



CATTAIL BRANCH SEWER PUMP STATION (SPS) UPGRADE – PHASE III

**BIDDING DOCUMENTS
SUPPLEMENTAL SPECIFICATIONS**

**TOWN OF LEESBURG
25 WEST MARKET STREET
LEESBURG, VIRGINIA 20176**

JANUARY 20, 2022

**INVITATION FOR BID (IFB)
IFB NO. 500640-FY22-20**

NOTE: Effective January 1, 2021, and until further notice, all bids and proposals in response to a formal solicitation issued by the Town will be securely received via eVA, the Commonwealth's eProcurement website. All formal solicitations, including notices of addenda, will be posted on the Town's Bid Board (<http://www.leesburgva.gov/bidboard>) and eVA (www.eva.virginia.gov). Courtesy notifications will be provided to interested parties who have registered to received updates. Interested parties are responsible for providing the correct contact information to the Town.

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**TOWN OF LEESBURG
ADVERTISEMENT FOR BID**

**IFB NO. 500640-FY22-20
CATTAIL BRANCH SEWER PUMP STATION (SPS) UPGRADE – PHASE III**

****NOTE: Effective January 1, 2021, all bids and proposals in response to a formal solicitation issued by the Town will be securely received via eVA, the Commonwealth’s eProcurement website. Additionally, at this time the Town is not conducting in-person public bid openings. ****

SEALED BIDS to construct the above project WILL BE RECEIVED by the Town of Leesburg, electronically via the Commonwealth’s e-procurement website (www.eva.virginia.gov), **UNTIL BUT NO LATER THAN 3:00 P.M. ON THURSDAY, FEBRUARY 22, 2022.** Bids shall be submitted electronically using the following naming convention: the IFB number and the name of the bidder (i.e. “IFB No. 500640-FY22-20_Your Company’s Name”).

All questions regarding this bid must be submitted in writing via email to bidquestions@leesburgva.gov until but no later than 5:00 P.M. on Friday, February 4, 2022.

Bids will be publicly opened via Microsoft Teams using the eVA e-Procurement website at the due date and time listed above. The bid opening will be livestreamed via Microsoft Teams and made available to the public.

- To join the meeting and view the video shared by the Town of Leesburg from your computer, please see the following link(s): https://teams.microsoft.com/l/meetup-join/19%3ameeting_NzKxZmJjZTAyYjc2OS00M2M3LWJmMmYtNmZhNTI3ZWQxNzQ4%40thread.v2/0?context=%7b%22Tid%22%3a%22fcff6f14-98e4-4734-bf54-941f010e77b7%22%2c%22Oid%22%3a%229bec83ad-0021-4134-81bd-403ce78b1921%22%7d
- To join the meeting via phone, please see the following dial-in info:
Dial In #: +1 689-218-0588
Meeting Conference ID: 309 745 849#
- For more information: [Learn More](#)

The project includes the partial rehabilitation of a Sewer Pump Station including two new dry pit submersible pumps, four new 200 horsepower variable frequency drives, odor control system and appurtenances.

A non-mandatory pre-bid meeting will be held on Tuesday, February 1, 2022 at 9:00AM at the Utility Maintenance Building located at 1385 Russell Branch Parkway SE, Leesburg, Virginia 20175. The meeting will also be streamed via Microsoft Teams. It is strongly recommended that all bidders attend this meeting to gain a thorough understanding of the project.

- To join the meeting and view the video shared by the Town of Leesburg from your computer, please see the following link(s): https://teams.microsoft.com/l/meetup-join/19%3ameeting_MjA2ODgyOTctYWZmMi00YzhkLTg2NmMtMzNmZjRiNTM5YTUz%40thread.v2/0?context=%7b%22Tid%22%3a%22fcff6f14-98e4-4734-bf54-941f010e77b7%22%2c%22Oid%22%3a%229bec83ad-0021-4134-81bd-

[403ce78b1921%22%7d](#)

- To join the meeting via phone, please see the following dial-in info:
Dial In #: +1 689-218-0588
Meeting Conference ID: 847 042 005#
- For more information: [Learn More](#)

All interested bidders who wish to attend the pre-bid meeting in person must bring their own personal protective equipment (mask)! Additionally, the Town reserves the right to deny any bidders from viewing the work site if they do not have the proper equipment or if they appear to not be physically well.

Bid Documents are available for download from the Town's Bid Board at <http://www.leesburgva.gov/bidboard>. Any addenda issued for this project will be posted on the Town's Bid Board and eVA (<https://eva.virginia.gov>) with a courtesy email to those firms who have registered on the Town's Bid Board. It is the bidders' responsibility to provide a correct email address and to be aware of any addenda.

**Kelly Neff, VCA, VCO
Buyer**



REQUIRED BID RESPONSE FORMS

IFB NO. 500640-FY22-20

CATTAIL BRANCH SEWER PUMP STATION (SPS) UPGRADE – PHASE III

Bidders shall submit bids to the Town in accordance with the Submission of Bids section of the Bid Documents and shall include the following completed documents with their bid submission:

Checklist

- _____ **Bid Submission Form (includes Conflict of Interest and Collusion Certifications)**
- _____ **Acknowledgement of Addenda**
- _____ **Bid Form – Pricing (For Reference Only) ** SUBMITTED ELECTRONICALLY VIA EVA****
- _____ **Escrow of Retained Funds**
- _____ **Bid Bond ** The original bid security shall be delivered to the Town within two (2) business days after the bids are due to the Town. See the Bid Bond section of the Bid Documents for details and instructions. ****
- _____ **Qualification Form**
- _____ **Reference Form**
- _____ **Subcontractor Plan**
- _____ **Bypass Pumping Plan**

Bidders shall use the required bid response forms included in the Bid Documents when submitting their bid to the Town. Bidders who do not provide all required bid response forms may be deemed non-responsive.



BID SUBMISSION FORM
IFB NO. 500640-FY22-20
CATTAIL BRANCH SEWER PUMP STATION (SPS) UPGRADE – PHASE III

SUBMIT A SIGNED BID FORM VIA EVA, WWW.EVA.VIRGINIA.GOV

**FORMAL BIDS WILL BE DUE NO LATER THAN:
3:00 P.M. ON TUESDAY, FEBRUARY 22, 2022**

The undersigned agrees to furnish all necessary labor, equipment, materials, and all things necessary to perform the work as set forth in accordance with the plans and specifications at the following prices.

SECTION I – COMPANY IDENTIFICATION AND OWNERSHIP DISCLOSURE

Company _____

Address _____

Contact Person _____ Title _____

Telephone No. _____ Fax No. _____

Email _____

Business Type (check one):

Corporation Limited Partnership Limited Liability Company

General Partnership Unincorporated Assoc. Sole Proprietorship

Organized under the laws of the State of _____

State Corp. Commission Registration No. _____ (attach Certificate of Good Standing)

Virginia Contractor's License No. _____

Federal Identification No. _____

The Town of Leesburg requests, as a matter of policy, that any bidder receiving a contract of award resulting from a formal solicitation issued by the Town shall make certification as specified below. Receipt of such certification, shall be a prerequisite to the award of contract and payment thereof.

SECTION II – EMPLOYEES NOT TO BENEFIT - I (we) hereby certify that if the contract is awarded to our company, partnership, or corporation, that no employee of the Town of Leesburg, or members of his/her immediate family, including spouse, parents or children has received or been promised, directly or indirectly, any financial benefit, by way of fee, commission, finder’s fee, political contribution or any similar form of remuneration on account of the act of awarding and/or executing this contract.

SECTION III – CONFLICTS OF INTEREST - This solicitation is subject to the provisions of VA Code Ann. Section 2.1-639.2 et seq., the State and Local Government Conflict of Interests Act. **The Bidder [] is [] is not aware of any information bearing on the existence of any potential organizational conflict of interest.**

SECTION IV – COLLUSION - I certify that this offer is made without prior understanding, agreement, or connection with any corporation, firm, or person submitting an offer for the same services, materials, supplies, or equipment and is in all respects fair and without collusion or fraud. I understand collusive bidding is a violation of the State and federal law and can result in fines, prison sentences, and civil damage awards. I hereby certify that the responses to the above representations, certifications, and other statements are accurate and complete. I agree to abide by all conditions of this IFB and certify that I am authorized to sign for my company.

Signature _____ Date _____

Name (Printed) _____ Title _____

BIDDER MUST RETURN THIS FORM WITH THEIR BID



ACKNOWLEDGEMENT OF ADDENDA
IFB NO. 500640-FY22-20
CATTAIL BRANCH SEWER PUMP STATION (SPS) UPGRADE – PHASE III

Bidder acknowledges receipt of the following ADDENDA, which have been considered in the preparation of this bid.

Addendum No. _____
Addendum No. _____
Addendum No. _____
Addendum No. _____

Dated: _____
Dated: _____
Dated: _____
Dated: _____

BIDDER MUST RETURN THIS FORM WITH THEIR BID

BID FORM – FOR REFERENCE ONLY

**** Submit bid pricing electronically via eVA. This form is for reference only and should not be submitted with a bid. ****

Item	Description	Quantity	Unit of Measure	Unit Price	Extended Price
	<i>CATTAIL BRANCH SEWER PUMP STATION (SPS) UPGRADE – PHASE III</i>				
1	CATTAIL BRANCH SPS UPGRADE – PHASE III, IN ACCORDANCE WITH CONTRACTOR DOCUMENTS, PLANS AND SPECIFICATIONS, AS NECESSARY TO COMPLETE OPERATING FACILITY	1	LS		
TOTAL BID PRICE					

NOT A PART OF THE BID PACKAGE. DO NOT RETURN THIS FORM WITH BID.

ESCROW OF RETAINED FUNDS

In accordance with Section 2.2-4334 of the Virginia Public Procurement Act (VPPA), any Contract valued at \$200,000.00 or more for construction of highways, roads, streets, bridges, parking lots, demolition, clearing, grading, excavating, paving, pile driving miscellaneous drainage structures, and the installation of water, gas, sewer lines and pumping stations where portions of the Contract price are to be retained, at the time of submitting a bid, the CONTRACTOR shall have the option to indicate preference for using the escrow account procedure for utilization of the Town retained funds by so indicating in the space provided in the proposal documents. In the event the successful Contract elects to use the escrow account procedure, the "Escrow Agreement" included in the Contract documents shall be executed and submitted to the Manager, Office of Capital Projects within 15 days after receipt of the Notice to Award. If the "Escrow Agreement" form is not submitted, the CONTRACTOR shall forfeit his rights to the use of the escrow account procedure within the 15-day period.

In order to have retained funds paid to an escrow agent, the CONTRACTOR, the escrow agent, and the surety shall execute the "Escrow Agreement" furnished by the TOWN, and submit same to the Manager of Capital Projects for approval. The CONTRACTOR's escrow agent shall be a trust company, approved bank or savings and loan institution with its principal office located in the Commonwealth of Virginia. The "Escrow Agreement" shall contain the complete address of the escrow agent and surety, and the executed "Escrow Agreement" will be authority for the TOWN to make payment of retained funds to the escrow agent. After approving the agreement, the TOWN will pay to the escrow agent the funds retained as provided herein, except that funds retained for lack of progress or other deficiencies on the part of the CONTRACTOR will not be paid to the escrow agent. The escrow agent may, in accordance with the stipulations contained in the "Escrow Agreement", invest the funds paid into the escrow account and pay earnings on such investments to the CONTRACTOR, or release the funds to the CONTRACTOR, provided such funds are fully secured by approved securities.

Retained funds invested, and securities held as collateral for retainage may be released only as and when directed by the Manager, Office of Capital Projects. When the final estimate is released for payment, the Manager, Office of Capital Projects will direct the escrow agent to settle the escrow amount by paying the CONTRACTOR or the TOWN monies due them as determined by the Manager, Office of Capital Projects. The TOWN reserves the right to recall retained funds and to release same to the surety upon receipt of written request from the CONTRACTOR or in the event of default.

- We elect to use the escrow account procedure for the deposit of retained funds.

- We elect not to use the escrow account procedure for the deposit of retained funds.

BIDDER MUST RETURN THIS FORM WITH THEIR BID

BID BOND

BOND NO. _____

AMOUNT: \$ _____

KNOW ALL MEN BY THESE MEN PRESENTS, that _____ hereinafter called the PRINCIPAL, and _____ a corporation duly organized under the laws of the State of _____ having its principal place of business at _____ in the State of _____ and authorized to do business in the Commonwealth of Virginia, as SURETY, are held and firmly bound unto _____, as OWNER, hereinafter called the OBLIGEE, in the sum of _____ DOLLARS (\$ _____) for the payment for which we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS BOND IS SUCH THAT:

WHEREAS, the PRINCIPAL is herewith submitting his or its Bid Proposal for _____ said Bid Proposal, by reference thereto, being hereby made a part hereof.

NOW THEREFORE,

- (A) If the bid shall remain open for a period of not less than 60 days following opening of the bids and be rejected, or in the alternate,
- (B) If the bid shall remain open for a period of not less than 60 days following opening of the bids and be accepted and the PRINCIPAL shall execute and deliver a Contract in the form of Contract attached hereto (properly completed in accordance with the bid) and shall furnish a performance and payment deposit or surety bond for his faithful performance of the Contract, and for the payment of all persons performing labor or furnishing materials in connection therewith,
- (C) THEN, this obligation shall be void; otherwise the same shall remain in force and effect, it being expressly understood and agreed that the liability of the SURETY for any and all claims hereunder shall, in no event, exceed the said amount of this obligation as herein stated. Provided, however, that in addition to the amount of this obligation as herein stated, the SURETY shall be liable for all costs and attorney's fees incurred by the OBLIGEE in enforcing the obligations hereunder.

The SURETY, for value received, hereby stipulates and agrees that the obligation of the SURETY and its bond shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such bid; and the SURETY does hereby waive notice of

such extension.

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

Signed and sealed this _____ day of _____, 20_____ .

PRINCIPAL

By _____

SURETY

By _____

Attorney-In-Fact

IMPORTANT: The SURETY executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the Commonwealth of Virginia.

BIDDER MUST RETURN THIS FORM WITH THEIR BID

QUALIFICATION FORM

Note: Please refer to the QUALIFICATIONS OF THE LOWEST BIDDER SECTION of the Bid Documents. The following information is required as part of your response to this solicitation. Failure to complete and provide this form with your bid response may result in the Town deeming your bid as non-responsive.

1. Qualification: Bidder must have the capability and capacity in all respects to satisfy fully all of the contractual requirements.

2. Years in Business: Indicate the length of time you have been in business providing this type of good or service:

Years: _____ Months: _____

3. Contractor's Primary Contact(s) for this project:

Project Manager: _____ Email: _____ Phone: _____

Superintendent: _____ Email: _____ Phone: _____

Other (list title): _____ Email: _____ Phone: _____

4. Indicate below a listing of at least three (3) projects of similar size and scope within the past ten (10) years for which both the Project Manager and Superintendent specified and assigned for this project have successfully worked. Include reference contact information (name, email, and phone number), a description of work performed, the dates of service, and the contract value of the referenced project.

Company (Owner): _____ Contact: _____

Phone: (____) _____ Email Address: _____

Project Description: _____

Dates of Service: _____ Value (\$): _____

Company (Owner): _____ Contact: _____

Phone: (____) _____ Email Address: _____

Project Description: _____

Dates of Service: _____ Value (\$): _____

Company (Owner): _____ Contact: _____

Phone: (____) _____ Email Address: _____

Project Description: _____

Dates of Service: _____ Value (\$): _____

BIDDER MUST RETURN THIS FORM WITH THEIR BID

REFERENCE FORM

Note: Please refer to the *QUALIFICATIONS OF THE LOWEST BIDDER SECTION* of the Bid Documents. Indicate below a listing of at least three (3) current or recent municipal clients for whom the Contractor has performed and completed this type of work. Include reference contact information (email and phone number), a short description of work performed, the dates of service, and the name, email address, and telephone number of the point of contact. Failure to complete and provide this form with your bid response may result in the Town deeming your bid as non-responsive.

Reference No. 1 (Required):

Customer (Owner) Representative's Name

Description of Work Performed & Dates of Service

Representative's Name

Phone Number

Email Address

Reference No. 2 (Required):

Customer (Owner) Representative's Name

Description of Work Performed & Dates of Service

Representative's Name

Phone Number

Email Address

Reference No. 3 (Required):

Customer (Owner) Representative's Name

Description of Work Performed & Dates of Service

Representative's Name

Phone Number

Email Address

Reference No. 4 (Optional):

Customer (Owner) Representative's Name

Description of Work Performed & Dates of Service

Representative's Name

Phone Number

Email Address

Reference No. 5 (Optional):

Customer (Owner) Representative's Name

Description of Work Performed & Dates of Service

Representative's Name

Phone Number

Email Address

BIDDER MUST RETURN THIS FORM WITH THEIR BID

SUBCONTRACTOR FORM

Note: Please note QUALIFICATIONS OF THE LOWEST BIDDER SECTION of the Bid Documents. The following information is required as part of your response to this solicitation. Failure to complete and provide this form with your bid response may result in the Town deeming your bid as non-responsive.

If you are NOT using any subcontractor(s), please initial here _____

If you are using subcontractor(s), please list them in the following table:

<i>Subcontractor(s) Name & Address</i>	<i>Contact Name, Email Address, & Phone Number</i>	<i>Type of Work to Be Performed</i>	<i>Percentage of Work</i>

I/We agree that the information provided herein is accurate, current, and complete to the best of my/our knowledge.

Signature: _____

Title of Company Official: _____

Date: _____

BIDDER MUST RETURN THIS FORM WITH THEIR BID

INSTRUCTIONS TO BIDDERS

BACKGROUND

The Cattail Branch Sewer Pump Station (SPS) Upgrade – Phase III project will restore the pump station to like new condition on various streets around town.

Project construction is scheduled for the spring of 2022.

SCOPE OF WORK

The Town of Leesburg, Virginia (“Town”) is requesting bids from qualified Bidders to provide rehabilitation of the Cattail Branch Sewer Pump Station.

The Bidder shall provide a complete mechanical and electrical rehabilitation, in accordance with contract documents, plans and specifications, as necessary to provide a complete operating facility. Additional work includes, bypass pumping, and other work conducive to completing the rehabilitation of the infrastructure.

The Town reserves the right to perform all, part, or none of the work.

COMMENTS CONCERNING SPECIFICATIONS (VPPA 2.2-4316)

General and Technical questions relating to this solicitation shall be submitted in writing to Kelly Neff, Buyer, by email at BidQuestions@leesburgva.gov. Please put the title of this IFB in the subject line of the email.

If any questions or responses require revisions to the solicitation as originally published, such revisions will be by formal addendum only. Bidders are cautioned that any written or oral representations made by any Town representative or other person that appear to change materially any portion of the solicitation shall not be relied upon unless subsequently ratified by a written addendum to this solicitation issued by the Town. For determination as to whether an oral or written representation of any Town representative or other person requires that an addendum be issued, contact Kelly Neff, Buyer, in writing via email at BidQuestions@leesburgva.gov.

INCOMPLETE DOCUMENTS

The Contractor, as a bidder, is responsible for having determined the accuracy and completeness of bid documents upon which it relied in making its bid, and having notified the Chief Procurement Officer immediately upon discovery of an apparent inaccuracy, error in, or omission of any pages, drawings, sections, or addenda whose omission from the documents was apparent from a reference or page numbering in the bidding documents.

If the Contractor proceeds with any activity that may be affected by an inaccuracy, error in, or omission described above, of which it has not notified Chief Procurement Officer, the Contractor hereby agrees to perform any work described in such missing or incomplete documents at no additional cost to the Town.

TOWN OF LEESBURG BUSINESS PROFESSIONAL AND OCCUPATION LICENSE (BPOL)

Bidders do not have to obtain a BPOL license in order to submit a bid to the Town; however, the successful bidder must obtain a license, if applicable, prior to award of the contract.

The successful bidder must comply with the provisions of Section 20-233 (License requirement) of the Town of Leesburg Code, if applicable. For information on the provisions of this chapter and its applicability to this Contract, contact the Town of Leesburg Accounting Associate, Finance Department, Town of Leesburg, Virginia, at telephone number 703-771-2753 or email BusinessLic@leesburgva.gov.

FORM AND STYLE OF BIDS

NOTE: THIS SECTION CONTAINS REVISED PROCUREMENT PROCEDURES

Bids shall be submitted electronically via the Commonwealth's electronic procurement website (eVA). Unless otherwise specified or permitted herein, prices shall be submitted on all line items shown in eVA. In addition to submitting bid pricing electronically via eVA, bidder shall also upload all completed bid response forms as required by the Town with their Bid.

Bids shall include the legal name of the Bidder and a statement that the Bidder is a sole proprietor, partnership, corporation, or other legal entity. Bids shall be signed by the person or persons legally authorized to bind the Bidder to a contract. During the COVID-19 State of Emergency, and for the duration of the Emergency or until further notice, electronic signatures will be accepted by the Town; submission of a bid through the eVa system constitutes your representation that your firm authorizes the use of electronic signatures. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. All names shall be typed or printed in ink below the signatures. The address, phone number and email address for communication regarding the bid shall be shown.

Bids shall contain evidence of the Bidder's authority to do business in the Commonwealth of Virginia. Bidder's Virginia State Contractor license number shall also be shown on the Bid Response Form.

BID BOND

NOTE: THIS SECTION CONTAINS REVISED PROCUREMENT PROCEDURES

Each bid shall be accompanied with a copy of the bid security (on enclosed form or cashier's check), in the amount of five percent (5%) of the bidder's Total Bid Price, pledging that the Bidder will enter into a Contract with the TOWN on the terms stated in the Bid. Should the Bidder refuse

to enter into such Contract the amount of the bid security shall be forfeited to the TOWN as liquidated damages, not as a penalty. The amount of the bid security shall not be forfeited to the TOWN in the event the TOWN fails to prove financial capability if requested in writing by the successful bidder. Pursuant to VPPA Section 2.2-4336.

The original bid security shall be delivered to the Town within two (2) business days after the bids are due to the Town. The original bid security shall be mailed to: Town of Leesburg, Virginia, Attn: Procurement Office, 25 W. Market Street, Leesburg, VA 20176. The Town reserves the right to deem bidders non-responsive for failure to provide the original bid security within the timeframe specified.

The TOWN will have the right to retain the bid security of Bidders to whom an award is being considered until either (a) the Contract has been executed or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

SUBMISSION OF BIDS

NOTE: THIS SECTION CONTAINS REVISED PROCUREMENT PROCEDURES

In order to be considered for a contract award, bidders must complete and submit a response to this IFB via the Commonwealth's electronic procurement website eVA (www.eva.virginia.gov). eVA streamlines and automates government purchasing activities in the Commonwealth. The eVA portal is the gateway for vendors to conduct business with state agencies and public bodies. Bidders desiring to provide goods and/or services to the Town must be a registered vendor in eVA. eVA Vendor Registration is free.

On the eVA website, www.eva.virginia.gov, applicants must login as a vendor using their eVA username and password. Please contact eVA Customer Care for instructions and/or assistance in registering to become a vendor, login, and/or uploading documents. eVA Customer Care:

Hours: 8:00 AM to 4:45 PM, Monday through Friday
Phone Toll Free: 866-289-7367
Email: eVACustomerCare@DGS.Virginia.gov

Guides for registering as a new vendor and submitting bids on eVA are included at the end of this bid document.

Bids shall be submitted electronically to the Town via the Commonwealth's eVA website **prior** to the bid submission deadline stipulated for this IFB or as amended via any subsequent addenda issued by the Town. Bidders assume full responsibility for the electronic delivery of the completed proposal to www.eva.virginia.gov on or before the deadline for submission. The Town is not responsible for any loss or delay with respect to the submission of bids. Late bids will **not** be accepted. Bids submitted by any method other than via the eVA website will **not** be accepted.

All required forms and documentation submitted in response to this IFB must be uploaded as one (1) pdf attachment to eVA (www.eva.virginia.gov). The attachment should use the

following naming convention: the IFB number and the name of the bidder (i.e. IFB No. _____ - Your Company's Name).

NOTE: eVA will not allow a bidder to upload documents after the deadline set for receipt of bids. Any submission partially uploaded at the deadline date and time will be considered incomplete and will not be accepted. ANY PROPOSAL RECEIVED BY THE TOWN AFTER THE DEADLINE FOR SUBMISSION WILL NOT BE ACCEPTED.

MODIFICATION/WITHDRAWAL OF BID

NOTE: THIS SECTION CONTAINS REVISED PROCUREMENT PROCEDURES

A Bid may not be modified, withdrawn, or cancelled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and each Bidder so agrees in submitting a Bid.

Prior to the time and date designated for receipt of Bids, a Bid submitted electronically to the Town via the Commonwealth's eVA website may be modified or withdrawn.

Withdrawn Bids may be resubmitted up to the date and time designated for the receipt of Bids, provided that they are then fully in conformance with these Instructions to Bidders.

Bid security, if required, shall be in an amount sufficient for the Bid as modified or resubmitted.

If within two (2) business days after Bids are opened and Bidder files a duly signed written notice, accompanied by original work papers, with the TOWN that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Withdrawal of bids submitted to the TOWN is governed by Section 2.2-4330 of the Virginia Public Procurement Act (VPPA).

CONSIDERATION OF BIDS & BID OPENING

NOTE: THIS SECTION CONTAINS REVISED PROCUREMENT PROCEDURES

The TOWN shall have the right to reject any or all Bids, reject a Bid not accompanied by a required bid security or by other data required by the Bidding Documents, or reject a Bid, which is in any way incomplete or irregular. Though the eVA website does not reject multiple bid submissions, the TOWN permits only one bid to be submitted by the same firm in response to this IFB. Accordingly, the Town reserves the right to reject multiple bids submitted by the same firm in eVA. If a bidder submits more than one bid in response to this IFB, only the most recent submission will be considered, and previously submitted bids will be rejected.

All bids received will be opened publicly and read aloud utilizing the Commonwealth's eVA website. The bid opening for this project will be held at date and time specified in the Advertisement for Bid. The bid opening will be livestreamed via Microsoft Teams for accessibility to the public.

After the bids are opened and publicly read aloud, the Town will recalculate the arithmetic of all bids. The recalculation will consist of the following:

1. The Extended Price will be the Quantity x Unit Price. The accuracy of this calculation will be verified for all unit price items of work. All mathematical errors will be corrected to arrive at the correct extended price. If a bidder submits “NO BID” or no price is shown or entered for the Unit Price, the bidder shall be deemed non-responsive. If a bidder submits a price of “0” for the Unit Price, it will be understood to be at a unit price of zero or no cost to the Town.
2. The sum of all extensions will be calculated and any mathematical errors will be corrected.
3. If there are multiple sections to the bid, for example the Total Base Bid = Section ‘A’ + ‘B’, the sum of the sections will be calculated. All mathematical errors will be corrected.

The corrected price and correct sum thereof will be used to determine the lowest responsive, responsible bidder and will become the value of the recommended contract award.

AWARD

It is the intent of the TOWN to award a Contract to the lowest responsive and responsible Bidder, provided the low bid does not exceed the funds available. The Town reserves the right to accept or to reject any or all bids in whole or in part, to make multiple awards, and to waive informalities in the process of awarding this contract. The Notice of Intent to Award a contract resulting from this Invitation for Bid will be posted on the Public Notice Board at 25 W. Market Street, Leesburg, VA and on the Town’s Bid Board (<https://www.leesburgva.gov/bidboard>).

NEGOTIATIONS WITH THE LOWEST RESPONSIVE BIDDER

Unless all bids are cancelled or rejected, the Town reserves the right granted by 2.2-4318 of the *Code of Virginia* to negotiate with the lowest responsive, responsible bidder to obtain a contract price within the funds available. Funds available shall mean those funds, which were budgeted for this contract prior to the issuance of the written Invitation for Bids. Negotiations with the low bidder may include both modifications of the bid price and the Scope of Work/Specifications to be performed. The Town shall initiate such negotiations by written notice to the lowest responsive, responsible bidder that its bid exceeds the available funds and the Town wishes to negotiate a lower contract price. The times, places, and manner of negotiating shall be agreed to by the Town and the lowest responsive, responsible bidder.

QUALIFICATIONS OF THE LOWEST RESPONSIVE BIDDER

This project requires specialized knowledge and expertise. The Contractor shall be well versed in the scope of work for this project. If the Contractor does not have specific experience with regards to projects similar in complexity they will not be considered for the award of this project. The Contractor must submit written information demonstrating experience by having completed

a minimum of three (3) similar projects within the last ten (10) years and commit to the availability of key, skilled personnel necessary to complete the entire scope of work required for the project.

All qualification documentation shall be submitted as part of the bidder's bid package. Bids received without the required documentation shall be deemed non-responsive.

1. Project descriptions (3 similar projects, maximum of three (3) pages per project) indicating client, project scope, location, time frame).
2. The Contractor shall have successfully completed similar mechanical, electrical, and instrumentation work at other similarly sized sewage pumping stations, as documented by verifiable references and documented in the qualification form. The Contractor shall submit a minimum of three (3) similarly sized projects and similar in scope, in the past ten (10) years. For work to be considered similar, work must have included sewage pump associated piping installation, electrical, instrumentation and controls.
3. The Superintendent assigned to this contract shall have successfully worked on three (3) similarly sized projects, and similar in scope, in the past ten (10) years.
4. Provide a reference list of five (5) municipal clients for whom the Contractor has performed and completed this type of work in the past ten (10) years. Include reference contact information (email and phone number), and a description of work to include pumping station size (in gpm), size of the facility, and work items included.
5. The Contractor shall self-perform a majority of the work. At the time of the bid, the Contractor shall name any anticipated subcontractors and define the work expected to be performed on the contract by each subcontractor.
6. The Contractor shall provide a Bypass Pumping Plan describing the proposed operation.

PROTEST

Any bidder or offeror who desires to protest the award or decision to award a contract shall submit such protest in writing to the TOWN, no later than 10 days after public notice of award or the announcement of the decision to award, whichever occurs first, pursuant to Section 2.2-4360 of the VPPA.

ACCEPTANCE OF BID (VPPA 2.2-4337)

The bids received shall be open to acceptance and is irrevocable for **sixty (60) days** from the Bid Closing date.

If the bid is accepted by the Town within the period specified above, the Contractor shall provide a certificate of insurance, Payment bond, and Performance Bond within 10 days of the Notice of

Award or Notice of Intent to Award. Each bond, the Performance Bond and the Payment Bond, shall be in the amount of 100% of the Contract Amount. The bonds shall be corporate surety bonds issued by a surety company authorized to do business in the Commonwealth of Virginia and acceptable to the Town. The Performance Bond will be conditioned upon the faithful performance of all of the work shown, described and required in the Contract Documents. The Payment Bond will be conditioned upon the payment of all persons who have and fulfill contracts for the Contractor for providing labor, equipment of material in the performance of the work provided for in the Contract Documents.

If this bid is accepted within the time stated, and the Contractor fails to provide the required Bonds, or commence the project as directed, the security deposit shall be forfeited as damages to the Town by reason or failure, limited in amount to the lesser of the face value of the security deposit or the difference between this Bid and the Bid upon which the Contract is signed.

SCC IDENTIFICATION NUMBER (VPPA SECTION 2.2-4311.2)

Every Bidder must include their State Corporation Commission (SCC) Identification Number or reason for exemption with his/her bid. If this information is not included, the Bid may be rejected.

VIRGINIA CONTRACTOR'S LICENSE NUMBER (CODE OF VIRGINIA §54.1-1115, A1 AND A6)

Bidder certifies that he/she is properly registered as a licensed Contractor under Title 54 of the Code of Virginia. Bidder shall provide his/her Virginia Contractor's License Number in the designated location on the Bid Response Form or the Bid may be rejected.

STIPULATED PRICES

The term "STIPULATED PRICE ITEM" means and includes an item of Work, unanticipated at the time of issuance of the solicitation for a Bid and determined to be executed, based on the actual field conditions during the progress of Work under the contract, mutually by the Engineer and the Contractor. The Unit Price for the "STIPULATED PRICE ITEM", as identified in the "Stipulated Price Items" section of the Bid Form, is predetermined by the Town as the current reasonably workable rate for the Item inclusive of all necessary labor, equipment, materials, overhead (provision and installation), and the Contractor's profit. Work on the "STIPULATED PRICE ITEM" shall be carried out either at the written request of the Contractor followed by a written approval by the Engineer or at the written order by the ENGINEER to the Contractor. The payment for a "STIPULATED PRICE ITEM" shall be made by the Town to the Contractor at the related Unit Price specified in the 'Stipulated Price Items' section of the Bid Form on the same basis as the payment for any other regular Bid Item.

COMPENSATION AND PAYMENT

Payments are due and payable forty-five (45) days from the date of the Contractor's invoice. Amounts unpaid sixty (60) days after the invoice date shall bear interest at the base rate on corporate loans (prime rate) at large United States money center commercial banks as reported daily in the Publication entitled The Wall Street Journal.

COORDINATION WITH UTILITIES

The Contractor shall notify Mike Osman, Town of Leesburg Utility Maintenance Manager or his designee before investigating manholes, wet wells, or sewer lines for the purpose of responding to this invitation to bid. The Town reserves the right to deny access for investigation or inspection of the system.

The Contractor shall coordinate the work of his forces with Mike Osman, Town of Leesburg Utility Maintenance Manager or his designee during the contract to ensure the continuing progress of all work to be performed within the project area.

The Contractor shall notify ‘MISS UTILITY’ at 1-800-552-7001, 72 hours prior to beginning construction.

It shall be the responsibility of the Contractor to notify operators who maintain underground utility lines in the area of proposed excavation or blasting at least five (5) business days prior to any construction, subsequent maintenance or repair.

The Contractor shall dig test holes over all existing utilities prior to construction to determine their exact location and shall notify the construction manager of any necessity for redesign.

CONTRACT TIME

Substantial Completion:	330 calendar days from Notice to Proceed
Final Completion:	60 calendar days from Substantial Completion
Liquidated Damages:	\$2,500.00 and \$1,000.00 per day, as noted in the Agreement

TREES

In the event that a tree is injured or damaged, the Contractor should contact the Town’s inspector immediately.

CONTRACT ITEMS OF WORK

Refer to the Contract Technical Specifications and Contract Drawings for work items.

MAINTENANCE OF TRAFFIC

The Contractor shall conduct its operations in a manner that will ensure that traffic will be uninterrupted except as approved by the Town. At the close of each workday, the Contractor shall make all private entrances and driveways accessible. The Contractor shall make provisions to maintain a safe area for pedestrian traffic at all times during the project. No excavation shall remain open within the roadway without the approval of the Town except when the excavation can be safely bridged with the use of steel plates or other materials acceptable to the Town. When areas of excavation outside of the roadway do remain open, the area shall be barricaded

and warning signs shall be posted.

At all times the Contractor shall use the personnel and traffic control signs and devices necessary to comply with Part VI of the "National Manual on Uniform Traffic Control Devices". During the progress of the work when the street may be obstructed to any extent by construction equipment or construction operations, in addition to the signs and barricades, special workers, equipped with VDOT required "STOP\SLOW" double-sided traffic control paddles, shall be designated by the Contractor to direct traffic. These workers so designated shall not be assigned to any other duties while engaged in directing traffic. The workers assigned to the flagging duties shall be VDOT-certified. The Contractor has sole responsibility for ensuring that its operations are conducted in a safe manner and notwithstanding any other provision to the contrary, shall fully indemnify the Town of Leesburg, its officers, agents and employees for any damage or injury related to traffic operations which is caused by negligent or otherwise improper or deficient performance under the Contract or nonperformance of the terms of the Contract.

1. All personnel, signs, barricades and any other items necessary for the maintenance of traffic and safety shall be provided by the Contractor. This item is to be considered incidental to all other items of work.
2. The Contractor will not be permitted to work on the following holidays:
 - Annual Flower and Garden Show
 - Memorial Day
 - Juneteenth Day
 - Independence Day
 - Labor Day
 - Columbus Day
 - Veterans Day
 - Thanksgiving
 - Day after Thanksgiving
 - Christmas Day
 - Day after Christmas
 - New Year's Day
3. Work hours on the project will be limited to 7:00 a.m. to 4:00 p.m., Monday through Friday. Weekend and/or night work will not be allowed without written permission from the project manager.
4. The Contractor is required to apply for a Town right-of-way permit which includes a Maintenance of Traffic Plan for review and approval. Approval of the Maintenance of Traffic Plan is required prior to beginning any construction activities on the project. **The Maintenance of Traffic Plan is required for the issuance of the required right-of-way permit issued by the Town of Leesburg.**

END OF SECTION

SAMPLE AGREEMENT

THIS AGREEMENT, dated this ____ day of _____, 20__ is between the Town of Leesburg (hereinafter called "TOWN" or "Owner") and _____ (hereinafter called "CONTRACTOR"). TOWN AND CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

1. **WORK**

1.1 The project's name is _____, project # _____.

1.2 CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

The project includes _____
_____.

2. **OWNER'S REPRESENTATIVES**

2.1 All references to the Owner's Chief Procurement Officer shall mean: _____.

2.2 All references to the Owner's Project Manager or ENGINEER shall mean: _____, who shall have the sole responsibility for clarifying any ambiguities.

3. **CONTRACT TIME AND LIQUIDATED DAMAGES**

3.1 Time of the Essence

A. All time limits for Interim Completion, Milestones, Substantial Completion, and Final Completion as stated in the Contract Documents are of the essence of the Contract.

B. Contract Time:

a. The Work to be performed under this Contract shall be commenced after issuance of the Notice to Proceed and Substantial Completion shall be achieved within _____ calendar days.

b. Final Completion shall be achieved within _____ calendar days.

c. [Insert Interim or Milestone dates as appropriate.]

