered during drilling operations. While some of these upper layers were penetrated during drilling, eventually, these became too hard for the drilling to continue. We recommend that the contractor be made aware of this and take the appropriate measures to address rock within the construction excavation depths.

4.2.4 Auger Refusal

Auger refusal is the drilling depth at which advancement of the borehole can no longer be accomplished by standard soil drilling techniques; rock coring must be employed for further penetration. Excavation or removal of the rock below auger refusal will most likely require the use of large pneumatic hammers, blasting, or other appropriate rock removal techniques.

We note that auger refusal was encountered during the drilling operations as follows.

Table 1 – Auger Refusal Depths

Boring	Auger Refusal Depth (feet below existing ground elevation)
1	22
2	22
3	17
4	16
5	18
6	10
7	16
8	12

[4] McCarthy, David F. *Essentials of Soil Mechanics and Foundations: Basic Geotechnics. 1982*

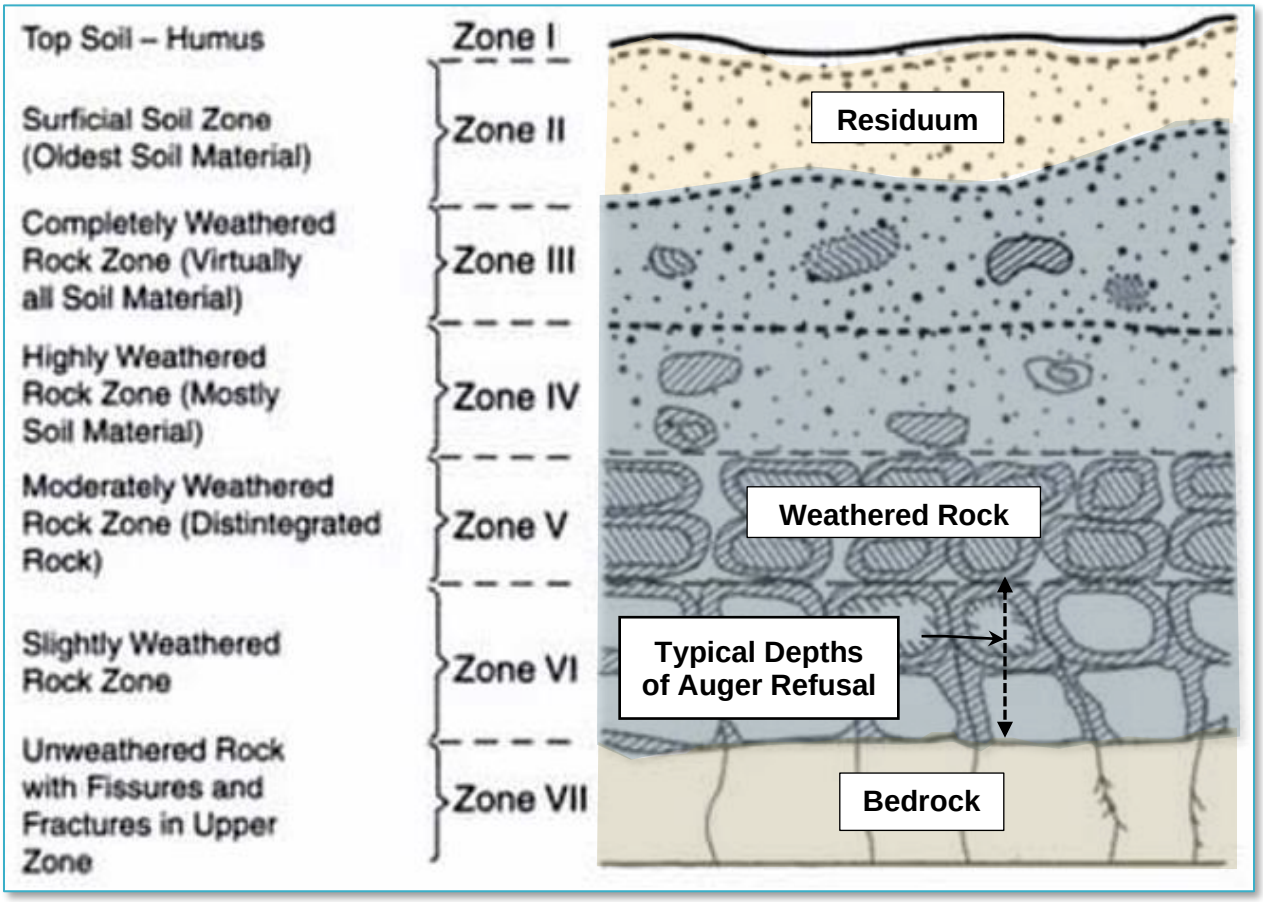

Figure 7 – Stages of Formation of Residuum (*Source: McCarthy 1982*)

4.2.5 Groundwater

Groundwater observations were made during drilling operations. Groundwater was observed at the time the soil borings were drilled between 10 and 13 *ft-begs*. Please note that short-term water level observations in test borings do not provide accurate groundwater levels and fluctuations in the level of the groundwater may occur due to variations in rainfall and other factors. In addition, perched water is possible and may be encountered at shallower depths.

5. LABORATORY TESTS

The Atlas laboratory routinely performs laboratory testing for building materials such as soils, concrete, asphalt, aggregates, and masonry. The laboratory is accredited by the AASHTO Materials Reference Laboratory (AMRL) in scopes of Soil, Aggregate, Portland Cement Concrete, Hot Mix Asphalt, and Quality Systems. Atlas has maintained these accreditations since 2009. Laboratory personnel hold certifications from the International Code Council (ICC), the National Institute for Certification in Engineering Technologies (NICET), the Alabama Department of Transportation (ALDOT), and the American Concrete Institute (ACI).

In addition to the field exploration, a series of soil samples was selected for laboratory testing in order to better classify and analyze the in-place soils on the subject property. Soil laboratory test results are indicated in the Boring Logs and in Laboratory Reports in the Appendix. Table 2 below summarizes the laboratory tests used to supplement the visual classification of the soil samples.

Table 2 – Laboratory Testing Procedures and Results Summary

Test Name	ASTM Designation	Description
Description of Soils (Unified Soil Classification System)	*D 2487-17*	The soil samples were visually examined by a geotechnical engineer and soil descriptions were obtained. Representative samples were then selected and tested to determine soil classification as described above. This data was used to correlate our visual descriptions with the Unified Soil Classification System. *Soils were classified as sandy lean clay (CL), clayey sand (SC), and sandy silt (ML).*
Natural Moisture Content	*D 2216-10*	Natural moisture contents (%*M*) were determined on selected samples. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles. *Values ranged from 15.0% to 27.4%.*
Atterberg Limits	*D 4318-17e1*	Atterberg limits tests were performed on selected samples to determine how the soil characteristics change upon variation in moisture content. The limits are bracketed by the Liquid Limit (*LL*) and the Plastic Limit (*PL*). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid. The Plastic Limit is the moisture content at which the soil is between the plastic and semi-solid stage. The soil's Plasticity Index (*PI*) is the difference between the Liquid Limit and the Plastic Limit. The PI is often used as the indicator of the soil's expansive tendencies. The greater the range between the LL and the PL, the higher the potential for expansion. *LL values ranged from 33 to 36. PL values ranged from 21 to 23. PI values ranged from 11 to 13.*
Particle-Size Distribution of Soils	*D 6913-17*	The soil samples were mechanically sieved using various sieve sizes necessary for determining the distribution of particle sizes in each sample. This data was used to correlate our visual descriptions with the Unified Soil Classification System. *Gravel-sized fragments ranged from 22.0 to 22.7%. Sand ranged from 40.8% to 49.5%. Silt/Clay content ranged from 27.8% to 37.2%.*

6. FOUNDATIONS RECOMMENDATIONS

We have developed foundation design recommendations based on the subsurface conditions found at the locations of soil test borings drilled for the field exploration. Subsurface data obtained from the borings was evaluated utilizing correlations between field test values and engineering performance characteristics of similar soils. It is recommended that Atlas perform a general review of final design plans and specifications to assure that the evaluations made in preparation of this report are consistent with final design.

The foundation design and construction recommendations stated in the following sections are based on the data obtained during exploration, the results from the subsequent soils lab testing, and Atlas' experience with similar structures and subgrade conditions. The following recommendations are based on estimated loads for the type of structure planned for construction. Nonetheless, when final structural loads become available, Atlas should be notified and given the opportunity to review recommendations if they differ from those previously referenced.

Low consistency soils were encountered to in the test borings at the following depths.

Table 3 – Low Consistency Soil Depths

Boring	Depth (feet below existing ground elevation)
1	19
2	18
3	6
4	1.5
5	---
6	6
7	8.5
8	1.5

6.1 Aluminum Walkway Abutting Existing Transfer Pump

Atlas understands that an elevated 4' wide aluminum walkway abutting the existing transfer pump station is to be constructed. The walkway is to support electrical gear and a canopy. The elevated aluminum platform is planned to be about 30'11" long. The concrete footing supporting the platform piers is to be 7'6" wide and 28'11" long.

The general recommendations provided in Section 6.1 of this report should be applicable for the walkway foundations. Based on the information obtained from Test Boring B-4 drilled in this area, suitable bearing soil layers should be encountered below 1.5 feet below the existing ground surface (*ft-begs*).

Provided all low consistency soils encountered during construction are completely removed (out to at least 5 feet beyond the proposed structure footprint) and replaced with well-compacted engineered fill according to Section 7 of this report, the proposed structure may be supported on conventional shallow footings designed using a maximum net allowable bearing pressure of 2,500 pounds per square foot (psf).[5] An alternative to undercutting the proposed structure area would

[5] The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.

be to lower the footings below any low consistency soils found at the time of construction to the underlying firm soils, disclosed by boring B-4 below 1.5 feet below the existing ground surface (*ft-begs*). To resist lateral movement, use a coefficient of friction of 0.45 and a passive earth pressure of 200 psf per foot of depth.

6.2 Splitter Box and Disk Filters

We understand that the existing abandoned old Effluent Pump Station is to be demolished. In its place, a new Splitter Box and Disk Filters are to be constructed, supported by a mat foundation.

Based on the information obtained from Test Borings B-1 through B-3 and B-5 through B-8 drilled in this area, suitable bearing soil layers should be encountered between 13 and 19 *ft-begs*.

Atlas recommends removing all low consistency soils to a minimum depth of 13 to 15 *ft-begs*, out to at least 10 feet beyond the proposed structure footprint (unless firm residual soils or hard weathered shale is encountered). Prior to placing fill, the bottom of the resulting excavation is to be treated as follows.

1. Place an approximately 24-inch layer of “surge stone” (8 to 12 inches in maximum dimension).

2. Drive stone into the soft subgrade and compact with a large, heavy smooth-drum compactor, or fully loaded dump truck until approved an Atlas geotechnical engineer or his representative.

3. Repeat Steps 1 and 2 above.

4. Place ALDOT No. 810, 8910, or 825 aggregate (“aggregate”) on the approved surge stone treated subgrade in 12-inch lifts.

5. Each 8-inch aggregate lift should be appropriately compacted with a large, heavy smooth-drum compactor to at least 98% of the Modified Proctor (ASTM D-1557) Maximum Dry Density.

6. After each approved compacted 8-inch lift, the surface should be proofrolled. If significant deflection or rutting is detected, recompact aggregate.

7. The thickness of the compacted aggregate should allow for at least 8 feet of compacted soil fill placement above (as per Section 7 of this report) to reach final grade, to allow for proper placement of underground piping within the soil fill.

Refer to the schematic in Figure 8 below for a graphical representation of Steps 1 through 7 above.