3.2 Liquidated Damages

- A. TOWN and CONTRACTOR recognize that time is of the essence of this Agreement and the TOWN will suffer financial loss if the Work is not completed within the time specified in Paragraph 3.1 above, plus any extensions thereof allowed in accordance with the General Conditions, Article 8, "TIME." Contractor recognizes the delays, expense, and difficulties involved in proving in a legal or other dispute resolution proceeding the actual loss suffered by TOWN if the Work is not completed on time. Accordingly, instead of requiring any such proof, TOWN and CONTRACTOR agree that as liquidated damages for delay, but not as a penalty, CONTRACTOR shall pay the TOWN as follows:
 - a. For each day that expires after the time established to achieve Substantial Completion as specified above, CONTRACTOR shall pay TOWN liquidated damages in the amount of \$2,500.00.
 - b. For each day that expires after the time established to achieve Final Completion as specified above, CONTRACTOR shall pay TOWN liquidated damages in the amount of \$1,000.00.
 - c. [Insert liquidated damage rate for and Interim or Milestone dates.]
- B. CONTRACTOR hereby waives any defense as to the validity of any liquidated damages stated in this Agreement as they may appear on the ground that such liquidated damages are void as penalties or are not reasonably related to actual damages.
- C. TOWN may recover liquidated damages by deducting the amount owed from progress payments, final payment or retainage.

4. **CONTRACT PRICE**

- 4.1. ***[If Fixed Price]*** In consideration of the Performance of the Contract, the Owner agrees to pay the Contractor as compensation for his services the firm, fixed price of: _____ Dollars and _____ Cents (\$_____).
- 4.2. ***[If Unit Price]*** In consideration of the Performance of the Contract, the Owner agrees to pay the Contractor as compensation for his services in accordance with the Bid Form and Contract Documents, which are included as Exhibits to this Agreement, an amount equal to the sum of the itemized prices as shown for each item of work multiplied by the actual quantity of each item completed:
 - A. Total Computed Price used for Comparison and Award:

(Words)

\$ _____
(Figures)

All specific cash allowances are included in the above price and have been computed to include the Contractors profit, overhead, all furnishing and installation charges.

This is a unit price contract and the estimated quantities are not guaranteed and are given only as a basis of calculation for comparing and awarding the project. The determinations of actual quantities and classifications are to be made by Project Manager, as provided in the General Conditions, Article 9. The Total Computed Price used for Comparison and Award will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately defined item times the estimated quantity for each item as indicated on the bid form. Notwithstanding the language of this paragraph, the contract price shall not exceed \$_____ without further authorization.

5. **INTEREST**

- 5.1 The TOWN will pay on all amounts owed to the CONTRACTOR accordance with Sections 2.2-4354 and 2.2-4355 of the Virginia Public Procurement Act.
- 5.2 The rate of interest charged shall be the base rate on corporate loans (prime rate) at large United States money center commercial banks as reported daily in the publication entitled The Wall Street Journal. Whenever a split prime rate is published, the lower of the two rates shall be used.

6. **CONTRACT DOCUMENTS**

- 6.1 The Contract Documents which comprise the entire Agreement between TOWN and CONTRACTOR concerning the Work are defined as follows:
 - A. The body of this Agreement;
 - B. Payment Bond (attached);
 - C. Performance Bond (attached);
 - D. Insurance Certificate (attached);
 - E. CONTRACTOR'S Bid (attached);
 - F. Bidding Documents (by reference) including:
 - 1. Advertisement for Bids;
 - 2. Instructions to Bidders;

3. General Conditions;
4. Specifications;
5. Supplemental Specifications;
6. Construction Drawings prepared by _____ bearing the following title:
 - _____(Sheets ____ through ____) approved
7. Addenda

G. Deliverables issued on or after the effective date of the Agreement and are not attached hereto:

1. Notice to Proceed
2. Written Amendments
3. Work Change Directives
4. Change Orders

7. **NOTICE**

The term "Notice" as used herein shall mean and include written notice. Any legal notice by any party shall be deemed to have been duly given if either delivered personally or enclosed in a certified mail, postage paid envelope addressed to:

The Owner:

The Owner's Project Manager:

The Contractor:

IN WITNESS WHEREOF, TOWN and CONTRACTOR have signed two copies of this Agreement. All portions of the Contract Documents have been signed or identified by TOWN and CONTRACTOR.

OWNER
TOWN OF LEESBURG
25 West Market Street
Leesburg, VA 20176

CONTRACTOR

By _____
Town Manager

By _____
President

Date _____

Date _____

License No: _____

[CORPORATE SEAL]

Approved as to Form:

Town Attorney

Resolution authorizing execution of Agreement is attached hereto.

Agent for service of process:

(If CONTRACTOR is a corporation attach evidence of authority to sign.)

VIRGINIA PAYMENT BOND

BOND NO. _____

AMOUNT: \$ _____

KNOW ALL MEN BY THESE PRESENTS, that _____

of _____ hereinafter called the CONTRACTOR
(Principal), and _____

a corporation duly organized and existing under and by virtue of the laws of the State
of _____, hereinafter called the SURETY, and authorized to
transact business within the Commonwealth of Virginia, as SURETY, are held and firmly bound
unto The Town of Leesburg as OWNER (Obligee), in the sum of:

_____ DOLLARS (\$ _____), lawful money
of the United States of America, for the payment of which, well and truly be made to the
OWNER. The CONTRACTOR and the SURETY bind themselves and each of their heirs,
executors, administrators, successors, and assigns, jointly and severally, firmly by these presents
as follows:

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT:

WHEREAS, the CONTRACTOR has executed and entered into a certain Contract hereto
attached with _____, naming the OWNER as beneficiary, dated this
_____ day of _____, 20 _____,
for: _____

NOW, THEREFORE, the CONTRACTOR shall promptly make payment to all persons, firms,
subcontractors, and corporations furnishing materials for or performing labor in the prosecution
of the work provided for in the Contract, and any authorized extension or modification thereof,
including all amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs on
machinery, equipment, and tools consumed or used in connection with the construction of the
work, and all insurance premiums on the work, and for all labor performed in the work, whether
by subcontractor or otherwise, then this obligation shall be void; otherwise to remain in full force
and effect.

Furthermore, the SURETY, for value received, hereby stipulates and agrees that no change,
extension of time, alteration, or addition to the terms of the Contract Documents or to the work
to be performed there under, or the Specifications accompanying the same, shall in any way
affect its obligation on this bond, and it does hereby waive notice of any such change, extension
of time, alteration, or addition to the terms of the Contract Documents.

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

IN WITNESS WHEREOF, the above parties bounded together have executed this instrument this _____ day of _____, 20____, the name and corporate seal of each corporate party being hereto affixed and those presents duly signed by its undersigned representative, pursuant to authority of its governing body.

CONTRACTOR

By _____(Seal)

Attest

SURETY

By _____(Seal)

Attest

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

IMPORTANT: The SURETY named on this bond shall be one who is licensed to conduct business in the Commonwealth of Virginia, and named in the current list of Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies, as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. All bonds signed by an agent must be accompanied by a certified copy of the authority to act for the SURETY at the time of the signing of this bond.

VIRGINIA PERFORMANCE BOND

BOND NO. _____

AMOUNT: \$ _____

KNOW ALL MEN BY THESE PRESENTS, that _____

of _____

hereinafter called the CONTRACTOR (Principal), and _____

_____ a corporation duly organized and existing under and by virtue of the laws of the State of _____, hereinafter called the SURETY, and authorized to transact business within the Commonwealth of Virginia, as SURETY, are held and firmly bound unto The Town of Leesburg as OWNER (Obligee), in the sum of:

_____ DOLLARS (\$ _____), lawful money of the United States of America, for the payment of which, well and truly be made to the OWNER. The CONTRACTOR and the SURETY bind themselves and each of their heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents as follows:

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT:

WHEREAS, the CONTRACTOR has executed and entered into a certain Contract hereto

attached with _____, naming the OWNER as beneficiary, dated this _____ day of

_____, 20 _____,

for: _____

NOW, THEREFORE, the CONTRACTOR shall at all times duly, promptly, and faithfully perform the Contract and any alteration in or addition to the obligations of the CONTRACTOR arising there under, including the matter of infringement, if any, of patents or other proprietary rights, and shall assure all guarantees against defective workmanship and materials, including the guarantee period following final completion by the CONTRACTOR and final acceptance by the OWNER and comply with all covenants therein contained in the Specifications, Drawings, and other Documents constituting a part of the Contract required to be performed by the CONTRACTOR, in the manner and within the times provided in the Contract, and shall fully indemnify and save harmless the OWNER from all cost and damage which it may suffer by reason or failure so to do, and shall fully reimburse and repay it all outlay and expenses which it may incur in making good any default, and reasonable counsel fees incurred in the prosecution of

or defense of any action arising out of or in connection with any such default, then this obligation shall be void; otherwise to remain in full force and effect.

Furthermore, the SURETY, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the Contract Documents or to the work to be performed there under, shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of the Contract Documents.

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

IN WITNESS WHEREOF, the above parties bounded together have executed this instrument this _____ day of _____, 20____, the name and corporate seal of each corporate party being hereto affixed and those presents duly signed by its undersigned representative, pursuant to authority of its governing body.

CONTRACTOR

By _____ (Seal)

Attest

SURETY

By _____ (Seal)

Attest

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

IMPORTANT: The SURETY named on this bond shall be one who is licensed to conduct business in the Commonwealth of Virginia, and named in the current list of Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies, as published in Circular 570 (amended) by the Audit Staff Bureau of Accounts, U.S. Treasury Department. All bonds signed by an agent must be accompanied by a certified copy of the authority to act for the SURETY at the time of the signing of this bond.

IFB NO. 500640-FY22-20

**CATTAIL BRANCH SANITARY PUMP STATION (SPS)
UPGRADE – PHASE III**

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TECHNICAL SPECIFICATIONS

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**APPENDIX A: TOWN OF LEESBURG CATTAIL BRANCH SPS UPGRADE –
 PHASE III DRAWINGS..... 1-57**

SECTION 01010

SUMMARY OF WORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Work to be done under these Contracts and in accordance with these Specifications consists of furnishing all equipment, superintendence, labor, skill, material and all other items necessary for the construction of the Cattail Branch SPS Phase III Upgrade project.

The Contractor shall perform all work required for such construction in accordance with the Contract Documents and subject to the terms and conditions of the Contract, complete and ready for use.

- B. The principal features of the Work to be performed under this Contract includes:
1. Demolition and installation of two (2) pumps, motors, associated suction and discharge valves and piping
 2. Replacement of VFDs for four (4) pumps
 3. Pump support improvements
 4. Piping and wall painting
 5. Improvements to existing access platform
 6. Electrical and I&C (including minor demolition, control equipment, and necessary conduit/wiring to control all four (4) pumps and associated valves)
 7. Dry well and wet well area HVAC system replacement
 8. Demolition of existing and installation of a new wet well odor control system and enclosure
 9. Installation and operation of temporary bypass equipment to allow for continuous operation of the Pump Station during construction.
- C. The foregoing description(s) shall not be construed as a complete description of all work required.

1.02 CONTRACT DOCUMENTS

- A. The work to be done is shown on the set of Drawings entitled Cattail Branch SPS, dated November 2021. The numbers and titles of all Drawings appear on the index sheet of the Drawings, Drawing G-2. All drawings so enumerated shall be considered an integral part of the Contract Documents as defined herein.
- B. Certain Document Sections refer to Divisions of the Contract Specifications. Sections are each individually numbered portions of the Specifications (numerically) such as 08110, 13182, 15206, etc. The term Division is used as a convenience term meaning all Sections within a numerical grouping. Division 16 would thus include Sections 16000 through 16902.
- C. Where references in the Contract Documents are made to Contractors for specific disciplines of work (i.e. Electrical Contractor, etc.), these references shall be interpreted

to be the single prime Contractor when the project is bid or awarded as a single prime contract.

1.03 GENERAL ARRANGEMENT

- A. Drawings indicate the extent and general arrangement of the work. If any departures from the Drawings are deemed necessary by the Contractor to accommodate the materials and equipment he proposes to furnish, details of such departures and reasons therefore shall be submitted as soon as practicable to the Engineer for approval. No such departures shall be made without the prior written approval of the Engineer. Approved changes shall be made without additional cost to the Owner for this work or related work under other Contracts of the Project.
- B. The specific equipment proposed for use by the Contractor on the project may require changes, in structures, auxiliary equipment, piping, electrical, mechanical, controls or other work to provide a complete satisfactory operating installation. The Contractor shall submit to the Engineer, for approval, all necessary Drawings and details showing such changes to verify conformance with the overall project structural and architectural requirements and overall project operating performance. The Bid Price shall include all costs in connection with the preparation of new drawings and details and all changes to construction work to accommodate the proposed equipment, including increases in the costs of other Contracts.

1.04 CONSTRUCTION PERMITS, EASEMENTS AND ENCROACHMENTS

- A. The Contractor shall obtain, keep current and pay all fees for any necessary construction permits from those authorities, agencies, or municipalities having jurisdiction over land areas, utilities, or structures which are located within the Contract limits and which will be occupied, encountered, used, or temporarily interrupted by the Contractor's operations unless otherwise stated. Record copies of all permits shall be furnished to the Engineer.
- B. When construction permits are accompanied by regulations or requirements issued by a particular authority, agency or municipality, it shall be the Contractor's responsibility to familiarize himself and comply with such regulations or requirements as they apply to his operations on this Project.
- C. The Contractor shall apply for and obtain building and associated permits for the new enclosure housing the odor control system and hydraulic power pack. It shall be the Contractor's responsibility to properly obtain and comply with these building permits, including paying any required permit fees. The Bid Price shall include all costs in connection with obtaining and complying with the building permit. The Contractor shall incorporate building and demolition permit review and approval duration into their schedule.
- D. A VSCAT permit is not required as this project is considered a maintenance project without any changes to capacity or design criteria. The Virginia Department of Environmental Quality (DEQ) has been notified regarding the scope of this project.
- E. Contractor is responsible for compliance with all Owner obtained permits.

- F. In the event a VSCAT dewatering and temporary groundwater appropriations permit is required for this project, it shall be the Contractor's responsibility to properly obtain and comply with this dewatering permit, including paying any required permit fees. The Bid Price shall include all costs in connection with obtaining and complying with the dewatering permit. The Contractor shall incorporate VSCAT permit review and approval duration into their schedule.

1.05 OR EQUAL CLAUSE

- A. When any article is specified by proprietary name, trade name, or name of manufacturer, with or without the addition of such expressions as "or equal", it is to be understood that the article named or the equal thereof is intended subject to the approval of Engineer as to the quality thereof; and it is distinctly understood: (1) that Engineer is to use his own judgment in determining whether or not any article proposed to be substituted is the equal of an article so specified; (2) that the decision on all such proposal of equality shall strictly on discretion of the Engineer and the Owner and be final; (3) that claims are not allowed against Engineer and/or Owner because of such decision; (4) Contract Time extension shall not be allowed; and (5) that no article submitted for approval will be approved which requires redesign of Project facilities unless the submittal of said article was requested in writing by Engineer.
- B. Applications for use of substitutes or "or equal" items for products listed in the Contract Documents by manufacturer and/or supplier shall be submitted by Contractor to Engineer within 30 days of Notice to Proceed unless Contractor produces satisfactory evidence that the specified item is no longer manufactured or is unavailable for the Project. Applications for use of substitutes or "or equal" items shall not be considered during bid period or until Notice to Proceed.
- C. Contractor shall provide a line-by-line comparison of the proposed product to the specified product. Line-by-line comparison shall not only include all specified features, but shall also include all other design and/or manufacturing differences and deviations between the proposed product and the specified product. Line-by-line comparison shall show no significant design or manufacturing differences that, in the Engineer's opinion, could result in lesser quality, performance, or reliability of the proposed product compared to the specified product.
- D. In order to aid Engineer in determining the equality of a proposed 'or equal' or substitute item (when compared to the item actually specified), Contractor shall arrange for the performance of any tests requested by the Engineer. The nature, extent, tester and supervisions of such tests including engineering costs, shall be borne by Contractor. Certified test results shall be mailed directly to Engineer for all tests requested.
- E. If the Engineer determines that the product may be substituted and a redesign is necessary, the Engineer shall provide a written notification to the Contractor for redesign of the Project facilities to allow installation of the substitute equipment.
- F. The Contractor shall submit, within 30 days of written notification of substitute approval, redesign plan and specifications (Division 1 through Division 17) showing required modifications to the structures, piping, layouts, electrical wiring, controls,

instrumentation and coordination with the equipment manufacturer. Redesign plans and specifications shall include structural design, architectural design, HVAC design, electrical and instrumentation design, changes to sequence of construction signed and sealed by a Professional Engineer registered in the Commonwealth of Virginia. The redesign shall include all necessary design information of proposed modifications necessary to accommodate the substitute item and to allow installation of a fully functional system.

- G. The Engineer shall review and approve or request additional revisions of the substitute design within 30 days of submittal of the redesign documents.
- H. The substitute redesign and final details and submittals of such modifications shall be prepared and submitted for approval by the Contractor in accordance with Specification Section 01300 – Submittals.

1.06 ADDITIONAL ENGINEERING SERVICES

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

1.07 ADDITIONAL OWNER'S EXPENSES

- A. In the event the Work of this Contract is not completed within the time set forth in the Contract or within the time to which such completion may have been extended in accordance with the Contract Documents, the additional engineering or inspection charges incurred by the Owner may be charged to the Contractor and deducted from the monies due him. Extra work or supplemental Contract work added to the original Contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the Owner before assessing engineering and inspection charges against the Contractor.

- B. Unless otherwise specifically permitted, the normal time of work under this Contract is limited to 8 hours per day, Monday through Friday. Work beyond these hours will result in additional expense to the Owner. Any expenses and/or damages, including the cost of the Engineer's on site personnel, arising from the Contractor's operations beyond the hours and days specified above shall be borne by the Contractor.
- C. Charges assessed to the Contractor for additional engineering and inspection costs will be determined based on actual hours charged to the job by the Engineer. Daily rates will depend on the number and classifications of employees involved, but in no case shall such charges exceed \$1,000 per day for field personnel and \$1,500 per day for engineering personnel, based on an eight hour workday.
- D. Charges for additional Owner's expenses shall be in addition to any liquidated damages assessed in accordance with the Contract.

1.08 TIME OF WORK

- A. The normal time of work for this Contract is limited to 40 hours per week and shall generally be between the hours of 7:00 a.m. and 4:00 p.m., Monday through Friday. The Contractor may elect to work beyond these hours or on weekends provided that all costs incurred by the Owner for additional engineering shall be borne by the Contractor.
 - 1. The Owner shall deduct the cost of additional engineering costs from monies due the Contractor.
- B. If it shall become imperative to perform work at night, the Owner and Engineer shall be informed a reasonable time in advance of the beginning of such work. Temporary lighting and all other necessary facilities for performing and inspecting the work shall be provided and maintained by the Contractor.
- C. Unless otherwise specifically permitted, all work that would be subject to damage shall be stopped during inclement, stormy or freezing weather. Only such work as will not suffer injury to workmanship or materials will be permitted. Contractor shall carefully protect his work against damage or injury from the weather, and when work is permitted during freezing weather, he shall provide and maintain approved facilities for heating the materials and for protecting the finished work.

1.09 SURVEYS AND LAYOUT

- A. All work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings or as directed by the Engineer. Elevation of existing ground and appurtenances are believed to be reasonably correct but are not guaranteed to be absolute and therefore are presented only as an approximation. Any error or apparent discrepancy in the data shown or omissions of data required for accurately accomplishing the stake out survey shall be referred immediately to the Engineer for interpretation or correction.
- B. All survey work for construction control purposes shall be made by the Contractor at his expense. The Contractor shall provide a Licensed Surveyor as Chief of Party, competently qualified men, all necessary instruments, stakes, and other material to perform the work.

- C. Contractor shall establish all baselines for the location of the principal component parts of the work together with a suitable number of bench marks and batter boards adjacent to the work. Based upon the information provided by the Contract Drawings, the Contractor shall develop and make all detail surveys necessary for construction, including slope stakes, batter boards, stakes for all working points, lines and elevations.
- D. Contractor shall have the responsibility to carefully preserve the bench marks, reference points and stakes, and in the case of destruction thereof by the Contractor or resulting from his negligence, the Contractor shall be charged with the expense and damage resulting therefrom and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.
- E. Existing or new control points, property markers and monuments that will be or are destroyed during the normal causes of construction shall be reestablished by the Contractor and all reference ties recorded therefore shall be furnished to the Engineer. All computations necessary to establish the exact position of the work shall be made and preserved by the Contractor.
- F. The Engineer may check all or any portion of the work and the Contractor shall afford all necessary assistance to the Engineer in carrying out such checks. Any necessary corrections to the work shall be immediately made by the Contractor. Such checking by the Engineer shall not relieve the Contractor of any responsibilities for the accuracy or completeness of his work.
- G. At completion of the work, the Contractor shall furnish Record Drawings indicating the final layout of all structures, roads, all structures, existing bench marks, etc. The Record Drawings shall indicate all critical elevations of piping, structures, finish grades, etc.

1.10 FIRE PROTECTION

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

1.11 CHEMICALS

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

1.12 FIRST AID FACILITIES AND ACCIDENTS

A. First Aid Facilities

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

B. Accidents

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

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

- A. During the progress of the work, other Contractors may be engaged in performing other work or may be awarded other Contracts for additional work on this project. In that event, the Contractor shall coordinate the work to be done hereunder with the work of such other Contractors and the Contractor shall fully cooperate with such other Contractors and carefully fit its own work to that provided under other Contracts as may be directed by the Engineer. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other Contractor.
- B. If the Engineer shall determine that the Contractor is failing to coordinate his work with the work of the other Contractors as the Engineer directed, then the Owner shall have the right to withhold any payments otherwise due hereunder until the Contractor completely complies with the Engineer's directions.
- C. If the Contractor notifies the Engineer in writing that another Contractor is failing to coordinate his work with the work of this Contract as directed, the Engineer will promptly investigate the charge. If the Engineer finds it to be true, he will promptly issue such directions to the other Contractor with respect thereto as the situation may require. The Owner, the Engineer, nor any of their agents shall not, however, be liable for any damages suffered by the Contractor by reason of the other Contractor's failure to promptly comply with the directions so issued by the Engineer, or by reason of another Contractor's default in performance, it being understood that the Owner does not guarantee the responsibility or continued efficiency of any Contractor.
- D. The Contractor shall indemnify and hold the Owner and the Engineer harmless from any and all claims of judgments for damages and from costs and expenses to which the Owner

may be subjected or which it may suffer or incur by reason of the Contractor's failure to comply with the Engineer's directions promptly.

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

1.15 LIMITS OF WORK AREA

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

1.16 OFF SITE PARKING AND STORAGE

- A. Materials shall be stored to assure preservation of their quality and acceptability for the Work. Stored materials, even though approved before storage, may again be inspected before their use. Stored materials shall be located to facilitate prompt inspection.
- B. Contractor shall provide all off site parking and secure storage as required for the prosecution of the Work at no additional cost to Owner. Only areas at the Site designated for such use by Owner may be used by Contractor for these purposes. Store and protect in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive items in weather tight, climate controlled enclosures in an environment favorable to item.

- C. For exterior storage of fabricated items, place on sloped supports, above ground. Cover items subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation. Store loose granular materials on solid flat surfaces in a well drained area. Prevent mixing with foreign matter. Provide equipment and personnel to store items by methods that prevent soiling, disfigurement, and damage. Arrange storage to permit access for inspection. Periodically inspect to assure items are undamaged and are maintained in acceptable conditions.
- D. Contractor shall obey all traffic laws and comply with all the requirements, rules and regulations of Town of Leesburg and other local authorities having jurisdiction to maintain adequate warning signs, lights, barriers, etc., for the protection of traffic on roadways.
- E. At the completion of the work, the surfaces of land used for access roads and parking areas shall be restored by each Contractor to its original condition and to the satisfaction of the Engineer. At a minimum, such restoration shall include establishment of a permanent ground cover adequate to restrain erosion for all disturbed areas.

1.17 WEATHER CONDITIONS

- A. No work shall be done when the weather is unsuitable. The Contractor shall take necessary precautions (in the event of impending storms) to protect all work, materials, or equipment from damage or deterioration due to floods, driving rain, or wind, and snow storms. The Owner reserves the right, through the opinion of the Engineer, to order that additional protection measures over and beyond those proposed by the Contractor, be taken to safeguard all components of the Project. The Contractor shall not claim any compensation for such precautionary measures so ordered, nor claim any compensation from the Owner for damage to the work from weather elements.

1.18 PERIODIC CLEANUP: BASIC SITE RESTORATION

- A. During construction, the Contractor shall regularly remove from the site of the work all accumulated debris and surplus materials of any kind which result from his operations. Unused equipment and tools shall be stored at the Contractor's yard or base of operations for the Project.
- B. The Contractor shall perform the cleanup work on a regular basis and as frequently as ordered by the Engineer. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished, when ordered by the Engineer, if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.
- C. Upon failure of the Contractor to perform periodic cleanup and basic restoration of the site to the Engineer's satisfaction, the Owner may, upon five (5) days prior written notice to the Contractor, without prejudice to any other rights or remedies of the Owner, cause such work for which the Contractor is responsible to be accomplished to the extent deemed necessary by the Engineer, and all costs resulting therefrom shall be charged to the Contractor and deducted from the amounts of money that may be due him.

1.19 USE OF FACILITIES BEFORE COMPLETION

- A. The Owner reserves the right to enter and use any portion of the constructed facilities before final completion of the whole work to be done under this Contract. However, only those portions of the facilities which have been completed to the Engineer's satisfaction, as evidenced by his issuing a Certificate of Substantial Completion covering that part of the work, shall be placed in service.
- B. It shall be the Owner's responsibility to prevent premature connections to or use of any portion of the installed facilities by private or public parties, persons or groups of persons, before the Engineer issues his Certificate of Substantial Completion covering that portion of the work to be placed in service.
- C. Consistent with the approved progress schedule, the Contractor shall cooperate with the Owner, his agents, and the Engineer to accelerate completion of those facilities, or portions thereof, which have been designated for early use by the Owner.
- D. Contractor's activities shall not disrupt Owner's access to operate and maintain existing equipment and facilities. Contractor shall furnish all required temporary access, including ladders, platforms, grating, walkways, and awnings, which shall comply with OSHA laws and regulations, necessary to maintain operation of existing facilities.
- E. Contractor shall note that in addition to the requirements of General Conditions Article 9.7, Substantial Completion shall not be approved until the Contractor has successfully completed all equipment installation, testing, training and startup requirements, has submitted and obtained approval for all Operation and Maintenance Manuals, all spare parts have been received by the Owner and all requirements of Startup have been successfully completed in accordance with the Contract Documents.

1.20 CONSTRUCTION VIDEO

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

1.21 TEMPORARY FACILITIES

- A. Provide and maintain required sanitary facilities and enclosures for use by all persons employed at the Site. Remove temporary sanitary facilities from Site at the end of construction.
- B. Facilities shall be maintained in conformance with applicable State Regulations and Local ordinances. Contents shall be regularly removed and disposed of in satisfactory manner.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01200
PROJECT MEETINGS

PART 1 -- GENERAL

1.01 PRE-BID MEETING

- A. A pre-bid meeting will be held at the time and place to be designated in the Instructions to Bidders.
- B. The Engineer will be available to discuss the project and answer pertinent questions. No oral interpretation will be made as to the meaning of the Documents. Interpretation, if deemed necessary by the Engineer, will be in the form of an Addendum to the Contract Documents.

1.02 PRECONSTRUCTION MEETING

- A. A preconstruction meeting will be held after Award of Contract, but prior to starting work at the site.
- B. Attendance:
 - 1. Owner
 - 2. Engineer
 - 3. Contractor
 - 4. Major subcontractors
 - 5. Safety representative
- C. Minimum Agenda:
 - 1. Tentative construction schedule
 - 2. Critical work sequencing
 - 3. Designation of responsible personnel
 - 4. Processing of Field Decisions and Change Orders
 - 5. Adequacy of distribution of Contract Documents
 - 6. Submittal of Shop Drawings and samples
 - 7. Procedures for maintaining record documents

8. Use of site and Owner's requirements
9. Major equipment deliveries and priorities
10. Safety and first aid procedures
11. Security procedures
12. Housekeeping procedures
13. Processing of Partial Payment Requests
14. General regard for community relations

1.03 PROGRESS MEETING

- A. Progress meetings will be held monthly at the Cattail Branch Sewage Pump Station Site, or at an alternate site agreed upon with the Owner, during the performance of the work of this Contract. Additional meetings may be called as progress of work dictates.
- B. Engineer will preside at meetings and record minutes of proceedings and decisions. Engineer will distribute copies of minutes to participants.
- C. Attendance:
 1. Owner
 2. Engineer
 3. Contractor
 4. Subcontractors, only with Engineer's approval or request, as pertinent to the agenda
- D. Minimum Agenda:
 1. Review and approve minutes of previous meetings.
 2. Review progress of Work since last meeting.
 3. Review proposed 30-60 day construction schedule.
 4. Note and identify problems which impede planned progress.
 5. Develop corrective measures and procedures to regain planned schedule.
 6. Revise construction schedule as indicated and plan progress during next work period.
 7. Maintaining of quality and work standards.

8. Complete other current business.
9. Schedule next progress meeting.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

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SECTION 01300

SUBMITTALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Progress Schedule

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

B. Equipment and Material Orders Schedule

1. Contractor shall prepare and submit five (5) copies of his schedule of principal items of equipment and materials to be purchased to the Engineer for review and approval.
2. If so required, the schedule shall be revised until it is approved by the Engineer.

3. Schedule shall be updated monthly and five (5) copies submitted to the Engineer not later than the fifth day of every month with the application for progress payment.
4. The updated schedule shall be based on the Progress Schedule developed under the requirements of Paragraph 1.01(A) of this Section.
5. Schedule shall be in tabular form with appropriate spaces to insert the following information for principal items of equipment and materials:
 - a. Dates on which Shop Drawings are requested and received from the manufacturer.
 - b. Dates on which certification is received from the manufacturer and transmitted to the Engineer.
 - c. Dates on which Shop Drawings are submitted to the Engineer and returned by the Engineer for revision.
 - d. Dates on which Shop Drawings are revised by manufacturer and resubmitted to the Engineer.
 - e. Date on which Shop Drawings are returned by Engineer annotated either "Furnish as Submitted" or "Furnish as Corrected".
 - f. Date on which accepted Shop Drawings are transmitted to manufacturer.
 - g. Date of manufacturer's scheduled delivery.
 - h. Date on which delivery is actually made.

C. Working Drawings

1. Within thirty (30) days after the Notice to Proceed, each prime Contractor shall prepare and submit five (5) copies of his preliminary schedule of Working Drawing submittals to the Engineer for review and approval. If so required, the schedule shall be revised until it is approved by the Engineer.
2. Working Drawings include, but are not limited to, Shop Drawings, layout drawings in plan and elevation, installation drawings, elementary wiring diagrams, interconnecting wiring diagrams, manufacturer's data, etc. Contractor shall be responsible for securing all of the information, details, dimensions, Drawings, etc., necessary to prepare the Working Drawings required and necessary under this Contract and to fulfill all other requirements of his Contract. Contractor shall secure such information, details, Drawings, etc., from all possible sources including the Drawings, Working Drawings prepared by subcontractors, Engineers, suppliers, etc.
3. Working Drawings shall accurately and clearly present the following:
 - a. All working and installation dimensions.

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

electrical cable trays, equipment, etc., may depend upon the dimensions of equipment and valves to be furnished by the Contractor.

- b. Layout and installation drawings are required for both interior and exterior piping, valves, fittings, sewers, drains, heating and ventilation ducts, conduits, plumbing lines, electrical cable trays, etc.
- c. Layout and installation Drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.
- d. Drawings shall show the location and type of all supports, hangers, foundations, etc., and the required clearances to operate valves, equipment, etc.
- e. The Drawings for pipes, ducts, conduits, etc., shall show all 3-inch and larger electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes, structure, manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe duct, conduit, etc., for which the profile is drawn.

9. Contractor Responsibilities

- a. All submittals from subcontractors, manufacturers or suppliers shall be sent directly to the Contractor for checking. Contractor shall thoroughly check all Drawings for accuracy and conformance to the intent of the Contract Documents. Drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors, manufacturers, or suppliers by the Contractor for correction before submitting them to the Engineer.
- b. All submittals shall be bound, dated, properly labeled and consecutively numbered. Information on the label shall indicate Specification Section, Drawing number, subcontractor's, manufacturer's or supplier's name and the name or type of item the submittal covers. Each part of a submittal shall be marked and tabulated.
- c. Working Drawings shall be submitted as a single complete package including all associated drawings relating to a complete assembly of the various parts necessary for a complete unit or system.
- d. Shop Drawings shall be submitted as a single complete package for any operating system and shall include all items of equipment and any mechanical units involved or necessary for the functioning of such system. Where applicable, the submittal shall include elementary wiring diagrams showing circuit functioning and necessary interconnection wiring diagrams for construction.
- e. ALL SUBMITTALS SHALL BE THOROUGHLY CHECKED BY THE CONTRACTOR FOR ACCURACY AND CONFORMANCE TO THE INTENT OF THE CONTRACT DOCUMENTS BEFORE BEING SUBMITTED TO THE ENGINEER AND SHALL BEAR THE CONTRACTOR'S STAMP OF APPROVAL CERTIFYING THAT THEY

HAVE BEEN SO CHECKED. SUBMITTALS WITHOUT THE CONTRACTOR'S STAMP OF APPROVAL WILL NOT BE REVIEWED BY THE ENGINEER AND WILL BE RETURNED TO THE CONTRACTOR.

- f. If the submittals contain any departures from the Contract Documents, specific mention thereof shall be made in the Contractor's letter of transmittal. Otherwise, the review of such submittals shall not constitute approval of the departure.
- g. No materials or equipment shall be ordered, fabricated, shipped or any work performed until the Engineer returns to the Contractor the submittals, herein required, annotated "Furnish as Submitted", "Furnish as Corrected", or "Furnish as Corrected – Confirm." If a submittal is returned "Furnish as Corrected – Confirm" the portions of work covered by the submittal that require confirmation by the Engineer shall not be ordered, fabricated, shipped, or any work performed until those portions are approved in a subsequent submittal either "Furnish as Submitted" or "Furnish as Corrected".
- h. Where errors, deviations, and/or omissions are discovered at a later date in any of the submittals, the Engineer's prior review of the submittals does not relieve the Contractor of the responsibility for correcting all errors, deviations, and/or omissions.

10. Procedure for Review

- a. Submittals shall be transmitted in sufficient time to allow the Engineer at least thirty (30) working days for review and processing.
- b. Contractor shall transmit seven (7) copies of all technical data or drawing to be reviewed.
- c. Submittal shall be accompanied by a letter of transmittal containing date, project title, Contractor's name, number and titles of submittals, a list of relevant specification sections, notification of departures from any Contract requirement, and any other pertinent data to facilitate review.
- d. Submittals will be annotated by the Engineer in one of the following ways:
 - "Furnish as Submitted" (FAS) - no exceptions are taken
 - "Furnish as Corrected" (FAC) - minor corrections are noted and shall be made.
 - "Furnish as Corrected – Confirm" (FACC) - some corrections are noted and a partial resubmittal or additional information are required as specifically requested.
 - "Revise and Resubmit" (R&R) - major corrections are noted and a full resubmittal is required.

"For Information Only – Not Reviewed" (FIO) – submittal was received and was distributed for record purposes without review.

- e. If a submittal is satisfactory to the Engineer in full or in part, the Engineer will annotate the submittal "Furnish as Submitted", "Furnish as Corrected", or "Furnish as Corrected – Confirm", retain four (4) copies and return remaining copies to the Contractor. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor. In the case of "Furnish as Corrected – Confirm" a partial resubmittal or additional information are required as specifically requested.
- f. If a full resubmittal is required, the Engineer will annotate the submittal "Revise and Resubmit" and transmit three (3) copies to the Contractor for appropriate action. If reproducible transparencies are submitted, the Engineer will retain the copies and return the reproducible transparencies to the Contractor.
- g. Contractor shall continue to resubmit submittals in part if they are returned "Furnish as Corrected – Confirm" or in full if they are returned "Revise and Resubmit" as required by the Engineer until submittals are acceptable to the Engineer. It is understood by the Contractor that Owner may charge the Contractor the Engineer's charges for review in the event a submittal is not approved (either "Furnish as Submitted" or "Furnish as Corrected") by the third submittal for a system or piece of equipment. These charges shall be for all costs associated with engineering review, meetings with the Contractor or manufacturer, etc., commencing with the fourth submittal of a system or type of equipment submitted for a particular Specification Section.
- h. Acceptance of a Working Drawing by the Engineer will constitute acceptance of the subject matter for which the Drawing was submitted and not for any other structure, material, equipment or appurtenances indicated or shown.