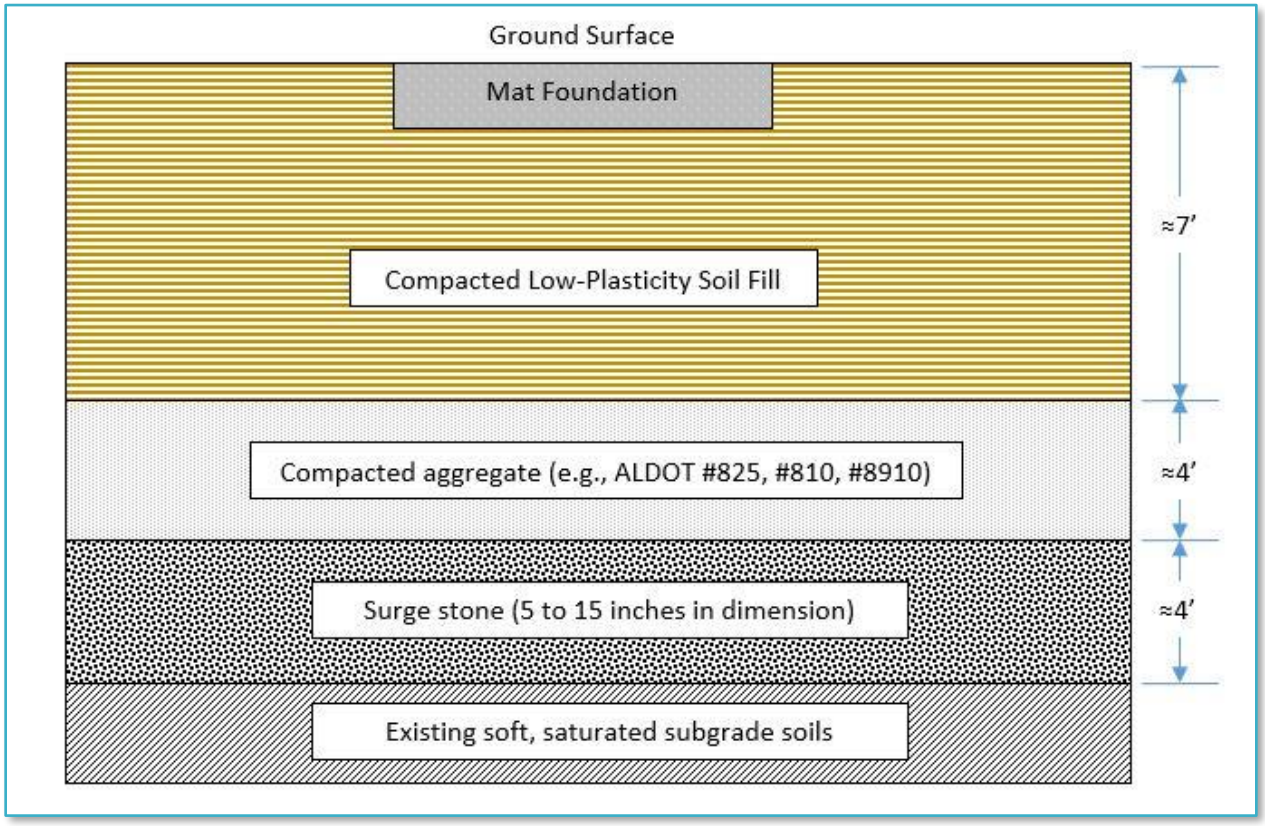

Figure 8 – Splitter Box and Disk Filters Excavation Procedure (*Source: Atlas*)

The well-compacted fill material referenced above should provide a maximum net allowable bearing pressure of 2,500 pounds per square foot (psf).[6] Use of modulus of Subgrade Reaction, k_s, equal to 200 pounds per cubic inch (pci) to design the mat foundation.

6.3 General Considerations

All footing bearing surfaces should be examined by an Atlas representative to verify that the footings bear on suitable materials. The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively disturbed or saturated, the affected soil should be removed prior to placing concrete.

The following items should be included in the project specifications regarding foundation design and construction.

1. In using net allowable soil pressures for footing design, the weight of the footing and backfill over the footings, including concrete slabs, need not be considered. Furthermore, continuous spread footings and isolated column footings should be designed with a minimum width of 18 inches and 24 inches, respectively.

[6] The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.

2. The footing bearing surface should be observed by an Atlas geotechnical engineer to verify that the soil complies with the above recommendations. A representative of the geotechnical engineer should be retained at the time of foundation construction to examine the bearing conditions in the foundation excavations. A combination of hand auger borings, dynamic cone penetrometer (DCP) testing, and probing should be performed as appropriate to confirm the suitability of the foundation bearing materials for the design bearing pressure. Soft, loose, or otherwise unsuitable materials should be overexcavated and replaced with compacted soil fill. Once the footings are excavated, it is recommended that the soils in the footing bottoms be compacted to a minimum of 98% of the Standard Proctor (ASTM D698-12) maximum dry density.

3. Where it is necessary to extend a footing beyond the planned bearing depth in order to reach a suitable bearing level, the over-excavation should be backfilled with compacted engineered fill or lean concrete. If the over-excavation is backfilled with engineered fill, the over-excavation must be widened an appropriate amount on all sides for every 1 foot of depth over-excavated. If lean concrete is used for backfill, the over-excavation does not require widening.

4. If water is encountered in the footing excavations, extreme care should be exercised to ensure that the foundation subgrade is not disturbed. A thin concrete “mud mat” poured over surfaces may be used to protect them from any seepage, which might enter foundation excavations.

5. The base of all satisfactory foundation excavations should be protected against any detrimental change in conditions such as disturbance from rain, frost, or flooding. Surface runoff water should be drained away from the excavation and not be allowed to pond. Re-evaluation of the foundations excavations will be required if those have been affected by storm water or disturbed in any way.

6. If possible, all footing concrete should be poured during the same day the excavation is made. If this is not possible, then the footing excavation should be adequately protected.

7. Exterior finished grades should be sloped away from the building footprint to achieve positive drainage of surface water.

8. Foundations designed as recommended should undergo total settlements of less than 1 inch and differential foundation settlements less than 0.75-inch between similarly loaded columns or along continuous footings that are 30 feet long or less. The actual magnitude of settlement that will occur beneath the foundation slab depends upon the variations within the subsurface soil profile, the structural loading conditions, and the quality of the foundation excavation. The estimated total and differential settlements listed assume that the foundation related earthwork and the foundation design are completed in accordance with our recommendations. Careful field control during foundation construction will contribute to keeping settlement to a minimum.

7. CONSTRUCTION AND GRADING CONSIDERATIONS

A review of the final plans should be conducted by Atlas, and subsequently some of the comments and recommendations included in this report may require modifications. It is recommended that an Atlas representative evaluate all exposed soils which are to support structural elements such as foundations, etc. Any soils containing organics observed during construction excavation activities should be removed and replaced with compacted engineered fill. Recommendations regarding construction monitoring are found in Section 8 of this report.

7.1 Conditioning of Subgrade Soils

All demolition debris, existing vegetation cover, and soils laden with organics or otherwise unsuitable material should be removed from the structural areas. The actual removal depth should be based on field observations, uneven topography, and excessively soft/wet soils (if present). The stripped areas should be observed to establish if additional excavation is required to remove weak or otherwise objectionable materials that would adversely affect fill or foundation placement.

Areas intended to foundations should be carefully evaluated by a geotechnical engineer. At that time, the engineer may require proof-rolling of the subgrade. The recommended equipment includes a tandem-axle rear dump truck, or a tri-axle rear dump truck (with raised third axle) loaded to a minimum gross weight of 20 tons. Another equipment option is the chariot-style roller loaded to a minimum gross weight of 40 tons. Proof rolling should be conducted by a single pass in each traffic lane and the passing criteria should be a 1” deflection (i.e., that includes both recoverable and non-recoverable deformation) for new construction and ½” deflection for reconstructed or stabilized subgrade, as well as the absence of pumping and cracking.

The purpose of the proof-rolling is to locate loose, weak, or excessively wet soils present at the time of construction and provides an opportunity for the geotechnical engineer to locate inconsistencies intermediate of the test boring locations. If an area is too small to be proof-rolled, then it must be observed by a geotechnical engineer, or their representative to establish its suitability.

The geotechnical engineer or qualified representative should be present during all undercut, proof-rolling, and/or mitigation activities to observe and document stability. It should be noted that the surficial clays are particularly moisture sensitive which will become difficult to work with and access in wet weather periods. Effective drainage in the short term and long term is important.

Our experience is that utility trenches are sometimes backfilled with very little compactive effort. Where utility lines are removed, the trench subgrade should be verified by an Atlas representative prior to backfilling in accordance with the engineered fill recommendations provided in this report. If in-place abandonment is preferred, open conduits, pipes, or culverts should be grouted full and the overlying in-place backfill evaluated prior to at grade and/or new fill construction.

In general, yielding subgrade problems are more prominent when construction takes place during periods of significant precipitation. Depending on consistency of the subgrade soils and weather conditions, it may be possible to stabilize some yielding subgrade soils by disking, aerating and then re-compacting the soils. However, this is often unsuccessful, particularly when the weather conditions do not permit drying of wet soil. In such case, it may be necessary to undercut and

replace with coarse aggregate and/or geogrid (such as Tensar TX-15 or equivalent) or to use chemical modification (such as lime, fly-ash, cement, etc.).

An Atlas representative should be present throughout the earthwork to verify that they are performed as recommended and identify areas where special stabilization is necessary. It will be very important to employ recommended proof-rolling and other subgrade verification techniques during construction and that it is inherently possible that non pre-identified conditions will be encountered at the time of construction. Any unsuitable materials observed during the evaluation and proof-rolling operations should be undercut and replaced with compacted fill and/or stabilized in-place. The possible need for, and extent of, undercutting and/or in-place stabilization required can best be determined by the geotechnical engineer or representative at the time of construction. Once the site has been properly prepared, further earthwork or at grade construction may proceed.

7.2 Controlled Structural Fill

All fill materials should be evaluated prior to use to determine its suitability. However, we anticipate that much of the site excavated soil will likely not be suitable for use as fill and/or backfill given the moisture content of much of the subsurface materials encountered in this exploration. Nonetheless, fill materials with organics or large rock fragments will not be suitable for use as fill and/or backfill.

Pertaining to fill material contemplated to be brought in from offsite sources, any non-organic, naturally-occurring soils with a Liquid Limit (LL) less than 50 and a Plasticity Index (PI) less than 30 can be used for structural fill. The fill should contain no pieces whose greatest dimension is greater than one-third of the lift thickness being placed. If fill construction takes place during the winter months, fill should not be placed over frozen soil, nor should frozen material be used within the fill. The following guidelines in Table 4 are recommended and preferred:

Table 4 – Controlled Structural Fill Guidelines

Description	Criteria
Liquid Limit (ASTM D-4318)	<50
Plastic Index (ASTM D-4318)	<30
Maximum Nominal Aggregate Size	<3 inches
Maximum Dry Density (ASTM D-698)	>100 pcf
Organic Content (ASTM D-2974)	<5%

7.3 Surface Drainage & Protection of Soils During Grading

The soils at the site are highly moisture sensitive and susceptible to become easily disturbed causing loss of strength. Proper surface drainage will be necessary during grading at the site. If the soils become saturated after exposure, it may be necessary to undercut or recondition. Atlas recommends that the specifications for this project provide performance guidelines for protection of exposed soils and correction of disturbed areas prior to construction.

7.4 Backfilling of Utility Trenches

Backfilling of storm drains and utility trenches is often accomplished in an uncontrolled manner, leading to subsequent settlement of the fill and cracking of foundations. We recommend that utility trenches be backfilled with acceptable fill in six-inch lifts and compacted with pneumatic-piston tampers to the project requirements. Should seepage occur in utility trenches, it may be necessary to "floor" the trench with open-graded gravel to provide a dry working surface.

7.5 Graded Aggregate Fill

Atlas recommends compaction criteria of 98% of the Modified Proctor maximum dry density (ASTM D1557) for graded aggregate fill placed. The graded aggregate base should be moisture conditioned to within 2% of the optimum moisture content.

7.6 Drainage

It should be noted that, the surficial soils are moisture sensitive and will become difficult to work with and access in wet weather periods. Effective drainage in the short term and long term is important. Adequate drainage should be provided at the site to minimize any increase in moisture content of the foundation soils. Positive drainage should also be maintained during construction.