11. Engineer's Review

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

12. Record Working Drawings

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

13. Operation and Maintenance Manuals

- a. Two (2) preliminary copies of Operation and Maintenance Manuals, prepared specifically for this Project, shall be furnished for each item of equipment furnished under this Contract. The preliminary manuals shall be provided to the Engineer not less than 60 days prior to the start-up of the respective equipment.
- b. The preliminary manuals shall be reviewed by the Engineer prior to the Contractor submitting final copies for distribution to the Owner. Following review of the preliminary copies of the Operation and Maintenance Manuals, one (1) copy will be returned to the Contractor with required revisions noted, or the acceptance of the Engineer noted.
- c. Manuals shall contain complete information in connection with assembly, operation, lubrication, adjustment, wiring diagrams and schematics, maintenance, and repair, including detailed parts lists with drawings or photographs identifying the parts.
- d. Manuals furnished shall be assembled and bound in separate volumes, by major equipment items or trades, and properly indexed to facilitate locating any required information. In addition, manuals should be labeled in the front cover with the project, name, equipment description, and manufacturer contact information.
- e. Engineer and the Owner shall be the sole judge of the acceptability and completeness of the manuals and may reject any submittal for insufficient information included, incorrect references and/or the manner in which the material is assembled.
- f. Following the Engineer's review of the preliminary manuals, the Contractor shall submit five (5) paper copies and two (2) electronic copies of the final Operation and Maintenance Manuals to the Engineer. The manuals shall reflect the required revisions noted during the Engineer's review of the preliminary documents. Failure of the final manuals to reflect the required revisions noted by the Engineer during a review of the Preliminary documents will result in the manuals being returned to the Contractor. Acceptable final Operation and Maintenance Manuals shall be provided not less than two week prior to equipment start-up.

14. Certified Shop Test Reports

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

15. Samples

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

16. PERFORMANCE AFFIDAVITS

- a. When required in the individual equipment Specifications, the Contractor shall submit manufacturer's Performance Affidavits for equipment to be furnished.
- b. By these affidavits, each manufacturer must certify to the Contractor and the Owner, jointly, that he has examined the Contract Documents and that the equipment, apparatus, or process he offers to furnish will meet in every way the performance requirements set forth or implied in the Contract Documents.
- c. The Contractor must transmit to the Engineer three (3) original copies of the affidavit given him by the manufacturer or supplier along with the initial Shop Drawing submittals.
- d. The Performance Affidavit must be signed by an officer of the basic corporation, partnership, or company manufacturing the equipment and witnessed by a notary public.

Addressed to CONTRACTOR and OWNER

Reference PROJECT NAME

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

Signature Corporate Officers shall be Vice President, or higher. (Unless statement authorizing signature is attached.)

17. Construction Photographs

- a. The General Contractor shall engage a competent photographer to take digital photographs at the locations and at such stages of the construction as directed by the Engineer.
- b. Electronic Copies
 - i. Maintain database of pictures for the entire length of the Project.
 - ii. Each month, provide two CDs with electronic versions of all prints taken in the past month.
 - iii. Provide two CDs with electronic versions of all prints taken in during the course of the Project (in .jpg format) with final Application for Payment.

- iv. All electronic copies of photos shall be in .jpg format. All electronic copies of photos shall be arranged on CDs by date and subject. Each .jpg photo file name shall include the subject description and date.

18. Construction Videography

- a. Digital video shall be made to document the condition of the Project Site prior to mobilization.
- b. Video shall show the entire Site and shall show sufficient detail to discern existing Site conditions.
- c. Video shall identify time and date electronically on each frame.

Provide four DVDs of video. Identify location, date, and time video was made

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01310

CPM CONSTRUCTION SCHEDULE

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies requirements and procedures in preparing and updating construction schedules and reports for planning, coordinating, executing, and monitoring the progress of the work. The construction work shall be scheduled using the Critical Path Method (CPM) of network analysis.

1.02 RELATED WORK SPECIFIED ELSEWHERE

1. Section 01010 – Summary of Work
2. Section 01300 – Submittals
3. Section 01520 – Maintenance of Utility Operations during Construction

1.03 FORM OF SCHEDULES

A. Prepare schedules in the form of critical path method (CPM) as described herein.

1. Provide separate CPM networks (sub-networks) of activities for each process or facility.
2. Each sub-network shall be assigned a code and separate activity numbering series.
3. Interrelationships between sub-networks and any individual activities shall be identified.

1.04 SCHEDULING RESPONSIBILITIES

- A. The Contractor shall prepare and submit a detailed construction schedule for review and approval and received written approval prior to mobilization.
- B. The Critical Path Method type construction schedule will be used to monitor job progress and as a means to make monthly payments to the Contractor. The Contractor will be responsible for providing all information concerning the sequencing, logic and durations of all activities as well as providing the initial logic network diagram. Once the schedule is accepted, the Contractor will be responsible for providing monthly update information on logic, percent complete, actual start and finish dates and duration changes. Copies of the updated schedule will be distributed at the progress meetings.
- C. From the Contractor's initial schedule submittal and from information received at the monthly schedule update meetings, computerized and dated tabular schedule reports, or

updated network diagrams, or bar charts will be produced by the Contractor. It shall at all times remain the Contractor's responsibility to schedule and direct his forces in a manner that will allow for the completion of the work within the contractual period.

- D. It should be clearly understood that the initial schedule and all update information must be provided by the Contractor, and that this information is a representation of the best efforts of the Contractor and his subcontractors as to how they envision the work to be accomplished. Similarly, all progress information to be provided by and through the Contractor must be an accurate representation of his or his subcontractor's or suppliers actual performance. The schedule shall at all times remain an accurate reflection of the Contractor's actual or projected sequencing of work. Once accepted, adherence to the established CPM schedule shall be obligatory upon the Contractor and his subcontractors for the work under this Contract. The Owner may require the Contractor to revise the schedule if, in his judgment, the schedule does not accurately reflect the actual execution of the work, or is in violation of any provision of this CPM scheduling specification, and the Contractor shall revise the schedule as often as is necessary during the course of performance of the work at no additional cost to the Owner.

1.05 PROGRESS OF THE WORK

- A. The work shall be started on the date indicated in the Notice to Proceed and shall be executed with such progress as may be required to prevent delay to other Contractors or to the general completion of the project. The work shall be executed at such times and in or on such parts of the project, and with such forces, material and equipment, as to assure completion of the work in the time established by the Contract. Additionally, the Contractor shall, at all times, schedule and direct his work so that it provides an orderly progression of the work to completion within the specified Contract Time.
- B. The Contractor agrees that whenever it becomes apparent from the current monthly CPM Schedule update that delays to the critical path have resulted and these delays are through no fault of the Owner or Owner's representatives, and hence, that the contract completion date will not be met, or when so directed by the Owner, he will take some or all of the following actions at no additional cost to the Owner.
1. Increase construction manpower in such quantities and crafts as will substantially eliminate the backlog of work.
 2. Increase the number of working hours per shift; shifts per working day, or days per week; the amount of construction equipment; etc., or any combination of the foregoing to substantially eliminate the backlog of work.
 3. Schedule activities to achieve maximum practical concurrence of accomplishment of activities, and comply with the revised schedule.
 4. The Contractor shall submit a written statement of the steps he intends to take, to remove or arrest the delay to the schedule. If the Contractor fails to submit a written statement of the steps he intends to take or fails to take such steps as required by the Contract, the Owner may direct the level of effort in manpower (trades), equipment, and work schedule (overtime) to remove or arrest the delay to the critical path in the accepted schedule, and the Contractor

shall promptly provide such level of effort at no additional cost to the Owner. In addition, should schedule delays persists, the Contractor's surety will be asked to attend meetings to update the schedule.

- C. Failure of the Contractor to comply with the requirements of this provision shall subject him to, at the Owner's sole discretion, withholding, in partial or in total, payments otherwise due to the Contractor for work performed under this contract. The Contractor agrees that any withholding of moneys is not a penalty for noncompliance, but is an assurance for the Owner that funds will be available to implement these requirements should the Contractor fail to do so, since failure of the Contractor to comply with these requirements shall mean that the Contractor failed to execute the work with such diligence as to ensure its completion within the time for completion.

PART 2 - CPM CONSTRUCTION SCHEDULE

2.01 NETWORK REQUIREMENTS

- A. The network diagram shall show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned by CONTRACTOR. The basic concept of the network analysis diagram is to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of succeeding activities. A time scaled precedence format will be followed. The detailed network diagram will be time scaled showing a continuous flow from left to right.
- B. The Schedule Activities shall be developed into three major groups:
 - 1. Procurement Activities (as applicable)
 - a. Permits
 - b. Submittal Items
 - c. Approval of Submittal Items
 - d. Fabrication and Delivery (F&D) of Submittal Items
 - 2. Each of the following procurement activities should be tied logically to the correct construction activity in the overall CPM construction schedule:
 - a. Permit activities
 - b. F &D activities
 - 3. Construction Activities: Construction activities will be physical work activities that describe how the job will be constructed.
 - 4. Testing, Startup, Training and Close-out: CPM activities for this group shall include all work required to satisfy to appropriate specification sections and meet the requirements of substantial and final completion.

- C. The Contractor shall break the work into activities durations of one to twenty (1 to 20) working days each, except for non-construction activities (such as procurement of materials and delivery of equipment) and other activities that may require longer durations. To the extent feasible, activities related to a specific physical area of the project should be grouped on the network for ease of understanding and simplification. The selection and number of activities shall be subject to the review of the Owner or Owner's representative.
- D. Each activity on the network shall have indicated for it the following:
1. A single duration, no longer than 20 days (i.e.: single best estimate of the expected elapsed time considering the scope of work involved in the activity) expressed in working days. Normal holidays and weather delays shall be included. One critical path shall be shown for the schedule.
 2. An activity identification number will be assigned to each activity.
 3. A brief description of the activity will be included. If this description is not definitive, a separate listing of each activity and a descriptive narrative may be required.
 4. Each activity shall be cost loaded to indicate the total estimated budget of the activity. No activity budget shall exceed \$50,000 except for F&D activities. Material and/or equipment costs to be paid as stored material shall be assigned to F&D activities.
 5. Each activity (except for procurement activities) shall be man-hour loaded with the estimated man-hours to be expended on each activity.
- F. The CPM schedule shall include a weather calendar that contains non-working days in addition to weekend and holidays to account for anticipated inclement weather days. The number of anticipated inclement weather days per month shall be equal to those specified in Figure 2 of this Specification Section. The weather calendar shall be applied to all activities, which may be affected by inclement weather.
- G. Failure to include in the CPM schedule any element of work required under the performance of this Contract shall not excuse the Contractor from completing all Work required within the applicable completion time, notwithstanding of Owner's network review.
- H. A CPM schedule which shows a completion of any portion of the work prior to the contractual completion date may be accepted but in no event shall be acceptable as a basis for a claim for delay against Owner by Contractor. The period of time between the Contractor's baseline accepted CPM schedules projected completion dates and the contractual stipulated completion dates, if any, will be treated as project float. The Owner's right to utilize project float is as provided in paragraph 4.03.

2.02 COSTING OF ACTIVITIES

- A. Each activity on the construction schedule shall be allocated a dollar value in accordance with 2.01.D.4, above. Each activity's assigned cost shall consist of labor, equipment, and materials costs, and a pro rata contribution of overhead and profit. The sum of activities

costs shall be equal to the total Contract Price. In submitting cost data, the Contractor certifies that the costs are not unbalanced and that the value assigned to each activity represents the Contractor's estimate of the actual costs of performing that activity.

- B. The accepted cost value shall represent a fair, reasonable and equitable dollar cost allocation for each activity on the Contractor's construction schedule.
- C. If it is determined that the cost data does not meet the requirements for a balanced bid breakdown in the opinion of the Owner, Contractor will present documentation substantiating the cost allocation. Cost allocations shall be considered unbalanced if an activity on the construction schedule has been assigned a disproportionate allocation of direct costs, overhead and profit.

PART 3 - SCHEDULE SUBMITTALS

3.01 CPM SCHEDULE IMPLEMENTATION

- A. Within 10 calendar days after the Notice to Proceed, Contractor shall submit three (3) prints of his proposed CPM network diagram and tabular reports for the first ninety (90) calendar days of the work. This initial logic diagram shall be drawn as described herein and submitted on sheets 24 inches by 36 inches, and shall include both procurement and construction activities. The schedule will be the subject of the schedule review meeting with the Contractor, Owner and/or Owner's representatives within two (2) weeks of its submission. The Contractor will revise and resubmit the ninety (90) day schedule until it is acceptable. The 90 day schedule will have costs assigned to activities and will be used for monthly pay requests until the complete project schedule is accepted.
- B. Within thirty (30) calendar days after Notice to Proceed, Contractor shall submit three (3) prints of his proposed CPM network diagram and tabular reports for the entire Contract duration and shall include both procurement and construction activities. These tabular reports shall be sorted by total float and activity number. They shall also contain a predecessor/successor resource loading report, and project calendar. This logic diagram shall be drawn as described herein and will be the subject of a schedule review meeting with the Contractor, Owner and/or Owner's representative within two (2) weeks of its submission.
- C. If a review of the submitted CPM Schedule indicates a work plan which will not complete the work within the time requirements stated in the Contract, it shall be the responsibility of the Contractor to revise the CPM Schedule as required and resubmit it until it is acceptable. Failure by the Contractor to submit an acceptable schedule may, at the Owner's sole discretion, be cause for the withholding of any partial payment(s) otherwise due under the Contract.

- D. Acceptance of the schedule shall not constitute a representation by the Owner that the work can be completed as shown on the schedule.

3.02 SUBMITTALS

- A. In addition to the above scheduling requirements, the Contractor will be required to submit a complete and detailed listing of anticipated submittals during the course of the Contract. The Contractor will coordinate his submittals with those of his subcontractors and suppliers, and will identify each submittal as specified. The anticipated submission due date for each submittal must be indicated along with the date on which its return is anticipated. For planning purposes, shop drawing submittals will usually be returned twenty (20) working days after receipt. However, longer durations for review will not be considered a basis for a claim unless the project critical path is delayed thereby. Durations shown for review shall be understood to share available float. Submissions, the review of which is on the critical path, shall be clearly marked in red with the words "Critical Path" by the Contractor at the time of submission.
- B. The Submittal Schedule must be submitted within twenty (20) working days from the Notice to Proceed. The Submittal Schedule will then be accepted or revised as required and the Contractor will incorporate the dates and review durations into his CPM Schedule.

3.03 SCHEDULE UPDATES

- A. Provide a Monthly Progress Status Report, which provides a narrative explanation of progress identified in the revised construction schedule. The report shall indicate the following items:
 - 1. Summarize revisions made to the Construction Schedule since the previous submittal.
 - 2. Work completed during the reporting period.
 - 3. Work anticipated to be started during the next period, including those activities already in progress.
 - 4. Problem areas, anticipated delays, and their impact on the schedule.
 - 5. Corrective action recommended, and its effect.
 - 6. The effect of changes on schedules of other prime Contractors.
 - 7. Updated Tabulation of Contract Time.
 - 8. An evaluation of the overall status of the schedule for the job.
- B. Failure to provide update information listed in 3.03.A or failure to attend the Monthly Progress Meeting may result in the Contractor not receiving progress payments.

PART 4 - CONTRACT COMPLETION TIME

4.01 CAUSES FOR EXTENSIONS OF TIME

- A. The Contract Times will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of Contract Time, he shall furnish justification and supporting evidence per requests specified elsewhere in these Contract Documents. The Owner and/or Owner representative will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If Owner finds that the Contractor is entitled to an extension of Contract Time under the provisions of the Contract, the Owner's determination as to the total number of days extensions shall be based upon the current accepted and updated CPM schedule and on all data relevant to the extension. Such data shall be included in the next monthly updating of the schedule. The Contractor acknowledges and agrees that actual delays in activities, which, according to the CPM schedule, do not affect any contract completion date shown by the Critical Path in the network, do not have any effect on the Contract Time, and therefore will not be the basis for a change in Contract Time.
- B. Contract Time extensions as a result of weather delays will be based only on the following criteria.
1. General Requirements: Even though a cause of delay meets any, or all, of the conditions stated herein, it shall in all cases be presumed that no extension, or further extension, of time is due unless the Contractor shall demonstrate that the delay is justified and had an impact to the critical path of the updated CPM schedule for the delay period. To this end, the Contractor shall maintain adequate records supporting any claim for an extension of time and shall submit such records, including a revised CPM schedule showing the impact of the delay, with the claim. Claims due to weather shall be submitted on a monthly basis and within five days after the end of the previous month of such delay.
 2. The Owner will determine Contractor's entitlement to an extension of the Contract Time, but in no event shall an extension be granted for days outside the contract period. The County daily records, maintained by the Water Treatment Plant staff, shall be the official source for weather data related to precipitation and temperature. A time extension of no more than one day will be granted for one day of lost work, regardless of the number of allowable reasons for lost time. The period of any extension of time shall be only for the portion of the contract actually delayed due to the abnormal weather conditions. Any extension of Contract Time allowed under any of the following conditions shall be considered non-compensable and have no impact on Contract Price.
 - a. If the total inches precipitation in a given month is less than the average stated below in Figure 1, no time extension due to precipitation will be allowed. If the average inches of precipitation for the month are exceeded, the following formula will be used to calculate the number of days allowed as a time extension due to precipitation during the month in question:

Total actual days of precipitation greater than one-tenth (0.10") inch.

 (-) Less expected precipitation days from Figure 2

(=) equals days allowable due to precipitation

Figure 1

Normal (Mean) Precipitation *(All measurements are in inches)*

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2.68	2.74	3.38	3.47	4.55	3.98	3.67	3.53	3.92	3.25	3.41	2.96

Figure 2

Average number of Calendar Days with Precipitation of 0.1 inch or more

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.7	5.4	6.8	6.8	7.5	6.6	6.5	5.6	5.8	5.1	6.5	6.1

(Information contained in Figures 1 & 2 are as provided by the Washington Dulles International Airport, VA from U.S. National Oceanic and Atmosphere Administration Web Site 1981-2010 U.S. Climate Normals)

4.02 ADJUSTMENT BY OWNER

- A. From time to time, it may be necessary for the Contract schedule and/or Contract Times to be adjusted by the Owner due to the effects of unforeseeable conditions that may indicate the need for schedule adjustments and/or completion time extension. Under such conditions, the Owner shall direct Contractor to reschedule the work to reflect the changed conditions, and the Contractor shall revise his schedule accordingly. Schedule extensions affecting the Contract Time shall be granted only by Owner in writing. No additional compensation shall be made to the Contractor for such schedule changes except for unavoidable overall Contract delays, in which case the Contractor shall take all possible action to minimize any time extension. Owner, therefore, has the right to accelerate the schedule and the Contractor will be compensated for such acceleration as long as such acceleration is not required through fault of the Contractor. It is specifically noted that available Project Float in the CPM schedule may be used by Owner and his representative, as well as by the Contractor.

4.03 FLOAT TIME

- A. Without obligation to extend the overall completion date or any intermediate completion dates set out in the CPM network, Owner may initiate changes to the Contract work that absorb float time. Owner initiated changes that affect the critical path on the CPM network shall be the sole grounds for extending (or shortening) said completion dates. Contractor initiated changes that encroach on the float time identified in the CPM network may be accomplished with Owner's concurrence. Such changes, however, shall give way to Owner initiated changes competing for the same float time.

- END OF SECTION -

SECTION 01350

SEISMIC ANCHORAGE AND BRACING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all equipment, labor, materials, and services required to design and provide seismic restraint and bracing for all nonstructural architectural, mechanical, electrical, and plumbing components and their supports and attachments permanently attached to the primary structure in which the components are to be installed in accordance with the Contract Documents and the seismic restraint requirements of Chapter 13 in ASCE 7.
- B. Furnish mechanical, electrical, and plumbing equipment manufacturer certifications showing seismic compliance in accordance with Chapter 13 of ASCE 7 for equipment designated as an essential component or to remain operational following a seismic event.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01450 – Special Inspections
- B. Section 05010 – Metal Materials
- C. Section 05050 – Metal Fastening
- D. Section 05061 – Stainless Steel
- E. Section 05120 – Structural Steel
- F. Section 15000 – Basic Mechanical Requirements
- G. Section 15020 – Pipe Supports
- H. Section 15400 – Plumbing
- I. Section 15500 – HVAC Requirements
- J. Section 16000 – Basic Electrical Requirements
- K. Division 17 – Control and Information Systems
- L. Further requirements for seismic anchorage and bracing may be included in other Sections of the Specifications. See section for the specific item in question.

1.03 DEFINITIONS

- A. Nonstructural components: All architectural, mechanical, electrical or plumbing elements or systems and their supports or attachments provided under this contract which are permanently attached to the floors, roof, walls, columns and beams of newly constructed buildings, building additions, existing buildings or non-building structures.
1. Architectural nonstructural components include, but are not limited to, interior nonstructural walls and partitions, exterior wall panels and glazing elements, glass curtain walls, skylights, cabinets, suspended ceilings, fascias, and cladding.
 2. Mechanical nonstructural components include, but are not limited to, HVAC units, fans, water and wastewater treatment process equipment, instrumentation cabinets, piping and ductwork.
 3. Electrical nonstructural components include, but are not limited to, conduit systems, cable tray systems, boxes, transformers, panelboards, switchboards, switchgear, busway, individual motor controllers, motor control centers, variable frequency drives, automatic transfer switches, and lighting systems.
 4. Plumbing nonstructural components include, but are not limited to, sprinkler systems and associated piping, and sump pumps.
- A. Seismic Restraint: Attachments and supports, including braces, frames, legs, hangers, saddles, and struts which anchor and brace nonstructural components to minimize their displacement during an earthquake and transmit loads between non-structural components and their attachments to the structure or building.
- B. Attachment: Elements including anchor bolts, welded connections, and mechanical fasteners which secure non-structural components or supports to the structure.
- C. Hazardous: Toxic, flammable, explosive or corrosive materials in excess of building code mandated threshold quantities for non-hazardous condition.
- D. Essential Components: Nonstructural components considered necessary to public safety for which the importance factor I_p applies, including:
1. Life safety systems which must function following an earthquake, including but not limited to, sprinklers for fire protection, emergency lighting, egress corridors and stairways, and smoke purge systems.
 2. Components which contain, convey or support hazardous materials.
 3. Components which are within or attached to an Occupancy or Risk Category IV structure as defined in ASCE 7 Chapter 1.
 4. Process systems and elements designated below:
 - a. Aeration pipe supports

- F. Nonbuilding Structures: All self-supporting structures which are supported by an independent foundation or by other structures which include, but are not limited to, storage tanks, silos, exhaust stacks, storage racks, and towers.
- G. Delegated Design: Design of a structure or structural element(s) which has been deferred by the contract documents to be performed during the project construction stage, by a registered design professional retained by the contractor and with the design submitted as a shop drawing to the Engineer.

1.04 EXEMPTIONS

- A. The following nonstructural components are exempt from requiring seismic anchorage and bracing: (See paragraph 1.07.C herein for Seismic Design Category)
 - 1. All architectural, mechanical, electrical and plumbing nonstructural components in Seismic Design Category A.
 - 2. All mechanical, electrical and plumbing nonstructural components in Seismic Design Category B.
 - 3. All architectural nonstructural components in Seismic Design Category B provided $I_p = 1.0$, except parapets supported by bearing or shear walls.
 - 4. All mechanical, electrical and plumbing nonstructural components in Seismic Design Category C provided $I_p = 1.0$.
 - 5. All mechanical, electrical and plumbing nonstructural components in Seismic Design Category D, E or F provided all the following apply:
 - a. $I_p = 1.0$.
 - b. Components are positively attached to the structure without consideration of frictional resistance and have flexible connections between the components and associated ductwork, piping and conduit.
 - c. Either of the following:
 - i. Component center of mass is 4 ft or less above a floor level and weighs 400 lbs or less.
 - ii. Component weighs 20 lbs or less or 5 plf or less for distribution systems.
 - 6. Other exemptions as allowed by the Specifications, Codes and Standards referenced herein.

1.05 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. The building code shall be the version in effect at the time of Bid within the jurisdiction where the Work is

located. All other referenced specifications, codes, and standards refer to the version as referenced by the building code. If no version is referenced by the building code, then the most current issue available at the time of Bid shall be used.

1. Virginia Building Code
2. ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures
3. NFPA 13 Standard for Installation of Sprinkler Systems
4. FEMA 412 Installing Seismic Restraints for Mechanical Equipment
5. FEMA 413 Installing Seismic Restraints for Electrical Equipment
6. FEMA 414 Installing Seismic Restraints for Duct and Pipe
7. SMACNA Sheet Metal and Air Conditioning Contractors' National Association, Seismic Restraint Manual: Guidelines for Mechanical Systems
8. ACI 318 Building Code Requirements for Structural Concrete and Commentary
9. ACI 355.2 Qualifications of Post-Installed Mechanical Anchors in Concrete
10. ACI 355.4 Qualifications of Post-Installed Adhesive Anchors in Concrete

1.06 SUBMITTALS

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

1. Seismic anchorage and bracing shop drawings for all architectural, mechanical, electrical, and plumbing nonstructural components, elements and systems not meeting any of the exemptions in paragraph 1.4 above and do not have a design for seismic anchorage and bracing provided within the contract documents. Submittals shall include the following:
 - a. Component manufacturer's cut sheets and fabrication details for equipment bases and foundations, including dimensions, structural member sizes, support point locations and equipment operational loads. Equipment anchorage details shall clearly indicate anchor size, pattern, embedment and edge distance requirements to satisfy operational and seismic forces. Details shall also indicate grout, bearing pads, isolators, etc required for complete installation.
 - b. Design calculations, signed and sealed by a Professional Engineer registered in the Commonwealth of Virginia confirming the proposed seismic restraints and attachment will provide sufficient strength and stiffness to resist the design earthquake and limit damage to nonstructural components and the entire support is sufficient to resist the combined gravity and seismic loads. Separate calculation submittals for vertical and

lateral load support systems shall not be allowed.

- c. Detailed Shop Drawings, signed and sealed by a Professional Engineer registered in the Commonwealth of Virginia, showing specific details of the support design including material, installation, attachments, connection hardware, etc, and the restraint layout and location of all hangers and supports (resisting both gravity and seismic loads), including restraint orientation and direction of force(s) to be resisted. Within each submittal, the Contractor shall include a **cumulative** set of hanger and support location drawings (one cumulative 'living drawing for each building structure) containing all proposed mechanical, electrical and plumbing support locations submitted to date showing the locations of all support attachments to the primary structure. Load magnitudes shall be indicated at attachments to the structure where the sum of the reaction loads on a single member exceeds 1000 pounds vertically or exceeds 500 pounds horizontally. Unless requested by the Engineer, load magnitudes need not be submitted for load values less than these stated values. Separate shop drawing submittals for vertical and lateral load support systems shall not be allowed.
 - d. For components required to be certified as seismically qualified in accordance with paragraph 1.06.A.2 below, submit installation guidelines provided by the equipment manufacturer for proper seismic mounting of the equipment.
2. For each mechanical, electrical and plumbing nonstructural components and systems furnished, including associated equipment appurtenances and attachments, designated as essential components in Seismic Design Categories C through F, provide Manufacturer's Certification signed and sealed by a registered Professional Engineer in the Commonwealth of Virginia to show the component is seismically qualified in accordance with the Specifications, Codes, and Standards requirements referenced herein. The following requirements shall be met:
- a. Seismic qualification shall be substantiated either by approved shake table testing or experience data, with the evidence of such qualification testing or experience data submitted to the Engineer along with the manufacturer's statement certifying the equipment shall remain operable following the design seismic event.
 - b. Components with hazardous contents shall also be certified by the manufacturer to maintain containment following the design seismic event based on analysis, approved shake table testing, or experience data. Evidence demonstrating compliance shall be submitted to the Engineer.
 - c. Seismic qualification testing shall be based on ASCE 7 and on a nationally recognized testing standard procedure such as ICC-ES AC 156.

1.07 DESIGN REQUIREMENTS

- A. Seismic restraints systems for nonstructural components shall be subject to the most current local Building Code in conjunction with the seismic provisions of the International Building Code (IBC) Section 1613 and referenced ASCE 7 Chapter 13.
- B. Seismic restraints systems for nonbuilding structures shall be subject to the most current local Building Code in conjunction with the seismic provisions of the International Building Code (IBC) Section 1613 and referenced ASCE 7 Chapter 15.
- C. Nonstructural components shall be assigned to the same Seismic Design Category as the structure they occupy or to which they are attached. Design of seismic support system and anchorage shall follow the site-specific seismic criteria noted on the drawings. Criteria shall include site-specific spectral response coefficients, site class, seismic design category, and risk category.
- D. Component Importance Factor I_p shall be 1.5 for all essential nonstructural components noted in item 1.03.E above. All other nonstructural components shall utilize $I_p = 1.0$ unless noted otherwise.
- E. Components shall be restrained and braced for earthquake forces both in the vertical and each orthogonal direction. Seismic restraint systems shall limit deflections of components per ASCE 7 and the displacements shall not impede component functionally and containment.
- F. Anchorage shall be designed in accordance with ASCE 7. Mechanical fasteners used to secure nonstructural architectural, mechanical, electrical and plumbing components shall meet the requirements of Specification Section 05050. All mechanical fasteners used to anchor essential components and other elements so designated in Specification Section 05050 shall be considered Structural Anchors.
- G. Avoid crossing structural expansion joints with seismic supports or bracing. Nonstructural components shall not be attached to multiple structure elements which may respond differently in an earthquake without provisions to accommodate independent movement. Flexible expansion loops or offsets, flexible joints, bellows type pipe expansion joints, couplings, etc shall be provided at structure expansion joints to allow for independent structure movement and thermal movement of piping, ductwork and conduit. Minimum movement capability in the vertical and each orthogonal direction shall equal the width of the joint.
- H. Provide flexible connections, piping, conduit, etc at foundation levels where below grade utilities enter into the structure.
- I. Design of support system for components with multiple attachments shall take into account the stiffness and ductility of the supporting members. Equipment designed as free-standing shall only be attached at its base. Use of non-free

standing equipment requiring both vertical and lateral attachment is contingent upon loads applied to the structure and requires approval by the Engineer.

- J. The seismic restraint design shall be based on actual equipment data (dimensions, weight, center of gravity, etc) obtained from the specifications or the approved equipment manufacturer. The equipment manufacturer shall verify the attachment points on the equipment can safely withstand the combination of seismic, self-weight and other loads imposed.
- K. Attachments of nonstructural component supports and seismic restraints causing the building structure slabs, beams, walls, columns, etc. to be overstressed shall not be permitted.
- L. Where the weight of a nonstructural component is greater than or equal to 25 percent of the effective seismic weight (as defined by ASCE 7) of the structure it is attached to, the component shall be classified as a nonbuilding structure and its support designed in accordance with ASCE 7 Chapter 15.
- M. No reaction loads (either vertical or lateral) from nonstructural component supports and seismic restraints shall be allowed on any element where design has been delegated unless the additional loads on the element have been coordinated with the delegated designer and the submittal is accompanied by a sealed letter from the delegated designer indicating the element has been designed to support the reaction loads.
- N. Reaction loads from nonstructural component supports and seismic restraints shall be transferred directly to the primary structural members, with no components supported from secondary members unless otherwise approved.
- O. No holes shall be drilled into any structural steel for attachment of component supports without prior approval of the Engineer.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Seismic restraints and braces shall be constructed of appropriate materials and connecting hardware to provide a continuous load path between the component and supporting structure of sufficient strength and stiffness to resist the calculated design seismic forces and displacements.
- B. Component restraint, bracing and connection materials shall be compatible with and in general match the component and component gravity support materials. Contact between dissimilar metals shall be prevented. See Section 15020 – Pipe Supports for additional details.
- C. Post-installed concrete anchors used for seismic restraint and bracing anchorage shall be considered structural anchors per Section 05050 and shall be prequalified for use in seismic applications.

- D. Powder actuated fasteners in steel or concrete shall not be used for sustained tension loads in Seismic Design Categories D, E or F unless approved for seismic loading or specifically exempted by ASCE 7. Powder actuated fasteners in masonry shall not be used unless approved for seismic loading regardless of Seismic Design Category.
- E. Friction clips shall not be used in Seismic Design Categories D, E or F for supporting sustained tension loads in combination with resisting seismic forces. C-type and large flange clamps may be used for hanger attachments provided restraining straps meeting NFPA 13 requirements are utilized and loosening of threaded connections is prevented by lock nuts, burred threads, etc.

PART 3 -- EXECUTION

3.01 INSTALLATION OF SEISMIC RESTRAINTS AND ANCHORAGES

- A. No components, seismic anchorages or restraints shall be installed prior to review and acceptance by the Engineer and permitting agency.
- B. Seismic certified equipment shall be installed per the manufacturer's recommendations. Fasteners shall meet manufacturer's requirements.
- C. Following installation, all seismic restraints, bracing and seismically qualified equipment shall be inspected. See Specification Section 01450 for Special Inspection requirements.

- END OF SECTION -

SECTION 01520

MAINTENANCE OF UTILITY OPERATIONS DURING CONSTRUCTION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Cattail Branch Pump Station will be maintained in continuous operation by the Owner during the entire construction period as hereinafter specified. The intent of this section is to outline the minimum requirements necessary to allow the Owner to continuously operate and maintain the facility in order to remain in compliance with all permit requirements.
- B. Work shall be scheduled and conducted by the Contractor so as not to impede any process or cause odor or other nuisance except as explicitly permitted hereinafter. In performing the work shown and specified, the Contractor shall plan and schedule his work to meet the pump station and collection system operating requirements, and the constraints and construction requirements as outlined in this Section. No discharge of raw or inadequately treated wastewater shall be allowed. The Contractor shall pay all civil penalties, costs, assessments, etc., associated with any discharge of raw or inadequately treated wastewater associated with the Contractor's work.
- C. The General Contractor shall be responsible for coordinating the general construction and construction schedules and for ensuring that permanent or temporary power is available for all existing, proposed, and temporary facilities that are required to be on line at any given time.
- D. The Contractor has the option of providing additional temporary facilities that can eliminate a constraint, provided it is done without cost to the Owner and provided that all requirements of these Specifications are fulfilled. The Contractor shall submit any such plan for providing additional temporary facilities to eliminate a constraint to the PM for review. Such plans must be approved by the Engineer and Owner prior to the Contractor proceeding. Work not specifically covered in the following paragraphs may, in general, be done at any time during the contract period, subject to the operating requirements and constraints and construction requirements outlined hereinafter. All references to days in this Section shall be consecutive calendar days.
- E. Construction may require the closing of various gates and valves to isolate tanks, channels, piping, and equipment. The Owner does not guarantee that the gates and valves will be completely water or air tight. It is Contractor's responsibility to take whatever measures are necessary to proceed with construction in the event that valves or gates leak. The Contractor shall inspect the gates and valves at least 30 days prior to initiation of construction impacted by the operation of the valves/gates. Inspection shall take place with the Owner or the Owner's representative to verify sealing capability of gates and valves. The Contractor shall submit in writing the results of the inspection to the Owner. If any valve or gate fails to seal adequately for performance of the work, the corrective actions will be discussed and implemented as approved by the Owner and the Engineer.

1.02 GENERAL CONSTRAINTS

- A. The Contractor shall schedule the Work so that the pump station is maintained in continuous operation. All systems shall be maintained in continuous operation during the construction period except during approved process interruptions. All short-term system or partial systems shutdowns and diversions shall be approved by the Engineer. Long-term process shutdowns will not be allowed. The contractor shall furnish and install all bypass equipment as required to maintain pump station operation. If in the judgement of the Engineer a requested shutdown is not required for the Contractor to perform the Work, the Contractor shall utilize approved alternative methods to accomplish the Work. All shutdowns shall be coordinated with and scheduled at times suitable to the Owner. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown period shall commence at a time approved by the Owner, and the Contractor shall proceed with the Work continuously, start to finish, until the Work is completed and normal operation is restored. If the Contractor completes all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back into service.
- B. The Contractor shall schedule short-term shutdowns in advance and shall present all desired shutdowns in the 30 and 60-day schedules at the progress meetings (see Section 01200). Shutdowns shall be fully coordinated with the Owner at least 48 hours before the scheduled shutdown. Owner personnel shall operate Owner's facilities involved in the short-term shutdowns and diversions.
- C. Short term shutdowns in pump station flow will be allowed for tie-ins to existing facilities, installation of temporary bulkheads, etc. All such shutdowns shall be scheduled for week-end low-flow periods and shall be limited to less than four (4) hours depending on incoming flow rate and storage volume in the collection and pump station system. Any shutdown of four (4) hours or longer duration shall be defined as a long-term shutdown, and will not be allowed. The Contractor shall provide appropriate diversion facilities to be approved by the Owner, and at no additional cost to the Owner, when the pump station cannot be shut down for a sufficient long time to accomplish the required work. The Contractor may be allowed additional time for short-term interruptions if he can demonstrate to the Owner and Engineer that the collection system will not surcharge or overflow during the requested shutdown period. Duration of short-term interruptions allowed will depend on incoming wastewater flow rate and prevention of any discharge of raw wastewater from the collection system. The schedule and duration of short-term shutdowns shall be at the discretion of the Owner.
- D. Any temporary work, facilities, roads, walks, protection of existing structures, piping, blind flanges, valves, equipment, etc. that may be required within the Contractor's work limits to maintain continuous and dependable plant operation shall be furnished by the Contractor at the direction of the Engineer at no extra cost to the Owner.
- E. The Owner shall have the authority to order Work stopped or prohibited that would, in his opinion, unreasonably result in interrupting the necessary functions of the pump station operations.

- F. If the contractor impairs performance or operation of the pump station as a result of not complying with specified provisions for maintaining operations, then the contractor shall immediately make all repairs or replacements and do all work necessary to restore the pump station to operation to the satisfaction of the Engineer. Such work shall progress continuously to completion on a 24-hours per day, seven work days per week basis.