8. CONSTRUCTION MONITORING

Since this exploration identified actual subsurface conditions only at the test boring locations, it was necessary for our engineers to extrapolate these conditions in order to characterize the entire site. Even under the best of circumstances, the conditions encountered during construction is expected to vary somewhat from the test boring results and may, in the extreme case, differ to the extent that modifications to the foundation recommendations become necessary. Therefore, we recommend that Atlas be retained as geotechnical consultant to provide a comprehensive construction-monitoring program when the project proceeds through the earth-related phases of this project to correlate actual soil conditions with test boring data, identify variations, conduct additional tests that may be needed and recommend solutions to earth-related problems that may develop.

This program would assist the owner in determining that the work is being carried out in general conformance with the plans and specifications and help avoid the potential of change orders and cost overruns. Construction monitoring includes testing of construction materials such as compacted fill and concrete and engineering observation during the site preparation, and paving construction phases of the project.

Monitoring and testing during the earthwork and paving construction phases, is particularly important since assumptions and recommendations have been made based on the soil boring data. Confirmation that actual subsurface conditions are comparable to the assumed conditions is an essential part of the subsurface exploration process.

8.1 Site Preparation

Following rough grading activities, the areas intended to support foundations should be carefully evaluated by a geotechnical engineer. At that time, the engineer may require proof-rolling of the subgrade with a fully loaded dump truck or similarly loaded piece of equipment weighing a minimum of 20 tons. The purpose of the proof-rolling is to locate loose, weak, or excessively wet soils present at the time of construction and provides an opportunity for the geotechnical engineer to locate inconsistencies intermediate of the test boring locations. If an area is too small to be proof-rolled, then it must be observed by a geotechnical engineer, or their representative to establish its suitability.

The geotechnical engineer or qualified representative should be present during all undercut and/or densification activities to observe and document stability.

Our experience is that utility trenches are sometimes backfilled with very little compactive effort. Where utility lines are removed, the trench subgrade should be verified by an Atlas representative prior to backfilling in accordance with the engineered fill recommendations provided in this report. If in-place abandonment is preferred, open conduits, pipes, or culverts should be grouted full and the overlying in-place backfill evaluated prior to at grade and/or new fill construction.

In general, yielding subgrade problems are more prominent in cut areas or where little or no fill is placed. Depending on weather conditions and time constraints, soft or loose soils may be aerated by disking or dried by other methods, and then re-compacted in place. However, if it is not possible to improve the subgrade soils because of weather conditions or scheduling, it may be necessary to remove the unsuitable materials and replace them with crushed stone with the possible inclusion of a geogrid and/or geotextile fabric layers or to stabilize them chemically(i.e. Soil Cement).

An Atlas representative should be present throughout the earthwork to verify that they are performed as recommended and identify areas where special stabilization is necessary. It will be very important to employ recommended proof-rolling and other subgrade verification techniques during construction and that it is inherently possible that non pre-identified conditions will be encountered at the time of construction. Any unsuitable materials observed during the evaluation and proof-rolling operations should be undercut and replaced with compacted fill and/or stabilized in-place. The possible need for, and extent of, undercutting and/or in-place stabilization required can best be determined by the geotechnical engineer or representative at the time of construction. Once the site has been properly prepared, further earthwork or at grade construction may proceed.

8.2 Excavations

Temporary excavations for the installation of foundations, utilities, etc., should be properly laid back or braced in accordance with Occupational Safety and Health Administration (OSHA) and any other applicable requirements. Existing facilities such as buildings, sidewalks, streets, utilities, etc., should be suitably protected from undermining due to excavation for the new structure and/or undercutting of unsuitable fill (if necessary). Applicable federal, state and local safety regulations should be followed in this regard.

8.3 Engineered (Structural) Fill Placement

We anticipate that much of the site excavated soil will likely not be suitable for use as fill and/or backfill given the subsurface materials encountered in this exploration and laboratory results. Fill materials with surficial silts (topsoil), organics, or excessive rock fragments will not be suitable for use as fill and/or backfill.

In the event additional fill is needed from an off-site source, any non-organic, naturally occurring soils with a Liquid Limit (LL) less than 50 and a Plasticity Index (PI) less than 30 can be used for structural fill. The fill should contain no pieces whose greatest dimension is greater than one-third of the lift thickness being placed. If fill construction takes place during the winter months, fill should not be placed over frozen soil, nor should frozen material be used within the fill.

The fill should be placed in lifts of uniform thickness. The lift thickness should not exceed that which can be properly compacted throughout its entire depth with the equipment available, typically 6 to 8 inches for these soils. For proper and timely construction of the fills, the soils should be compacted to at least 98% of the Maximum Dry Density of the Standard Proctor (ASTM D-698) at or near the optimum moisture content.

8.4 Undercutting Operations

It is recommended that any undercutting operations be observed by an Atlas geotechnical engineer to confirm that the recommended depth of undercut has been achieved. The engineer can then determine if additional undercutting is required.

8.5 Shallow Foundation Subgrade Observation

The exposed foundation subgrade should be carefully observed by an Atlas representative to verify that the new footings will be placed on suitable bearing materials. Representative hand auger borings with Dynamic Cone Penetrometer testing (DCPT) may be performed in the

excavations to verify that the materials at the foundation subgrade resemble those described on the Test Boring Records. In addition, in situ shear strength tests may also be conducted in conjunction with the auger borings.

Unsuitable fill materials must be removed from the proposed foundation areas and replaced with engineered fill or lean concrete. The use of lean concrete does not require the excavation to be widened, but it does require that the concrete be allowed to set-up so that it can support the weight of the foundation concrete. The undercut depths should be determined by an Atlas representative present during the excavations.

All foundation bearing surfaces should be protected against freezing, flooding by surface water, and undue disturbance, since the foundation soils will tend to soften and loose strength when subjected to these conditions. Footing concrete should be placed the same day that footing excavations are completed, unless lean concrete is used to backfill the excavations to design bearing elevation, in which case the footing concrete should be placed as soon as it can be suitably supported by the lean concrete.

8.6 Groundwater Control

Groundwater observations were made during drilling operations. Groundwater was encountered at the time the soil borings were drilled at depths ranging from 10 to 13 feet below existing ground surface. Therefore, groundwater should be expected and accounted for during construction.

Groundwater conditions may change and the contractor must be prepared to handle both surface and groundwater during the construction activities.

If water accumulates or ponds in the construction area, it should be promptly and properly removed. Any dewatering should be designed and performed by an experienced contractor. Improper dewatering may deteriorate the subgrade and may damage nearby structures. The most appropriate dewatering system should be determined at the time of construction based upon those field conditions encountered.

9. GENERAL REMARKS AND REPORT LIMITATIONS

Atlas notes the following limitations associated with this geotechnical exploration.

Differing Conditions: Our recommendations for this project were developed utilizing soils information obtained from the test borings that were made at the proposed site. At this time, we would like to point out that soil test borings only depict the soil conditions at the specific locations and time at which they were made. The soil conditions at other locations on the site may differ from those occurring at the boring locations. If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the attention of the soils engineer. This study did not include an assessment of the possibility of the presence of abandoned or active underground utilities on the site.

Changes in Plans: The conclusions and recommendations herein have been based upon the available soil information and the preliminary design details furnished by a representative of the owner of the proposed project and/or as assumed herein. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the soils engineer to determine whether any changes in the foundation or earthwork recommendations are necessary.

Recommendations vs. Final Design: This report and the recommendations included within are not to be considered a final design, but rather as a basis for the final design to be completed by others (architect, civil or structural engineer, etc.). It is the client's responsibility to ensure that the recommendations of the geotechnical engineer are properly integrated into the design, and that the geotechnical engineer is provided the opportunity for design input and comment after the submittal of this report, as needed.

We recommend that this firm be retained to review the final construction documents to confirm that the proposed project design sufficiently considers our geotechnical recommendations. We also suggest that our firm be represented at pre-bid and/or pre-construction meetings regarding this project to offer any needed clarifications of the geotechnical information to all involved.

Construction Issues: Although general constructability issues have been considered in this report, the means, methods, techniques, sequences and operations of construction, safety precautions, and all items incidental thereto and consequences of, are the responsibility of the parties to the project other than Atlas. This office should be contacted if additional guidance is needed in these matters.

Report Interpretation: Atlas is not responsible for the conclusions, opinions, or recommendations by others based upon the data included herein. It is the client's responsibility to seek any guidance and clarifications from the geotechnical engineer needed for proper interpretation of this report.

Environmental & Other Considerations: The scope of our services does not include any environmental assessment investigation for the presence or absence of hazardous, toxic or corrosive materials in the soil, groundwater, or surface water within or beyond the site studies. Any statements in this report or on the test boring records regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client. Unless complete environmental information regarding the site is already available, an environmental assessment is recommended prior to the development of this site.

Standard of Care: Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This statement is made in lieu of all other warranties either expressed or implied.

APPENDIX I
Boring Logs

ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

BORING NUMBER B-1

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL
DATE STARTED 4/12/22 **COMPLETED** 4/12/22
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR GSE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 10.00 ft
LOGGED BY B. Olive **CHECKED BY** F. DeLeon, Jr.
AT END OF DRILLING ---
NOTES Location: Abandoned Effluent Pump Station
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(7.5YR 3/4) POSSIBLE FILL: Firm, Brown, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 1		5-5-5 (10)			17.5				
		(7.5YR 5/6) POSSIBLE FILL: Very Soft, Light Brown, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 2		1-2-1 (3)			20.0				
5		(10YR 5/6) POSSIBLE FILL: Firm, Yellowish Brown, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 3		1-5-4 (9)			20.5				
			SPT 4		2-4-4 (8)			18.5				
		(10YR 4/1) POSSIBLE FILL: Very Loose, Dark Gray, Clayey Sand (SC), with trace shale fragments	SPT 5		0-0-0 (0)			21.0	33	22	11	27.8
10		▽										
		(10YR 6/1) POSSIBLE FILL: Soft, Gray, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 6		2-2-2 (4)			21.5				
15												
		(10YR 4/1) POSSIBLE RESIDUUM: Firm, Gray, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 7		1-3-8 (11)			15.0				
20		(10YR 3/1) WEATHERED ROCK: Hard, Black Shale										

Refusal at 22.0 feet.
Bottom of borehole at 22.0 feet.

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ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

BORING NUMBER B-2

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL
DATE STARTED 4/12/22 **COMPLETED** 4/12/22
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR GSE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 13.00 ft
LOGGED BY B. Olive **CHECKED BY** F. DeLeon, Jr.
AT END OF DRILLING ---
NOTES Location: Abandoned Effluent Pump Station
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(7.5YR 3/4) POSSIBLE FILL: Firm, Brown, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 1		3-3-4 (7)			20.8				
			SPT 2		3-3-6 (9)			20.2				
		(10YR 5/6) POSSIBLE FILL: Loose, Yellowish Brown, Clayey Sand (SC), with trace shale fragments	SPT 3		4-4-5 (9)			17.4	36	23	13	37.2
5			SPT 4		4-4-4 (8)			17.2				
		(2.5Y 7/3) POSSIBLE FILL: Very Soft, Yellowish Gray, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 5		1-1-1 (2)			20.2				
10		▽										
			SPT 6		2-1-1 (2)			25.0				
15		(10YR 4/1) POSSIBLE RESIDUUM: Very Stiff, Gray, Sandy Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 7		5-8-12 (20)			23.4				
20		(10YR 3/1) WEATHERD ROCK: Hard, Black Shale										

Refusal at 22.0 feet.
Bottom of borehole at 22.0 feet.

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ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

BORING NUMBER B-3

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL
DATE STARTED 4/12/22 **COMPLETED** 4/12/22
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR GSE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Olive **CHECKED BY** F. DeLeon, Jr.
AT END OF DRILLING ---
NOTES Location: Abandoned Effluent Pump Station
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(7.5YR 3/4) POSSIBLE FILL: Firm, Brown, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 1		3-3-4 (7)			27.4				
			SPT 2		2-3-3 (6)			18.7				
5		(10YR 5/6) POSSIBLE FILL: Very Loose, Yellowish Brown, Clayey Sand (SC), with trace shale fragments	SPT 3		2-1-1 (2)			23.3				
		(2.5Y 7/3) POSSIBLE FILL: Firm, Yellowish Gray, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 4		3-3-4 (7)			20.4				
10			SPT 5		2-4-3 (7)			22.6				
15		(10YR 4/1) POSSIBLE RESIDUUM: Firm, Gray, Sandy Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 6		1-3-3 (6)			23.9				
		(10YR 3/1) WEATHERED ROCK: Hard, Black Shale										

Refusal at 17.0 feet.
Bottom of borehole at 17.0 feet.

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ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

BORING NUMBER B-4

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL
DATE STARTED 4/12/22 **COMPLETED** 4/12/22
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR GSE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY B. Olive **CHECKED BY** F. DeLeon, Jr.
AT END OF DRILLING ---
NOTES Location: Adjacent to Existing Transfer Pump Station
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(7.5YR 3/4) POSSIBLE FILL: Soft, Brown, Sandy Lean Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 1		2-2-2 (4)			15.9				
		(10YR 5/6) POSSIBLE FILL: Loose, Yellowish Brown, Clayey Sand (SC), with trace shale fragments	SPT 2		3-3-4 (7)			20.2				
5			SPT 3		2-3-4 (7)			16.8	33	21	12	35.6
			SPT 4		2-3-4 (7)			24.1				
		(2.5Y 7/3) POSSIBLE FILL: Firm, Yellowish Gray, Sandy Clay (CL) to Clayey Sand (SC), with trace shale fragments										
		(10YR 4/1) POSSIBLE RESIDUUM: Firm, Gray, Sandy Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 5		9-50/2"							
10												
		(10YR 3/1) WEATHERED ROCK: Hard, Black Shale	SPT 6		50/1"							
15												

Refusal at 16.0 feet.
Bottom of borehole at 16.0 feet.

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ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

BORING NUMBER B-5

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL
DATE STARTED 7/15/22 **COMPLETED** 7/15/22
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR GSE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 10.00 ft
LOGGED BY F. DeLeon, Jr. **CHECKED BY** B. White
AT END OF DRILLING ---
NOTES Location: Abandoned Effluent Pump Station
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(10YR 4/1) POSSIBLE FILL: Firm, Dark Gray, Sandy Silt (ML), and shale fragments	AU 1									
			AU 2									
		(10YR 5/6) POSSIBLE RESIDUUM: Firm, Yellowish Brown, Sandy Lean Clay (CL), with trace shale fragments	SPT 3		12-3-3 (6)							
5		(10YR 6/1) POSSIBLE RESIDUUM: Stiff, Gray, Sandy Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 4		5-6-9 (15)							
		(N5) POSSIBLE RESIDUUM: Hard, Gray, Sandy Clay (CL) to Clayey Sand (SC), with trace shale fragments	SPT 5		4-22-15 (37)							
10	▽											
		(10YR 3/1) WEATHERED ROCK: Hard, Black Shale										
			SPT 6		14-25-27 (52)							
15												

Refusal at 18.0 feet.
Bottom of borehole at 18.0 feet.

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ATLAS
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Office: 205-733-8775
Fax: 205-733-8954

BORING NUMBER B-6

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL
DATE STARTED 7/15/22 **COMPLETED** 7/15/22
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR GSE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY F. DeLeon, Jr. **CHECKED BY** B. White
AT END OF DRILLING ---
NOTES Location: Abandoned Effluent Pump Station
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(10YR 7/4) POSSIBLE FILL: Very Stiff, Light Brown, Sandy Lean Clay (CL), with trace shale fragments	SPT 1		6-9-9 (18)							
		(10B 5/1) POSSIBLE FILL: Stiff, Dark Gray, Sandy Silt (ML), and shale fragments	SPT 2		14-8-6 (14)							
5		(7.5YR 5/6) POSSIBLE RESIDUUM: Soft, Dark Gray and Brown, Sandy Silt (ML), and shale fragments	SPT 3		4-1-3 (4)							
		(7.5YR 5/8) WEATHERED ROCK: Hard, Brown Shale	SPT 4		16-21-26 (47)							
10		(10YR 3/1) WEATHERED ROCK: Hard, Black Shale	SPT 5		50/2"							

Refusal at 10.0 feet.
Bottom of borehole at 10.0 feet.

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ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

BORING NUMBER B-7

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL
DATE STARTED 7/15/22 **COMPLETED** 7/15/22
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR GSE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 13.00 ft
LOGGED BY F. DeLeon, Jr. **CHECKED BY** B. White
AT END OF DRILLING ---
NOTES Location: Abandoned Effluent Pump Station
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(10B 5/1) POSSIBLE FILL: Very Soft to Soft, Dark Gray and Brown, Sandy Silt (ML), and shale fragments	SPT 1		4-3-2 (5)							
			SPT 2		3-1-1 (2)							
5			SPT 3		1-1-0 (1)							
			SPT 4		1-0-0 (0)							
		(7.5YR 5/6) POSSIBLE RESIDUUM: Very Stiff, Dark Gray, Sandy Silt (ML), and shale fragments	SPT 5		6-6-10/0"							
10												
		▽	SPT 6		6-7-12/0"							
15		(10YR 3/1) WEATHERED ROCK: Hard, Black Shale										

Refusal at 16.0 feet.
Bottom of borehole at 16.0 feet.

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ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

BORING NUMBER B-8

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL
DATE STARTED 7/15/22 **COMPLETED** 7/15/22
GROUND ELEVATION _____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR GSE
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 10.00 ft
LOGGED BY F. DeLeon, Jr. **CHECKED BY** B. White
AT END OF DRILLING ---
NOTES Location: Abandoned Effluent Pump Station
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	PENETROMETER (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		(7.5YR 4/4) POSSIBLE FILL: Very Soft to Soft, Dark Brown, Sandy Silt (ML), and shale fragments	SPT 1		2-3-2 (5)							
		(2.5YR 4/4) POSSIBLE RESIDUUM: Very Stiff, Brown, Sandy Lean Clay (CL), and shale fragments	SPT 2		5-7-8 (15)							
		(10BG 4/1) POSSIBLE RESIDUUM: Firm, Dark Gray, Sandy Silt (ML), and shale fragments	SPT 3		4-4-4 (8)							
5			SPT 4		5-5-5 (10)							
		(10YR 3/1) WEATHERED ROCK: Hard, Black Shale	SPT 5		50/1"							
10		▽										

Refusal at 12.0 feet.
Bottom of borehole at 12.0 feet.

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APPENDIX II
Key to Symbols / Explanation of Terms

ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

KEY TO SYMBOLS

CLIENT Municipal Consultants
PROJECT NAME North Shelby WRRF - Filter Project
PROJECT NUMBER Z003001227
PROJECT LOCATION Birmingham, AL

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)


CLS-G: Sandy LEAN CLAY (CL) with Gravel


MLG: USCS Gravelly Silt


SC: USCS Clayey Sand


SHALE: Shale

SAMPLER SYMBOLS


Auger Cuttings


Standard Penetration Test

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
Water Level at Time Drilling, or as Shown
Water Level at End of Drilling, or as Shown
Water Level After 24 Hours, or as Shown

KEY TO SYMBOLS - GINT STD US LAB.GDT - 7/28/22 12:32 - D:\LIBRARY\ACTIVE\PROJECTS_3_WRITING REPORT\LOCAL_Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

FIELD CLASSIFICATION SYSTEM

Sands and Gravels

No. of Blows	Relative Consistency
0-5	Very Loose
6-10	Loose
11-30	Medium Dense
31-50	Dense
Over 50	Very Dense

Silts and Clays

No. of Blows	Relative Consistency
0-3	Very Soft
4-5	Soft
6-10	Firm
11-15	Stiff
16-30	Very Stiff
31-50	Hard
Over 50	Very Hard

Particle Size Identification

Boulders:	8-inch diameter or more
Cobbles:	3- to 8-inch diameter
Gravel:	
Medium:	.50- to 1-inch
Fine:	.25- to .50-inch
Sand:	
Coarse:	2.00-mm to .25-inch (diameter of pencil lead)
Medium:	0.42-mm to 2.00-mm (diameter of broom straw)
Fine:	0.074-mm to 0.042-mm (diameter of human hair)
Silt:	0.042-mm to 0.002-mm (Cannot see particles)
Clay:	<0.002-mm

Relative Proportions

Descriptive Term	Percent
Trace	1-10
Little	11-20
Some	21-35
And	36-50

Relative Quality of Rock Cores

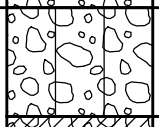
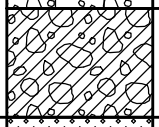
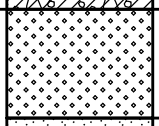
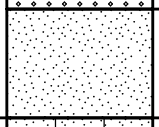
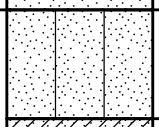
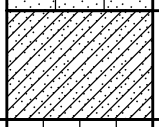
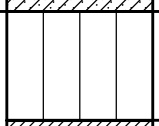
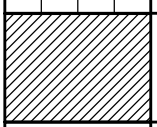
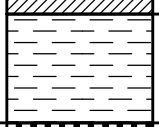
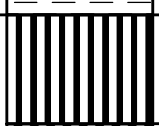
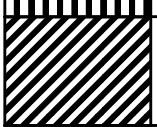
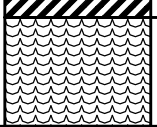
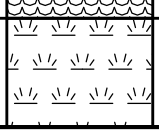
Quality	RQD
Very Poor	0-25%
Poor	25-50%
Fair	50-75%
Good	75-90%
Excellent	90-100%

$$\text{RQD} = \frac{\text{Total core, counting only pieces over 4" long}}{\text{Length of core run}} \times 100\%$$

Rock Hardness

Very Soft	Rock disintegrates or easily compressed to touch; can be hard to very hard soil
Soft	Rock is coherent but breaks easily to thumb pressure at sharp edges and crumbles with firm hand pressure.
Moderately Hard	Small pieces can be broken off along sharp edges by considerable hard thumb pressure; can be broken by light hammer blows.
Hard	Rock cannot be broken by thumb pressure, but can be broken by moderate hammer blows.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

APPENDIX III
Laboratory Testing Reports

ATLAS
200 Wellington Manor Court, Suite 100
Alabaster, AL 35007
Office: 205-733-8775
Fax: 205-733-8954

SUMMARY OF LABORATORY RESULTS

CLIENT Municipal Consultants **PROJECT NAME** North Shelby WRRF

PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Specific Gravity	Void Ratio
B-1	0.0							17.5			
B-1	1.5							20.0			
B-1	3.5							20.5			
B-1	6.0							18.5			
B-1	8.5	33	22	11	25	27.8	SC	21.0			
B-1	13.5							21.5			
B-1	18.5							15.0			
B-2	0.0							20.8			
B-2	1.5							20.2			
B-2	3.5	36	23	13	25	37.2	SC	17.4			
B-2	6.0							17.2			
B-2	8.5							20.2			
B-2	13.5							25.0			
B-2	18.5							23.4			
B-3	0.0							27.4			
B-3	1.5							18.7			
B-3	3.5							23.3			
B-3	6.0							20.4			
B-3	8.5							22.6			
B-3	13.5							23.9			
B-4	0.0							15.9			
B-4	1.5							20.2			
B-4	3.5	33	21	12	25	35.6	SC	16.8			
B-4	6.0							24.1			

LAB SUMMARY - GINT STD US LAB.GDT - 4/18/22 10:36 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