1.03 GENERAL OPERATING REQUIREMENTS, CONSTRAINTS, AND CONSTRUCTION REQUIREMENTS

A. Access to Site, Roadways, and Parking Areas

1. An unobstructed traffic route through the Main Gate shall be maintained at all times for the Owner's operations personnel and maintenance equipment. Parking for personal vehicles of construction personnel shall not be allowed within the fence of the pump station. Construction personnel may park on Town property outside the fence in areas approved by the Engineer. The General Contractor shall be responsible for providing access to and for preparing and maintaining/approved parking areas.
2. The Contractor shall provide temporary measures to protect the existing pavement by filling over with earthen material or supplying other measures acceptable to the Engineer, and he shall repair any damage to existing paved surfaces that occurs during the construction period. Any areas disturbed along the shoulders of the access road and interior roads and elsewhere inside and outside of the pump station shall be repaired, graded, seeded, etc. as necessary to match pre-existing conditions.
3. It shall be the responsibility of the General Contractor to obtain any permits required from the VA Department of Transportation and pay all associated fees.

B. Personnel Access

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

C. Building Heating and Ventilating

1. Building heating and ventilating for the existing structure shall be in service for the entire construction period. Additional temporary heating and ventilation shall be provided as required to maintain facilities under construction adequately heated and vented. The temperatures to be maintained in all other interior pump station areas shall be maintained at a minimum of 55°F.

E. Power, Light and Communications Systems (General)

1. Electric power, lighting service and communications systems shall be maintained in uninterrupted operation. Individual units may be disconnected as required for replacement, but service shall be available at all times including periods when pump station elements are out of service. Shutdown of electrical facilities shall be limited to not more than four (4) hours. The Owner may allow longer outages under conditions determined by the Owner by making use of the existing and/or the proposed engine-generator at the pump station. All costs associated with operation of the engine-generator shall be paid by the Contractor. The Electrical Contractor shall coordinate shutdowns required with the General Contractor to minimize the total number of shutdowns required to complete construction. Owner's phone service to the plant shall be maintained in continuous operation during construction.
2. When a MCC busbar is de-energized for performance of work beyond a short term shutdown as defined in Paragraph 1.02.C of this Section, the Contractor shall provide temporary power to lighting, equipment including any pump that may be de-energized, and devices that are served from the de-energized busbar in order to provide continuous operation of these components.
3. No equipment shall be de-energized until the shutdown plan and schedule is approved.

F. Draining Wet Well, Process Pipes and Conduits (General)

2. The contents of wet well, all pipes and conduits to be removed, replaced or relocated (or dewatered for a specific purpose) shall be transferred to a suitable facility in a manner approved by the Owner through hoses or piping, or by using pumps if hydraulic conditions so require them. The Contractor shall provide the pumps, piping and hoses at no additional cost to the Owner. No uncontrolled spillage of a pipe or conduit shall be permitted. Any spillage, other than potable water, shall be immediately washed down and flushed into the appropriate location.
3. Potable Water System
4. Potable water service shall be maintained in continuous service at all times during construction.
5. Sump Pumps and Sumps
6. All existing sumps shall be maintained in an operable condition with either existing pumps or temporary pumps. Interim piping, power and controls shall be provided as required by the staged construction sequence.

J. Seal Water and Service Water Piping

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

1.04 SPECIFIC OPERATIONAL CONSTRAINTS

- A. The respective Contractors shall schedule the work for the following based on the constraints given in such a manner as to maintain the pump station in continuous operation.
1. All Work shall be performed without any stoppage of flow to the Cattail Branch SPS or backup of sewage in collection system at all times by means of a bypass pumping system.
 2. Bypass pumping system shall remain in place and operational until all work associated with pumps 1, 2, 3 and 4 are complete and accepted.
 3. The Contractor may find it necessary to perform Work during low flow conditions. Work performed outside of specified working hours shall be approved by the Owner as specified in these Specifications and shall be at no additional cost to the Owner.
 4. The ventilation system downtime for dry well area shall not exceed 15 calendar days. If wet well ventilation and odor control system work is performed for any duration beyond bypass pumping operation and the pump station is operational, the wet well area shall have temporary ventilation provided at a capacity of 1,500 cfm to maintain 12 air changes and to prevent wet well space from dropping below 45 degrees Fahrenheit.
 5. The wet well shall be drained and cleaned completely prior to performance of any work to prevent odorous conditions.
 6. Protect existing hydraulic power pack and associated electrical components from elements for the period between demolition of the existing enclosure and construction of new enclosure.

1.05 RECOMMENDED SEQUENCE OF CONSTRUCTION

- A. The contractor is required to submit a planned sequence of construction for approval by the Engineer.
- B. The following suggested Sequence of Construction is intended to illustrate one possible approach for the installation of new facilities, structures, and equipment, and is not intended to be a complete list of all required construction activities.
1. Install bypass pump and piping.
 2. Test bypass pumping system.
 3. Start bypass pumping system operation upon successful test.
 4. Drain and clean wet wells 1 and 2
 5. Close suction and discharge plug valves on Pump 3 and Pump 4.
 6. Replace check and control valves for each pump discharge.

7. Remove Pump 3 and Pump 4, including VFD, motor, and extended shaft. Remove seal water system.
 8. Install pump 3 and pump 4 and install VFD, PLC and controls on upper level for control of pump 3 and pump 4.
 9. Isolate, drain, and dewater wet well no. 1.
 10. Remove suction and discharge isolation plug valves for pump 3 and 4 and install new suction and discharge isolation plug valves.
 11. Place wet well no. 1 back in service.
 12. Integrate pump 3 and 4 controls into existing pump control panel.
 13. Test and start-up pumps 3 and 4.
 14. Replace VFD for Pump No 1 and 2
 15. Test and start Pump No 1 and 2
 16. Remove bypass pumping equipment upon completion of pumping station work including acceptance of new pumps and replacement of VFDs.
 17. Modify intermediate level platform.
 18. Ventilation and odor control system replacement concurrent with other work. Refer to Paragraph 1.05.C.
 19. Paint work concurrent with other work.
 20. Clean site and demobilize.
- C. The following suggested Sequence of Construction for the modifications associated with the wetwell odor control system and is intended to illustrate one possible approach for the installation of new facilities, structures, and equipment, and is not intended to be a complete list of all required construction activities.
1. Install temporary ventilation and heating associated with the wet well (see Paragraph 1.04).
 2. Remove the existing odor control system including ductwork within the wetwell.
 3. Demolish existing enclosure housing the odor control system and hydraulic power pack
 4. Build new enclosure.
 5. Install new odor control equipment and duct system.
 6. Test all components associated with the new odor control system. Upon acceptance of the equipment temporary ventilation and heating may be removed.
 7. Clean the odor control equipment and odor control room and demobilize.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

3.01 Measurement and Payment

1. Maintenance of utility operations during construction will not be measured.
2. Maintenance of utility operations during construction will not be paid separately. Costs shall be considered incidental.

- END OF SECTION -

SECTION 01530

PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 PROTECTION OF WORK AND MATERIAL

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

1.03 EXISTING UTILITIES AND STRUCTURES

- A. The term existing utilities shall be deemed to refer to both publicly-owned and privately-owned utilities such as electric power and lighting, telephone, water, gas, storm drains, process lines, sanitary sewers and all appurtenant structures.

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

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

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SECTION 01540

DEMOLITION AND REMOVAL OF EXISTING STRUCTURES AND EQUIPMENT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. This Section covers the demolition, removal, and disposal of existing equipment and structural components as indicated on the Drawings and as specified herein. The Contractor shall furnish all labor, materials and equipment to demolish buildings and structures and to remove fixtures, anchors, supports, piping and accessories designated to be removed on the Drawings.

1.02 TITLE TO EQUIPMENT AND MATERIALS

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

1.03 CONDITION OF STRUCTURES AND EQUIPMENT

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

1.04 REMOVAL AND DISPOSAL OF SOLIDS

Contractor shall pump down wet well and piping contents to a location specified by the Owner and to pressure wash and clean the area and dispose of the material including sludge, grit, grease, debris, and wastewater before beginning work and after completing work.

The Contractor shall remove and dispose of the contents (amount of liquid and solids that are not approved by Town for disposal to an active tank at Leesburg WWTP) of the channels, wetwell and piping to a licensed disposal facility in accordance with applicable local, state, and federal regulations.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

3.01 DEMOLITION AND REMOVALS

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

3.02 PROTECTION

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

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

3.03 WORKMANSHIP

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

- E. Materials or items demolished and not designated to become the property of the Owner or to be reinstalled shall become the property of the Contractor and shall be removed from the property and legally disposed of.
- F. The Contractor shall execute the work in a careful and orderly manner, with the least possible disturbance to the public and to the occupants of the building.
- G. Where alterations occur, or new and old work join, the Contractor shall cut, remove, patch, repair or refinish the adjacent surfaces to the extent required by the construction conditions, so as to leave the altered work in as good a condition as existed prior to the start of the work. The materials and workmanship employed in the alterations, unless otherwise shown on the Drawing or specified, shall comply with that of the various respective trades which normally perform the particular items or work.
- H. The Contractor shall finish adjacent existing surfaces to new work to match the specified finish for new work. The Contractor shall clean existing surfaces of dirt, grease, loose paint, etc., before refinishing.
- I. The Contractor shall cut out embedded anchorage and attachment items as required to properly provide for patching and repair of the respective finishes.
- J. The Contractor shall remove temporary work, such as enclosures, signs, guards, and the like when such temporary work is no longer required or when directed at the completion of the work.

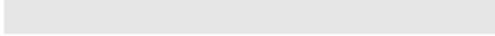
3.04 MAINTENANCE

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

3.05 EQUIPMENT AND MATERIALS RETAINED BY OWNER

- A. The following equipment and materials will be retained by the Owner:

- 1) Pump 3
- 2) Pump 3 Motor
- 3) Pump 4
- 4) Pump 4 Motor
- 5) Suction and Discharge Isolation Valves
- 6) Check Valves
- 7) Control Valves



- B. The equipment and materials shall be moved by the Contractor to the Town's Wastewater Treatment Plant, to be designated by the Owner.

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SECTION 01550

SITE ACCESS AND STORAGE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Access Roads

1. The General Contractor shall construct and maintain such temporary access roads as required to perform the work of this Contract.
2. Access roads, where possible, shall be located over the areas of the future road system.
3. Access roads shall be located within the property lines of the Owner unless the Contractor independently secures easements for his use and convenience. Contractor shall submit written documentation to the Engineer for any Contractor secured easements across privately held property. Easement agreement shall specify terms and conditions of use and provisions for site restoration. A written release from the property owner certifying that all terms of the easement agreement have been complied by the Contractor shall be furnished to the Engineer prior to final payment.
4. Existing access roads used by the Contractor shall be suitably maintained by the Contractor at his expense during construction. Contractor shall not be permitted to restrict Owner access to existing facilities. Engineer may direct Contractor to perform maintenance of existing access roads when Engineer determines that such work is required to insure all weather access by the Owner.

B. Parking Areas

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

C. Restoration

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

D. Traffic Regulations

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

E. Storage of Equipment and Materials

1. Contractor shall store his equipment and materials at the job site in accordance with the requirements of the General Conditions, the Supplemental Conditions, 01010 - Summary of Work and as hereinafter specified. All equipment and materials shall be stored in accordance with manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations and rulings of the public authority having jurisdiction. Where space or strip heaters are provided within the enclosure for motors, valve operators, motor starters, panels, instruments, or other electrical equipment, the Contractor shall make connections to these heaters from an appropriate power source and operate the heaters with temperature control as necessary until the equipment is installed and being operated according to its intended use. The Contractor shall coordinate the appropriate electric power source with the Owner.
2. Contractor shall enforce the instructions of Owner and Engineer regarding the posting of regulatory signs for loadings on structures, fire safety, and smoking areas.
3. Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.
4. Contractor shall not store unnecessary materials or equipment on the job site, and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
5. Materials shall not be placed within ten (10) feet of fire hydrants. Gutters, drainage channels and inlets shall be kept unobstructed at all times.
6. Contractor shall provide adequate temporary storage buildings/facilities, if required, to protect materials or equipment on the job site.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 01590

FIELD OFFICE, EQUIPMENT AND SERVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Contractor's Field Office

1. The Contractor may furnish, equip and maintain a field office at the site of a size required for his operations at his own option. The Contractor shall provide their own services including telecommunications, electric power, water and portable toilet facilities. The Owner shall not provide any utilities.
2. The trailer shall be located as directed by the Owner and within staging area as shown on the Contract Drawings.

B. Project Sign and Sign Panel

1. The Contractor shall erect a sign at the Project site identifying the Project. The sign shall be erected within twenty-one (21) days after the Notice to Proceed and shall be in accordance with the Specifications and details included in this Section. The project sign and sign panel shall be furnished, erected, and maintained by the Contractor at the location designated by the Engineer. Wording and colors shall be as shown on the detail after the end of this Section.
2. The project sign shall be fabricated, erected and maintained by the Contractor in accordance with the following specifications:
 - a. Sign Panel: The sign panel shall be constructed of 3/4 inch minimum thickness marine plywood rabbeted into a 2 inch x 4 inch wood frame. All fasteners used in the construction of the sign shall be of a rustproof nature.
 - b. Painting: All supports, trim and back of the sign panel shall be painted with at least two (2) coats of the same paint used for the sign face. All paint used shall be exterior grade paint, suitable for use on wood signs.
 - c. Sign Supports: The supports for the project sign shall be at least two 4" by 4" treated wood posts. The sign panel shall be securely fastened to the sign supports with at least six (6) 3/8 ϕ galvanized bolts, nuts and washers. The positioning and alignment of the sign shall be as determined by the Engineer.
 - d. Maintenance: The project sign shall be maintained by the Contractor, in good condition, at all times, for the duration of construction.

- e. Removal of Sign from Project Site: The removal of the project sign from the construction site by the Contractor shall be at the completion of construction, when ordered by the Engineer.
- f. Payment: The cost of the fabrication, erection, maintenance, and removal of the project sign, including all labor and materials, shall be included in the General Contractor's Lump Sum Bid. No extra payment will be made for obliterating certain names and offices and replacement thereof of others because of administrative changes during the course of this Contract.

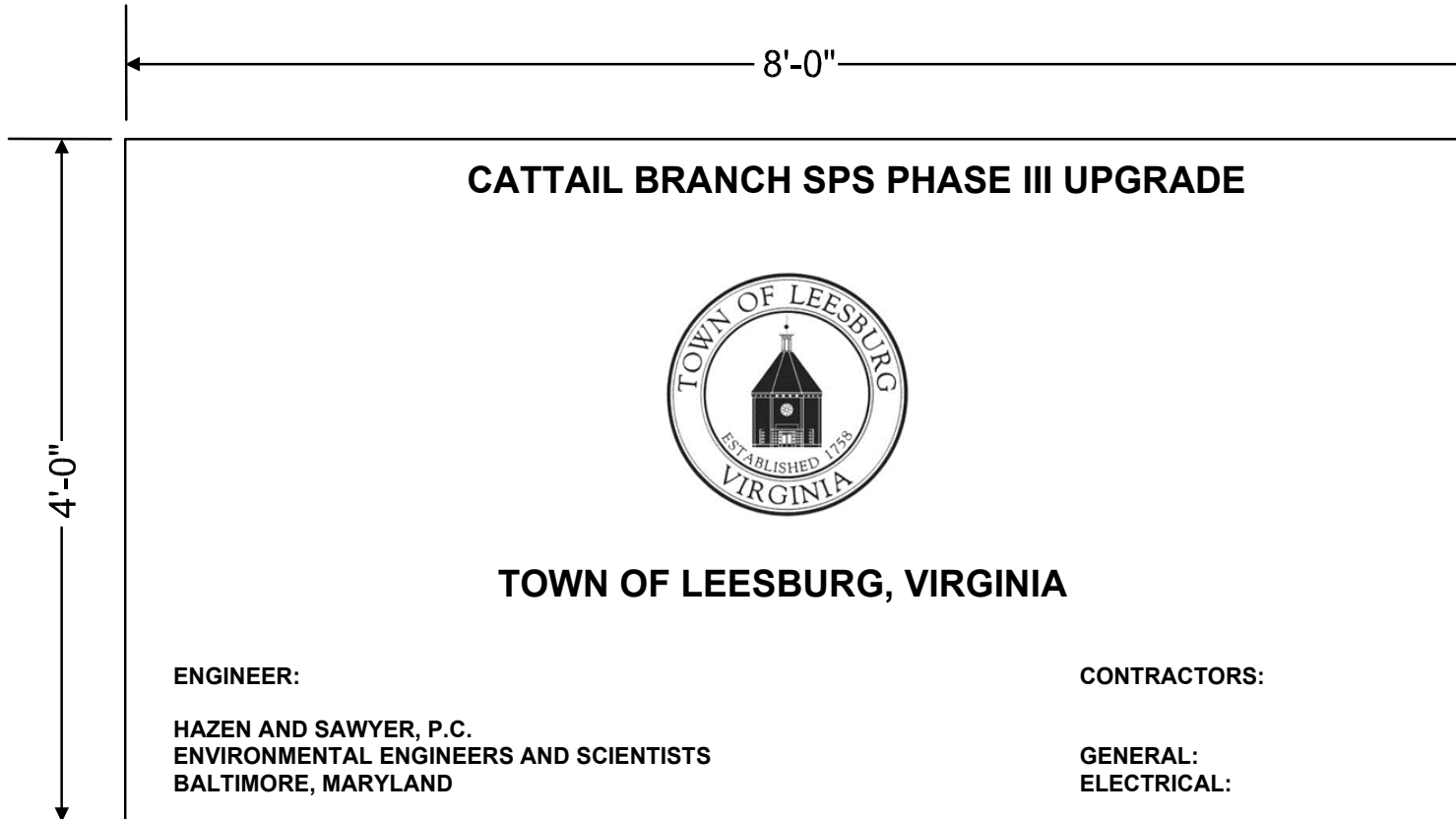
PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

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1. Provide black letters on white background.
2. Use of 1/2" duraply signboard with vinyl lettering will be acceptable as an alternate to plywood and painted letters.

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SECTION 01700
PROJECT CLOSEOUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

A. Final Cleaning

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

B. Lubrication Survey

1. A lubrication survey, made by a lubricant supply firm, subject to the approval of the Owner shall be provided and paid for by the Contractor.
2. The lubrication survey shall list all equipment, the equipment manufacturer's lubrication recommendations, and an interchangeable lubricants tabulation standardizing and consolidating lubricants whenever possible.
3. The Contractor shall supply all lubricants, applicators and labor for lubricating the equipment, in accordance with manufacturer's recommendations, for field testing and prior to final acceptance. A supply of required lubricants sufficient for start-up and one year of operation shall also be supplied by the Contractor.
4. Six (6) copies of the approved lubrication survey shall be furnished to the Engineer prior to final acceptance.

C. Spare Parts and Special Tools

1. As soon as practicable after approval of the list of equipment, the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source or sources of supply.

2. Contractor shall also furnish a list of parts, and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be furnished as part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for a period of one-hundred and twenty (120) days for the particular installation.
3. All parts shall be securely boxed and tagged, and clearly marked on the box and individually for identification as to the name of manufacturer or supplier, applicable equipment, part number, description and location in the equipment. All parts shall be protected and packaged for a shelf life of at least ten (10) years.
4. Contractor shall furnish at no additional cost to the Owner with each piece of equipment as a minimum, one (1) complete set, or the number of sets called for in the Technical Specifications, of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.
5. Contractor shall submit, for approval by the Engineer, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.

D. Equipment Start-Up Services

1. Equipment start-up period, for the training of plant personnel, shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for the part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.
2. During the equipment start-up period the Contractor shall furnish, at no additional cost to the Owner the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
 - a. Assist in the start-up and operations of the equipment.
 - b. Assist in the training of plant personnel, designated by the Owner in the proper operation and maintenance of the equipment.
3. The Owner shall:
 - a. Provide the necessary plant personnel to be instructed in the operation and maintenance of the equipment. The Owner's personnel shall operate all equipment.
 - b. Pay for all fuel, power and chemicals consumed beyond quantities specified in the Contract Documents. The Contractor shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.

4. Contractor shall be available to promptly repair all work during the start-up period so as to cause minimum disruption to the total plant operation.
5. Upon completion of a minimum of ten (10) consecutive and continuous days of satisfactory operation, or the number of days called for in the Technical Specifications, the Owner will assume operation and operating cost of the equipment. If the equipment malfunctions during this start-up period, the start-up period will be repeated until satisfactory operation is achieved.
6. In the event a system, equipment or component proves defective or is unable to meet specified performance criteria, the Contractor shall replace the defective item and the minimum one (1) year guarantee period, or the guarantee period called for in the Technical Specifications for the item shall start after satisfactory replacement and testing of the item.

E. Final Cleanup; Site Rehabilitation

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

F. Final Inspection

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

properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

G. Project Close Out

1. As construction of the project enters the final stages of completion, the Contractor shall, in concert with accomplishing the requirements set forth in the Contract Documents, attend to or have already completed the following items as they apply to his contract:
 - a. Scheduling equipment manufacturers' visits to site.
 - b. Required testing of project components.
 - c. Scheduling start-up and initial operation.
 - d. Scheduling and furnishing skilled personnel during initial operation.
 - e. Correcting or replacing defective work, including completion of items previously overlooked or work which remains incomplete, all as evidenced by the Engineer's "Punch" Lists.
 - f. Attend to any other items listed herein or brought to the Contractor's attention by the Engineer.

2. Just before the Engineer's Certificate of Substantial Completion is issued, the Contractor shall accomplish the cleaning and final adjustment of the various building components as specified in the Specifications and as follows:
 - a. Clean all glass and adjust all windows and doors for proper operation.
 - b. Clean all finish hardware after adjustment for proper operation.
 - c. Touch up marks or defects in painted surfaces and touch up any similar defects in factory finished surfaces.
 - d. Wax all resilient flooring materials.
 - e. Remove bitumen from gravel stops, fascias, and other exposed surfaces.
 - f. Remove all stains, marks, fingerprints, soil, spots, and blemishes from all finished surfaces, tile, stone, brick, and similar surfaces.

3. In addition, and before the Certificate of Substantial Completion is issued, the Contractor shall submit to the Engineer (or to the Owner if indicated) certain records, certifications, etc., which are specified elsewhere in the Contract Documents. A partial list of such items appears below, but it shall be the Contractor's responsibility to submit any other items which are required in the Contract Documents:
 - a. Test results of project components.

- b. Performance Affidavits for equipment.
 - c. Certification of equipment or materials in compliance with Contract Documents.
 - d. Operation and maintenance instructions or manuals for equipment.
 - e. One set of neatly marked-up record drawings showing as-built changes and additions to the work under his Contract.
 - f. Any special guarantees or bonds (Submit to Owner).
 - g. Licensed surveyor's report showing elevations of weirs specified in the Contract Drawings and the final surveyed elevation.
4. The Contractor's attention is directed to the fact that required certifications and information under Item 3 above, must actually be submitted earlier in accordance with other Sections of the Specifications.

PART 2 -- PRODUCTS

(NOT USED)

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 03100
CONCRETE FORMWORK

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 - Reinforcing Steel
- B. Section 03250 - Concrete Accessories
- C. Section 03290 - Joints in Concrete
- D. Section 03300 - Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Building Code for the Commonwealth of Virginia.
 - 2. ACI 318 - Building Code Requirements for Structural Concrete
 - 3. ACI 301 - Specifications for Structural Concrete for Buildings
 - 4. ACI 347 - Recommended Practice for Concrete Formwork
 - 5. U.S. Product Standard for Concrete Forms, Class I, PS 1
 - 6. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

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

PART 2 -- PRODUCTS

2.01 FORMS AND FALSEWORK

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

2.02 FORMWORK ACCESSORIES

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

PART 3 -- EXECUTION

3.01 FORM DESIGN

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

3.02 CONSTRUCTION

- A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.
- B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.
- C. Forms shall be true to line and grade and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.
- D. Forms shall be mortar tight to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form.
- E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that

it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

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

3.03 TOLERANCES

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

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

3.04 FORM ACCESSORIES

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

3.05 APPLICATION - FORM RELEASE AGENT

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

3.06 INSERTS AND EMBEDDED ITEMS

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

3.07 FORM CLEANING AND REUSE

- A. The inner faces of all forms shall be thoroughly cleaned prior to concreting. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture.

Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.08 FORM REMOVAL AND SHORING

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

Ambient Temperature (°F.) During Concrete Placement

	<u>Over 95°</u>	<u>70°-95°</u>	<u>60°-70°</u>	<u>50°-60°</u>	<u>Below 50°</u>
Walls	5 days	2 days	2 days	3 days	Do not remove until directed by Engineer (7 days minimum)
Columns	7 days	2 days	3 days	4 days	
Beam Soffits	10 days	7 days	7 days	7 days	
Elevated Slabs	12 days	7 days	7 days	7 days	

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

3.09 RESHORING

- A. When reshoring is permitted or required the operations shall be planned in advance and subjected to approval by the Engineer.
- B. Reshores shall be placed after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.
- C. Reshoring for the purpose of early form removal shall be performed so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, no construction or live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads but they shall not be overtightened

so that the new construction is overstressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified.

- D. For floors supporting shores under newly placed concrete, the original supporting shores shall remain in place or reshores shall be placed. The shoring or reshoring system shall have a capacity sufficient to resist the anticipated loads and in all cases shall have a capacity equal to at least one-half of the capacity of the shoring system above. Reshores shall be located directly under a reshore position above unless other locations are permitted.
- E. In multi-story buildings, reshoring shall extend over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads so the design superimposed loads of the floors supporting shores are not exceeded.

- END OF SECTION -

SECTION 03200
REINFORCING STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this section.
- B. Provide deformed reinforcing bars to be grouted into reinforced concrete masonry walls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- C. Section 03250 - Concrete Accessories
- D. Section 03300 - Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Building Code for the Commonwealth of Virginia.
 - 2. CRSI - Concrete Reinforcing Institute Manual of Standard Practice
 - 3. ACI SP66 - ACI Detailing Manual
 - 4. ACI 315 - Details and Detailing of Concrete Reinforcing
 - 5. ACI 318 - Building Code Requirements for Structural Concrete
 - 6. ICC-ES AC193 Acceptance Criteria for Expansion and Screw Anchors (Concrete)
 - 7. WRI - Manual of Standard Practice for Welded Wire Fabric
 - 8. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing
 - 9. ASTM A 1064 - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

10. ASTM E 3121 - Standard Test Methods for Field Testing of Anchors in Concrete or Masonry

1.04 SUBMITTALS

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

1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.
2. Mill test certificates - 3 copies of each.
3. Description of the reinforcing steel manufacturer's marking pattern.
4. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.
5. Proposed supports for each type of reinforcing.
6. Request to use splices not shown on the Drawings.
7. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' capacity.
8. Request for placement of column dowels without the use of templates.
9. Request and procedure to field bend or straighten partially embedded reinforcing.
10. International Code Council–Evaluation Services Report (ICC-ES ESR) for dowel adhesives.
11. Certification that all installers of dowel adhesive are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.
12. Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

- A. If requested by the Engineer, the Contractor shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.
- B. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the installer name, date of training, products included in the training and trainer name and contact information.

- C. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.
- D. Inspections of the adhesive dowel system may be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injection, installation, and proof testing.

PART 2 -- PRODUCTS

2.01 REINFORCING STEEL

- A. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.
- B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.
- C. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Engineer reserves the right to require the Contractor to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Contractor.
- D. Field welding of reinforcing steel will not be allowed.
- E. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORIES

- A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Wire bar supports shall be plastic protected (CRSI Class 1).
- B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

2.03 MECHANICAL COUPLERS

- A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

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

2.04 DOWEL ADHESIVE SYSTEM

- A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.
- B. All holes shall be drilled in accordance with the manufacturer's instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer's requirements.
- C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer's instructions prior to installation of adhesive and reinforcing bar.
- D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be dry or water saturated unless otherwise permitted by the Engineer. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.
- E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer's instructions.
- F. Embedment Depth:
 - 1. The embedment depth of the bar shall be as shown on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on "Pure 110+" by DeWalt" ESR 3298 issued 7/2020. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.
 - 2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.
 - 3. The embedment depth shall be determined using design parameters listed below. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer's ICC-ES ESR.

4. Design of adhesive anchor system shall be based on the following parameters:
 - a. Cracked concrete state.
 - b. Dry or water saturated condition for installation.
 - c. Base material temperature between 40- and 104-degrees Fahrenheit.
 - d. Installation with either a hammer drill with carbide bit or hollow-drill bit system drilling methods.
 - e. Minimum age of concrete 21 days at time of installation.
- G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.
- H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "Epcon C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. "SET-XP Epoxy Adhesive Anchors" as manufactured by Simpson Strong-Tie Co. or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.
- I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

PART 3 – EXECUTION

3.01 FABRICATION

- A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
- B. The Contractor shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.
- C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or rebent in a manner that will injure the material. Heating of bars will not be permitted.
- D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3.02 DELIVERY, STORAGE AND HANDLING

- A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.
- B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.
- C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.03 PLACING

- A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or plastic protected (CRSI Class 1) metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.
- B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcing in position, shall be provided by the Contractor at no additional cost to the Owner.
- E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.
- F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.
- G. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.

- H. Reinforcing shall not be straightened or rebent unless specifically shown on the drawings. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.
- I. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.
- J. All adhesive dowel installations in the horizontal or overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-11 9.2.2. Current AAI Certificated must be submitted to the Engineer of Record for approval prior to commencement of any adhesive anchor installations.
- K. Adhesive Dowel Testing
 - 1. At all locations where adhesive dowels are shown on the Drawings, at least 10 percent of all adhesive dowels installed shall be tested to the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.
 - 2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.
 - 3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State or Commonwealth in which the project is located. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.
 - 4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.
 - 5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.04 SPLICING

- A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.
- B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.
- C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
- D. Mechanical splices shall be used only where shown on the drawings or when approved by the Engineer.
- E. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

3.05 INSPECTION

- A. The Contractor shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.
- B. The Contractor shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

3.06 CUTTING OF EMBEDDED REBAR

- A. The Contractor shall not cut embedded rebar cast into structural concrete without prior approval.

- END OF SECTION -

SECTION 03250

CONCRETE ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, contraction joint inserts, and epoxy bonding agent.

1.02 RELATED WORK SPECIFIED ELSEWHERE

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

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

- | | | |
|----|-------------|---|
| 1. | ASTM C881 | Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete |
| 2. | ASTM D412 | Standard Tests for Rubber Properties in Tension |
| 3. | ASTM D 624 | Standard Test method for Rubber Property - Tear Resistance |
| 4. | ASTM D 638 | Standard Test Method for Tensile Properties of Plastics |
| 5. | ASTM D1751 | Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (nonextruding and resilient bituminous types) |
| 6. | ASTM D 1752 | Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction |
| 7. | ASTM D 1171 | Standard Test Method for Ozone Resistance at 500 pphm |
| 8. | ASTM D 471 | Standard Test Method for Rubber Properties |

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Manufacturer's literature on all products specified herein including material certifications.
 - 2. Proposed system for supporting PVC waterstops in position during concrete placement
 - 3. Samples of products if requested by the Engineer.

PART 2 -- PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) WATERSTOPS

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

2.02 RETROFIT WATERSTOPS

- A. Retrofit waterstops shall be used where specifically shown on Drawings for sealing joints between existing concrete construction and new construction.

- B. Retrofit waterstops shall be PVC waterstops fabricated from material as described in Section 2.01 of this Specification.
- C. Retrofit waterstop shall be attached to existing concrete surface as shown on Drawings.
- D. Use of split waterstop in lieu of specially fabricated retrofit waterstop will not be acceptable.
- E. Retrofit Waterstop manufacturer must provide a complete system including all Waterstop, stainless steel anchoring hardware, and epoxy for installation.
- F. For construction joints, retrofit waterstop shall be style number 609 by Sika Greenstreak, RF-638 by BoMetals, Inc., Type 18 kit by DuraJoint Concrete Accessories, or approved equal. For expansion joints, retrofit waterstop shall be style number 667 by Sika Greenstreak, RF-912 by BoMetals, Inc., Type 18-9 kit by DuraJoint Concrete Accessories, or approved equal.

2.03 CHEMICAL RESISTANT WATERSTOPS

- A. Where specifically noted on Contract Drawings, chemical resistant waterstops shall be used instead of PVC waterstops.
- B. Chemical resistant waterstops for construction joints shall be ribbed with a center bulb. They shall be 6 inches wide with a minimum thickness at any point of 3/16 inches.
- C. Chemical resistant waterstops for expansion joints shall be ribbed tear web. They shall be 9 inches wide with a tear web designed to accommodate 1 inch of free movement minimum.
- D. Chemical resistant retrofit waterstop shall be a minimum of 2½" wide along the ribbed side and a minimum 5" wide along the side attached to the existing concrete surface. Retrofit waterstop shall include a centerbulb and shall have a minimum thickness of 3/16". Retrofit waterstop manufacturer shall provide a complete system including waterstop, stainless steel anchoring hardware and epoxy for installation.
- E. Chemical resistant waterstops shall be manufactured from a fully crosslinked thermoplastic vulcanizate rubber.
- F. Waterstops shall be TPER by BoMetals, Inc., Earth Shield TPV/TPE-R by JP Specialties, Inc., Westec TPER by Westec Barrier Technologies, or TPE-R by DuraJoint Concrete Accessories.

2.04 HYPALON RUBBER WATERSTOPS

- A. Hypalon rubber waterstops shall be Sikadur Combiflex by Sika Corporation or approved equal. Minimum width of waterstop material shall be twelve (12) inches unless shown otherwise on Contract Drawings.

2.05 EXPANDING RUBBER WATERSTOP

- A. Expanding rubber shall be designed to expand under hydrostatic conditions. Waterstops shall be Adeka Ultra Seal MC-2010MN by Adeka Ultra Seal/OCM, Inc., or Hydrotite CJ-

1020-2K by Sika Greenstreak, for concrete thickness greater than nine inches. For thicknesses less than nine inches, Adeka Ultra Seal KBA-1510FF or Hydrotite CJ-1020-2K shall be used.

- B. Waterstop shall be a chemically modified natural rubber product with a hydrophilic agent.
- C. Waterstop has a stainless steel mesh or coextrusion of non-hydrophilic rubber to direct expansion in the thickness direction and restrict the expansion in the longitudinal direction.

2.06 WATERSTOP ADHESIVE

- A. Adhesive between waterstops and existing concrete shall be Neoprene Adhesive 77-198 by JGF Adhesives, Sikadur 31 Hi-Mod Gel by Sika Corporation, DP-605 NS Urethane Adhesive by 3M Adhesive Systems.
- B. Hydrophilic, non-bentonite water swelling elastic sealant shall be used to bond expanding rubber waterstops to rough surfaces. Hydrophilic elastic sealant shall be P-201 by Adeka Ultra Seal/OCM, Inc., Leakmaster LV-1 by Sika Greenstreak, or approved equal.

2.07 JOINT SEALANTS

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

2.08 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:
 - 1. Type I - Sponge rubber, conforming to ASTM D1752, Type I.
 - 2. Type II - Cork, conforming to ASTM D1752, Type II.
 - 3. Type III - Self-expanding cork, conforming to ASTM D1752, Type III.
 - 4. Type IV - Bituminous fiber, conforming to ASTM Designation D1751.

2.09 EXPANSION JOINT SEAL

- A. Expansion Joint Seal System shall consist of a preformed neoprene profile, installed using the same dimensions as the joint gap, bonded with a two-component epoxy adhesive and pressurized during the adhesive cure time.
- B. The expansion joint system shall be Hydrozo/Jeene Structural Sealing joint system by Hydrozo/Jeene, Inc.

2.10 CONTRACTION JOINT INSERTS

- A. Contraction joint inserts shall be Zip-Cap by Greenstreak Plastic Products, Zip-Joint by BoMetals, Inc. control joint formers.

2.11 EPOXY BONDING AGENT

- A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterInject 1500 by BASF Master Builder Solutions (BASF).

2.12 EPOXY RESIN BINDER

- A. Epoxy resin binder shall conform to the requirements of ASTM C-881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by BASF Master Builder Solutions.

PART 3 -- EXECUTION

3.01 PVC AND CHEMICAL RESISTANT WATERSTOPS

- A. PVC and chemical resistant waterstops shall be provided in all construction and expansion joints in water bearing structures and at other such locations as required by the Drawings.
- B. Waterstops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all waterstops shall be secured in correct position at 12" on center along the length of the waterstop on each side, prior to placing concrete. Such method of support shall be submitted to the Engineer for review and approval. Grommets or small pre-punched holes as close to the edges as possible will be acceptable for securing waterstops.
- C. Splices in PVC waterstops and chemical resistant waterstops shall be made with a thermostatically controlled heating element. Only straight butt joint splices will be allowed in the field. Factory fabricated corners and transitions shall be used at all intersections. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80 percent of the strength of the unspliced material.
- D. All splices in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, discoloration, charring, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review and all faulty material shall be removed from the site and disposed of by the Contractor at no additional cost to the Owner.
- E. Retrofit waterstops shall be installed as shown on Contract Drawings using approved waterstop adhesive and Type 316 stainless steel batten bars and expansion anchors.
- F. Waterstop installation and splicing defects which are unacceptable include, but are not limited to the following:
 - 1. Tensile strength not less than 80 percent of parent material.

2. Overlapped (not spliced) Waterstop.
3. Misalignment of Waterstop geometry at any point greater than 1/16 inch.
4. Visible porosity or charred or burnt material in weld area.
5. Visible signs of splice separation when splice (24 hours or greater) is bent by hand at sharp angle.

3.02 HYPALON RUBBER AND EXPANDING RUBBER WATERSTOPS

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

3.03 WATERSTOP ADHESIVE

- A. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.
- B. Adhesive shall be used where waterstops are attached to existing concrete surfaces.