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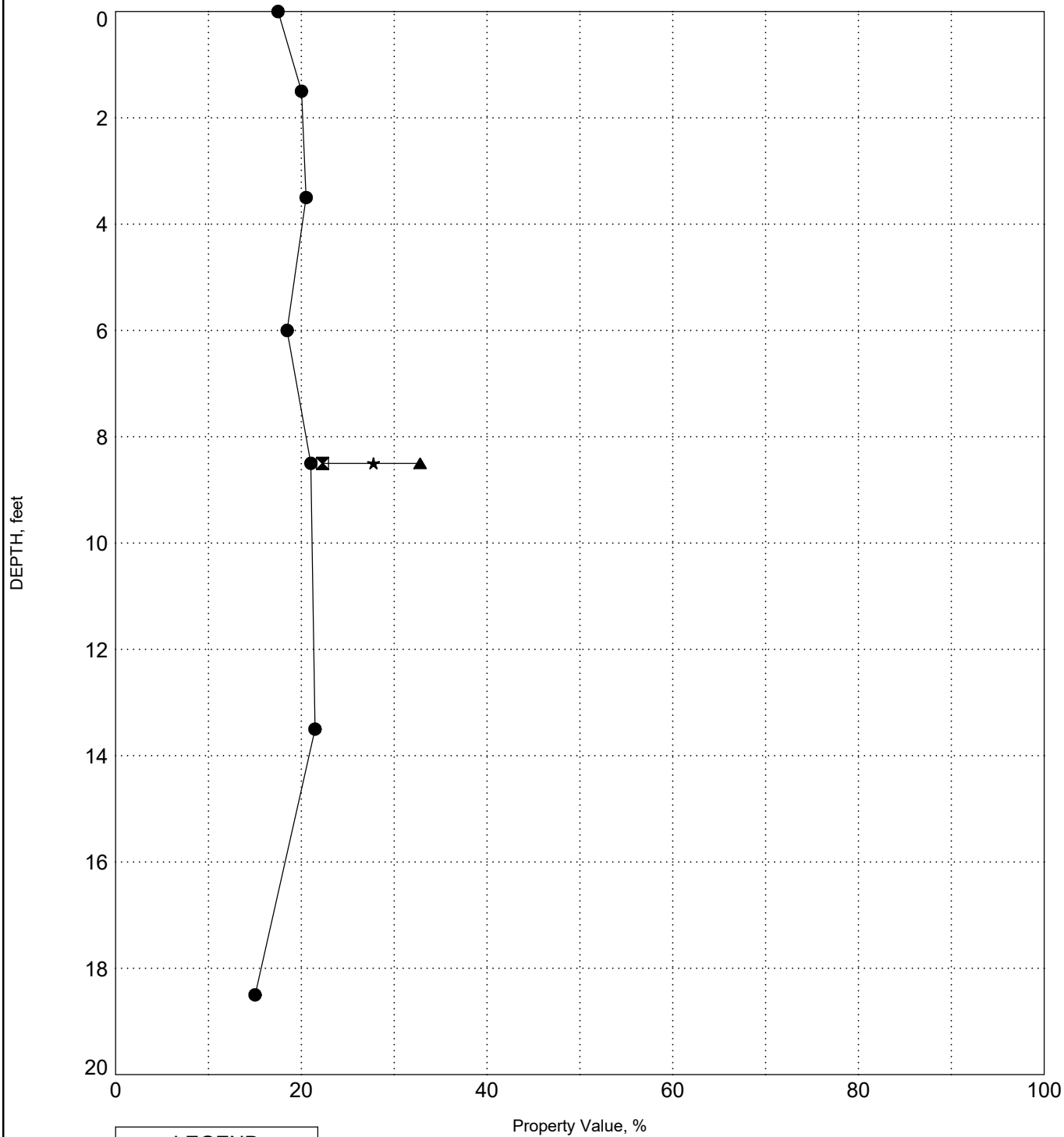
INDEX PROPERTIES VERSUS DEPTH

CLIENT Municipal Consultants **PROJECT NAME** North Shelby WRRF

PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL

BORING B-1



INDEX PROPS - GINT STD US LAB.GDT - 4/18/22 10:37 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

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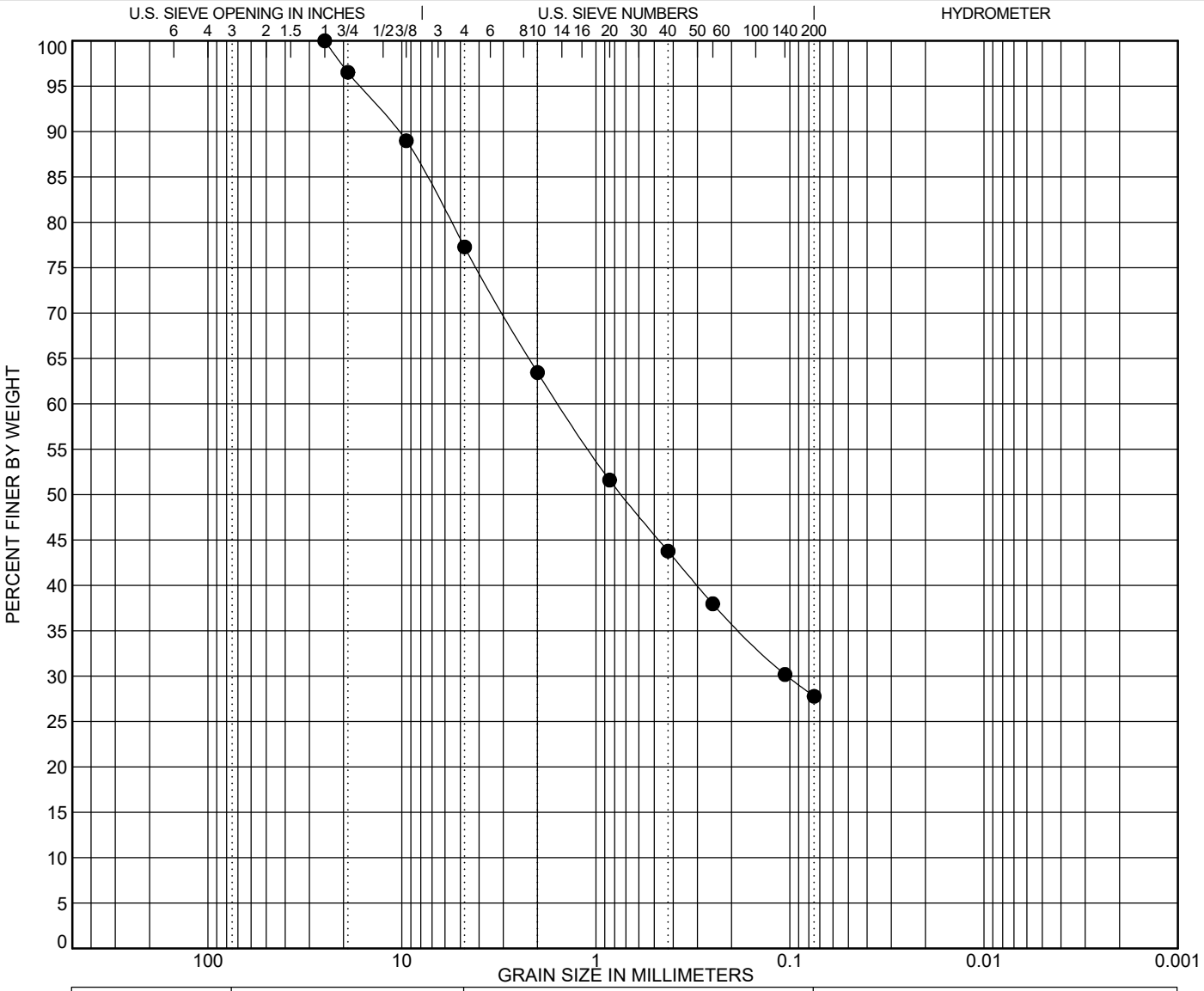
GRAIN SIZE DISTRIBUTION

CLIENT Municipal Consultants **PROJECT NAME** North Shelby WRRF

PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL



BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
● B-1	8.5	**CLAYEY SAND with GRAVEL(SC)**	**33**	**22**	**11**		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-1	8.5	**25**	**1.559**	**0.103**		**22.7**	**49.5**	**27.8**	

GRAIN SIZE - GINT STD US LAB.GDT - 4/18/22 10:38 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

ATTERBERG LIMITS RESULTS

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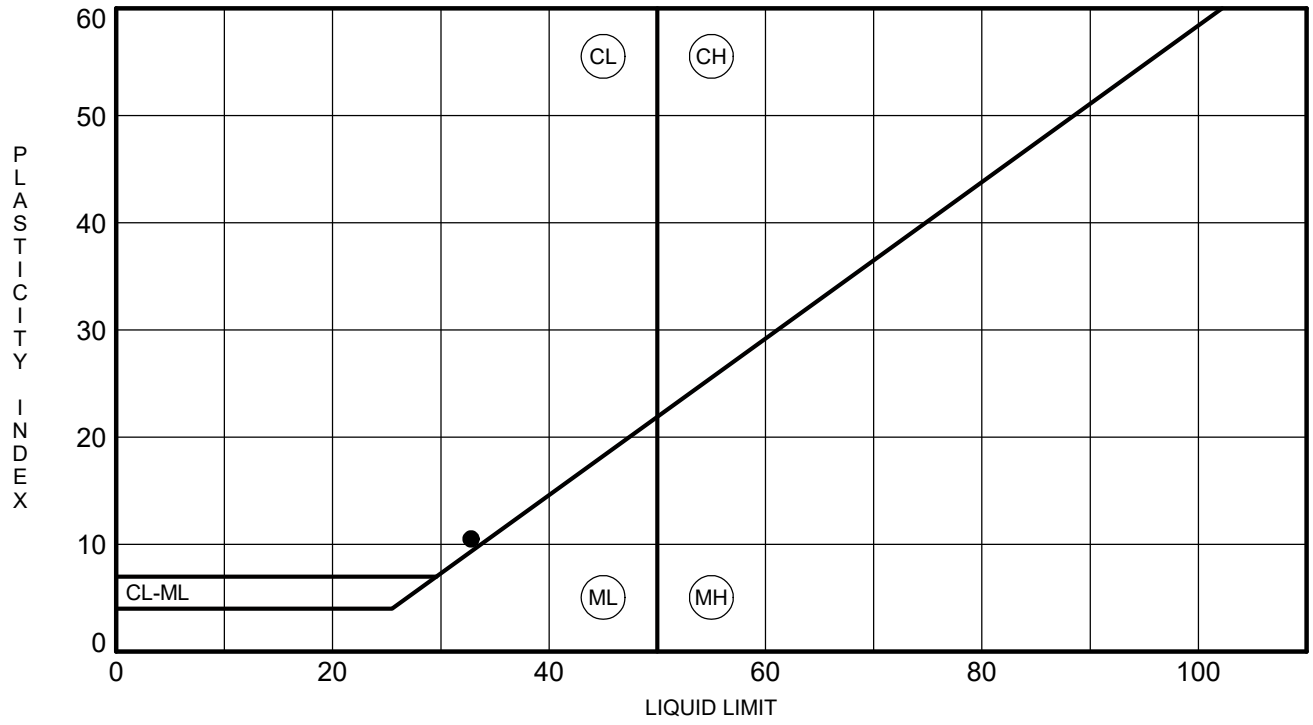
CLIENT Municipal Consultants **PROJECT NAME** North Shelby WRRF

PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL



BOREHOLE	DEPTH	LL	PL	PI	%M	Fines	Classification
● **B-1**	**8.5**	**33**	**22**	**11**	**21.0**	**28**	**CLAYEY SAND with GRAVEL(SC)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/18/22 10:38 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

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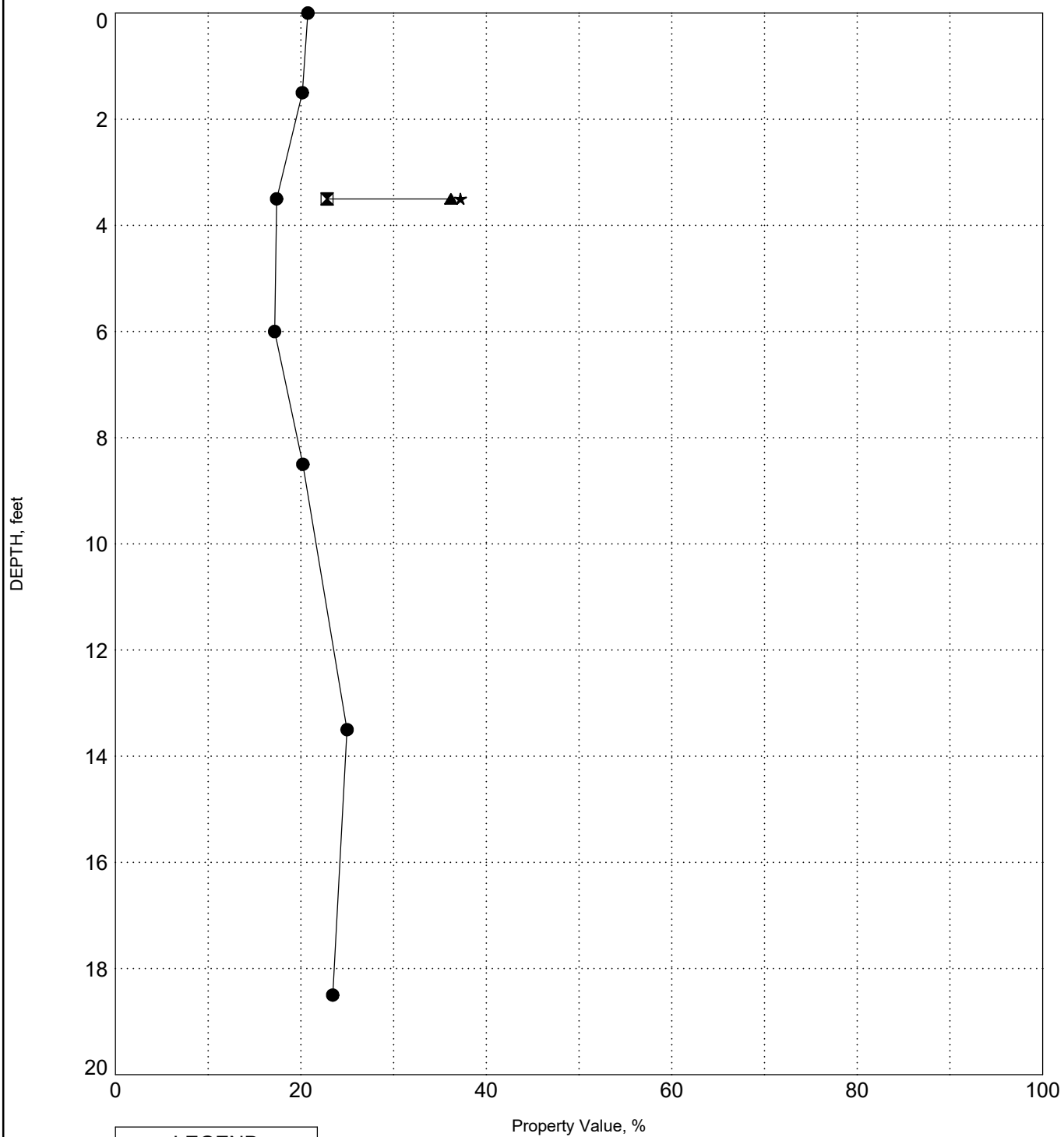
INDEX PROPERTIES VERSUS DEPTH

CLIENT Municipal Consultants **PROJECT NAME** North Shelby WRRF

PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL

BORING B-2



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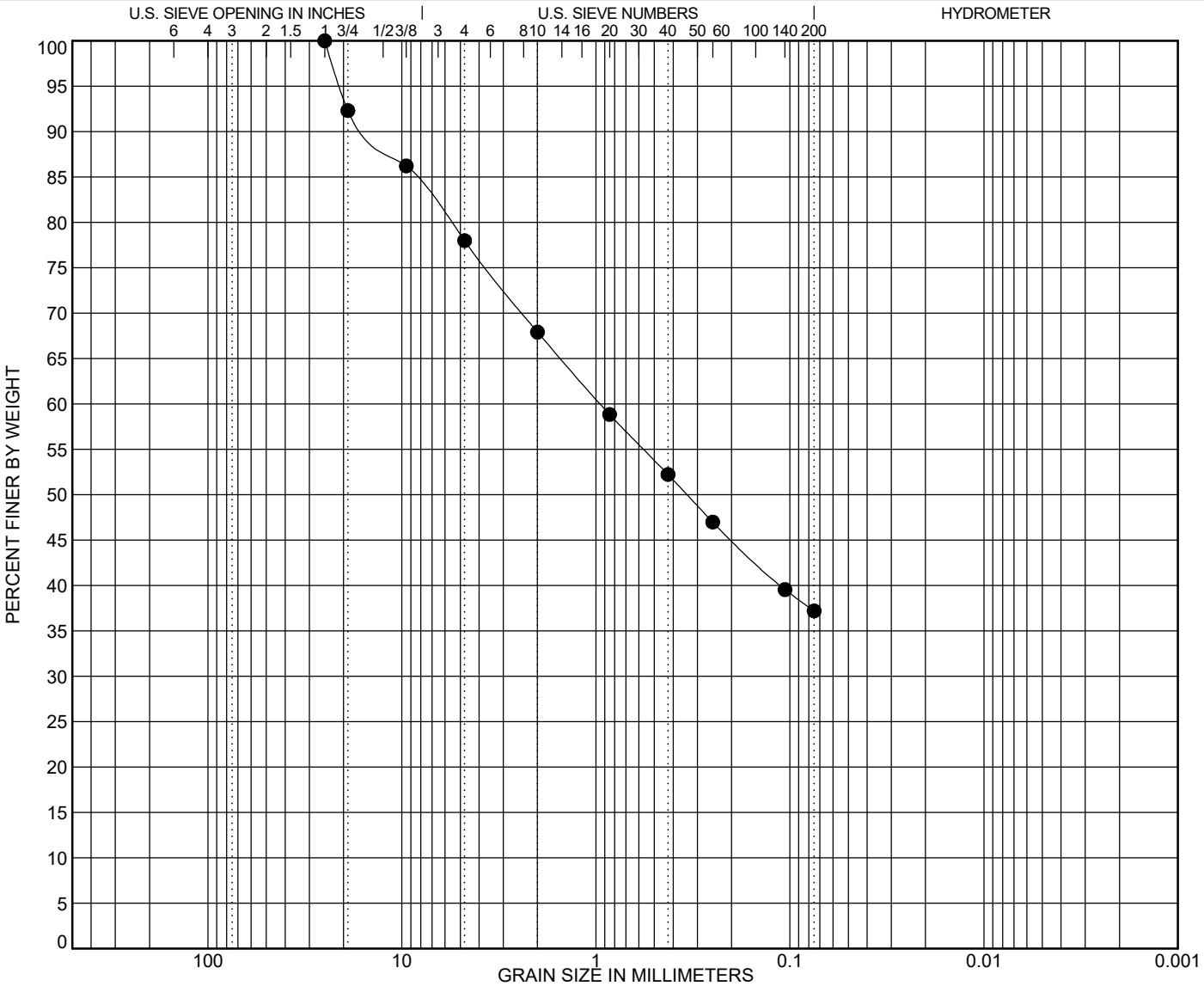
GRAIN SIZE DISTRIBUTION

CLIENT Municipal Consultants **PROJECT NAME** North Shelby WRRF

PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL



BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
● B-2	3.5	**CLAYEY SAND with GRAVEL(SC)**	**36**	**23**	**13**		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-2	3.5	**25**	**0.948**			**22.0**	**40.8**	**37.2**	

GRAIN SIZE - GINT STD US LAB.GDT - 4/18/22 10:39 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

ATTERBERG LIMITS RESULTS

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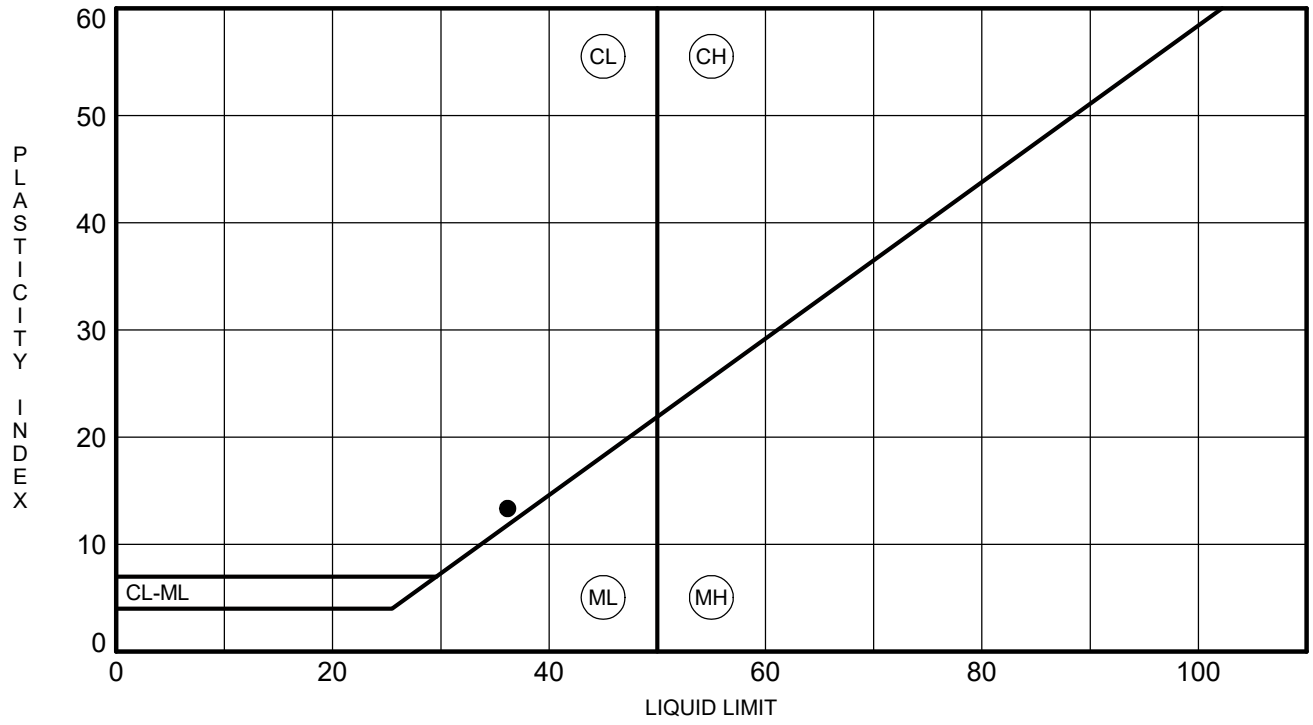
PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL



BOREHOLE	DEPTH	LL	PL	PI	%M	Fines	Classification
● **B-2**	**3.5**	**36**	**23**	**13**	**17.4**	**37**	**CLAYEY SAND with GRAVEL(SC)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/18/22 10:39 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