3.04 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

- A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.
- B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.
- C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.
- D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.
- E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.

- F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.
- G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

3.05 EXPANSION JOINT SEAL

- A. The expansion joint seal system shall be installed as shown on the Drawings in strict accordance with the manufacturer's recommendations.

3.06 CONTRACTION JOINT INSERTS

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

3.07 EPOXY BONDING AGENT

- A. The Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.
- B. Bonding surface shall be clean, sound and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.
- C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.
- D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

3.08 EPOXY RESIN BINDER

- A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

- END OF SECTION -

SECTION 03290
JOINTS IN CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

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

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 - Specifications for Structural Concrete for Buildings
 - 2. ACI 318 - Building Code Requirements for Structural Concrete
 - 3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures
 - 4. ACI 224.3 – Joints in Concrete Construction

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Layout drawings showing location and type of all joints to be placed in each structure.
 - 2. Details of proposed joints in each structure.
 - 3. For sawcut contraction joints submit documentation indicating the following:
 - a. Proposed method of sawcutting indicating early entry or conventional sawing.
 - b. Description of how work is to be performed including equipment to be utilized, size of crew performing the work and curing methods.
 - c. Description of alternate method in case of time constraint issues or failure of equipment.

PART 2 -- MATERIALS

2.01 MATERIALS

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

PART 3 -- EXECUTION

3.01 CONSTRUCTION JOINTS

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

Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.

- F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.02 EXPANSION JOINTS

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

3.03 CONTRACTION JOINTS

- A. Location of contraction joints shall be as shown on the Drawings.
- B. Contraction joints shall be formed either by sawcutting or with contraction joint inserts as specified in Section 03250, Concrete Accessories. Sawcutting of joints will not be permitted unless specifically approved by the Engineer.
- C. If approved by the Engineer, sawcutting of contraction joints in lieu of forming shall conform to the following requirements:
 1. Joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.
 2. Curing shall be performed using wet curing methods as indicated in Section 03370 – Concrete Curing. Curing mats, fabrics or sheeting materials shall remain in place to the extent possible while cutting of joint is being performed. Curing materials shall only be removed as required and shall be immediately reinstalled once cutting of the joint has been completed.
 3. Depth of joint shall be as shown on the drawings or noted in these specifications. At locations where the joint cannot be installed to full depth due to curbs or other stopping points hand tools shall be used to complete joints.
 4. Saw cut joints shall meet the requirements of ACI 224.3, Section 2.8, Jointing Practice.
- D. Unless noted otherwise on Drawings, depth of contraction joints shall be 1-1/2 inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

3.04 JOINT PREPARATION

- A. No concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.

- B. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.
- C. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.
- D. All joints shall be sealed as shown on the Drawings and specified in Section 03250, Concrete Accessories.

- END OF SECTION -

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Provide all labor, equipment, materials and services necessary for the manufacture, transportation and placement of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the Engineer.
- B. The requirements in this section shall apply to the following types of concrete:
 - 1. Class A2 Concrete: Normal weight structural concrete in all structures other than structures qualifying as environmental concrete structures as described above, and for all sidewalks and pavement.
 - 2. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03200 - Reinforcing Steel
- C. Section 03250 - Concrete Accessories
- D. Section 03290 - Joints in Concrete
- E. Section 03350 - Concrete Finishes
- F. Section 03370 - Concrete Curing
- G. Section 03600 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Building Code for the Commonwealth of Virginia.
 - 2. ACI 214 Guide to Evaluation of Strength Test Results of Concrete

3. ACI 301 Specifications for Structural Concrete
4. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete
5. ACI 305 Guide to Hot Weather Concreting
6. ACI 306 Guide to Cold Weather Concreting
7. ACI 309 Guide for Consolidation of Concrete
8. ACI 318 Building Code Requirements for Structural Concrete and Comentary
9. ACI 350 Code Requirements for Environmental Engineering Concrete Structures
10. ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
11. ASTM C 33 Standard Specification for Concrete Aggregates
12. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
13. ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
14. ASTM C 88 Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
15. ASTM C 94 Standard Specification for Ready-Mixed Concrete
16. ASTM C 114 Standard Test Method for Chemical Analysis of Hydraulic Cement
17. ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
18. ASTM C 138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
19. ASTM C 143 Standard Test Method for Slump of Hydraulic Cement Concrete
20. ASTM C 150 Standard Specification for Portland Cement
21. ASTM C 172 Standard Practice for Sampling Freshly Mixed Concrete
22. ASTM C 192 Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

23. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
24. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete
25. ASTM C 295 Standard Guide for Petrographic Examination of Aggregates for Concrete
26. ASTM C 457 Standard Test Method for Microscopical Determination of the Air-Void System in Hardened Concrete
27. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
28. ASTM C 595 Standard Specification for Blended Hydraulic Cements
29. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
30. ASTM C 989 Standard Specification for Slag Cement for Use in Concrete and Mortars
31. ASTM C 1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
32. ASTM C 1260 Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)
33. ASTM C 1567 Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
34. ASTM C 1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
35. ASTM C 1778 Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 1. Sources of all materials and certifications of compliance with specifications for all materials.
 2. Certified current (less than 1 year old) chemical analysis of the Portland Cement or Blended Cement to be used.
 3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.

4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, potential reactivity, aggregate soundness tests, petrographic analysis, mortar bar expansion testing, etc.
5. Manufacturer's data on all admixtures stating compliance with required standards.
6. Concrete mix design for each class of concrete specified herein.
7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

1.05 QUALITY ASSURANCE

- A. Tests on materials used in the production of concrete shall be required as specified in PART 2 -- PRODUCTS. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.
- B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the Owner.
- C. Field quality control tests, as specified in Article 3.10, unless otherwise stated, will be performed by a materials testing consultant employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

PART 2 -- PRODUCTS

2.01 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.02 or 2.03 respectively.
2. When potentially reactive aggregates as defined in Article 2.05 are to be used in concrete mix, cement shall meet the following requirements:
 - a. For concrete mixed with only Portland Cement, the total alkalis in the cement (calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.40%.
 - b. For concrete mixed with Portland Cement and an appropriate amount of fly ash (Article 2.02) or slag cement (Article 2.03) the total alkalis in the Portland Cement (calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85%.

3. When non-reactive aggregates as defined in Article 2.05 are used in concrete mix, total alkalis in the cement shall not exceed 1.0%.
4. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Slag Cement) conforming to ASTM C 595.
2. Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.
3. Type IS cement shall be an interground blend of Portland Cement and slag cement in which the slag constituent is between 35% and 50% of the weight of the total blend.
4. Fly ash and slag cement used in the production of blended cements shall meet the requirements of Articles 2.02 and 2.03, respectively.
5. When reactive aggregates as defined in Article 2.05 are used in concrete mix, the total alkalis in the Portland Cement (calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85%. The percentage of fly ash or slag cement shall be set to meet provisions of Article 2.05.G.2.

C. Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

- A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618.
- B. For fly ash to be used in the production of type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.
- C. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the fly ash constituent shall be between 15% and 25% of the total weight of the combined Portland Cement and fly ash. The percentage of fly ash shall be set to meet the mean mortar bar expansion requirements in provisions of Article 2.05.G.2.

- D. For Type A1 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.
- E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2.03 SLAG CEMENT

- A. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.
- B. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the slag cement constituent shall be between 35% and 40% of the total weight of the combined Portland Cement and slag. The percentage of slag cement shall be set to meet the mean mortar bar expansion requirements in provisions of Article 2.05.G.2.
- C. For Type A1 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.
- D. Additional slag cement shall not be included in concrete mixed with type IS or IP cement.

2.04 WATER

- A. Water used for mixing concrete shall be clear, potable and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts and other impurities.
- B. Water shall not contain more than 100 PPM chloride.
- C. Water shall not contain more than 500 PPM dissolved solids.
- D. Water shall have a pH in the range of 4.5 to 8.5.
- E. Water shall meet requirements of ASTM C 1602.

2.05 AGGREGATES

- A. All aggregates used in normal weight concrete shall conform to ASTM C 33.
- B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.
- C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.
- D. For Class A4 concrete, coarse aggregate shall be Size #8 in accordance with ASTM C33.

- E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.
- F. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.
- G. All aggregates shall be evaluated in accordance with ASTM C 1778 to determine potential reactivity. All aggregates shall be considered reactive unless they meet the requirements below for non-reactive aggregates. Aggregates with a lithology essentially similar to sources in the same region found to be reactive in service shall be considered reactive regardless of the results of the tests above.

1. Non-reactive aggregates shall meet the following requirements:

A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Non-reactive aggregates shall meet the following limitations:

- (a) Optically strained, microfractured, or microcrystalline quartz, 5.0%, maximum.
- (b) Chert or chalcedony, 3.0%, maximum.
- (c) Tridymite or cristobalite, 1.0%, maximum.
- (d) Opal, 0.5%, maximum.
- e) Natural volcanic glass in volcanic rocks, 3.0%, maximum.

2. Concrete mixed with reactive aggregates shall meet the following requirements:

- (a) If aggregates are deemed potentially reactive as per ASTM C-1778 and fly ash or slag cement is included in proposed concrete mix design, proposed concrete mix including proposed aggregates shall be evaluated by ASTM C-1567. Mean mortar bar expansions at 16 days shall be less than 0.08%. Tests shall be made using exact proportion of all materials proposed for use on the job in design mix submitted.
- (b) If aggregates are deemed potentially reactive as per ASTM C-1778 and a straight cement mix without fly ash or slag cement is proposed for concrete mix design, aggregates shall be evaluated by ASTM C-1260. Mean mortar bar expansions at 16 days shall be less than 0.08%.

- H. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.07 ADMIXTURES

- A. Admixtures containing intentionally added chlorides shall not be used.

- B. Admixtures containing 1,4 Dioxane shall not be used in Projects located in a State or Commonwealth where 1,4 Dioxan limits are required.
- C. Air entraining agent shall be added to all concrete unless noted otherwise. The agent shall consist of a neutralized vinsol resin solution or a purified hydrocarbon with a cement catalyst which will provide entrained air in the concrete in accordance with ASTM C 260. The admixture proposed shall be selected in advance so that adequate samples may be obtained and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.
- D. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set. Admixtures permitted shall confirm to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.
1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are "Eucon Series" by the Euclid Chemical Company, "Master Pozzoloth Series" by BASF, and "Plastocrete Series" by Sika Corporation.
 2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at either the batch plant or at the job site and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are "Eucon 37" or Plastol 5000 by the Euclid Chemical Company, "Master Rheobuild 1000 or Master Glenium Series" by BASF, and "Daracem 100 or Advaflo Series" by W.R. Grace.
 3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.
 4. A water reducing retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type D and shall not contain more than 0.05% chloride ions. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "Pozzoloth Retarder" by BASF, and "Plastiment" by Sika Corporation.
- E. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.

- F. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

2.08 CONCRETE MIX DESIGN

- A. The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or preferably laboratory trial mixes in conformance with Section 5.3. "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350. When trial mixes are used they shall also conform to Article 3.01 of this Section of the Specifications. If field experience records are used, concrete strength results shall be from concrete mixed with all of the ingredients proposed for use on job used in similar proportions to mix proposed for use on job. Contractor shall submit verification confirming this stipulation has been followed. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

- B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

- 1. Compressive Strength (28-Day)

- b. Concrete Class A2 4,000 psi (minimum)
 - c. Concrete Class B 3,000 psi (minimum)

- 2. Water/cementitious materials ratio, by weight

- | | Maximum | Minimum |
|----------------------|---------|---------|
| b. Concrete Class A2 | 0.45 | 0.39 |
| c. Concrete Class B | 0.50 | 0.39 |

- 3. Slump range

4" nominal unless high range water reducing admixture is used.
8" max if high range water reducing admixture is used.

- 4. Air Content

- a. Class A2 6% ±1.5%
 - b. Class B 3% Max (non air-entrained)

PART 3 -- EXECUTION

3.01 TRIAL MIXES

- A. When trial mixes are used to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350, an independent qualified testing laboratory designated and retained by the Contractor shall test a trial batch of each of the preliminary concrete mixes submitted

by the Contractor. The trial batches shall be prepared using the aggregates, cement and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PART 2 -- PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the Owner.

- B. The independent testing laboratory shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and unit weight (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. _____, Product _____." If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the Owner. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

3.02 PRODUCTION OF CONCRETE

- A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready mix plant or from a site mixed plant. In selecting the source for concrete production the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.
- B. Ready-Mixed Concrete
 - 1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
 - 2. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
 - 3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
 - 4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4

points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.

5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed before the drum has been revolved 300 revolutions and within the time requirements stated in Article 3.03 of this Section.
6. Each and every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:
 - a. Date and truck number
 - b. Ticket number
 - c. Mix designation of concrete
 - d. Cubic yards of concrete
 - e. Cement brand, type and weight in pounds
 - f. Weight in pounds of fine aggregate (sand)
 - g. Weight in pounds of coarse aggregate (stone)
 - h. Air entraining agent, brand, and weight in pounds and ounces
 - i. Other admixtures, brand, and weight in pounds and ounces
 - j. Water, in gallons, stored in attached tank
 - k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio
 - l. Water, in gallons, actually used (by truck driver)
 - m. Time of loading
 - n. Time of delivery to job (by truck driver)
7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.
8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

C. Site Mixed Concrete

1. Scales for weighing concrete ingredients shall be accurate when in use within ± 0.4 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.
2. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:

- | | | |
|----|---------------------------------|-------------|
| a. | Cement, fly ash, or slag cement | ± 1 percent |
| b. | Water | ± 1 percent |
| c. | Aggregates | ± 2 percent |
| d. | Admixtures | ± 3 percent |
3. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.
 4. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.
 5. Mixers with a rate capacity of 1 cu.yd. or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.
 6. Except as provided below, batches of 1 cu. yd. or less shall be mixed for not less than 1 minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.
 7. Shorter mixing time may be permitted provided performance tests made in accordance with of ASTM C 94 indicate that the time is sufficient to produce uniform concrete.
 8. Controls shall be provided to insure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.
 9. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.
 10. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.
 11. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.
 12. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.

13. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C 94.

3.03 CONCRETE PLACEMENT

- A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.
- B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures which are subsequently required.
- C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture or cement grout shall be placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.
- D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.
- E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided that the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix that meets all specified requirements.
- F. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients. It shall be so deposited that rehandling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.09 of this Section.
- G. Where concrete is conveyed to position by chutes, a practically continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such as to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.

- H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in all forms in such way as to prevent any segregation.
- I. Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.
- J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed five (5) feet and a sufficient number shall be placed in the form to ensure the concrete is kept level at all times.
- K. When placing concrete which is to be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.
- L. Concrete shall be placed so as to thoroughly embed all reinforcement, inserts, and fixtures.
- M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. To achieve this, concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.
- N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in the area of freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.
- O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration, however, shall not be continued in any one location to the extent that pools of grout are formed.
- P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall be such as to ensure that each layer is placed while the previous layer is soft or plastic, so that the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.
- Q. To prevent featheredges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.

- R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators so as to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and waterstops, and/or any proposed deviations from the aforementioned to the Engineer for review and approval.
- S. Concrete shall not be placed during rains sufficiently heavy or prolonged to wash mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.04 PLACING FLOOR SLABS ON GRADE

- A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant.
- B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50° long enough to remove all frost from the subgrade.
- C. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.
- D. Thirty-pound felt paper shall be provided between edges of slab-on-grade and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.
- E. Contraction joints shall be provided in slabs-on-grade at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03290 - Joints in Concrete.
- F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03350 - Concrete Finishes. Interior floor slabs shall be placed with non-air-entrained concrete (Class A3) if a steel troweled or hardened finish is required.

3.05 PLACING CONCRETE UNDERWATER (CLASS A5 CONCRETE)

- A. Placing concrete underwater (tremie concrete) will be permitted only when shown on the Drawings. Concrete deposited under water shall be carefully placed in a compacted mass in final position by means of a tremie, a closed bottom dump bucket or other approved method. Care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. Underwater formwork shall be watertight. The consistency of the concrete shall be regulated to prevent segregation of materials. The method of depositing concrete shall be regulated such that the concrete enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete.
- B. Tremie shall consist of a tube having a diameter of not less than 10 inches and constructed in sections having flanged couplings fitted with gaskets. The tremie shall be supported to permit free movement of the discharge and over the entire top surface of the work and shall permit rapid lowering when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the placement has been completed.

3.06 PLACING CONCRETE UNDER PRESSURE

- A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.
- B. Priming of the concrete pumping equipment shall be with cement grout only. Use of specialty mix pump primers or pumping aids will not be allowed.
- C. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.
- D. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a materials testing consultant proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions is required prior to acceptance of the mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated. All submissions shall be subject to approval by the Engineer.
- E. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

- F. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.
- G. The minimum diameter of the hose (conduits) shall be four inches.
- H. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.
- I. Concrete samples for quality control in accordance with Article 3.10 will be taken at the placement (discharge) end of the line.

3.07 ORDER OF PLACING CONCRETE

- A. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in a strip pattern in accordance with ACI 302.1. A minimum of 72 hours shall pass prior to placing concrete directly adjacent to previously placed concrete.

3.08 CONCRETE WORK IN COLD WEATHER

- A. Cold weather concreting procedures shall conform to the requirements of ACI 306.
- B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed the aforementioned minimum values by more than 20°F, unless otherwise approved by the Engineer.
- C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature in excess of 100°F. in order to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories with which the concrete is to come in contact shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

3.09 CONCRETE WORK IN HOT WEATHER

- A. Hot weather concreting procedures shall conform to the requirements of ACI 305.
- B. When air temperatures exceed 85°F., or when extremely dry conditions exist even at lower temperatures, particularly if accompanied by high winds, the Contractor and his concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation and the Engineer reserves the right to modify the proposed measures consistent with the requirements of this Section of the Specifications. All necessary materials and equipment shall be on hand in position prior to each placing operation.

- C. Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.
- D. The temperature of the concrete mix when placed shall not exceed 90°F.
- E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being taken into account. Stockpiled aggregates shall, if necessary, be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, it must be entirely melted prior to addition of the water to the dry mix.
- F. Delivery schedules shall be carefully planned in advance so that concrete is placed as soon as practical after it is properly mixed. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched.
- G. The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

3.10 QUALITY CONTROL

A. Field Testing of Concrete

1. The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.
2. Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall provide assistance to the materials testing consultant in obtaining samples. The Contractor shall dispose of and clean up all excess material.

B. Consistency

1. The consistency of the concrete will be checked by the materials testing consultant by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer and/or the materials testing consultant may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for any delays, material or labor costs due to such eventualities.
2. Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.
3. Concrete with a specified nominal slump shall be placed having a slump within 1" (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Unit Weight

1. Samples of freshly mixed concrete shall be tested for unit weight by the materials testing consultant in accordance with ASTM C 138.
2. Unit weight tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the materials testing consultant in accordance with ASTM C 231.
2. Air content tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.
3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the materials testing consultant and tested for compressive strength in accordance with ASTM C 172, C 31 and C 39, except as modified herein.
2. In general, one sampling shall be taken for each placement in excess of five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater.
3. Each sampling shall consist of at least five (5) 6x12 cylinders or (8) 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The materials testing consultant will fill out the required information on the tag, and the Contractor shall satisfy himself that such information shown is correct.
4. The Contractor shall be required to furnish labor to the Owner for assisting in preparing test cylinders for testing. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds and such that all specimen are shielded from direct sunlight and/or radiant heating sources. No concrete requiring inspection shall be delivered to the site until such storage curing box has been

provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.

5. The Contractor shall be responsible for maintaining the temperatures of the curing box during the initial curing of test specimens with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Contractor shall maintain a written record of curing box temperatures for each day curing box contains test specimens. Temperature shall be recorded a minimum of three times a day with one recording at the start of the work day and one recording at the end of the work day.
6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.
7. Compression tests shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at seven days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at seven days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.
2. The strength level of concrete will be considered satisfactory if all of the following conditions are satisfied.
 - a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix (see Article 2.08).
 - b. No individual compressive strength test results falls below the minimum specified strength by more than 500 psi.
3. In the event any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.
4. In the event that condition 2B is not met, additional tests in accordance with Article 3.10, paragraph H shall be performed.
5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Contractor shall:
 - a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.
 - b. Maintain or add temporary structural support as required.

- c. Correct the mix for the next concrete placement operation, if required to remedy the situation.
- 6. All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at no additional cost to the Owner.
- G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.
- H. Additional Tests
 - 1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.
 - 2. In the event the 28-day test cylinders fail to meet the minimum strength requirements as outlined in Article 3.10, paragraph F, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.
 - a. Three cores shall be taken for each sample in which the strength requirements were not met.
 - b. The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by a materials testing consultant approved by the Engineer.
 - c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.
 - d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.
 - e. The diameter of core specimens should be at least 3 times the maximum nominal size of the course aggregate used in the concrete, but must be at least 2-inches in diameter.
 - f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.
 - g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.
 - h. Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.
 - 3. In the event that concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage a materials testing consultant

approved by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.

3.11 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.
- B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.
- C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.
- D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced, or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system, unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the Owner.
- E. Concrete which fails to meet the strength requirements as outlined in Article 3.10, paragraph F, will be analyzed as to its adequacy based upon loading conditions, resultant stresses and exposure conditions for the particular area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the Owner. The method of strengthening or extent of replacement shall be as directed by the Engineer.

- END OF SECTION -

SECTION 03350
CONCRETE FINISHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 – Concrete Formwork
- B. Section 03300 – Cast-in-Place Concrete
- C. Section 03600 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 – Specifications for Structural Concrete for Buildings
 - 2. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Manufacturer's literature on all products specified herein.

PART 2 -- PRODUCTS

2.01 CONCRETE FLOOR SEALER

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

2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

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

2.03 NON-METALLIC FLOOR HARDENER

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

2.04 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

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

2.05 NON-SLIP FLOORING ADDITIVE

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

PART 3 -- EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

- A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.05 - Concrete Finish Schedule. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.
 - 1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than 1/4-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than 1/4-inch in any dimension. Honeycombs shall be chipped

back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.
3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

- A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.
 1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2" minimum deep grooves prior to final set.
 2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.
 3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.

4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.
5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.
6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03600 shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations.
7. Type "G" Hardened Finish: This finish shall be applied after completion of a Type "B" or Type "C" finish and prior to application of a Type "D" finish. Hardeners shall be applied in strict accordance with the manufacturer's requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising 2/3 of the total amount. Type "D" finish shall be applied following completion of application of the hardener.
 - a. Non-metallic floor hardener shall be applied where specifically required on the Contract Drawings at the rate of 1.0 pounds/ft.².
 - b. Non-oxidizing heavy duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Contract Drawings or specified herein at the rate of 1.5 pounds/ft.².
8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.
9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of ±1/4 inch.

3.03 CONCRETE SEALERS

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

3.04 FINISHES ON EQUIPMENT PADS

- A. Formed surfaces of equipment pads shall receive a Type III finish.
- B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 CONCRETE FINISH SCHEDULE

Item	Type of Finish
All other exposed concrete surfaces not specified elsewhere	II
All interior finish floors of buildings and structures which are not continuously or intermittently wet	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E

- END OF SECTION -

SECTION 03370
CONCRETE CURING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 – Concrete Formwork
- B. Section 03300 – Cast-In-Place Concrete
- C. Section 03350 – Concrete Finishes

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 – Specifications for Structural Concrete for Buildings
 - 2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 3. ACI 305 – Hot Weather Concreting
 - 4. ACI 306 – Cold Weather Concreting
 - 5. ACI 308 – Standard Practice for Curing Concrete
 - 6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete
 - 7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.04 SUBMITTALS

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

1. Proposed procedures for protection of concrete under wet weather placement conditions.
2. Proposed normal procedures for protection and curing of concrete.
3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
4. Proposed method of measuring concrete surface temperature changes.
5. Manufacturer's literature and material certification for proposed curing compounds.

PART 2 -- PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

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

2.02 EVAPORATION REDUCER

- A. Evaporation reducer shall be "MasterKure ER 50" by Master Builders Solutions, or "Euco-Bar" by Euclid Chemical Company.

PART 3 -- EXECUTION

3.01 PROTECTION AND CURING

- A. All freshly placed concrete shall be protected from the elements, flowing water and from defacement of any nature during construction operations.
- B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a 5-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.
- C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days. Use of a curing compound will not be acceptable for applications of this type.

- D. The Contractor shall use one of the following methods to insure that the concrete remains in a moist condition for the minimum period stated above.
 - 1. Ponding or continuous fogging or sprinkling.
 - 2. Application of mats or fabric kept continuously wet.
 - 3. Continuous application of steam (under 150°F).
 - 4. Application of sheet materials conforming to ASTM C171.
 - 5. If approved by the Engineer, application of a curing compound in accordance with Article 3.04.
- E. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in paragraph D.
- F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

- A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03300, Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.
- B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.
- C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.
- D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

- A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to

guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.

- B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.
- C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.
- D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least six (6) additional days using one of the methods listed in paragraph 3.01D.
- E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

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

3.05 EARLY TERMINATION OF CURING

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

2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

- END OF SECTION -

SECTION 03600

GROUT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

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

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

- | | | |
|----|-------------|---|
| 1. | CRD-C 621 | Corps of Engineers Specification for Non-shrink Grout |
| 2. | ASTM C 109 | Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens) |
| 3. | ASTM C 531 | Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing |
| 4. | ASTM C 579 | Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing |
| 5. | ASTM C 827 | Standard Test Method for Early Volume Change of Cementitious Mixtures |
| 6. | ASTM C 144 | Standard Specification for Aggregate for Masonry Mortar |
| 7. | ASTM C 1107 | Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink) |

1.04 SUBMITTALS

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

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.
2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.
 - a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.
 - b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.
2. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.
3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength

requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4000 psi.
3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.
4. Sand shall conform to the requirements of ASTM C144.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "SikagROUT 212" by Sika Corporation, "Conspec 100 Non-Shrink Non-Metallic Grout" by Conspec, "Masterflow 555 Grout" by BASF Master Builder Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, "MasterEmaco ADH 1090 RS" by BASF Master Builder Solutions.
2. Epoxy grout shall be modified as required for each particular application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be "Sikadur 42, Grout-Pak" by Sika Corporation, or "Masterflow 648" by BASF Master Builder Solutions.

2.02 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03370, Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 -- EXECUTION

3.01 GENERAL

- A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents

which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.

1. Cement grout shall be used for grout toppings and for patching of fresh concrete.
 2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.
 3. Epoxy grout shall be used for bonding new concrete to hardened concrete.
 4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.
- B. New concrete surfaces to receive cement grout shall be as specified in Section 03350, Concrete Finishes, and shall be cleaned of all dirt, grease and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03370, Concrete Curing.
- C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.
- 3.02 CONSISTENCY
- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.
- 3.03 MEASUREMENT OF INGREDIENTS
- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.
- 3.04 GROUT INSTALLATION
- A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be poured from one side only and thence flow across to the open side to avoid air-entrapment.

- END OF SECTION -

SECTION 05010
METAL MATERIALS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials for fasteners are included in Section 05050, Metal Fastening.
- B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM A36 Standard Specification for Structural Steel
- B. ASTM A47 Standard Specification for Malleable Iron Castings
- C. ASTM A48 Standard Specification for Gray Iron Castings
- D. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- E. ASTM A167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- F. ASTM A276 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
- G. ASTM A307 Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
- H. ASTM A446 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality
- I. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- J. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- K. ASTM A529 Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)

- L. ASTM A536 Standard Specification for Ductile Iron Castings
 - M. ASTM A570 Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
 - N. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 - O. ASTM A992 Standard Specification for Structural Steel Shapes
 - P. ASTM A666 Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
 - Q. ASTM A1085 Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
 - R. ASTM B26 Standard Specification for Aluminum-Alloy Sand Castings
 - S. ASTM B85 Standard Specification for Aluminum-Alloy Die Castings
 - T. ASTM B108 Standard Specification for Aluminum-Alloy Permanent Mold Castings
 - U. ASTM B138 Standard Specification for Manganese Bronze Rod, Bar, and Shapes
 - V. ASTM B209 Standard Specification for Aluminum-Alloy Sheet and Plate
 - W. ASTM B221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
 - X. ASTM B308 Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
 - Y. ASTM B574 Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod
 - Z. ASTM F468 Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
 - ZZ. ASTM F593 Standard Specification for Stainless Steel Fasteners
- 1.04 SUBMITTALS
- A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.
- 1.05 QUALITY ASSURANCE
- A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing

materials the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 -- PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

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

- | | | |
|----|---|-----------------------|
| 1. | Steel W Shapes | A992 |
| 2. | Steel HP Shapes | A572 Grade 50 |
| 3. | Steel M, S, C, and MC shapes and Angles, Bars, and Plates | A36 |
| 4. | Rods | F 1554 Grade 36 |
| 5. | Pipe - Structural Use | A53 Grade B |
| 6. | Hollow Structural Sections | A500 Grade C or A1085 |
| 7. | Cold-Formed Steel Framing | A 653 |

2.02 STAINLESS STEEL

A. All stainless steel fabrications exposed to underwater service shall be Type 316. All other stainless steel fabrications shall be Type 304, unless noted otherwise.

B. Material types and ASTM designations are listed below:

- | | | |
|----|-------------------------|---------------------------|
| 1. | Plates and Sheets | ASTM A167 or A666 Grade A |
| 2. | Structural Shapes | ASTM A276 |
| 3. | Fasteners (Bolts, etc.) | ASTM F593 |

2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

- | | | |
|----|---------------------------------|------------------------|
| 1. | Structural Shapes | ASTM B308 |
| 2. | Castings | ASTM B26, B85, or B108 |
| 3. | Extruded Bars | ASTM B221 - Alloy 6061 |
| 4. | Extruded Rods, Shapes and Tubes | ASTM B221 - Alloy 6063 |
| 5. | Plates | ASTM B209 - Alloy 6061 |
| 6. | Sheets | ASTM B221 - Alloy 3003 |

- C. All aluminum structural members shall conform to the requirements of Section 05140, Structural Aluminum.
- D. All aluminum shall be provided with mill finish unless otherwise noted.
- E. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

2.04 CAST IRON

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

- | | | |
|----|-----------|--------------------------|
| 1. | Gray | ASTM A48 Class 30B |
| 2. | Malleable | ASTM A47 |
| 3. | Ductile | ASTM A536 Grade 60-40-18 |

2.05 BRONZE

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

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

2.06 HASTELLOY

- A. All Hastelloy shall be Alloy C-276.

2.07 DISSIMILAR METALS

- A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			•	•	•	•	•	•	•
Galvanized Steel			•	•	•	•	•	•	•
Aluminum	•	•		•	•	•	•	•	•
Cast Iron	•	•	•				•	•	•
Ductile Iron	•	•	•				•	•	•
Mild Steel/ Carbon Steel	•	•	•				•	•	•
Copper	•	•	•	•	•	•			•
Brass	•	•	•	•	•	•			•
Stainless Steel	•	•	•	•	•	•	•	•	
1. "•" signifies dielectric isolation is required between the two materials noted. 2. Consult Engineer for items not listed in table.									

PART 3 -- EXECUTION

(NOT USED)

- END OF SECTION -

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SECTION 05035

GALVANIZING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

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

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

1. Virginia Construction Code
2. ASTM A123 - Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
5. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
6. ASTM A780 - Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings
7. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

1.04 SUBMITTALS

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

PART 2 -- PRODUCTS

2.01 GALVANIC COATING

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

PART 3 -- EXECUTION

3.01 FABRICATED PRODUCTS

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

3.02 HARDWARE

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

3.03 ASSEMBLED PRODUCTS

- A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.
- B. Assemblies shall be provided with vent and drain holes as required by the fabricator. Vent and drain hole sizes and locations shall be included in the structural steel shop drawings required in Specification 05120 Structural Steel for approval. All vent and drain holes shall be plugged and finished to be flush with and blend in with the surrounding surface. Where

water intrusion can occur, the plug shall be carefully melted into the surrounding zinc coating using an appropriate fluxing agent.

3.04 METAL DECK

- A. Unless noted otherwise, metal deck shall be galvanized in accordance with ASTM A653 G60 minimum. In moist environments or as indicated on the Contract Drawings, galvanizing shall meet the requirements of ASTM A653 G90.
- B. Galvanized metal deck shall meet the requirements of ASTM A924.

3.05 REPAIR OF GALVANIZING

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

- END OF SECTION -

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SECTION 05050
METAL FASTENING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

1. 2015 Virginia Uniform Statewide Building Code
2. AC 193 Acceptance Criteria for Mechanical Anchors in Concrete Elements
3. AC 308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
4. ACI 318 Building Code Requirements for Structural Concrete
5. ACI 355.2 Qualifications of Post-Installed Mechanical Anchors in Concrete
6. ACI 355.4 Qualifications of Post-Installed Adhesive Anchors in Concrete
7. AISC 348 The 2009 RCSC Specification for Structural Joints
8. AISC Code of Standard Practice
9. AWS D1.1 Structural Welding Code - Steel
10. AWS D1.2 Structural Welding Code - Aluminum
11. AWS D1.6 Structural Welding Code – Stainless Steel
12. Aluminum Association Specifications for Aluminum Structures
13. ASTM A572/A572M-94C Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50

- | | | |
|-----|------------|--|
| 14. | ASTM A36 | Standard Specification for Carbon Structural Steel |
| 15. | ASTM A325 | Standard Specification for High-Strength Bolts for Structural Steel Joints |
| 16. | ASTM A489 | Standard Specification for Eyebolts |
| 17. | ASTM A490 | Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints |
| 18. | ASTM A563 | Standard Specifications for Carbon and Alloy Steel Nuts |
| 19. | ASTM D1785 | Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe |
| 20. | ASTM E488 | Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements |
| 21. | ASTM F436 | Standard Specification for Hardened Steel Washers |
| 22. | ASTM F467 | Standard Specification for Nonferrous Nuts for General Use |
| 23. | ASTM F593 | Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs |
| 24. | ASTM F594 | Standard Specification for Stainless Steel Nuts |
| 25. | ASTM F1554 | Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength |

1.04 SUBMITTALS

A. Submit the following:

1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of Virginia. Only required if design not shown on Contract Drawings.
3. Manufacturer's installation instructions.
4. Copy of valid certification for each person who is to perform field welding.
5. Certified weld inspection reports, when required.
6. Welding procedures.

7. Installer qualifications.
8. Certification of Installer Training.
9. Inspection Reports.
10. Results of Anchor Proof Testing.

1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- C. Installer Training: For concrete adhesive anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process to include but not be limited to the following:
 1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Concrete adhesive anchor preparation and installation.
 5. Proof loading/torquing.
- D. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.
- E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.
- F. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.

- G. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.
- H. Inspections of the adhesive dowel system shall be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injections, installation, and proof testing.

PART 2 -- PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

- A. Anchor rods shall conform to ASTM F1554 Grade 36 except where stainless steel or other approved anchor rods are shown on the Drawings. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A.
- B. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.
- C. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

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

2.03 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless steel members not subject to the above conditions shall be Type 316 stainless steel unless otherwise noted.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

A. General

1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:
 - a. Expansion anchors shall be mechanical anchors of the wedge, sleeve, drop-in or undercut type.
 - b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.
2. Expansion anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.
3. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.
4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Expansion or mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193. Anchors in Seismic Design Categories C through F shall conform to the International Building Code and ACI 318 Appendix D requirements as applicable, including seismic test requirements.
5. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.
6. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Concrete Anchor Design:

An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

1. Structural Anchors: All concrete anchors shall be considered structural anchors if they transmit load between structural elements; transmit load between non-structural components that make up a portion of the structure and structural elements; or transmit load between life-safety related attachments and structural elements. Examples of structural concrete anchors include but are not limited to column anchor bolts, anchors supporting non-structural walls, sprinkler piping support anchors, anchors supporting heavy, suspended piping or equipment, anchors supporting barrier rails, etc. For structural anchors, the Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State of Virginia. Structural anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Appendix D.
2. Non-Structural Anchors: All other concrete anchors may be considered non-structural concrete anchors. The Contractor shall perform an engineered design for non-structural anchors. The Engineer may request the Contractor provide anchor design details for review, but submission of a signed, sealed design is not required. Non-structural anchors shall be designed by the contractor for use in uncracked concrete.
3. Embedment Depth
 - a. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor's engineered design in accordance with requirements of manufacturer of anchor system.
 - b. Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).
 - c. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

C. Structural Anchors:

1. Mechanical Anchors:
 - a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "TruBolt +" by ITW Redhead, "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Powerstud SD-1" or "Powerstud SD-2" by Powers Fasteners.
 - b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" by Simpson Strong-Tie Co., or "Wedge-Bolt +" by Powers Fasteners. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.