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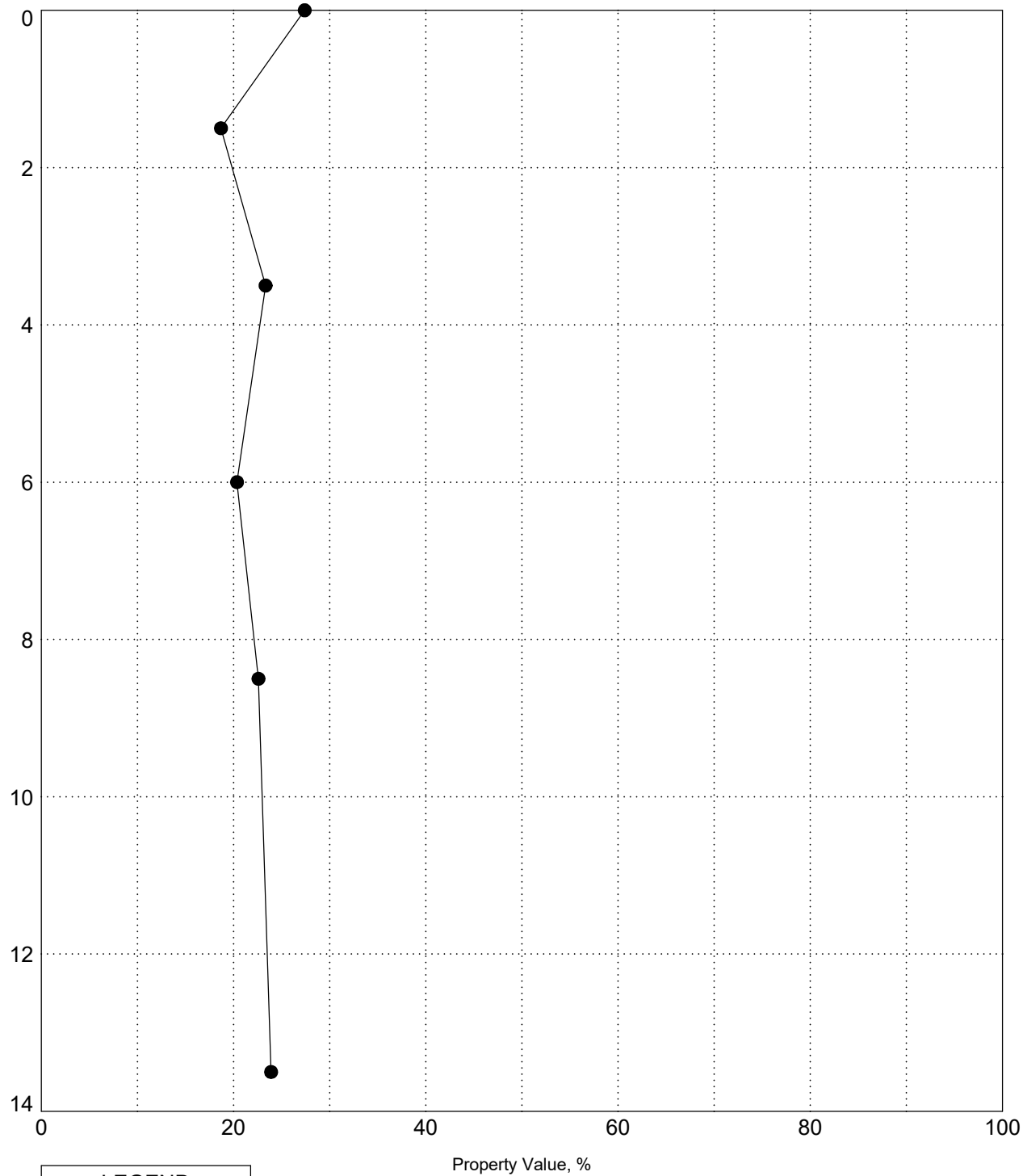
INDEX PROPERTIES VERSUS DEPTH

CLIENT Municipal Consultants **PROJECT NAME** North Shelby WRRF

PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL

BORING B-3



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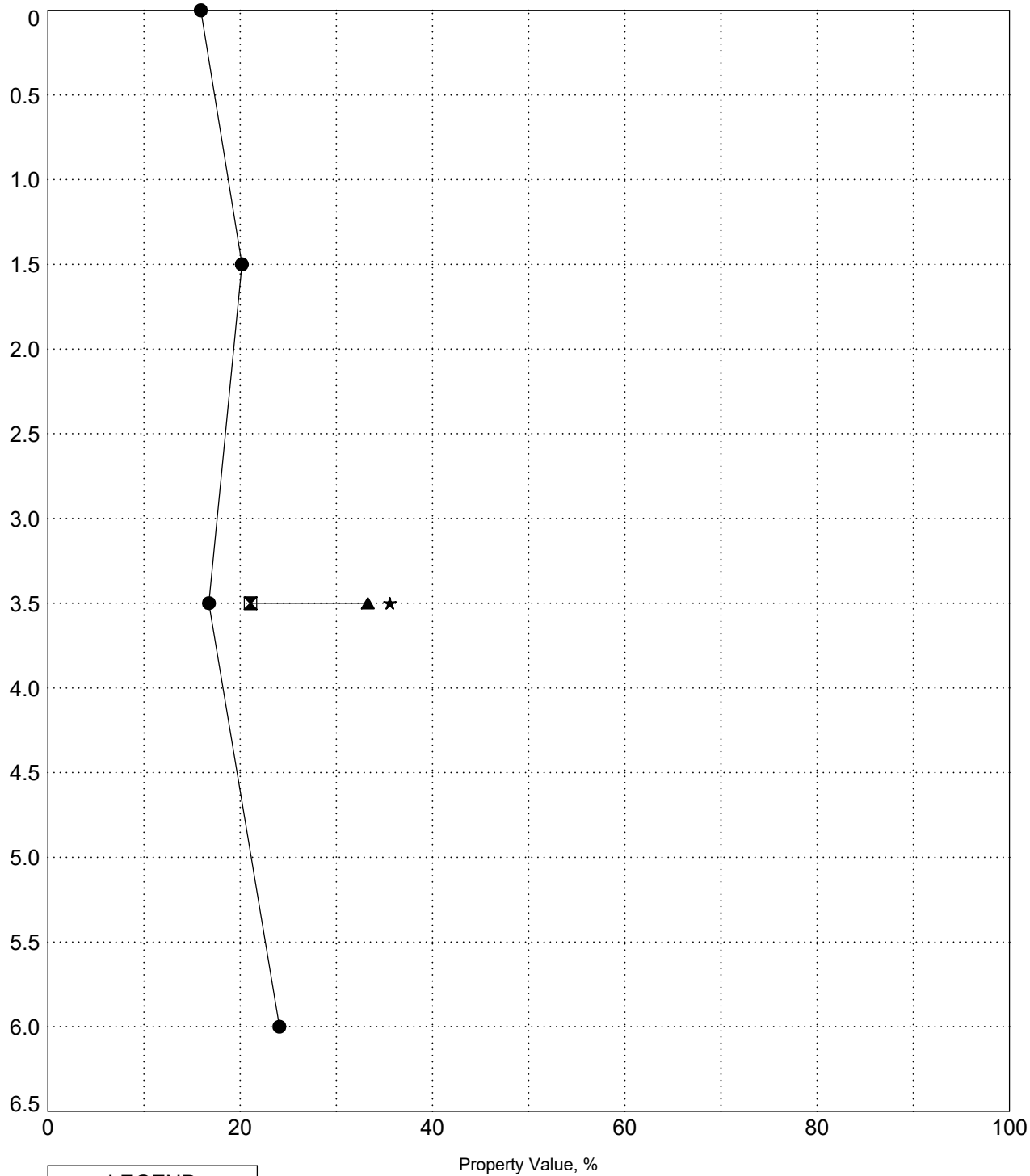
INDEX PROPERTIES VERSUS DEPTH

CLIENT Municipal Consultants **PROJECT NAME** North Shelby WRRF

PROJECT NUMBER Z003001227 **PROJECT LOCATION** Birmingham, AL

BORING B-4



LEGEND
● Water Content
⊠ Plastic Limit
▲ Liquid Limit
★ Fines

INDEX PROPS - GINT STD US LAB.GDT - 4/18/22 10:38 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

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GRAIN SIZE DISTRIBUTION

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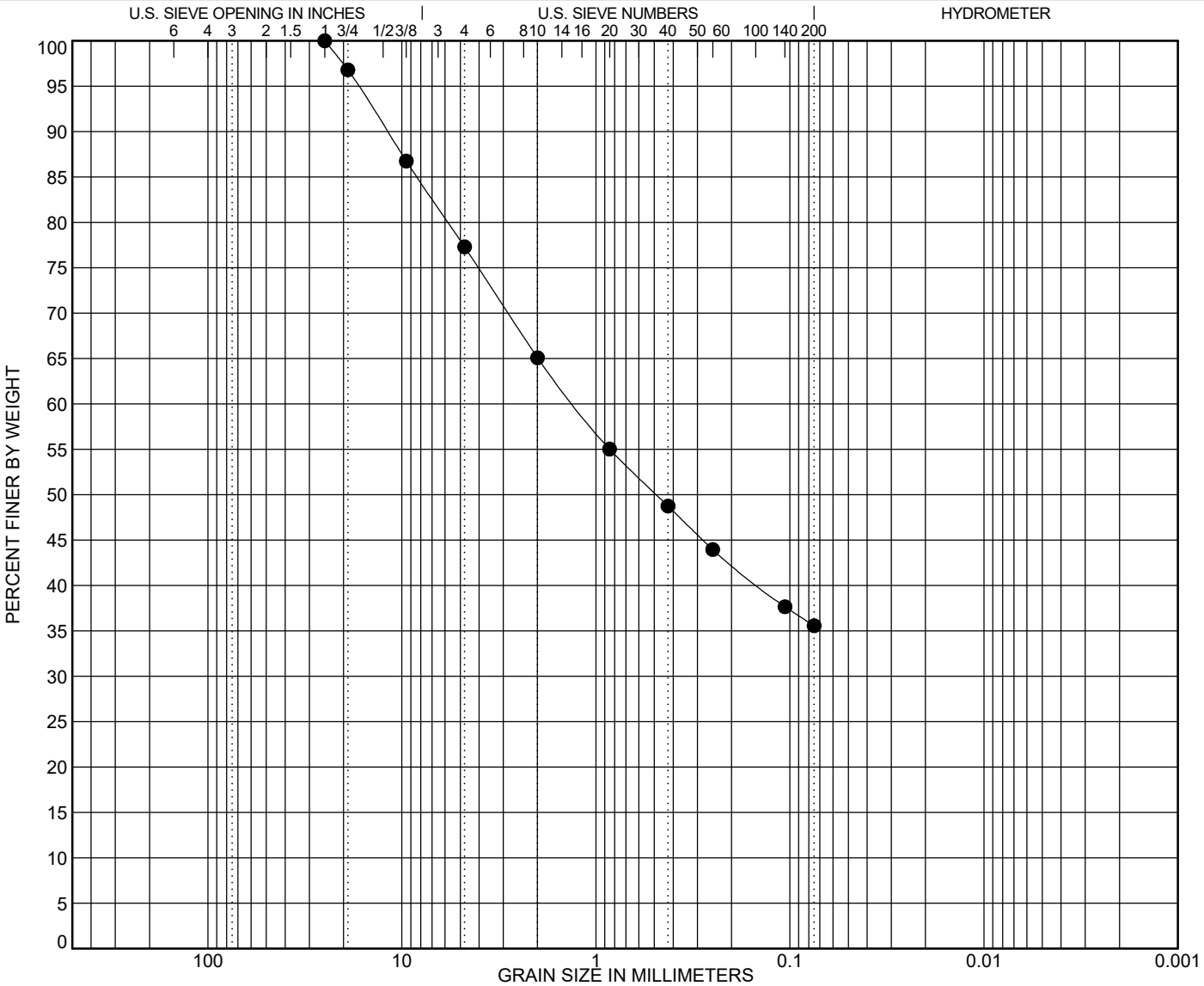

BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
● B-4	3.5	**CLAYEY SAND with GRAVEL(SC)**	**33**	**21**	**12**		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-4	3.5	**25**	**1.298**			**22.7**	**41.7**	**35.6**	

GRAIN SIZE - GINT STD US LAB.GDT - 4/18/22 10:40 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