- c. Sleeve Anchors: Sleeve anchors shall be “HSL-3 Heavy Duty Sleeve Anchor” by Hilti, Inc. or “Power-Bolt +” by Powers Fasteners.
 - d. Undercut Anchors: Undercut anchors shall be “HDA Undercut Anchor” by Hilti, Inc., “Torq-Cut Undercut Anchor” by Simpson Strong-Tie Co., “Atomic + Undercut Anchor” by Powers Fasteners
2. Adhesive Anchors:
- a. Adhesive anchors shall be “Epcon C6+ Adhesive Anchoring System” by ITW Redhead, “HIT HY-200 Adhesive Anchoring System” by Hilti, Inc., “AT-XP” or “SET-XP Epoxy Adhesive Anchors” by Simpson Strong-Tie Co., or “PE-1000+ Epoxy Adhesive Anchor System” by Powers Fasteners.
 - b. Structural adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Structural adhesive anchor systems shall comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the applicable building code. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner.**
- D. Non-Structural Anchors: In addition to the acceptable non-structural anchors listed below, all structural anchors listed above may also be used as non-structural anchors.
1. Mechanical Anchors:
- a. Wedge Anchors: Wedge anchors shall be “Kwik Bolt 3” by Hilti, Inc., “Wedge-All” by Simpson Strong-Tie Co. or “TruBolt” by ITW Redhead.
 - b. Screw Anchors: Screw anchors shall be “Kwik HUS” by Hilti, Inc., “Wedge-Bolt” by Powers Fasteners “Large Diameter Tapcon (LDT) Anchor” by ITW Redhead, or “Titen HD” by Simpson Strong-Tie Co. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
 - c. Sleeve Anchors: Sleeve anchors shall be “HSL Heavy Duty Sleeve Anchors” by Hilti, Inc. “Power-Bolt” by Powers Fasteners “Dynabolt Sleeve Anchor” by ITW Redhead, or “Sleeve-All” by Simpson Strong-Tie Co.
 - d. Drop-In Anchors: Drop-in anchors shall be “Drop-In” by Simpson Strong-Tie Co., “HDI Drop-In Anchor” by Hilti, Inc. or “Multi-Set II Drop-In Anchor” by ITW Redhead.
 - e. Undercut Anchors: Undercut anchors shall be “HDA Undercut Anchor” by Hilti, Inc., or “Torq-Cut” by Simpson Strong-Tie Co.

2. Adhesive Anchors:

- a. Adhesive anchors shall be “Epcon A7” or “Epcon C6+ Adhesive Anchoring System” by ITW Redhead, “HIT HY-200 Adhesive Anchoring System” by Hilti, Inc., “SET Epoxy Tie High Strength Anchoring Adhesive” or “AT High Strength Anchoring Adhesive” by Simpson Strong-Tie Co., or “Powers AC 100+ Gold Vinylester Injection Adhesive Anchoring System” or “T308+ Epoxy Adhesive Injection System” by Powers Fasteners.
- b. Non-structural adhesive anchors systems shall be IBC compliant and capable of resisting short term wind and seismic (Seismic Design Categories A and B) as well as long term and short term sustained static loads in uncracked concrete.
- c. Non-structural adhesive anchor embedment depth of the rod shall provide a minimum allowable bond strength that is equal to the allowable yield capacity of the rod unless noted otherwise on the Drawings.
- d. **No or equal products will be considered unless prequalified and approved by the Engineer and Owner.**

E. Concrete Anchor Rod Materials:

1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer’s recommendations for proposed adhesive system, but shall not have a yield strength (f_y) less than 58 ksi nor an ultimate strength (f_u) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.
2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 316 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.
3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.05 MASONRY ANCHORS

- A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.
- B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust with nylon (not wire) brush prior to installation of adhesive and anchor. Contractor shall follow manufacturer’s installation instructions. The adhesive system shall be “HIT HY-70 System” as manufactured by Hilti, Inc., or “SET-XP Epoxy-Tie or “AT-XP Acrylic-Tie” as manufactured by Simpson Strong-Tie Co.

- C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (fy) less than 58 ksi nor an ultimate strength (fu) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.
- D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 316 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

2.06 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.07 WELDED STUD CONNECTORS

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

2.08 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.09 HASTELLOY FASTENERS

- A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.10 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 -- EXECUTION

3.01 MEASUREMENTS

- A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

- A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.
2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.
4. All stainless steel threads shall be coated with antiseize lubricant.

B. High Strength Bolts

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

C. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.
2. Concrete anchors designed by the Contractor shall be classified as structural or non-structural based on the requirements indicated above.
3. Concrete Anchor Testing:
 - a. At all locations where concrete anchors meet the requirements for structural anchors at least 10 percent of all concrete anchors installed shall be proof tested, with a minimum of one tested anchor per anchor group. Load for proof testing shall be determined by anchor manufacturer.
 - b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.
 - c. Where Contract Documents indicate anchorage design to be the Contractor's responsibility and the anchors are considered structural per

the above criteria, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the Commonwealth of Virginia. The Contractor's Engineer shall also submit documentation indicating the Contractor's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E488.

- d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.
 - e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.
- 4. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.
 - 5. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. . Injection of adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

D. Other Bolts

- 1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.
- 2. All stainless steel bolts shall be coated with antiseize lubricant.

3.03 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

- A. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required.
- B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.
- C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

- A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

- END OF SECTION -

SECTION 05061
STAINLESS STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

- A. The Contractor shall furnish, install and erect the stainless steel work as shown on the Contract Drawings and specified herein.
- B. Stainless steel work shall be furnished complete with all accessories, mountings and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 05010 - Metal Materials
- C. Section 05050 - Metal Fastening

1.03 REFERENCES

- A. ASTM A193 - Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
- B. ASTM A194 - Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
- C. ASTM A262 - Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel.
- D. ASTM A276 - Stainless and Heat-Resisting Steel Bars and Shapes.
- E. ASTM A314 - Stainless and Heat-Resisting Steel Billets and Bars for Forging.
- F. ASTM A380 - Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems.
- G. ASTM A473 - Stainless and Heat-Resisting Steel Forgings.
- H. ASTM A666 - Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar.
- I. ASTM A774 - Stainless Steel Pipe Fittings
- J. ASTM A778 - Stainless Steel Pipe

- K. ASTM F593 - Stainless Steel Bolts, Hex Cap Screws and Studs.
- L. ASTM F594 - Stainless Steel Nuts.
- M. ANSI/ASME B1.1 - Unified Inch Screw Thread (UN and UNR Thread Form).

1.04 TESTS

- A. All stainless steel materials including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.
- B. Sample selection for the susceptibility to intergranular attack tests shall be as follows:
 - 1. One (1) sample per heat treatment lot for plates and forgings;
 - 2. One (1) sample per each Welding Procedure Qualification regardless of the joint design;
 - 3. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance.
 - 4. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

1.05 SUBMITTALS

- A. The Contractor shall prepare and submit for approval shop drawings for all stainless steel fabrication in accordance with Section 01300, Submittals.
- B. Submittals shall include, but not be limited to, the following:
 - 1. Certified test reports for susceptibility to intergranular attack.
 - 2. Affidavit of compliance with type of stainless steel shown on the Contract Drawings or specified herein.
 - 3. Certified weld inspection reports.
 - 4. Cleaning and handling of stainless steel in accordance with Paragraph 3.04, Cleaning and Handling.

- C. Samples of finish, on each type of stainless steel to be furnished, shall be submitted to the Engineer upon request.

1.06 QUALITY ASSURANCE

- A. Shop inspections may be made by the Engineer. The Contractor shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.
- B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of the Contract Drawings or the Specifications.
- C. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship.

1.07 HANDLING, STORAGE AND DELIVERY

- A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material shall not be permitted and is cause for rejection. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically-passivated surface.
- B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.
- C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.
- D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.
- E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.
- F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.
- G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be supported above ground surfaces on wood runners and protected with approved effective and durable covers.
- H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

1.08 FIELD MEASUREMENTS

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

PART 2 -- PRODUCTS

2.01 MATERIALS AND FINISHES

- A. Stainless steel shall be Type 304 unless it is used for underwater service. Stainless steel for underwater service shall be Type 316. Minimum mechanical finish shall be No. 4 as stated in Table 2 unless otherwise noted on the Contract Drawings.
- B. The basic mill forms (sheet, strip, plate and bar) are classified by size as shown on Table 1. Tables 2, 3 and 4 identify finishes and conditions in which sheet, bar and plate are available.
- C. Tables 2, 3 and 4 show numbered finishes and conditions for sheet, bar and plate. While there are no specific designations for polished finishes on bar or plate, the sheet finish designations are used to describe the desired effect. This also applies to finishes on ornamental tubing.
- D. There are three standard finishes for strip, which are broadly described by the finishing operations employed:
 - 1. No. 1 Strip Finish

No. 1 strip finish is approximately the same as No. 2D Sheet Finish. It varies in appearance from dull gray matte to a fairly reflective surface, depending largely on alloy composition and amount of cold reduction.
 - 2. No. 2 Strip Finish is approximately the same as a No. 2B sheet finish. It is smoother, more reflective than No. 1, and likewise varies with alloy composition.
 - 3. Bright annealed finish is a highly reflective finish that is retained by final annealing in a controlled atmosphere furnace.

Table 1

Classification of Stainless Steel Product Form

Item	Description	Dimensions		
		Thickness	Width	Diameter or Size
Sheet	Coils and cut length: Mill finishes Nos. 1, 2D and 2B Polished finishes Nos. 3, 4, 6, 7 & 8	under 3/16" under 3/16"	24" and over all widths	-- --
Strip	Cold finished, coils or cut lengths Polished finishes Nos. 3, 4, 6, 7 & 8	under 3/16" under 3/16"	under 24" all widths	-- --
Plate	Flat rolled or forged	3/16" and over	over 10"	--
Bar	Hot finished rounds, squares, octagons and hexagons Hot finished flats	-- 1/8" to 8" incl.	-- 1/4" to 10" incl.	1/4" and over --
	Cold finished rounds, squares, octagons and hexagons Cold finished flats	-- 1/8" to 4-1/2"	-- 3/8" to 4-1/2"	over 1/8" --
Wire	Cold finishes only: (in coil) Round, square, octagon, hexagon and flat wire	under 3/16"	under 3/8"	--
Pipe & Tubing	Several different classifications, with differing specifications, are available.			
Extrusion	Not considered "standard" shapes. Currently limited in size to approximately 6-1/2" diameter or structurals.			

Table 2

Standard Mechanical Sheet Finishes

<p>Unpolished or Rolled Finishes: No. 1 A rough dull surface which results from hot rolling to the specified thickness followed by annealing and descaling.</p>	<p>No. 4 A polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives. This is a general purpose bright finish with a visible "grain" which prevents mirror reflection.</p>
<p>No. 2D A dull finish which results from cold rolling followed by annealing and descaling, and may perhaps get a final light roll pass through unpolished rolls. A 2D finish is used where appearance is of no concern.</p>	<p>No. 6 A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undesirable, and to contrast with brighter finishes.</p>
<p>No. 2B A bright cold-rolled finish resulting in the same manner as No. 2D finish, except that the annealed and descaled sheet receives a final light roll pass through polished rolls. This is the general purpose cold-rolled finish that can be used as is, or as a preliminary step to polishing.</p>	<p>No. 7 A high reflective finish that is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes.</p>
<p>Polished Finishes: No. 3 An intermediate polish surface obtained by finishing with a 100 grit abrasive. Generally used where a semi-finished polished surface is required. A No. 3 finish usually receives additional polishing during fabrication.</p>	<p>No. 8 The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors.</p>

Table 3
Conditions and Finishes for Bar

Conditions	Surface Finishes¹
Hot worked only	(a) Scale not removed (excluding spot conditioning) (b) Rough turned ² (c) Pickled or blast cleaned and pickled.
Annealed or otherwise heat treated.	(a) Scale not removed (excluding spot conditioning) (b) Rough turned (c) Pickled or blast cleaned and pickled (d) Cold drawn or cold rolled (e) Centerless ground (f) Polished
Annealed and cold worked to high tensile strength ³	(d) Cold drawn or cold rolled (e) Centerless ground (f) Polished

Table 4

Conditions and Finishes for Plate

Condition and Finish	Description and Remarks
Hot rolled	Scale not removed. Not heat treated. Plates not recommended for final use in this condition. ⁴
Hot rolled, annealed or heat treated	Scale not removed. Use of plates in this condition is generally confined to heat resisting applications. Scale impairs corrosion resistance. ¹
Hot rolled, annealed or heat treated, blast cleaned or pickled	Condition and finish commonly preferred for corrosion resisting and most heat resisting applications.
Hot rolled, annealed, descaled and temper passed	Smoother finish for specialized applications.
Hot rolled, annealed, descaled cold rolled, annealed, descaled, optionally temper passed	Smooth finish with greater freedom from surface imperfection than the above.
Hot rolled, annealed or heat treated, surface cleaned and polished	Polished finishes refer to Table 2.

¹ Surface finishes (b), (e) and (f) are applicable to round bars only.

² Bars of the 4xx series stainless steels which are highly hardenable, such as Types 414, 420, 420F, 431, 440A, 440B and 440C, are annealed before rough turning. Other hardenable grades, such as Types 403, 410, 416 and 416Se, may also require annealing depending on their composition and size.

³ Produced in Types 302, 303Se, 304 and 316.

⁴ Surface inspection is not practicable on plates which have not been pickled or otherwise descaled.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.
- B. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.
- C. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.
- D. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.

- E. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

3.02 WELDING

- A. Welding shall be done in a manner that will prevent buckling and in accordance with Specification 05050 – Metal Fastening, and as modified hereinafter.
- B. All welds exposed in the work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.
- C. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to insure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.
- D. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:
 - 1. Use lower weld current setting.
 - 2. Use skip-weld techniques to minimize heat concentration.
 - 3. Use back-up chill bars or other cooling techniques to dissipate heat.
- E. Edges of the stainless steel to be welded shall be cleaned of contaminants.

3.03 FASTENERS

- A. Stainless steel fasteners shall be used for joining stainless steel work.
- B. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

3.04 CLEANING AND HANDLING

- A. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of work. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.
- B. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.
 - 1. The Contractor shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.

2. Area showing clear indications of contamination shall be re-cleaned, re-passivated and re-inspected.
- C. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirt, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.
- D. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.
1. Stainless steel and stainless steel welds shall be cleaned with clean sand free of iron, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.
 2. Approved methods of cutting, grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.
 3. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the work.

3.05 INSTALLATION

- A. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.
- B. All inserts, anchor rods and all other miscellaneous work specified in the Detailed Specifications or shown on the Contract Drawings or required for the proper completion of the work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.
- C. All stainless steel fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved shop drawings.

-END OF SECTION -

SECTION 05120
STRUCTURAL STEEL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

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

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

1.04 SUBMITTALS

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

- c. Detailed drawings indicating jointing, anchoring and connection details and vent and drain holes where required.

1.05 QUALITY ASSURANCE

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

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. Structural Steel
 - 1. Structural steel for W shapes shall conform to ASTM A992 unless otherwise indicated.
 - 2. Structural steel for HP shapes shall conform to ASTM A572 Grade 50 unless otherwise indicated.
 - 3. Structural steel for S, M, C, and MC shapes and angles and plates shall conform to ASTM A36 unless otherwise indicated.
 - 4. Steel pipe shall be ASTM A53, Grade B.
 - 5. HSS shall be ASTM A500, Grade C or ASTM A1085. All members shall be furnished full length without splices unless otherwise noted or accepted by the Engineer.
 - 6. All unidentified steel will be rejected and shall be removed from the site and replaced by the Contractor, all at the expense of the Contractor.
 - 7. Fasteners for structural steel shall be in accordance with Section 05050, Metal Fastening.

B. Welds

1. Electrodes for welding shall be in accordance with Section 05050, Metal Fastening.

PART 3 -- EXECUTION

3.01 MEASUREMENT

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

3.02 FABRICATION

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

3.03 DELIVERY, STORAGE AND HANDLING

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

3.04 ERECTION

- A. The erection of all structural steel shall conform to the applicable requirements of the AISC "Specification for Structural Steel Buildings" and AISC "Code of Standard Practice". All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.

- B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before permanently fastened.
- C. No cutting of structural steel members in the field will be allowed except by the written approval of the Engineer.
- D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.
- E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05050, Metal Fastening.
- F. All bolted connections shall use high strength bolts in accordance with Section 05050, Metal Fastening. High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Bolts specified or noted on the Drawings to be a tension or slip critical "SC" type connection shall be fully pretensioned with proper preparation of the faying surfaces. All other bolts shall be snug tightened unless otherwise noted on the Drawings.
- G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.
- H. Misfits at Bolted Connections
 - 1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.
 - 2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.
 - 3. Where misalignment between anchor rods and rod holes in steel members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.
- I. Grouting of Base Plates and Bearing Plates
 - 1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.
 - 2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.

3. Baseplates shall be grouted with non-shrink grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink grout shall conform to Section 03600, Grout.
 4. Anchor rods shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.
- J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.

3.05 PAINTING

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

- END OF SECTION -

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SECTION 05531

GRATINGS, ACCESS HATCHES, AND ACCESS DOORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all gratings, floor plates, and hatches in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Virginia Construction Code
 - 2. Aluminum Association Specifications for Aluminum Structures
 - 3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Complete fabrication and erection Drawings of all gratings, access hatches, and access doors specified herein.
 - 2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 -- PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used for gratings, floor plates, and hatches shall conform to Section 05010, Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

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

2.03 GRATING

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

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

B. Aluminum Grating

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

C. Aluminum Plank Grating

1. Aluminum plank grating shall be unpunched planks of extruded aluminum welded together to form panels. Panel ends shall have an extruded aluminum end bar welded in place. All support members shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.
2. Aluminum plank grating shall be HD-P manufactured by Harsco Industrial IKG., Heavy Duty Series manufactured by Ohio Gratings, Inc., or Unpunched Duo-Grip Extruded Series manufactured by Alabama Metal Industries Corporation (AMICO).

D. Heavy Duty Steel Grating

1. Heavy duty steel grating shall be galvanized according to Section 05035, Galvanizing.
2. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating. Provide embedded galvanized steel support frames for cast-in-place concrete installations.
3. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for H-20 truck.
4. Grating shall be manufactured by Harsco Industrial IKG, Alabama Metal Industries Corporation (AMICO), and Ohio Gratings, Inc.

2.04 ACCESS HATCHES

- A. Access hatches shall be aluminum unless noted otherwise.
- B. All access hatches shall be checker plate with an approved raised pattern, non-skid surface.
- C. Access hatches shall be designed to carry a minimum live load of 150 psf, or a concentrated load of 300 pounds at the center, whichever produces the greatest stress.
- D. Access hatches shall not exceed an allowable fiber stress of 16,000 psi. Live load deflection shall be limited to $L/240$ of the span, but not more than 1/4-inch.
- E. All access hatches shall be fabricated from 1/4" plate, minimum and shall be stiffened as required to maintain allowable stress and deflection requirements specified herein. Stiffeners shall consist of angles or bars welded to the bottom of the plate.
- F. Hinges, where indicated on the Drawings, shall be insulated, heavy-duty, cadmium plated bronze with stainless steel pins and fasteners.
- G. All access hatches as indicated on the Drawings shall be provided with recessed handles. Handle material shall be as shown on the Contract Drawings.
- H. Air-tight and water-tight access hatches shall be provided with a 1/8 inch thick neoprene gasket between the checkered plate and the support frame. Gasket material shall be bonded to the support frame and access hatches shall be bolted to the structural support frame with countersunk stainless steel flathead screws.

2.05 ACCESS DOORS

A. General

1. Door opening sizes, number and direction of swing of door leaves, and locations shall be as shown on the Drawings. The Drawings shall indicate the clear opening dimensions.

2. All doors shall be aluminum unless otherwise noted.
3. Openings larger than 42 inches in either direction shall have double leaf doors.
4. Doors shall be designed for flush mounting and for easy opening from both inside and outside.
5. All doors shall be provided with an automatic hold-open arm with release handle.
6. Double leaf doors shall be provided with safety bars to go across the open sides of the door, when in the open position. Brackets shall be provided on the underside of the doors to hold the safety bars when not in use.
7. All hardware, including but not limited to, all parts of the latch and lifting mechanism assemblies, hold open arms and guides, brackets, hinges, springs, pins, and fasteners shall be stainless steel.
8. All doors shall be watertight with a continuous gasket. All single door applications shall include a continuous EPDM odor reduction gasket.
9. Door frames shall be extruded and equipped with a 1-1/2 inch minimum drain pipe located by the manufacturer. The drain pipe shall be provided by the Contractor and shall extend to the nearest point of discharge acceptable to the Engineer.

B. Floor, Wet Well and Dry Pit Access Doors

1. Door leaves shall be 1/4 inch, minimum, diamond pattern plate with an approved raised pattern, non-skid surface. Plate shall be stiffened as required to maintain allowable stress and deflection requirements. Stiffeners shall consist of angles or bars welded to the bottom of plate.
2. Doors shall be designed for a 300 psf live load minimum, unless noted otherwise.
3. Doors shall be designed for flush mounting and for easy opening from both inside and outside.
4. All doors shall have an enclosed compression spring assist and open to 90 degrees.
5. Exterior doors shall be Type "J-AL" or "JD-AL", by Bilco Company, Type "W1S" or "W2S" by Halliday Products Inc., Type "TPS" or "TPD", by U.S.F. Fabrication Inc., Type "THG" or "THG-D", by Thompson Fabricating LLC.
6. Interior doors shall be Type "K" or "KD", by Bilco Company, Type "S1S" or "S2S" by Halliday Products Inc., Type "APS300" or "APD300", by U.S.F. Fabrication Inc., Type "TH" or "TH-D", by Thompson Fabricating LLC.
7. Doors rated for H-20 traffic loading shall be "JAL-HD" or "JDAL-HD" by the Bilco Company, Type "H1C" or "H2C" by Halliday Products, Inc., or Type "THS" or "THD" by U.S.F. Fabrication Inc.

C. Roof Access Doors

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

D. Fixed Ladders

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

2.06 FALL THROUGH PREVENTION SYSTEM

- A. All access hatches and access doors covering openings measuring 12 inches or more in its least dimension through which persons may fall shall be equipped with a fall through prevention system, except where noted on the Contract Drawings. Access hatches and access doors shall be provided with a permanent installed fall through prevention grate system that provides continuous safety assurance in both its closed and open positions. The grate system shall be made with 6061-T6 aluminum or FRP and be designed for a 300 psf minimum liveload, unless noted otherwise.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.

- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All gratings, access hatches, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.
- C. Grating shall not be field cut or modified unless approved by Engineer.
- D. Grating shall not be used for equipment support or anchorage.

- END OF SECTION -

SECTION 06100
ROUGH CARPENTRY

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on the Drawings and specified herein.
- B. Principal items of work include:
 - 1. Wood wall, roof rafters, and plywood sheathing.
 - 2. T1-11 Plywood Sheathing
 - 3. Wood blocking, nailers, grounds, furring, ties, centering, etc., necessary or required for attachment or support of work under this Section and other Sections.
 - 4. Fasteners, including nails, screws, bolts, anchors and other fastenings, required to secure work under this Section.
 - 5. Temporary enclosures and protective boarding.
 - 6. Wood preservative treatment for all wood members in contact with roofing, masonry, concrete, and exposed to the elements.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:
 - 1. AWPA-CA – Preservative Standards, Lumber and Plywood
 - 2. AWPA-C20 – Structural Lumber Fire-Retardant Treatment by Pressure Process
 - 3. AWPC-C27 – Plywood Fire-Retardant Treatment by Pressure Process
 - 4. AWPA-M4 – Standards for Care of Preservative Treated Wood Products
 - 5. APA – Guide to Plywood Grades
 - 6. FM 1-49 – Perimeter Flashing

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:
 - 1. Certifications of Preservative and Fire Retardant Treatment.
 - 2. Warranty of treatment manufacturer.
 - 3. Certification of type and grade of lumber to be used.
 - 4. Certification of type, rating and conformance to APA Standards.

1.04 DELIVERY AND STORAGE

- A. Take all measures necessary to protect products against damage during delivery and storage.
- B. Store lumber in enclosed places in such a manner to provide ventilation and protection from the weather.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Blocking, nailers, grounds and the like: Eastern Spruce or Douglas Fir - No. 3 Dimension Lumber or Construction Grade, with a moisture content not to exceed 19%.
- B. Plates, blocking, and nailers in contact with concrete or masonry: Pressure treated southern yellow pine.
- C. Plywood: Identified with APA Grade trademarks of the American Plywood Association, in thickness as shown on the Drawings.
 - 1. Exterior: AC-EXT-APA where exposed to view or a finish is required, CD-EXT-APA where concealed.
 - 2. Interior: AC-INT-APA where exposed to view or a finish is required, CD-INT-APA where concealed.
 - 3. T1-11 Siding softwood plywood.
- D. Structural Framing Lumber: Southern Pine No.1 grade, 19 percent moisture content or equal.
- E. Fasteners: Provide clamps, connectors, straps, nails, bolts, screws, anchors, ties and other accessories and fasteners shown or required to properly secure all rough

carpentry. Fasteners and accessories shall be stainless steel, galvanized, or other noncorrosive metal recommended for use. Fasteners used with pressure treated wood shall be compatible with the wood preservative treatment to prevent corrosion of fasteners.

- F. Wood Preservative Treatment: Waterborne pressure treatment in conformance with the American Wood Preservers' Association standard P5. Retention shall be in accordance with AWWA Standards and be a minimum of 0.40 pounds per cubic foot for contact with or below ground, concrete, or masonry and 0.25 pounds per cubic foot for above ground. Stamp each piece of treated wood with a trademark identifying the classification of the treatment or a certificate from the processor for each shipment.
- G. Fire Retardant Treatment: Fire-retardant lumber and plywood must have an Underwriters Laboratories stamp signifying a FR-S rating and certifying a 25 or less flame spread and smoke developed value, when tested in accordance to UL 723, ASTM E 84, and NFPA 255 "Tunnel Test", and when the test is extended for 20 additional minutes. Treatment formulation shall contain no halogens, sulfates, chlorides or ammonium phosphate. Smoke toxicity shall be no more than that of untreated wood.

PART 3 – EXECUTION

3.01 COORDINATION

- A. Coordinate with all trades as to nailers, blocking, grounds and the like required for the attachment of their work and other items requiring same. Carry out all work as required to cooperate work of other trades.

3.02 INSTALLATION

- A. Perform work in conformance manufacturer's recommendations and specifications, industry, national and local standards and codes.
- B. Layout, cut, fit and erect rough blocking, nailers, furring and other rough carpentry. Do cutting work in connection with carpentry and finish for other trades. Brace plumb and level all members in true alignment and rigidly secure in place with sufficient nails, spikes, screws and bolts. Defects which render any piece or part unable to serve its intended purpose shall be discarded or, cut out and replaced.
- C. Provide all bracing, supports and shoring required to support construction.
- D. Protect all masonry including edges of concrete platforms and similar items. Remove protective covering when directed. Take special precautions at masonry openings and corners of the building.

- E. Set all rough hardware, such as plates, spikes, bolts, nails, lag screws, lagging bolts, anchors, etc., as required to hold woodwork together or to anchor or secure it to other materials and construction.
- F. Provide wood grounds, nailing strips and similar items wherever necessary or required throughout the project for the support, proper erection or installation of the work and support of mirrors, cabinets, shelf cleats, base and similar items. Thoroughly secure in place by approved means.
- G. Secure wood grounds, nailing strips and similar items to metal plugs set in masonry, toggle or expansion bolts. Give the mason all necessary information to enable him to lay out correctly the location for metal wall plugs. Wood plugs will not be accepted.
- H. Construct joints to support dead loads, live loads, snow loads, wind loads, or combinations in conformance with "National Design Specifications for Stress Grade Lumber and its Fastenings", recommended by National Forest Products Association.
- I. Nailers and Blocking: Provide and secure wood nailers, blocking, for the reception of roof curbs, roofing, etc. in accordance with FM I-49, or as required by the Building Code, whichever is most stringent. Coordinate attachment with roofing system, where roofing system design includes design of nailers provide attachment in accordance with engineered roofing design.
 - 1. Provide nailers of sizes, shapes and profiles indicated on the Drawings. Nailers shall not be less than 2 x6. Build up nailers as required to achieve thickness of insulation or as required to provide proper attachment of roofing and curbs. Provide anchors as required for secure attachment of roofing systems, copings, gravel stops or other edge terminations.

3.03 TEMPORARY PROTECTION

- A. Provide and install all temporary protection in accordance with applicable provisions of the Contract Documents, OSHA regulations, and as follows:
 - 1. Temporary protection shall include wood doors, railings, protection of floor or roof openings, temporary partitions, and the like; adequately maintained in good repair during the life of the Contract.
 - 2. Furnish and set temporary partitions with wood doors at all exterior doorways, exterior openings or in locations exposed to weather. Substantially build and hang, with proper hinges, locks and other necessary hardware, and remove and reset whenever required to accommodate the Work and keep in good repair.
 - 3. Provide substantial temporary wood covering or guards for openings left in floor or roof slabs for ducts, shafts, etc., using rough planking at least 2 inch thick, cleated together and otherwise made sufficiently strong and put in place wherever required immediately after the forms have been removed.

3.04 JOB CONDITIONS

- A. If the installation of metal frames and glass does not promptly follow the completion of the exterior enclosures, and if the absence of enclosures would cause damage, close in all such openings temporarily by the use of heavy polyethylene plastic sheeting, or canvas stretched over and nailed to frames of 1 inch x 2 inch or heavier strips.

3.05 REMOVAL OF TEMPORARY WORK

- A. Remove all temporary protection when so directed, or prior to acceptance of this project.

- END OF SECTION -

SECTION 06200
FINISH CARPENTRY

PART 1 -- GENERAL

1.01 THE REQUIREMENTS

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

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Architectural Woodwork Institute (AWI) -"Architectural Woodwork Quality Standards."

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:
 - 1. Manufacturer's product data of hardware and plastic laminate.
 - 2. Certification that woodwork manufacturer's work complies with the quality grades and other requirements indicated.
 - 3. Plastic laminate color samples. Up to four colors will be selected by Owner.
 - 4. Provide plans, section, and elevations, drawn to scale, of architectural casework shop drawings showing the construction of all materials, dimensions, construction types, and plastic laminate types.

1.04 SHIPPING, HANDLING AND STORAGE

- A. Protect finish carpentry during transit, delivery, storage, and handling to prevent damage, soiling, and deterioration.
- B. Do not deliver woodwork, until painting, wet work, sanding, and other similar operations have been completed.

PART 2 -- PRODUCTS

2.01 WOOD PRODUCTS

- A. Plywood: APA INT.
- B. Standing and Running Trim: Cedar, Grade clear.

2.03 FASTENERS AND ANCHORAGES

- A. Provide nails, screws, and other anchoring devices of the type, size, material, and finish required for the application indicated to provide secure attachment, concealed where possible, and complying with applicable standards and codes.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Use only sound, thoroughly seasoned, well manufactured materials of the correct practical lengths and sizes to minimize jointing. Use materials free from warp which cannot be easily corrected by anchoring and attachment. Sort out and discard warped material and material with either defects which would impair the quality of the work.
- B. Securely attach carpentry to substrates by anchoring and fastening as shown, and as required by recognized standards.
- C. Provide washers under bolt heads and nuts in contact with wood.
- D. Nail plywood to comply with the recommendations of the American Plywood Association.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Set carpentry work accurately to required levels and lines with members plumb and true and accurately cut and fitted.
- G. Shim with metal for full bearing on concrete, steel, or masonry substrates.

- END OF SECTION -

SECTION 07210
BUILDING INSULATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 06100 – Rough Carpentry
- B. Section 09260 - Gypsum Drywall Systems

1.03 SUBMITTALS

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

1.05 DELIVERY, STORAGE AND HANDLING

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

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the requirements, provide products as manufactured by the following:
 - 1. Manufacturers of Glass Fiber Insulation
 - a. CertainTeed Corporation

- b. Manville Corporation
- c. Owens-Corning Fiberglass Corporation

2.02 MATERIALS

- A. Thermal Batt Insulation: Aluminum foil faced, R-19 for walls, R-38 for ceilings or as indicated on the Drawings. Provide batts conforming to ASTM C665 Type-III.
- B. Gap Sealant: General Purpose Type: single-component polyurethane sealant. Gun-applied and Straw-applied products, Thermal Value R3.5 per inch. Provide GREATSTUFF PRO™ Gaps & Cracks Insulating Foam Sealant as manufactured by The Dow Chemical Company or approved equal. Provide Substrate Cleaner as recommended by foam sealer manufacturer.

PART 3 -- EXECUTION

3.01 GENERAL

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

3.02 INSTALLATION OF INSULATION

- A. Install in accordance with the manufacturer's printed installation instructions to provide maximum sound and thermal benefits for material specified. Install to fill or cover voids. Cut neatly to snugly fit angles, corners and irregular areas and carefully wrapped around pipes, conduits, outlets, switches, beams, etc., to maintain continuity of insulation. Avoid gaps or bridges.

3.03 ADJUSTMENT AND CLEANING

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

- END OF SECTION -

SECTION 07310
SHINGLE ROOFING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install 3-tab, self-sealing fiberglass shingles over underlayment as shown on the Contract Drawings and as specified herein.

1.02 RELATED WORK ELSEWHERE

- A. Section 06100 – Rough Carpentry
- B. Section 07700 – Roof Specialties and Accessories

1.03 SUBMITTALS

- A. The Contractor shall submit a written description of the complete roofing system proposed in accordance with the Shop Drawing requirements in the Section 01300, Submittals. The description shall include the complete system starting from the exposed structural deck surface on up to fiberglass shingles including roofing felt, flashing details, etc., required for this specific project.
- B. Samples shall be required with color selection approved by the Engineer.

1.04 PRODUCT HANDLING

- A. Materials shall be delivered in original, unopened containers. The containers shall be labeled with the manufacturer's name, brand name, installation instructions, and identification of various items. Store all materials, except the membrane, between 60°F and 80°F. If exposed to lower temperatures, restore to proper temperature before using. Store all materials, except the membrane in a dry, protected area. Damaged materials shall be replaced at the Contractor's expense.

1.05 STORAGE AND DELIVERY

- A. Materials shall be delivered in original, unopened containers. The Containers shall be labeled with the manufacturer's name, brand name, installation instructions, and identification of various items. Damaged materials shall be replaced at the Contractor's expense.

1.06 GUARANTEE

- A. Fiberglass shingle roofs shall carry a lifetime manufacturer's limited warranty.
- B. Provide Contractor's written 2-year warranty against workmanship defects.

PART 2 -- MATERIALS

2.01 FIBERGLASS ROOF SHINGLES

- A. Fiberglass roof shingles shall be mineral surfaced, self sealing, architectural asphalt fiberglass shingles meeting U.L. Class A fire and wind ratings. Shingles shall be manufactured in accordance with ASTM D3018 Class A, D3161 and D3462 Specifications.
- B. Shingles shall be closely match existing shingles as manufactured of Owens Corning, GAF, or equal
- C. Color shall be as selected to match existing shingles by Owner from manufacturer's full range of colors.

2.02 UNDERLAYMENT MEMBRANE

- A. Underlayment membrane shall be self adhering reinforced rubberized asphalt sheet. Sheets shall have granular top surface, disposable film protection on bottom surface and be self sealing around fastener penetrations. Provide manufacturer's 5 year warranty. Underlayment membrane shall be manufactured in accordance with ASTM D1970 and shall be Class A fire rated. Provide products as manufactured by Certainteed Corp., G.A.F. Materials Corp, or Owens Corning.
- B. Products shall conform to the following requirements:

Property	Test Method	Minimum Values
Elongation (rubberized asphalt)	ASTM D-412	250%
Pliability	ASTM D-1970	Passed
Adhesion to Plywood	ASTM D903	3 lbs./in.
Permeance	ASTM E-96	.05 maximum
Minimum Thickness		50 mils (1.4 mm)

2.03 NAILS

- A. Nails shall be 11 gauge galvanized roofing nails with 3/8" heads.

2.04 ROOF CEMENT

- A. Roof cement shall be asphalt plastic roof cement compatible with the roof material supplied. Roof cement shall be in accordance with ASTM D2822 Type 1 Specifications.

2.05 METAL DRIP EDGE

- A. Minimum .024" mill finish aluminum sheet, brake formed to provide 3" roof deck flange, 1-1/2" fascia flange with 3/8" drip at lower edge. Furnish in 10' lengths. Fold back exposed edge to form hem.

PART 3 -- EXECUTION

3.01 SURFACE PREPARATION

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

3.02 INSTALLATION

- A. Roofing shall be furnished and installed in compliance with U.L. Class "A" requirements. Manufacturer's instructions for the installation of such roofing system shall be strictly adhered to. All accessories necessary to complete the installation shall be provided.
- B. Fiberglass shingle roofs shall be installed according to manufacturer's recommendations. All eaves and roof deck edges shall be protected with a corrosion-resistant drip edge. Install drip edge over felt underlayment on rakes. Valleys and hips shall be installed in accordance with manufacturer's recommendations.
- C. Roofing felts shall be installed providing one layer of felt applied horizontally over entire surface lapping succeeding courses 2" minimum and fastening with sufficient nails to hold in place until shingle application. Install starter strip of inverted shingles with tabs removed; fasten shingles in pattern, weather exposure and number of nails per shingle as recommended by manufacturer. Use horizontal and straight coursing lines to ensure straight coursing. Install metal flashing, vent flashing, and edge protection as necessary and according to the recommendations of the manufacturer and NRCA Steep Roofing Manual.

3.03 UNDERLAYMENT MEMBRANE

- A. Prepare substrate as recommended by membrane manufacturer. Provide primers as needed. Surface should be clean, dry and free of debris.

- B. Plies shall be installed beginning at the lowest point of roof. At the lowest point of roof. Provide laps at all edges as required by manufacturer but no less than 6" overlap at any seam.
- C. Continue membrane from eave edge up to a minimum of 24" past the interior wall line, or greater if indicated on Drawings or required by manufacturer.
- D. Install underlayment membrane along all valleys, hips and ridges. Sheets shall extend a minimum of 12" to each side of centerlines.

3.04 EXTRA STOCK

- A. Provide a minimum of 2% of installed quantity of shingles used in the work. Provide in unopened clearly labeled bundles or containers.