ATTERBERG LIMITS RESULTS

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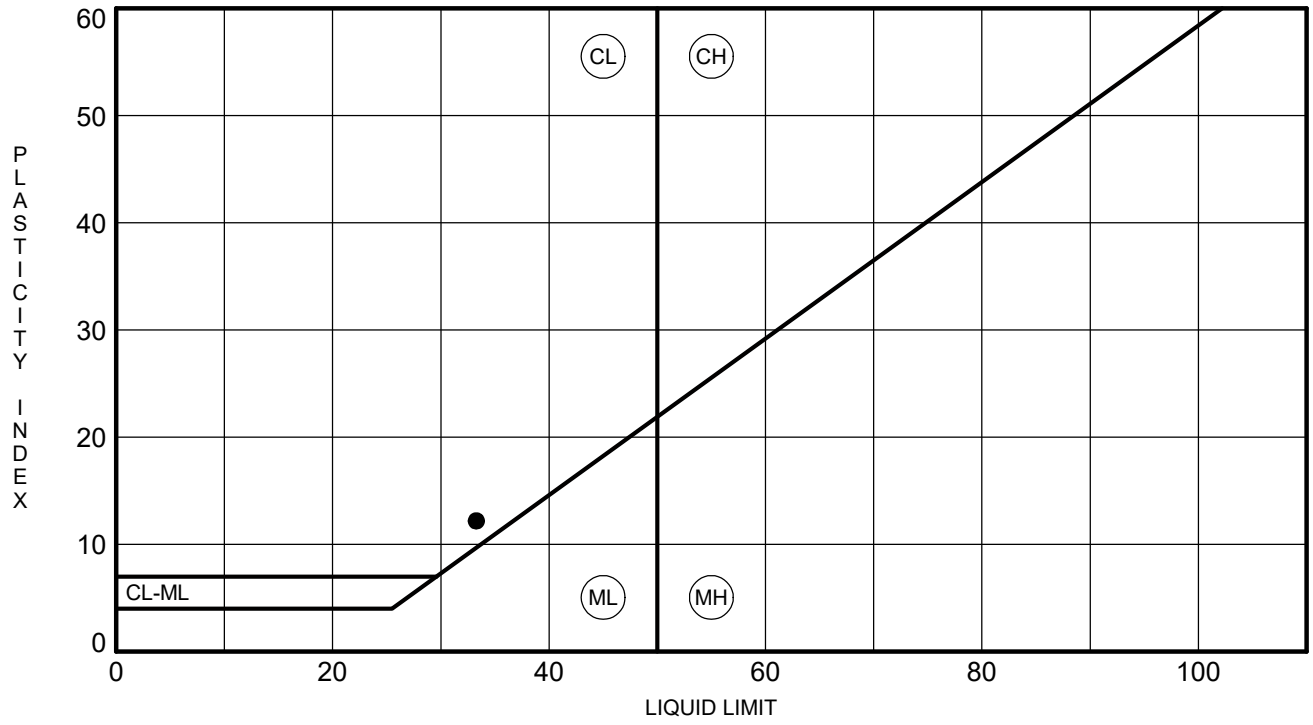

BOREHOLE	DEPTH	LL	PL	PI	%M	Fines	Classification
● **B-4**	**3.5**	**33**	**21**	**12**	**16.8**	**36**	**CLAYEY SAND with GRAVEL(SC)**

ATTERBERG LIMITS - GINT STD US LAB.GDT - 4/18/22 10:40 - S:\TRADITIONAL\BIRMINGHAM CMT & GEO\MUNICIPAL CONSULTANTS\Z003001227 GEO NORTH SHELBY WRRF - FILTER PROJECT\LAB\NORTH SHELBY WRRF.GPJ

APPENDIX IV
Important Information About This Geotechnical Engineering Report

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
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September 29, 2022 Email

From Atlas Technical Consultants LLC in Clarification of

Certain Items in August 2, 2022 Geotechnical Engineering Exploration

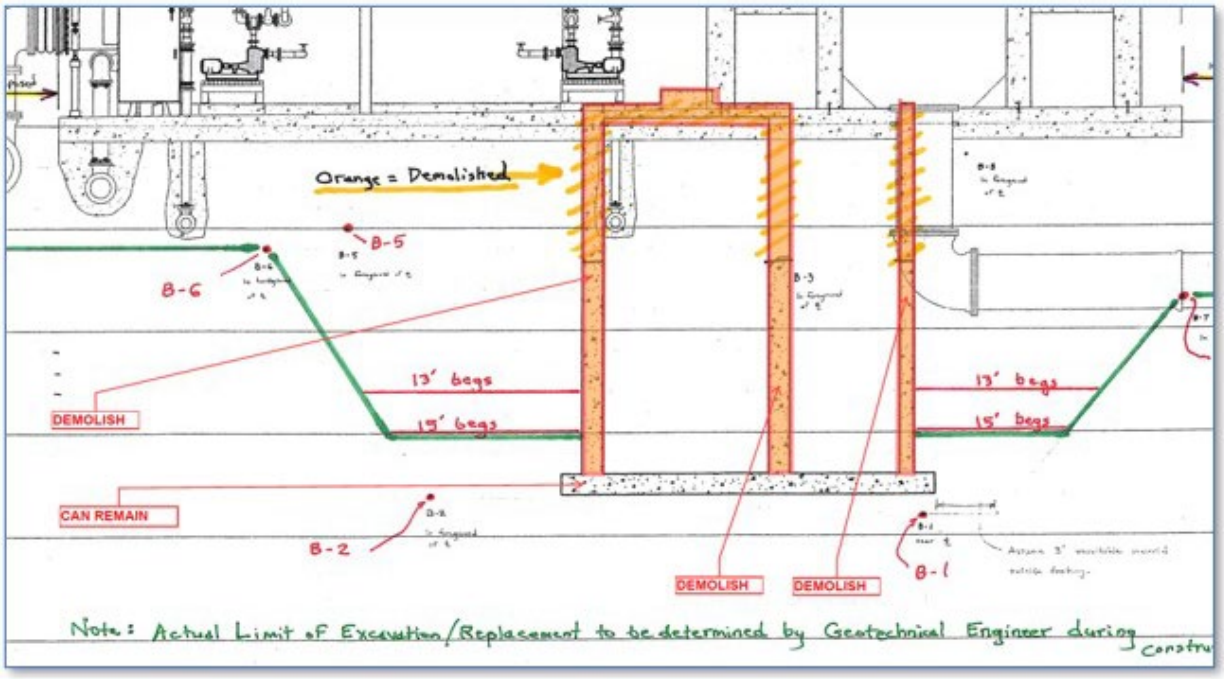
3 pages

From: Fred DeLeon Jr
To: Stuckey Godfrey
Subject: RE: Geotechnical Report Comments - North Shelby WRRF Filter Improvements
Date: Thursday, September 29, 2022 12:38:27 PM
Attachments: image003.png

Stuckey,

See my comments in red below.

I am in the process of making changes to our drawings that will be needed to accommodate the removal and replacement of unsuitable material under the new splitter box filter pad and extending 10' outside the pad. I need your input regarding a couple of items. Please refer to the attached plan (the left side of "SWWC NS WRRF Filter Bores Holes with Contours – 09-02-22") showing the location of the new filter pad as well as the existing effluent pump station shown with yellow highlighting. Note the section A location on that drawing. We have also included the Section A drawing (actually 2 drawings as explained below) on which we have shown the existing effluent pump station as well as our interpretation of the geotechnical recommendations. Our preliminary drawings prepared prior to the geotechnical drilling called for the demolition of the upper 7' of the existing effluent pump station while leaving the lower 12' (11' wall + 1' bottom slab) in place and backfilling the interior of that remaining portion with compacted crushed stone. The geotechnical report recommended the removal of 13' to 15' of unsuitable material and the placement of two 24" thick layers of compacted surge material. We have shown these depths on Section A. As you can see, the existing bottom slab is beneath the 15' depth of material to be replaced. If the bottom portion of the existing station is not removed, the bottom slab will prevent the placement and compaction of surge stone within the interior of or below the remaining portion of the station. This is depicted in the Section A indicated as "Sec A – Existing Effluent Pump Station Partially Remains". Instead of what was shown in our drawings prior to the geotech drilling, should we require the demolition and removal of the entire existing pump station (including the bottom slab)? This is depicted in the Section A indicated as "Sec A – Existing Effluent Pump Station Totally Removed". Surge stone will only be required to be driven into the soft subgrade in those areas not covered by the remaining concrete slab at the bottom of the excavation, See figure below:



Also, if you can understand what we have shown on Section A, does this look like it is in accordance with your intentions? If you have concerns, please let us know. Section A appears in accordance with my recommendations, providing the demolition is as per the figure above.

Since we are inquiring regarding the above, we will also note the following:

With respect to page 11 of the report, item 2 says each of the 2 – 24" layers should be driven into the soft subgrade with a "large, heavy smooth-drum compactor, or fully loaded dump truck until approved by an Atlas geotechnical engineer …". Even though a lot of material will be removed, we do not believe the size of the excavation will allow for a dump truck. Item 5 also requires the use of a "large" compactor. Could you offer more specificity on the "large" roller so the contractor will know what is expected of him (but small enough to fit within the excavation)? Will a compactor that is small enough to operate in the excavation suitably drive the surge stone into the subgrade or are there other measures that the Contractor may need to use? Given the access restrictions, I would recommend sufficiently large (the contractors can assist with equipment selection) compactors: smooth drum compactor for the surge stone and aggregate, and a "sheep's foot" type compactor for the soil fill. If these compactors cannot be driven into the excavation, then those will likely need to be craned into the excavation. The excavation will need to be as per OSHA regulations so that contractor's personnel, as well as Atlas testing personnel, have safe working conditions within the excavation.

The 3rd paragraph on page 14 also mentions various construction equipment for proof rolling. As noted in our preceding comment, this will not be practical for this site. This is addressed by the 4th paragraph.

Please clarify the preferred size of the surge stone (8 to 12 inches on page 11 vs 5 to 15 inches in Figure 8 on page 12). 8 to 12 inches in maximum dimension should suffice.

If the Contractor is required to remove the entire existing effluent pump station, and since the bottom of the station is apparently at or within a foot or so of refusal, is it possible that some of surge stone may not be forced into the weak material? I know that this is something that will be addressed during construction (based on what is actually encountered) but maybe we should note that the Contractor shall not place more material than can be forced into the weak material. Otherwise it seems it may be difficult to fill the voids between the surge stone with the finer aggregate placed on top of it. The extent of the "forcing" of the surge stone into the soft subgrade will be better determined at the time of construction. Nonetheless, the surge stone modified subgrade will need to be relatively firm and stable prior to the placement of finer aggregate.

Page 13 item 7 of the report notes that the exterior grades should be sloped away from the building footprint. Due to the site topography, this will not be achievable as the eastern part of the site slopes to the new structure and the west side is essentially flat. As long as significant ponding is avoided, it should be fine.

Page 15 item 7.2 regarding Controlled Structural Fill and Table 8 on page 12 may allow for satisfactory soil meeting the specifications to be used for part of the fill. We would typically require crushed limestone in such applications to avoid potential issues with soils (including variability and moisture content, etc.). Do you have any concern with requiring that as well? Crushed limestone should be acceptable, provided it has sufficient (>20%) fine (silt, clay) material (i.e., passing the #200 sieve) in order to allow for proper compaction.

Fred R. DeLeon, Jr., PE, DGE, PG, CPG
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From: Stuckey Godfrey <stuckeyg@municipalconsultants.org>
Sent: Wednesday, September 7, 2022 4:37 PM
To: Fred DeLeon Jr <fred.deleon@oneatlas.com>
Subject: [EXTERNAL] Geotechnical Report Comments - North Shelby WRRF Filter Improvements

[External Email] This email originated from outside of the Atlas mail system. Please use caution when

Controlled Structural Fill Requirements

June 1, 2023

Controlled Structural Fill Requirements

June 1, 2023

<u>These requirements modify and supersede any contradictions in the August 22, 2022, Geotechnical Engineering Exploration report.</u>

The Geotechnical Engineering Exploration states that much of the site excavated soil likely will not be suitable for use as fill or backfill. In order to avoid concerns with soils on the site or soils imported to be used for fill or backfill on the project, all fill or backfill on the project shall be imported crushed limestone that has 20% or greater fines (i.e., passing the #200 sieve). Materials other than crushed limestone will not be acceptable. The limestone used for controlled structural fill shall be either an ASTM 8910 or AASHTO (ALDOT) 825b. The crushed limestone must be approved by the Owner's Geotechnical Engineer for the project. Because of the critical importance of the fill and backfill, the crushed limestone shall be thoroughly compacted in accordance with all the requirements contained in the Geotechnical Engineering Exploration as modified herein and those of the Owner's Geotechnical Engineer. The fill shall be placed in a loose fill lifts not exceeding 8" thickness. Each 8-inch (maximum thickness) aggregate lift shall be appropriately compacted with a large, heavy smooth-drum compactor to 100% of the Modified Proctor (ASTM D-1557) Maximum Dry Density. The Contractor shall at his expense haul and dispose of excavated material offsite except for any excavated material that the Owner desires to retain shall be placed onsite by the Contractor at a location designated by the Owner.