- END OF SECTION -

SECTION 07700

ROOF SPECIALTIES AND ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 06100 – Rough Carpentry
- B. Section 07310 – Shingle Roofing
- C. Section 07900 - Joint Fillers, Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

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

1.04 SUBMITTALS

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

2. Samples, of each material listed.

1.05 DELIVERY, STORAGE AND HANDLING

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

PART 2 -- PRODUCTS

2.01 MATERIALS

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

2.02 GUTTERS AND DOWNSPOUTS

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

PART 3 -- EXECUTION

3.01 INSTALLATION - GENERAL

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

3.02 DAMAGED MATERIAL

- A. Repair or replace materials damaged during installation.

3.03 ADJUSTING AND CLEANING

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

- END OF SECTION -

SECTION 07900

JOINT FILLERS, SEALANTS AND CAULKING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03250 - Concrete Accessories
- B. Section 03290 - Joints in Concrete
- C. Section 08800 - Glass and Glazing

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

- 1. ASTM C-920 Elastomeric Joint Sealants
- 2. ASTM D-1056 Flexible Cellular Materials - Sponge or Expanded Rubber
- 3. SWRI Sealant and Caulking Guide Specification

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE AND HANDLING

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

PART 2 -- PRODUCTS

2.01 MATERIALS

A. Sealants

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

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

PART 3 -- EXECUTION

3.01 QUALITY CONTROL

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

3.02 PREPARATION

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

and the joint completely filled with sealant. The back-up material shall not project beyond the 1/4 inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

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

3.03 APPLICATION

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

3.04 ADJUSTMENT AND CLEANING

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

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal joints bordered on both sides by masonry, precast concrete, natural stone or other porous building material, unless	Type 2	To closely match adjacent surfaces or mortar and as selected by the Owner.
<i>CATTAIL BRANCH SPS UPGRADE – PHASE III</i>	07900-4	<i>JOINT FILLERS, SEALANTS, AND CAULKING</i>

Application	Sealant	Color
noted otherwise herein or on Drawings.		
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the Owner.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit. See Note 1.	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the Owner.
Below thresholds.	Type 6	Manufacturer's standard
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

Note 1. Provide UL approved sealants for penetrations thru fire-rated walls and as specified in Section 07270.

- END OF SECTION -

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 06100 – Rough Carpentry
- B. Section 08710 - Finish Hardware
- C. Section 09900 - Painting

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

- 1. ANSI/DHI A115 Series Specifications for Steel Door and Frame Preparation for Hardware
- 2. ANSI/SDI 100 Recommended Specifications: Standard Steel Doors and Frames
- 3. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- 4. ASTM A366/A 366M Standard Specification for Steel, Sheet, Carbon, Cold-Rolled Commercial Quality
- 5. ASTM A525 Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

1.04 SUBMITTALS

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

2. Complete layout and installation drawings and schedules with clearly marked dimensions. Indicate details of construction, profiles, gauges, reinforcing and location of doors and frames.
3. Certify that shop applied primer is compatible with finish coats specified in Section 09900, Painting.

1.05 QUALITY ASSURANCE

- A. Comply with ANSI/SDI 100.
- B. Locations where fire-rated door and frame assemblies are required, provide assemblies which comply with NFPA 80 and have been tested and labeled in accordance with ASTM E152 by agency acceptable to governing authorities.
- C. Provide certificate or label for fire-rated doors which exceed sizes tested from a independent testing and inspection agency. Certificate or label shall indicate that door and frame assembly conforms to the requirements of the design.
- D. Provide stairwell doors which have temperature rise rating of 450 degrees F maximum in 30 minutes of fire exposure.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver products boxed or crated suitable for storage.
- B. Store products under cover, raised above ground level, and stacked to prevent warping and damage.
- C. Replace items damaged during delivery, storage, or handling.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 1. Curries Company, Mason City, Iowa
 2. Amweld Building Products, Inc.
 3. Steelcraft, Cincinnati, Ohio

2.02 MATERIALS

- A. Steel Sheets: Commercial quality hot or cold rolled. Galvanize sheet steel in accordance with ASTM A525, commercial quality, A60 zinc coating, mill phosphatized.
- B. Anchorages: Galvanized steel, minimum 18 gauge.

- C. Fasteners and Inserts: Galvanized units standard with manufacturer.
- D. Primer: Rust-inhibitive coating, suitable to receive finish coatings specified in Section 09900, Painting.

2.03 FABRICATION, GENERAL

- A. Shop-fabricate assemblies to greatest extent possible.
- B. Fabricate exterior and interior doors, frames and louvers from hot-dip galvanized steel.
- C. Where exposed screws and fasteners are used, provide countersunk, flat Phillips-head fasteners.
- D. Fabricate exterior, vestibule and other doors indicated to be insulated in the schedule with foam in place insulation. Door and frame assembly shall have a maximum calculated core U-Value of 0.10 BTU per hour per square foot per degree F in accordance with ASTM C518.
- E. Comply with ANSI/DHI A115 series specifications for door and frame hardware preparation. Prepare door and frame using final hardware schedule and templates from hardware supplier.
- F. Shop Painting
 - 1. Clean surfaces thoroughly before beginning painting operations, removing rust, scale, oil, grease and other contaminants.
 - 2. Apply primer evenly to provide full protection of all exposed surfaces.

2.04 STEEL (HOLLOW METAL) DOORS

- A. Provide doors of size and style indicated.
 - 1. Exterior Doors: SDI-100, Grade III, extra heavy-duty, Model 4, seamless, 16 gauge for doors less than four feet wide and 14 gauge for doors greater than four feet wide.
- B. Top and bottom closures on all doors and a weather tight cap on all exterior doors.

2.05 STEEL (HOLLOW METAL) DOOR FRAMES

- A. Fabricate door frames with mitered and welded corners.
- B. Provide concealed fastenings, unless otherwise indicated.
- C. Provide galvanized plaster guards or mortar boxes at back of finish hardware cutouts.
- D. Drill frames to receive three silencers on strike jamb of side swinging doors, and two silencers on heads of double doors, unless doors are to receive weatherstripping.
- E. Provide a minimum of three jamb anchors per jamb for doors 96 inches or less in height and one additional anchor for each additional 24 inches of height.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All doors and frames specified herein shall be neatly installed in designated locations indicated on Drawings.
- B. Install frames in accordance with SDI-105 and as herein specified.
- C. Install doors in accordance with SDI-100 and as herein specified.

3.02 PROTECTION AND CLEANING

- A. Provide protection against stains, dirt or damage to the finished installation. Adjust doors for proper operation.
- B. Immediately after erection and prior to finish painting, remove rusted or damaged prime coat and apply touch-up primer compatible with original primer and final coats.

- END OF SECTION -

SECTION 08710
FINISH HARDWARE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 08110 – Steel Doors and Frames

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

- 1. ANSI/BHMA 156

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE AND HANDLING

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

PART 2 -- PRODUCTS

2.01 MATERIALS AND FABRICATION

- A. Hand of Door
 - 1. Drawings show swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish hardware for proper installation and operation of door.
- B. Manufacturer's Name Plate
 - 1. Do not use manufacturer's products which have name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels.
- C. Base Metals
 - 1. Produce hardware units of the basic metal and forming method indicated, using

manufacturer's non-corrosive metal alloy, composition, temper and hardness but in no case of lesser quality material than specified.

D. Fasteners

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

E. Tools for Maintenance

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

F. Hardware Finishes

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

G. Field Checks

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

2.02 DESCRIPTION OF PRODUCTS

A. Hinges

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

- d. Fire Rated Doors up to 36 inches – 5 inches regular weight.
 3. Provide three hinges per door leaf up to and including 90 inches and one additional hinge for each 30 inches of additional height.
 4. Acceptable Manufacturers: Stanley Hardware, Hager Hardware
- B. Locksets and Latchsets
1. Stainless steel, heavy-duty mortise type conforming to ANSI A156.13 Series 1000, Grade 1.
 2. Wrought steel box strikes.
 3. Stainless steel deadbolt with 1" throw approval.
 4. 2 3/4 inch back set, 3/4 inch throw, two-piece anti-friction latchbolt.
 5. Non-ferrous critical internal parts.
 6. Cylinders shall be manufactured to conform to grand master key program.
 7. Trim Design: LWM with wrought escutcheon by Corbin\Russwin or equal lever with return. Provide knurling on all levers leading into hazardous rooms and electrical rooms.
 8. Acceptable Manufacturers: Yale, Corbin\Russwin, Schlage
- C. Keys and Keying
1. Provide construction keyed, removable core master key system as directed by the Owner.
 2. Furnish ten core removal keys and a quantity of master keys as directed by the Owner, not to exceed ten each per group. Furnish a minimum of 15 change keys per cylinder.
 3. Furnish cylinders with six pin cores.
 4. Provide a key schedule showing all key numbers and spaces to which each permits entry. The schedule and key cabinet, along with key gathering envelopes containing keys for each lock endorsed with lock number and space designation, shall be turned over to the Owner. Install keys with proper tags in the key cabinet. Establish a construction master key, and apply to locks and cylinders, except for closets, within major spaces. Locks for closets shall be shipped unlocked and the keys delivered to the Owner with the balance of the keys.
 5. Acceptable Manufacturers: Yale, Corbin\Russwin, Schlage

D. Closers

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

E. Flush Bolts

1. U.L. listed.
2. Forged brass construction, 1/2" diameter flattened bolt tip, 12" long rod.
3. Fit standard ANSI door preparation.
4. Acceptable manufacturers: Glynn-Johnson, Hager Hardware, and H.B. Ives.

F. Kickplates

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

G. Thresholds

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

Zero International. Fiberglass threshold by fiberglass door and frame manufacturer.

H. Door Bottom Seal

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

I. Weatherstripping

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

PART 3 -- EXECUTION

3.01 GENERAL

A. Templates

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

B. Packaging and Marking

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

3.02 INSTALLATION

A. Install hardware in a manner which will eliminate cracks on surfaces.

B. Mount hardware units at heights recommended in "Recommended Locations for Builders Hardware" by BHMA, except as otherwise indicated or required to comply with governing regulations.

C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on the substrate.

- D. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as is necessary for proper installation and operation.
- E. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with factory standards.
- F. Cut and fit thresholds and floor covers to profile of door frames, with mitered corners and hair-line joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.
- G. Screw thresholds to substrate with No. 10 or larger screws, of the proper type for permanent anchorage and of bronze or stainless steel which will not corrode in contact with the threshold metal.
- H. Set thresholds in a bed of either butyl rubber sealant or polyisobutylene mastic sealant to completely fill concealed voids and exclude moisture. Do not plug drainage holes or block weeps. Remove excess sealant.

3.03 ADJUST AND CLEAN

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

3.04 HARDWARE SETS

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

B. Hardware shall be as follows:

Hardware Sets

1. Hinges
Entrance Lockset
Overhead Door Closer Holder (each leaf)
Flush Bolts
Kickplate
Threshold
Door Bottom Seal
Weatherstripping
Astragal w/Weatherstripping

2. Hinges
Entrance Lock Set
Door Closer
Kickplate
Threshold
Door Bottom Seal
Weatherstripping

- END OF SECTION -

SECTION 09900

PAINTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.
- B. Section Includes:
 - 1. Paint Materials
 - 2. Shop Painting
 - 3. Field Painting
 - a. Surface Preparation
 - b. Piping and Equipment Identification
 - c. Schedule of Colors
 - d. Work in Confined Spaces
 - e. OSHA Safety Colors

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications the Work shall conform to the applicable requirements of the following documents:
 - 1. SSPC – The Society for Protective Coatings Standards
 - a. SSPC-Vis 1 Pictorial Surface Preparation Standards for Painting Steel Structures
 - b. SSPC-SP2 Hand Tool Cleaning
 - c. SSPC-SP3 Power Tool Cleaning
 - d. SSPC-SP5 White Metal Blast Cleaning
 - e. SSPC-SP6 Commercial Blast Cleaning
 - f. SSPC-SP10 Near-White Metal Blast

- g. SSPC-SP13/NACE6 Surface Preparation of Concrete
- 2. NACE - National Association of Corrosion Engineers
- 3. ASTM D1737 - Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
- 4. ASTM B117 - Method of Salt Spray (Fog) Testing
- 5. ASTM D4060 - Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
- 6. ASTM D3359 - Method for Measuring Adhesion by Tape Test

1.03 SUBMITTALS

A. Submit the following:

- 1. Manufacturer's literature and Material Safety Data Sheets for each product.
- 2. Painting schedule identifying surface preparation and paint systems proposed. Cross-reference with Tables 9-1 and 9-2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items.

1.04 SYSTEM DESCRIPTION

- A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping, miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenance.
- B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.
- C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.
- D. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

1.05 QUALITY ASSURANCE

- A. Painting operations shall be accomplished by skilled craftsman and licensed by the state to perform painting work.
- B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.

1.06 STORAGE AND DELIVERY

- A. Bring materials to the job site in the original sealed and labeled containers.
- B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

PART 2 -- MATERIALS

2.01 GENERAL INFORMATION

- A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.
- B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared, products were properly applied, and the paint systems were proper for the exposure and service.
- C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.
- D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.

- F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Tnemec Company Inc.
 - 2. Ameron
 - 3. CARBOLINE
 - 4. Sherwin-Williams

PART 3 -- EXECUTION

3.01 SHOP PAINTING

- A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.
- B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.

3.02 SURFACE PREPARATION

- A. General
 - 1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.
 - 2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.

3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.
4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.
5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touch-up coats are in addition to the specified applied systems, and not considered a field coat.
6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.
7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.
2. Perform blast cleaning operations for metal when following conditions exist:
 - a. Moisture is not present on the surface.
 - b. Relative humidity is below 80%.
 - c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
 - d. Painting or drying of paint is not being performed in the area.
 - e. Equipment is in good operating condition.
 - f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
3. Sandblast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.

4. Sandblast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service.
5. Sandblast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment.
6. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system.
7. Prime cleaned metals immediately after cleaning to prevent rusting.
8. Clean rusted metals down to bright metal by sandblasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 30 days before surface preparation, and painting begins.
2. Test concrete for moisture content using test method recommended by the paint manufacturer. Do not begin surface preparation, or painting until moisture content is acceptable to manufacturer.
3. Prepare concrete surfaces to receive coatings in accordance with SSPC-13 – Concrete Surface Preparation. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities. Do not expose underlying aggregate. Use dry, oil-free air for blasting operations. Surface texture after blasting shall be similar to that of medium grit sandpaper. Remove residual abrasives, dust, and loose particles by vacuuming or blowing with high pressure air.
4. Acid etch (Reference ASTM D 260) concrete floors to receive paint. Following method is a minimum requirement. Remove residual dust and dirt. Wet surface of concrete until surface is damp. Etch surface with 15% to 20% muriatic acid solution to produce a "medium sandpaper" texture. Do not allow acid solution to dry on concrete. Rinse concrete when bubbling action of the acid begins to subside. Continue rinsing process until pH is 7 or higher. Remove excess water and allow concrete to thoroughly dry before coating. Other methods may be used, if approved by Engineer.
5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric filler compatible with painting system. Complete fill coats may be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.

6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.
7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.

D. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.
2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

E. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.
3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.
5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

- A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.
- B. Apply paint without runs, sags, thin spots, or unacceptable marks.
- C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.
- D. Special attention shall be given to nuts, bolts, edges, angles, flanges, etc., where insufficient film thicknesses are likely. Stripe paint prior to applying prime coat. Stripe painting shall be in addition to coats specified.

- E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.
- F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.
- G. Suspend painting when any of the following conditions exist:
 - 1. Rainy or excessively damp weather.
 - 2. Relative humidity exceeds 85%.
 - 3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.
 - 4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.
 - 5. Surface temperature of item is within 5 degrees of dewpoint.
 - 6. Dew or moisture condensation are anticipated.
 - 7. Surface temperature exceeds the manufacturer's recommendations.

3.04 INSPECTION

- A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.
- B. Use magnetic dry film thickness gauges and wet film thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.
- C. Coatings shall pass a holiday detector test.
- D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.

- E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.
 - 1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - 2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Razor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.
- F. Paint manufacturer or his representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

- A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.
- B. Take all necessary precautions to contain dispersion of sandblasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the sandblasting debris and paint. Suspend painting operations when sanding debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 SCHEDULE OF COLORS

- A. Match colors indicated. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.07 WORK IN CONFINED SPACES

- A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or direct air supply to individual

workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosion-proof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state and local regulations at all times.

3.08 OSHA SAFETY COLORS

- A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not exceed 2-feet wide by 3-feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.
- B. Paint hazardous areas and objects in accordance with OSHA regulations.

3.09 VOC REQUIREMENTS

- A. Coatings indicated in Table 9.2 represent the minimum performance. Where coatings listed do not meet local, state, regional, or federal VOC limits provide equal or better products which meet performance of coating indicated.

**TABLE 9-1
PAINTING SCHEDULE**

SURFACE	APPLICATION	PAINTING SYSTEM & NO. OF COATS	PRODUCT REFERENCE (TABLE 9.2)	TOTAL MIN. DRY FILM THICKNESS (MILS)
<u>Concrete and Masonry</u>				
Interior masonry and concrete walls and ceilings	Dry Well/Pump Room Walls, Floor and Ceiling	1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Submerged wastewater		2 coats high solids epoxy Provide filler as required and recommended by manufacturer	119	6-10/coat
<u>Metals</u>				
Interior and exterior nonsubmerged (gloss)	Pumps, motors and mechanical equipment, piping, supports, etc.	1 coat epoxy polyamide primer 1 coat epoxy polyamide 1 coat aliphatic polyurethane	104 102 115	4-6 4-6 3-5
Interior insulated		1 coat acrylic latex	103	4
Submerged Wastewater		2 coats high solids epoxy	119	8-10/coat
Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel)	Addition	1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Other				
Interior: Gypsum Wallboard	All new structures	2 coats acrylic latex matte or satin	103	2-3/coat
Exterior Wood Trim/Exterior T1-11 plywood	All New Structures Color to match existing	2 coats transparent stain	121	2 coats
PVC Piping		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4

TABLE 9-2
PRODUCT LISTING

REF.	SYSTEM	PURPOSE	PRODUCT			
			<u>Tnemec Series</u>	<u>PPG1 AMERON</u>	<u>CARBOLINE</u>	<u>Sherwin-Williams</u>
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 4000	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	N69	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
103	Acrylic latex	Sealer	1094	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	N69	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
105	Epoxy	Primer/Finish	20	AMERLOCK 2	Carboguard 561/56LT	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	--
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 385	Carboguard 893SG	--
115	Aliphatic Polyurethane	Finish coat	1074 or 1075	AMERCOAT 450 HS	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	54-562	AMERLOCK 400 BF	Sanitile 600	Cement Plex 875
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 400	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	AMERLOCK 2/400	Carboguard 890	--
121	Stain	Primer/Finish	--	--	--	Super Deck Solid Wood Stain Olympic Elite Solid Wd Stain

- END OF SECTION

SECTION 11000

EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.
- B. It is the intent of these Specifications that the Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to coordinate all interfaces with related mechanical, structural, electrical, instrumentation and control work and to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as intended by the Specifications.
- D. The complete installation shall be free from excessive vibration, cavitation, noise, and oil or water leaks.
- D. The requirements of this section shall apply to equipment furnished under Divisions 11 and 15.

1.02 SHOP DRAWINGS

- A. Shop Drawings shall be submitted to the Engineer for all equipment in accordance with Section 01300, Submittals and shall include the following information in addition to the requirements of Section 01300, Submittals:
 - 1. A written plan indicating the proposed sequence of construction and plan for installation with associated construction schedule.
 - 2. Performance characteristics and descriptive data.
 - 3. Detailed equipment dimensional drawings and setting plans.
 - 4. General lifting, erection, installation, and adjustment instructions, and recommendations.
 - 5. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.
 - 6. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.

7. Details on materials of construction of all components including applicable ASTM designations.
8. Information on bearing types and bearing life.
9. Gear box design and performance criteria and AGMA service factor.
10. Piping schematics.
11. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at $\frac{1}{2}$, $\frac{3}{4}$, and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.
12. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
13. Equipment shop coating systems, interior and exterior.
14. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
15. A list of spare parts and special tools to be provided.
16. Any additional information required to show conformance with the equipment specifications.
17. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.
18. Submit a comprehensive schedule for all required tests.
19. Testing Plans.
 - A. Submit at least 45 days prior to proposed testing date in accordance with procedures identified in Section 01300 - Submittals and in individual specification sections.
 - B. Submit individual plans for each piece of equipment requiring a Second Stage Field and Reliability Test.
 - C. Coordinate with Owner to determine testing fluid sources and include in testing plans.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes.

1.04 PERFORMANCE AFFIDAVITS

- A. When required in the individual equipment Specifications, the Contractor shall submit manufacturer's Performance Affidavits for equipment to be furnished.

1.01 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

- A. Operation and Maintenance (O&M) manuals shall be submitted in accordance with Section 01300, Submittals.
- B. O&M manuals shall include instructions, equipment ratings, technical bulletins, and any other printed matter such as wiring diagrams and schematics, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. Included in this submission shall be a spare parts diagram, complete spare parts list, bill of materials, OEM part numbers and manufacturer's catalog information of all equipment components.
- C. Each set of instructions shall be bound together in appropriate three-ring binders with a detailed Table of Contents.
- D. Written operation and maintenance instructions shall be required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item.
- E. Information not applicable to the specific piece of equipment installed on this project shall be struck from the submission.
- F. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.
- G. Extensive pictorial cuts of equipment are required for operator reference in servicing.
- H. When written instructions include Shop Drawings and other information previously reviewed by the Engineer, only those editions thereof which were approved by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the instructions.

1.02 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the equipment furnished shall, be designed and constructed for the maximum stresses occurring during fabrication, transportation, installation, testing, and all conditions of operation. All materials shall be new, and both workmanship and materials shall be entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications.
- B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards.

- D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for accessible lubrication by extending lubrication lines and fittings to approximately 30 inches above finished floor elevation.
- E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.
- G. All machinery and equipment shall be safeguarded in accordance with the safety codes of the USA and the State in which the project is located.
- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.
- J. All manufactured items provided under this Section shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products.

1.03 EQUIPMENT WARRANTIES

- A. Warranty requirements may be added to or modified in the individual equipment specifications.
- B. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of eighteen (18) months unless otherwise specified in the individual equipment specifications. The period of such warranties shall start on the date of Substantial Completion. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.
- C. The Contractor shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Engineer prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.
- D. The Equipment Supplier shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the

manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the Owner as user is likely to be made the defendant.

- a. Where patent infringements are likely to occur, each Equipment Supplier shall submit, as a part of his bid, license arrangements between himself, or the manufacturer of the equipment offered, and the patent owner or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be bidding.
- b. Each Equipment Supplier, by submitting his bid, agrees to hold and save the Owner and Engineer or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of the same by the Owner.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The materials covered by these Specifications are intended to be equipment of proven reliability, and as manufactured by reputable manufacturers having experience in the production of such equipment. The Contractor shall, upon request of the Engineer, furnish the names of not less than 5 successful installations of the manufacturer's equipment of the same size and model of that offered under this contract. The equipment furnished shall be designed, constructed, and installed in accordance with the industry accepted practices and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

2.02 ANCHORS AND SUPPORTS

- A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.
- B. Anchor bolts and fasteners shall be furnished in accordance with Section 05050, Metal Fastening, and with the individual equipment Specifications. All anchor bolts shall be a minimum of 1/2-inch diameter. All anchor bolts, handrail bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel, unless otherwise specified the individual equipment Specifications.
- C. The Contractor shall provide all concrete pads or pedestals required for equipment furnished, unless otherwise shown on Drawings. All concrete equipment pads shall be a minimum of 6" high, unless otherwise shown on the Drawings and shall be doweled.
 1. D. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the

anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps, or chemical grout). Non-shrink grout shall be as specified in Section 03600, Grout.

2.03 STRUCTURAL STEEL

- A. Structural steel used for fabricating equipment shall conform to the requirements of Section 05120, Structural Steel.
- B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, and to pertinent ASTM Standard Specifications.

2.04 DISSIMILAR METALS

- A. All dissimilar metals shall be properly isolated to the satisfaction of the Engineer.

2.05 GALVANIZING

- D. Where required by the equipment specifications, galvanizing shall be performed in accordance with Section 05035, Galvanizing.

2.06 STANDARDIZATION OF GREASE FITTINGS

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be "Zerk" type.

2.07 ELECTRICAL REQUIREMENTS

- A. All electrical equipment and appurtenances, including but not limited to motors, panels, conduit and wiring, etc., specified in the equipment specifications shall comply with the applicable requirements of the Division 16 specifications and the latest National Electric Code.
- B. Motors shall conform to the applicable requirements of Section 15170, Low Voltage Electric Motors.
- C. In the individual equipment specifications, specified motor horsepower is intended to be the minimum size motor to be provided. If a larger motor is required to meet the specified operating conditions and performance requirements, the Contractor shall furnish the larger sized motor and shall upgrade the electrical service (conduit, wires, starters, etc.) at no additional cost to the Owner.
- D. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between equipment supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16495, Variable Frequency Drive Systems.
- E. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.08 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Spare parts for equipment shall be furnished where indicated in the equipment Specifications or where recommended by the equipment manufacturer.
- B. Spare parts shall be identical and interchangeable with original parts.
- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Painting requirements for spare parts shall be identical to those for original, installed parts. Where no painting or protective coating is specified, suitable provisions shall be made to protect against corrosion.

- E. Spare parts shall be delivered at the same time as the equipment to which they pertain. Spare parts shall be stored separately in a locked area, maintained by the Contractor, and shall be turned over to the Owner in a group prior to substantial completion. All of these materials shall be properly packed, labeled, and stored where directed by the Owner and Engineer.
- F. The Contractor shall furnish all special tools necessary to operate, disassemble, service, repair, and adjust the equipment in accordance with the manufacturers operation and maintenance manual.
- G. The Contractor shall furnish a one year supply of all recommended lubricating oils and greases. The manufacturer shall submit a list of at least four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. All of these materials shall be properly packed, labeled and stored where directed by the Engineer.

2.09 EQUIPMENT IDENTIFICATION

- A. All mechanical equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.
- C. Nameplates shall not be painted over.

PART 3 -- EXECUTION

3.01 SHOP TESTING

- A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.
- B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- C. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- D. If required by the individual equipment Specifications, arrangements shall be made for the Owner/Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences. Expenses are to be paid by Owner.

- E. Shop testing of electric motors shall be in accordance with applicable requirements of Section 15170, Electric Motors; Basic Electrical Requirements.

3.02 STORAGE OF EQUIPMENT AND MATERIALS

- A. Contractor shall store his equipment and materials at the job site in strict accordance with the manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction. Equipment and materials shall not be delivered to the site prior to 90 days in advance of the scheduled installation. Partial payment requests will not be processed for materials delivered prior to 90 days before installation or for materials that are not properly stored.
- B. Material or equipment stored on the job site is stored at the Contractor's risk. Any damage sustained of whatever nature shall be repaired to the Engineer's satisfaction at no expense to the Owner. Stored electrical equipment is to be protected from the elements and shall have space heaters energized.
- C. Contractor shall not store unnecessary materials or equipment on the job site and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
- D. Contractor shall observe all regulatory signs for loadings on structures, fire safety, and smoking areas.
- E. Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.

3.03 MANUFACTURER'S FIELD SERVICES

- A. The Contractor shall arrange for a qualified Technical Representative from each manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment. When necessary, the Contractor shall schedule multiple Technical Representatives to be present at the same time for the purpose of coordinating the operation of multiple pieces of related equipment.
- B. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.
- C. The manufacturer's Technical Representative shall provide the following services.

1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.
2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.
3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. In the event that equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
4. Training: The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The Contractor shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 7:00 A.M. and 3:00 P.M. as necessary. The Contractor shall provide professional video taping of all training sessions. Completed, labeled tapes shall be provided to the Owner for each type of training session.
5. Services after Startup: Where required by the individual equipment specifications, the Technical Representative shall return to the project site thirty (30) days after the start up date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, each manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

- D. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections.
- E. The Contract amount shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
- F. The Contractor shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.
- G. The Technical Representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.

3.04 INSTALLATION

- A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.
- B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.
- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. All equipment sections and loose items shall be match-marked prior to shipping.
- E. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base. Alignment shall be as specified herein.
- F. Pump foundation shall be installed as designed with the baseplates flat and level in both directions.
- G. Installed pump shall be free of piping strain. To check for piping strain, piping flanges shall be loosened up separately with flange movement observed continuously. Should movement exceed 1/8 inch, piping strain is considered excessive and shall be corrected

by adding or adjusting pipe supports, hangers, expansion joints, etc. Installation of piping at pump casing connections shall be as follows:

- H. Mating flanges shall be concentric to within 1/16-inch tolerance unbolted.
- I. Mating flange faces shall be parallel to within a tolerance of no greater than the gasket thickness unbolted.
- J. Flange face separation shall be no more than 1/8-inch beyond the normal gasket thickness unbolted.
- K. Pump support stand shall be resting firmly on the mounting bases and soleplates with equal loading on each support.
- L. Pump support stand, base plate pads and soleplates shall be free of burrs, rust and obstructions.
- M. When required stainless steel pre-cut shims shall be used to provide a firm, solid, adjustable link between pump and base plate.
- N. Pump mounting feet and surfaces must be free of soft foot. To check for soft foot, the pump must be firmly bolted to the base plate. Each support foot is checked with the dial indicator or feeler gauges, loosening hold down bolts one at a time. If movement exceeds 0.003 inches, soft foot is indicated. Shim and torque uniformly to minimize soft foot.
- O. After erection the Contractor shall demonstrate that all equipment is operating in a satisfactory manner. All adjustments shall be made to suit anticipated station operating conditions. Each piece of machinery shall be tested to show that it operates quietly without excessive vibrations, overheating, or signs of distress at specified capacity.
- P. No modifications to equipment shall be made without the written consent of the manufacturer and approval of Engineer.
- Q. Field verify all dimensions and elevations. Notify Engineer of specific differences
- R. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup. The manufacturer and grades of oil and grease shall be in accordance with the recommendations of the equipment manufacturer.
- S. Surface preparation and field painting shall be manufacturer's standard coating.
- T. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- U. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.
- V. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.
- W. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.05 ALIGNMENT

- A. Set equipment to dimensions shown on drawings. Dimensions shall be accurate to +/- 1/16 inch unless otherwise noted on the drawings. Wedges shall not be used for leveling, aligning, or supporting equipment.
- B. General Equipment Leveling: Non-rotating equipment shall be set level to +/- 1/16 inch per 10 foot length (.005 inch per foot) unless otherwise noted on the drawings. Shims shall be used unless equipment is furnished with leveling feet. Set shims flush with equipment baseplate edges. When grouting is required, equipment shall be shimmed to allow a minimum of one inch grout thickness. Grout shall cover shims at least 3 inches. Final level check shall be held for inspection and approval by Engineer before proceeding.
- C. Grouting
 - 1. Fill anchor bolt holes or sleeves with grout, after bolt alignment is proven, and prior to placing grout under equipment bases.
 - 2. Surface Preparation. Roughen surface by chipping, removing laitance, and unsound concrete. Clean area of all foreign material such as oil, grease, and scale. Saturate area with water at least 4 hours prior to grouting, removing excess water ponds.
 - 3. Application. Place grout after the equipment base has been set and its alignment and level have been approved. Form around the base, mix grout, and place in accordance with the grout manufacturers published instructions. Eliminate all air or water pockets beneath the base using a drag chain or rope.
 - 4. Finishing. Point the edges of the grout to form a smooth 45 degree slope.
 - 5. After grout has cured (not before 3 days after placement) paint exposed surfaces of grout with shellac.
 - 6. Level Verification. After grout has cured, and immediately prior to drive alignment, recheck equipment for level and plumb. Re-level and square as necessary. Hold final checks for inspection and approval by Engineer.
- D. Inspect for and remove all machining burrs or thread pulls in female holes on mating surfaces of mounting frame and machine feet.
- E. Inspect and clean equipment mounting base pads, feet, and frames to remove all grease, rust, paint and dirt.
- F. Assembled equipment shafts shall be set level to .0015 inches per foot of shaft length (+/- .0005 inches) up to a maximum of 0.015 inches for any length shaft unless the manufacturers requirements are more stringent or unless otherwise noted in the equipment specifications. Use the machined surfaces on which the equipment sets for the base/mounting frame leveling plane. Use the machined shaft surface for equipment leveling plane.

- G. Sprocket and Sheave Alignment. Check shaft mounted components for face runout and eccentricity (outside diameter) runout by magnetically mounting a dial indicator on a stationary base and indicating over 360 degrees on a continuous machined surface at the outside diameter of the component. Maximum allowable total indicated face runout and eccentricity for sprockets and sheaves will be per ANSI Standard B29.1-1975.
- H. Belt tensioning. Set drive belt tension to manufacturer's specification for the belt type. Recheck alignment after drive tensioning.
- I. Thermal/Mechanical Growth. Thermal/mechanical growth corrections for driver and driven machines will be used in vertical and horizontal alignment where applicable. The equipment manufacturer will determine thermal/mechanical growth applicability for any machine and provide the correction offsets to be used.
- J. Rotating Shaft Alignment
 - 1. Fixtures will be set up on the driver and driven machine, machines shaft surfaces. Machined coupling hubs may be used only if there is no clearance to mount fixtures directly on the shafts.
 - 2. Primary alignment method for direct drive machines is when coupled. Uncoupled alignment will be used only when approved by the Engineer.
 - 3. Account for possible coupling flex by always rotating coupled machines in the same direction during alignment.
 - 4. Uncoupled machines must be connected so that both shafts turn together without relative motion during alignment.
 - 5. Indicator bar sag will be measured and included for each reverse indicator alignment setup.
 - 6. Reverse Dial Indicator. The final maximum allowable misalignment: vertical and horizontal from the desired targets of .000 inches (for a non-thermal growth machine) or from the given target readings (for a thermal growth machine) must meet BOTH of the following conditions simultaneously: 1/2 the final total indicator reading at each indicator will be no more than shown in the table below AND the final remaining correction at each machine foot be no more than .001 inches of required movement.

Machine Speed (RPM)	Total Misalignment* (inches)
Up to 1800	.002
1800 and greater	.001

* 1/2 indicator reading

3.06 FIELD TESTING

- A. All equipment shall be set, aligned and assembled in conformance with the manufacturer's drawings and instructions. Provide all necessary calibrated instruments to execute performance tests. Submit report certified by the pump manufacturer's representative.

B. Preliminary Field Tests, Yellow Tag

1. As soon as conditions permit, after the equipment has been secured in its permanent position, the Contractor shall:
 - a. Verify that the equipment is free from defects.
 - b. Check for alignment as specified herein.
 - c. Check for direction of rotation.
 - d. Check motor for no load current draw.
2. Contractor shall flush all bearings, gear housings, etc., in accordance with the manufacturer's recommendations, to remove any foreign matter accumulated during shipment, storage or erection. Lubricants shall be added as required by the manufacturer's instructions.
3. When the Contractor has demonstrated to the Engineer that the equipment is ready for operation, a yellow tag will be issued. The tag will be signed by the Engineer, or his assigned representative and attached to the equipment. The tag shall not be removed.
4. Preliminary field tests, yellow tag, must be completed before equipment is subjected to final field tests, blue tag.

D. Second Stage Field Tests, Blue Tag

1. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, ducting, electrical and controls, and other ancillary facilities.
2. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
3. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:
 - a. Check equipment for excessive vibration and noise as specified herein.
 - b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.
 - c. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.

E. Reliability Testing

1. The Contractor shall perform a 7 day reliability test of the entire pumping station upon installation and completion of Second Stage Field Tests provided under this contract. The reliability testing shall not start until all Second Stage Field Tests are completed successfully. The reliability test shall continue seven (7) consecutive calendar days.
2. Operate all systems of the pumping station under Owner's direction demonstrating all modes of operations. This shall include, when practical, simulation of extreme conditions so as to check the response of instrumentation and control devices, bypass functions, pumping cycles, etc. Contractor in coordination with the Owner shall be responsible for the complete operation of the systems of the pumping station, including equipment, valves, level instruments, switches, proper equipment devices, electrical systems, controls and associated components furnished and/or installed under this Contract.
3. The Contractor shall maintain the bypass pumping system in accordance with Section 11400 during entire reliability testing period.
4. Testing fluid shall be raw sewage or non-potable water provided by Contractor.
5. If any component of the System fails to operate in accordance with the Contract Documents during reliability testing, provide all necessary repairs, maintenance, replacement of parts, corrections, adjustments, and other actions necessary to restore proper operation of the systems. Required adjustments to equipment shall be made by a qualified manufacturer's representative. After the System is restored to proper operating conditions, restart the test. No credit will be given for operating time prior to system failures when calculating test durations. Examples of System failures include, but are not limited to the following:
 - a. Wet well overflows, level monitoring system malfunction or high level alarms.
 - b. Equipment failures and/or malfunctions.
 - c. Instrumentation failures or malfunctions.
 - d. Power distribution system malfunction
 - e. Loss of power to equipment and/or devices.
 - f. Controls malfunctions.
 - g. SCADA malfunctions

6. Upon successful completion of reliability testing, the pumping station shall be delivered to the Owner for partial utilization.
 7. Contractor shall provide Owner with minimum 7 days written notice prior to commencing reliability testing.
- E. In addition to the above described field tests, any other tests specifically required by Section 11100, Pumps-General, the individual equipment Specifications, or by the manufacturer shall be performed.
 - F. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, readjustments and replacements at no additional cost to the Owner.
 - G. Upon acceptance of the field tests, a blue tag will be issued. The tag will be signed by the Engineer and attached to the unit. The tag shall not be removed and no further construction work will be performed on the unit, except as required during start-up operations and directed by the Engineer.
 - H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
 - I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.
 - J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
 - K. Field testing of electric motors shall be in accordance with Section 15170, Electric Motors.

3.07 VIBRATION TESTING

- A. Unless specified otherwise in the detailed equipment specifications, each pump, blower, compressor, motor or similar item of stationary rotating equipment having a rated power in excess of 40HP shall be tested after installation for acceptable vibration levels.
- B. Vibration testing shall be performed by an experienced factory-trained and authorized third-party analysis expert (not a sales representative) retained by the Contractor and approved by the Engineer. Each unit or pump system shall be tested separately without duplicate equipment running. All field testing shall be done in the presence of the Engineer. The Engineer shall be furnished with four (4) certified copies of vibration test data for each test performed.
- C. For systems with variable speed drives, tests shall be conducted at various speeds between maximum and minimum. For systems with two-speed drives, tests shall be

conducted at both speeds. For systems with constant-speed drive, tests shall be conducted under various loading conditions as determined by the Engineer.

- D. All field vibration tests shall be performed with the equipment operating on the product for which it is intended, or a substitute acceptable to the Engineer.
- E. The term displacement, as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in G's. Displacement and velocity shall be measured by suitable equipment equal to IRD Mechanalysis, Bentley, Nevada.
- E. Frequency of vibration, in cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing, unless other locations are deemed necessary by the vibration analysis expert and Engineer.
- F. For all equipment tested, vibration shall be checked in the radial and axial directions. Unless otherwise specified elsewhere, axial vibration shall not exceed 0.1 in/sec; and radial vibration shall not exceed 0.2 in/sec. For pumps radial vibration shall not exceed that permitted by the Hydraulic Institute Standards except that, at vibration frequencies in excess of 8,000 cpm, the velocity shall not exceed 0.2 in/sec.
- G. Copies of test results shall be submitted to the Engineer for review. Should the vibration field test results exceed shop test results, the manufacturer's recommendations, or the limits specified herein, the Contractor shall correct the deficiencies within thirty (30) days. After corrections have been completed, the vibration testing shall be re-run and the results re-submitted to the Engineer for review.
- H. Noise or vibration in any rotating equipment which the Engineer judges to be excessive or damaging, shall be cause for rejection.

3.08 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.
- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.

- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.
- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.09 PAINTING

- A. All surface preparation, shop painting, field repairs, finish painting, and other pertinent detailed painting specifications shall conform to applicable sections of Section 09900, Painting.
- B. All shop coatings shall be compatible with proposed field coatings.
- C. All inaccessible surfaces of the equipment, which normally require painting, shall be finished painted by the manufacturer. The equipment and motor shall be painted with a high quality epoxy polyamide semi-gloss coating specifically resistant to chemical, solvent, moisture, and acid environmental conditions, unless otherwise specified.
- D. Gears, bearing surfaces, and other unpainted surfaces shall be protected prior to shipment by a heavy covering of rust-preventive compound sprayed or hand applied which shall be maintained until the equipment is placed in operation. This coating shall be easily removable by a solvent.

3.10 WELDING

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- B. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- C. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

- END OF SECTION -

SECTION 11100
PUMPS - GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and make fully operational all pumping equipment, complete with all necessary accessories, in compliance with the Contract Documents.
- B. All pumping equipment shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.
- C. The provisions of this section shall apply to all pumps and pumping equipment specified except where specifically noted otherwise in the Contract Documents.
- D. The pumps shall be provided complete with all accessories, shims, sheaves, couplings, and other appurtenances as specified, and as may be required for a complete and operating installation.

1.02 SHOP DRAWINGS

- A. Shop Drawings shall conform to the requirements of Section 01300, Submittals and Section 11000, Equipment General Provisions.
 - 1. Details of shaft sealing system
 - 2. Pump performance curves at rated speed and reduced speed (if reduced speeds are specified). Curves shall indicate flow, head, efficiency, brake horsepower, NPSH required, and minimum submergence. Curves shall include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.
 - 3. General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces.
 - 4. Foundry certificates and results of Brinnell hardness testing showing compliance to ASTM A 532 (where required in the individual pump specifications).
 - 5. Submersible pump submittals shall also include:
 - a. Product data sheets for power and control cables and length of cables.
 - b. Details on pump guide rail system and mounting requirements.

PART 2 -- PRODUCTS

2.01 MATERIALS

- A. All materials employed in the pumping equipment shall be suitable for the intended application. Material not specifically called for shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements unless otherwise specified in individual pumping equipment Specifications:
 - 1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48, or equal.
 - 2. Bronze pump impellers shall conform to ASTM B 584, "G" bronze.
 - 3. Stainless steel pump shafts shall be of Type 400, Series. Miscellaneous stainless steel parts shall be of Type 316.
- B. Suction and discharge flanges shall conform to ANSI standard B16.1 or B16.5 dimensions.
- C. Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.02 APPURTENANCES

- A. Pressure Gauges
 - 1. The Contractor shall furnish and install pressure gauges on the suction and discharge of each pump, except wet-pit submersible pumps and vertical turbine pumps.
 - 2. Suction gauges shall be of the single scale compound type to indicate both pressure and vacuum. Each suction gauge shall be graduated in feet of water over the span of 34 feet below and above zero.
 - 3. Discharge gauges shall be graduated in feet from zero to a minimum of five (5) feet of water above the respective pump shutoff head or to a minimum of 30% above the maximum operation pressure, whichever is greater. Graduation shall be in feet of water.
 - 4. All gauges shall be supplied by one manufacturer and shall be as follows:
 - a. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".
 - b. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full-scale range.

c. Features

1. Mounting: ½" NPT, lower stem mount type
 2. Accuracy: 0.5% full scale
 3. Case: Solid front, black phenolic material
 4. Dial: White background and black letters
 5. Glass: Shatterproof
 6. Blow-out protection: Back
 7. Pressure element: stainless steel bourdon tube
 8. Movement: Stainless steel, Teflon coated pinion gear and segment
 9. Gaskets: Buna-N
- d. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.
- e. Gauge size shall be 2" for line sizes up to 3" and 4½" for line sizes of 4" or greater.
- f. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under Section 17698 - Instrumentation and Control System Accessories.
- g. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.
- h. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

5. All gauges shall be provided with diaphragm seals or isolating ring seals.

- B. Flexible couplings for direct driven pumps shall be as manufactured by Falk, Dodge, Woods Corp., or equal and shall be furnished with guards in accordance with OSHA Rules and Regulations. Spacer couplings shall be provided where necessary to allow removal of the pump rotating element without disturbing the driver.

2.02 ELECTRICAL REQUIREMENTS

- A. All pumps shall be furnished with motors such that the motor shall not be overloaded throughout the full range of the pump operation, unless otherwise specifically approved by the Engineer.
- B. Where variable frequency drives (VFDs) are specified, the Contractor shall be responsible for coordinating between pump supplier and VFD supplier to ensure a complete and operational system. VFDs shall be furnished under Division 16 and shall be as specified in Section 16495, Variable Frequency Drive Systems.
- C. Motor starters and controls shall be furnished and installed under Division 16 and Division 17 unless otherwise specified in the individual pump specifications.

2.03 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of Section 11000, Equipment General Provisions, nameplate data for each pump shall include the rating in gallons per minute, rated head, speed, and efficiency at the primary design point.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Drains: All gland seals, air valves, and drains shall be piped to the nearest floor drain or trench drain with galvanized steel pipe or copper tube, properly supported with brackets.
- B. Solenoid Valves: Where required, the pump manufacturer shall furnish and install solenoid valves on the water or oil lubrication lines. Solenoid valve electrical rating shall be compatible with the motor control voltage and shall be furnished complete with all necessary conduit and wiring installation from control panel to solenoid.

3.02 SHOP TESTING

- A. Shop tests shall be performed in accordance with Section 11000, Equipment General Provisions, and except where stated otherwise herein, shall be conducted in accordance with applicable methods and standards of the American National Standard for Centrifugal Pump Tests by the Hydraulic Institute, or American National Standard for Vertical Pump Tests by the Hydraulic Institute for Vertical Pumps.
- B. Pump testing shall be witnessed by the Owner/Engineer where specified in the individual pump specifications. The testing procedure shall be submitted to the Engineer for review before scheduling the testing. The Engineer shall be given at least 2 weeks advanced notice of the scheduled testing date.
- C. Certified test curves for shall be provided for all centrifugal pumps unless otherwise specified in the individual pump specifications.
- D. Pumps shall be within the tolerances specified by the Hydraulic Institute Standards with the following exceptions:

1. At design heads, +10% of design capacities or at design capacities, +5% of design heads.
 2. No minus tolerances shall be allowed with respect to capacity, head, or efficiency at the design points.
- E. For wet pit submersible pumps and vertical turbine pumps, all tests shall be run at minimum pump submergence specified in the individual pump specifications.
- F. Where required in the individual pump specifications, each individual casting shall be Brinnell tested in a minimum of two places, in an area of representative casting thickness to ASTM Method E-10. Results shall be certified by a registered professional ENGINEER. Test results shall verify the satisfaction of the required Brinnell hardness of the finished product as specified in respective subsections.

3.03 FIELD TESTING

- A. Field tests shall be performed in accordance with Section 11000, Equipment General Provisions and additionally as specified below and in the individual pump specification.
- B. Field test shall be performed by a manufacturer's Technical Representative, as provided by the Equipment Supplier under a separate contract. The Contractor shall coordinate the field test with Owner, Engineer, and Equipment Supplier. The Contractor shall be responsible for performing work necessary to ensure the pumps are installed and operating correctly.
- C. Final acceptance tests shall demonstrate the following:
1. The pumps have been properly installed and are in proper alignment.
 2. The pumps operate without overheating or overloading of any parts and without objectionable vibration. Vibration shall be within the Hydraulic Institute limits, or manufacturer's limits if more stringent.
 3. The pumps can meet the specified operating conditions. All pumps shall be checked at maximum speed for a minimum of four points on the pump curve for capacity, head, and amperage. The rated motor nameplate current shall not be exceeded at any point. Pumps with drive motors rated at less than five horsepower shall only be tested for overcurrent when overheating or other malfunction becomes evident in general testing.

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SECTION 11151

VERTICAL NON-CLOG PUMPS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and make fully operational two (2) vertical, single-stage, close-coupled, centrifugal non-clog immersible pumps as specified herein. Each unit shall be supplied with a pump and motor. The motor shall be mounted on a heavy duty high ring base with coupling guard and connected to the pump with a flexible coupling allowing for mechanical seal service without removing pump rotating assembly.
- B. Equipment shall be in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps - General.
- C. The Contractor shall verify that the pumps and motors can fit through the existing floor penetration and fit in the allotted space with no piping modification required (except valve replacements, as shown). Additionally, the Contractor shall verify that the supplied equipment is within the lifting limits of the existing bridge crane (1.5 Ton).

1.02 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

Sewage Pumps

Number of Units		2	
Design Capacity (gpm)	950	2035	2900
Total Dynamic Head (feet)	245	208	150
Maximum Brake Horsepower	110	150	170
Maximum Pump Speed (rpm)		1750	
Temperature of Liquid Pumped		Ambient	
Suction Condition		Flooded	
Minimum Size of Solids (Spherical Diameter, In.)		3	
Suction Diameter (In.)		8	
Discharge Diameter (In.)		5	

1.03 SUBMITTALS

- A. Submittals shall be provided as specified in Section 01300, Submittals, and Section 11000, Equipment General Provisions.
- B. The following items shall be submitted:
 - 1. Bill of materials.

2. Written certification that the pumps and motors can fit through existing floor penetrations and into the allotted space with no piping (suction and discharge) modifications required (except valve replacements, as shown) and the equipment is within acceptable limits to be lifted by the existing bridge crane (1.5 ton).
3. Performance characteristics and descriptive data.
4. Detailed equipment dimensional drawings and setting plans.
5. General lifting, erection, installation, and adjustment instructions, and recommendations.
6. Details of shaft sealing system.
7. Pump performance curves at rated speed and reduced speed (100%, 90%, 80%, 70%, 60%). Curves shall indicate flow, head, efficiency, brake horsepower, NPSH required, and minimum submergence. Curves shall include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.
8. General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces.
9. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.
10. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.
11. Details on materials of construction of all components including applicable ASTM designations.
12. Information on bearing types and bearing life.
13. Piping schematics.
14. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at $\frac{1}{2}$, $\frac{3}{4}$, and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.
15. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
16. Equipment shop coating systems, interior and exterior.

17. A list of spare parts and special tools to be provided.
18. Any additional information required to show conformance with the equipment specifications.
19. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.

1.04 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

- A. O&M Manuals shall be provided as specified in Section 01300, Submittals, and Section 11000, Equipment General Provisions.
- B. O&M manuals shall include instructions, equipment ratings, technical bulletins, and any other printed matter such as wiring diagrams and schematics, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. Included in this submission shall be a spare parts diagram, complete spare parts list, bill of materials, OEM part numbers and manufacturer's catalog information of all equipment components.
- C. Each set of instructions shall be bound together in appropriate three-ring binders with a detailed Table of Contents.
- D. Written operation and maintenance instructions shall be required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item.
- E. Information not applicable to the specific piece of equipment procured on this project shall be struck from the submission.
- F. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.
- G. Extensive pictorial cuts of equipment are required for operator reference in servicing.

1.05 WARRANTY AND GUARANTEE

- A. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of eighteen (18) months unless otherwise specified in the individual equipment specifications. The period of such warranties shall start on the date of Substantial Completion. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.
- B. The Contractor shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Engineer prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A

copy of each equipment warranty and equipment start-up certification shall also be provided in the document.

- C. The Equipment Supplier shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the Owner as user is likely to be made the defendant.
 - a. Where patent infringements are likely to occur, each Equipment Supplier shall submit, as a part of his bid, license arrangements between himself, or the manufacturer of the equipment offered, and the patent owner or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be bidding.
 - b. Each Equipment Supplier, by submitting his bid, agrees to hold and save the Owner and Engineer or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of the same by the Owner.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Each pump shall be a vertical, single-stage, non-clog, centrifugal pump, Model C5446 as manufactured by Fairbanks-Morse. Substitutions are not allowed.

2.02 MATERIALS

- A. Pump Design - The pump shall be bottom suction, side discharge construction and shall be supplied with and installed upon an integral suction elbow of the pump manufacturer's design matched to the pump suction connection piece. The volute shall be provided with a cleanout port to allow for removal of any foreign material blocking or impeding performance of the pump. The unit shall be designed such that the motor may be removed from the pump for independent servicing.
- B. Casing shall be made of close grained cast iron conforming to ASTM A48, Class 25 and 35 or ASTM 278, Class 30, and shall provide smooth unobstructed passages large enough to pass solids of the specified size (3-inch). A cleanout handhole with removable cover shall be provided for non-clog type pumps. The inner contours of the handhole cover shall match the contours of the casing in which it fits. Casing shall be enclosed by a removable suction and stuffing box cover carefully machined and aligned. Suction and discharge connections shall be ANSI Standard flat faced 125 pound flanges, and shall be drilled and tapped for gauge, drain and vent connections or shall be self-venting. The necessary lifting bolts and eye lugs shall be provided for installation and maintenance of the pumps. Tapped and plugged ½ in. diameter for gauge connections shall be provided on all nozzles. Actual pressure gauges will be provided and installed at a later date by others.

- C. Suction cover shall be constructed of the same material as the casing and shall be integrally cast with 125 pound ANSI standard flange. Cover shall be quickly removable for access to the impeller.
- D. Impeller shall be of the one piece, single suction, enclosed non-clog type and shall be made from closed-grain cast iron, conforming to ASTM A48, Class 25 and 35, and shall be statically, hydraulically, and dynamically balanced. The impeller shall be designed with smooth flow passages to pass solids of specified size and to prevent clogging by stringy materials. The impeller shall be bolted, keyed and locked to the pump shaft at the factory.
- E. Rotation of pumps shall be clockwise when viewed from the driven end, unless otherwise shown on the Drawings.
- F. Sealing shall be accomplished by a single mechanical seal. The single mechanical seal shall be a split mechanical seal, Model # 442 by Chesterton, or equal. The mechanical seal system shall be designed to require no seal flush water. The stuffing box shall be equipped with a spiral bushing to remove air and solids from seal chamber. Bushing shall be Spiral-Trac, or equal. The mechanical seal shall consist of silicon carbide seal faces, ethylene propylene flexible members, and 316 stainless metal parts.
- G. Shaft shall be Type SAE 1045 steel, minimum, sufficiently large in diameter to transmit safely the maximum torque developed by the drive unit and of such a design as to provide a rigid support for the impeller and to prevent excessive vibration. The shaft shall be suitably heat-treated, turned, ground, and polished over its entire length and shall be protected through the stuffing box by a removable hardened stainless steel shaft sleeve with seal to prevent leakage.
- H. Shaft sleeve shall be constructed of 420 series stainless steel hardened to 450 Brinell or better or corrosion resistant bronze, and secured to prevent reversal of rotation. A machined fit with Loctite seal shall be provided between the shaft and the impeller hub to prevent leakage under the sleeve. The shaft sleeve shall not be threaded.
- I. Bearings shall be of the anti-friction ball or tapered roller type in a dust-proof housing. Bearings shall be oil or grease lubricated with provisions for the addition or draining of lubricant. The bearings shall be designed for continuous heavy duty loads and for both axial and radial thrust loads. The bearing frame shall be of rigid cast iron construction to support the shaft and the bearings, and shall be designed so that the complete rotating element can be removed from the casing without disconnecting the piping. Bearings shall have a minimum AFBMA B-10 life of 100,000 hours under worst possible operating conditions.
- J. Bearing housing shall be constructed of cast iron, ASTM, A48, Class 30 designed to provide a fully enclosed bearing housing. The bearing housing shall be of immersible design, incorporating dual lip-type grease seals in contact with the shaft to prevent the entrance of water/contaminants as well as o-ring sealing at connection to pump backhead. Gasketed joints are not allowed. Zerk-type grease fittings for bearing lubrication shall be supplied at the bearing housing.
- K. Wearing rings shall be of the removable type, of 400 series stainless steel hardened to 450 Brinell. One wearing ring shall be on the impeller and one on the casing.

- L. Wear Adjustment - Rotating assembly shall be readily adjustable by jack screws at the end of the bearing housing so that, as wear occurs, proper impeller-to-suction cover liner clearance can be maintained without dismantling the pump.
- M. Base - The pump shall be supported by a cast iron mounting foot type pedestal cast integrally with, or especially fabricated for, the pump casing and sufficiently sized to ensure rigid support of the pump and motor. The common pump and motor base shall be suitably constructed to support the equipment and shall be provided with grout holes and drain connections with drip-lip, as necessary.
- N. Suction elbow shall be close grained cast iron conforming to ASTM A48, class 30 with integral ANSI 125 lb flange and hand hole with cover.
- O. Gauge tap and drain tap with plug shall be provided on the discharge volute.
- P. Coupling - Pump shaft connections to drives shall be directly connected through flexible couplings as manufactured by Falk, Dodge, or equal. Couplings shall be provided with coupling guards.

2.03 ELECTRICAL AND CONTROL REQUIREMENTS

- A. Motors shall be immersible, inverter duty rated motors meeting the requirements of this Section and as described below. The pump/motor assemblies will be controlled from the VFD units. VFD units shall be in accordance with Section 16495.
- B. Electrical Requirements

	Sewage Pumps
Motors	
Rating	460V, 3 ph, 60 Hz
Horsepower	200
Speed, rpm	1800
Enclosure	TEBC
Insulation	Class F
Inverter Duty	Yes
Service Factor	1.0
Space Heater	Yes
Motor Winding Temperature Switches	Yes
RTDs	No
Separate Cooling Fan	Yes
Motor Differential Current Transformers / Six-Lead External Wye Connection	No

- C. Provide cooling blower complete with ½ HP, 460 VAC, three-phase motor and level switch for de-energizing the blower during periods of submergence.
- D. Temperature monitoring devices shall be provided in motor windings for use in conjunction with and supplemental to external motor overload protection.
- E. Set temperature monitors at levels recommended by pump manufacturer.

- D. Provide stranded, PVC insulated submersible pump cables as needed. Cable shall be UL listed and rated at 600 volts. Control conductors shall be a minimum of AWG No. 14 gauge and power conductors shall be sized per the NEC. Provide waterproof termination at the pump as needed to maintain the IP rating of the unit. Cable length shall be 75 feet.

2.04 SPARE PARTS

- A. Spare parts shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following for each series of pumps.

- One (1) set of wearing rings
- One (1) - shaft sleeve
- One (1) - set of motor and pump bearings
- One (1) - complete mechanical shaft seal assembly
- Two (2) - sets of gaskets and O-ring seals

2.05 EQUIPMENT IDENTIFICATION

- A. All mechanical equipment shall be provided with a substantial stainless steel nameplate, mechanically fastened with stainless steel hardware in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or stainless steel nameplate mechanically fastened with stainless steel hardware; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, and other related equipment.
- C. Nameplates shall not be painted over.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer shall coordinate with Owner and Contractor for field services. For each series of pumps, field services shall include the following site visits:

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

- B. The manufacturer shall provide a qualified Technical Representative from the manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where

equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment.

- C. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.
- D. The Manufacturer's Technical Representative shall provide the following services.
 - 1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.
 - 2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.
 - 3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. In the event that equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
 - 4. Training: The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The equipment supplier shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 8:00 A.M. and 6:00 P.M. as necessary.
 - 5. Services after Startup: The Technical Representative shall return to the project site thirty (30) days after the start up date to review the equipment performance, correct

any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, the manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

- D. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections.
- E. The equipment supplier shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
- F. The equipment supplier shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

3.02 INSTALLATION

- A. Installation shall be in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps – General.

3.03 SHOP TESTING

- A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied. Tests shall be performed on the actual assembled pumps to be supplied. All testing must be conducted at the point of manufacture where corrections can be easily made if required.
- B. Shop testing shall be conducted in accordance with the latest version of Hydraulic Institute Standards 14.6, Hydraulic Performance Acceptance Tests.
 - a. Certified test curves shall be provided.
 - b. Pumps shall be within the tolerances specified for Acceptance Grade 1U, in accordance with the latest version of Hydraulic Institute Standards 14.6.
- C. Pump tests shall be witnessed by the Owner/Engineer. The testing procedure shall be submitted to the Engineer for review before scheduling the testing. The Engineer shall be given at least 2 weeks advanced notice of the scheduled testing date. Travel expenses for Owner's shop test witness are to be paid by the Owner.

- D. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- E. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- F. Shop testing of electric motors shall be in accordance with applicable requirements of Section 15170, Electric Motors.

3.04 VIBRATION TESTING

- A. Vibration Testing shall be in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps – General.

3.05 FIELD TESTING

- A. Field Testing shall be in accordance with the requirements of Section 11000, Equipment General Provisions and Section 11100, Pumps – General.

- END OF SECTION -

SECTION 11400

TEMPORARY BYPASS PUMPING SYSTEM

PART 1 -- GENERAL

1.01 Summary

- A. The Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the work area for the entire duration of the existing Cattail Branch SPS shutdown.

1.02 Quality Assurance

- A. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate experience in the design and operation of temporary bypass pumping systems. The vendor shall provide at least five (5) references of projects of a similar size and complexity as this project performed within the past three years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

1.03. Submittals

- A. The Contractor shall submit detailed plans and descriptions outlining provisions precautions to be taken by the Contractor regarding the handling of existing wastewater flows for performance of the work. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. The plan shall include pump operating levels, a "HIGH WATER ALARM" in the manhole or structure used for bypass pumping. High Water Alarm shall be tied to the Town's existing SCADA system. The "HIGH WATER ALARM" float will be provided by the Contractor and this float shall be connected to the RTU. The submittals shall include electrical schematics and control panel information for the pumps including start/stop and alarming configurations. No construction shall begin until all provisions and requirements have been reviewed by the Engineer/Owner. The Contractor shall allow 30 days for review and comment of this plan.
- B. The plan shall include but not limited to details of the following:
 - 1. Staging areas for pumps;
 - 2. Plan showing proposed equipment and piping layouts including details of tie-ins to existing sewer lines and force mains;

3. Suction manhole, suction piping configuration, pump operating and alarm levels
4. List of pump sizes, valves, flow meters, air release valves, piping, fittings and other appurtenances;
5. Pump TDH calculations
6. Pump curve and operating ranges
7. Method of noise control for each pump and/or generator;
8. Method for controlling and monitoring the pumps.

PART 2 -- MATERIALS

2.01 Equipment

- A. All pumps used shall be automatic self-priming units that do not require the use of footvalves in the priming system. The pumps must be diesel powered. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of pumping station sewage flows.
- B. Pumps shall be Godwin Dri-Prime® Automatic self-priming pumps with sound attenuation enclosures as manufactured by Godwin Pumps of America, Inc., or equal. Sound attenuation enclosures shall reduce operating noise to 66 dB at 30 feet. Sizing of pumps is per this Specification.
- C. The by-pass pumping system shall include the necessary stop/start instruments and controls for the pumps. The Contractor shall provide level control instruments including a "Lag Pump On" and "High Level" alarm. The control panel shall also include an auto dialer to relay alarm conditions to the Contractor. The auto dialer shall also notify "Town Dispatcher" for alarm conditions in addition to RTU high level notification. Contractor shall make a mobile phone application available for the operator for bypass pumping system status monitoring and alarm conditions.
- D. A back-up pump of size equal to the largest by-pass pump shall be included.
- E. The back-up pump shall be on-line, isolated from the primary system by a valve.
- F. An ultrasonic flow meter shall be provided for flow monitoring.
- G. Temporary discharge piping shall be constructed of rigid pipe with positive, restrained joints. Aluminum "irrigation" type piping or glued PVC pipe will not be allowed. Discharge hose will only be allowed in short sections and as accepted by the Engineer.
- H. Allowable piping materials will be Godwin "QD" Steel Pipe (Godwin Pumps of America, Inc.) Or fused, high-density polyethylene pipe as manufactured by Phillips Driscopipe, Inc. or equal.

2.02 System Description

A. Design Requirements:

1. The bypass pumping system shall have sufficient capacity to pump a peak flow of 6,105 gpm not including the back-up pump capacity. Each bypass pump capacity shall not exceed 2,035 gpm and minimum of three bypass pumps shall be provided not including the back-up pump. The low level in the wet well is 186.60 feet elevation, high level is 197.23 feet elevation.
2. Existing sewage pump duty point is 2,035 gpm at 208 ft TDH.
3. The grade elevation is 214.60 feet \pm .
4. Based on information obtained from as-builts, manhole MH-1A top and bottom elevations are 217.24 ft and 200.90 ft respectively. The 20-inch force main elevation at discharge manhole is 323 feet.
5. The Contractor shall provide all pipeline plugs, pumps of adequate size to handle the peak flow, and temporary discharge piping to ensure that the total flow influent flow can be safely diverted around the section to be repaired. Bypass pumping system will be required to be operated and manned 24 hours per day from the time when one or both existing sewage pumps are taken off line, and until successful completion of 7 day reliability testing in accordance with Section 11000.
6. Temporary bypass pumping during construction may be accomplished by utilizing existing sanitary sewer manhole MH-1A upstream of wet well and the existing 16-inch tap as shown on the Contract Drawings. The force main shall be isolated from the pumping station by means of existing plug valve located in the yard as shown on the drawings. The Contractor shall verify location of all utilities, size of fittings, couplings and all other bypass requirements as previously noted. The bypass connection and piping shall be installed and tested prior to bypassing.
7. The Contractor shall verify that existing valves necessary for the bypassing operation, are in good working condition. The Town shall be responsible for operating these valves during construction/upgrades at existing facilities. The Contractor shall coordinate with Town of Leesburg personnel regarding the operation of these valves and providing a minimum of five (5) days notice to the Town prior to any verification or construction operation.

B. Performance Requirements:

1. The design, determination of pump total dynamic head, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

2. The Contractor shall provide all necessary means to safely convey the incoming sewage past the work area. The Contractor will not be permitted to stop or impede the flows in existing force mains.
3. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers and that will protect public and private property from damage and flooding. Any sanitary sewer overflow that occurs due to a failure in the bypass system will be the responsibility of the Contractor. Any penalties issued to the Town by Virginia DEQ will be reimbursed to the Town by the Contractor.
4. Prior to initiating any by-pass pumping, the Contractor shall submit a contingency plan.
5. The Contractor shall protect water resources wetlands and other natural resources.
6. The Contractor shall be responsible to coordinate with the Town at least one week in advance for the bypass pumping system monitoring tie-ins to the Town SCADA system. The Contractor shall provide temporary power to the RTU panel for Bypass Pumping System status or alarm condition communications to the Town SCADA system.
7. All bypass pumping system status monitoring and alarm conditions (power system condition, pump condition, level, flow etc.) shall be displayed in the on-site control panel. Only high level alarm shall be relayed to Town SCADA system.

PART 3 -- EXECUTION

3.01 Field Quality Control and Maintenance

A. Test:

1. The Contractor shall perform leakage and pressure tests of the new bypass pumping discharge piping using clean water prior to actual operation. The Engineer shall be given 24 hours notice prior to testing.
2. The bypass pumping system shall be tested and operated successfully for 24 continuous hours, and the wet well shall be emptied, prior to start of work.

B. Inspection:

Contractor's bypass pumping system attendant shall inspect bypass pumping system every two hours on a continuous basis (24/7) to ensure that the system is working correctly.

C. Operation and Maintenance:

The Contractor shall insure that the temporary pumping system is properly operated and maintained and a responsible attendant shall be on-site when pumps are operating. The bypass pumping system shall be operated in accordance with the requirements of this Section. The attendant shall observe the operation continuously and respond to and resolve any power and pumping system malfunction or high flow/level conditions. The responses shall include but not limited to adjustments, repairs, replacements, communications with equipment supplier and arrangement of on-site services to resolve issues as needed, start-up or stopping of additional or spare units to maintain the sewer flow around the work area and to ensure proper response to the operational conditions.

D. Extra Materials:

1. Spare parts for pumps and piping shall be kept on site as required.
2. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.02 Preparation

A. Precautions

1. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Town and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.
2. During all bypass pumping operation, the Contractor shall protect the Pumping Station and main and all local sewer lines from damage inflicted by any equipment.

3.03 Installation and Removal

- A. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the Drawings and as may be required to provide adequate suction conduit.
- B. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
- C. When working inside manholes or sewer lines, the Contractor shall comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.
- D. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement. The Contractor is

responsible for obtaining any approvals for placement of the temporary pipeline within public ways from the Town.

3.04 Bypass Pump Supplier Requirements

- A. Bypass Pump supplier shall conduct a training class to instruct Contractor designated pump attendant to operate the bypass system. Items covered during the training will be pump monitoring, basic pump operation, basic repair, and emergency reaction sequence. Pump watch personnel will be instructed how to monitor the suction well level and react if the level rises beyond the high level alarms. In addition, how to inspect the system for leaks, recognizing clogs and recording flow meter information. This includes instruction on pump operation in manual mode to bypass the auto start controls and manually operate a pump as needed.

- END OF SECTION -

SECTION 13255

PHOTOIONIZATION ODOR CONTROL SYSTEM

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Contractor shall furnish, deliver, install, test, and place into satisfactory operation a Photoionization Odor Control System (System), as shown on the Drawings and as specified herein. The photoionization System shall utilize an ultraviolet/oxidation process providing effective removal of odorous compounds, such as hydrogen sulfide, reduced sulfur compounds (e.g., mercaptans), hydrocarbons, and other odorous compounds associated with wastewater. The Work included this Section includes the following:
1. Odor Control System:
 - a. Treatment System stainless steel enclosure and accessories.
 - b. Exhaust fan.
 - c. Mist eliminator.
 - d. Ultraviolet (UV) bulbs.
 - e. Catalytic media.
 - f. Air filters.
 - g. Local control panel (LCP).
 - h. Wiring and instrumentation.
 - i. Anchorage devices.
- B. Installation, Startup, Testing, Certification, and Training Services.
- C. Deliver, store, and handle all materials in a manner, which protects them from damage. Installation of the System will be the responsibility of the Contractor with the guidance and instruction from the Manufacturer.

1.02 QUALIFICATIONS

- A. Manufacturers providing the products specified in this Section shall have a minimum of five years of documented experience in the design and fabrication of photoionization odor control systems as demonstrated by a reference list of at least ten successful installations of similar size.

1.03 REFERENCES

- A. Section 11000 – Equipment General Provisions.
- B. Section 15590 – Fans.
- C. Applicable Sections of Division 3.
- D. Applicable Sections of Division 5.

- E. Applicable Sections of Division 15.
 - F. Applicable Sections of Division 16.
 - G. Applicable Sections of Division 17.
 - H. NEC, latest edition.
 - I. NFPA 820, latest edition.
- 1.04 OPERATING CONDITIONS AND PERFORMANCE REQUIREMENTS

Photoionization Odor Control System

Location:	Indoors, (Leesburg, VA).
Inlet Air Temperature Range:	40 to 100 degrees F.
Relative Humidity:	10% to 100%.
Foul Air Characteristics (avg):	3 ppm hydrogen sulfide (H ₂ S), 0.05 ppm reduced sulfur compounds
Airflow Rate:	2,500 cfm.
Guaranteed Treatment Efficiency:	< 500 exhaust D/T odor strength.
Number of Odor Control Systems:	One (1).
Fan Configuration:	Draw through, single-pass.
Enclosure Width (max):	7.5 ft.
Enclosure Depth (max):	3.7 ft.
Enclosure Height (max):	8.4 ft.
Total Power Demand:	7.0 kW
System Pressure Drop (max):	5.0 in. w.c.

1.05 SUBMITTALS

- A. Shop drawing submittals shall conform to the requirements of Section 01300, Submittals. In addition to the requirements of Section 01300, Submittals, submit the following:
 1. Catalog cut sheets, specifications, drawings, bill of materials, and other information sufficient to clearly demonstrate compliance with all parts of the Contract Documents.
 2. Dimensional and weight information, including shipping weight and operating weight.
 3. Structural design calculations for the system supports and loadings to be transmitted to foundations or supports. Provide pressure drop calculations across the modules with enough detail to confirm the blower fan selection. All design calculations shall be signed and sealed by a registered professional engineer in the United States.
 4. Enclosure fabrication details and materials of the components shall be included in shop drawings, submitted for Engineer's approval prior to fabrication.

5. Recommended shipping, handling, storage, protection, and installation instructions for System and all associated components.
6. Recommended spare parts list to maintain the System in service for a period of one year.
7. Manufacturer installation and reference lists, including Owner, location, contact name, title, phone number, and system design capacity (cfm).
8. Contact information for the System Manufacturer, including name, address, phone number, and email address, as well as address and phone number of the nearest service center(s) and manufacturer's representatives.
9. Any proposed exceptions to these specifications.
10. Startup and System Performance Testing Plan for approval by Engineer.
11. Panel layout, wiring diagrams, network connection diagram, and process control narrative.
12. The following data for motors shall be provided:
 - a. Name and manufacturer
 - b. Type and model
 - c. Bearing type and lubrication
 - d. Horsepower rating and service factor
 - e. Temperature rating
 - f. Full load rotative speed
 - g. Net weight
 - h. Efficiency at rated load
 - i. Full load current
 - j. Overall dimensions

Quality Control Submittals: Conform to the requirements of Section 01300, Submittals.

1. Operation and Maintenance Manuals.
2. Manufacturer's Certificate of Proper Installation.
3. Manufacturer's Certificate of Compliance, including performance guarantee.
4. Equipment Testing and Field Startup Report.

D. Operation and Maintenance Manuals:

1. Include instructions, product data sheets, technical bulletins, and any other printed matter containing full information required for the proper operation and maintenance of the System.

2. Each set of manuals shall be bound together in appropriate three ring binders with a detailed Table of Contents. Manuals shall also be submitted in electronic .pdf format.
3. Written operation and maintenance instructions shall be provided for items supplied for this project, as required.
4. Information not applicable to the specific materials installed on this project shall be struck from the submission.
5. Information provided shall include a source of replacement materials and names of service representatives, including address and telephone number.
6. When written instructions include Shop Drawings and other information previously reviewed by the Engineer, only those editions thereof which were approved by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the instructions.

1.06 NFPA 820

- A. The system shall be designed, fabricated, and installed in compliance with the National Fire and Protection Agency Code 820. All equipment located within three (3) feet of the odor control ductwork, odor control system, and exhaust fan, under positive pressure, shall be explosion-proof rated to NEC Class I, Division 2, Group D.

1.07 WARRANTY AND GUARANTEE

- A. The Manufacturer shall warrant the System equipment, controls, and appurtenances for a period of one (1) year after Final Acceptance, provided that the System is operated in accordance with the manufacturer's Operation and Maintenance Manual instructions provided hereunder.
- B. The System shall be guaranteed to meet the respective removal efficiencies and Performance Criteria as outlined in this specification.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The System shall be manufactured by:
 1. Neutralox Inc., Chicago, Illinois as supplied by Enviro Sales of Florida, Inc.
 2. Or equal.

2.02 CONSTRUCTION

- A. General: System shall be of modular construction, delivered as a compact pre-assembled, pre-mounted system, requiring minimal on-site installation.

- B. System shall be of draw through, single-pass configuration. Provide vertical exhaust stack, minimum of 7.5-feet in length, with SMACNA no loss rain guard.
- C. System Enclosure and Accessories:
1. Enclosure shall be constructed of Type 304 Stainless Steel. The enclosure shall consist of a weather-proof, insulated double wall (sandwich build-up), suitable for installation outdoors in any climate. The UV bulbs, catalyst modules, and air filters shall be easily accessible from the front and/or back of the enclosure through removable maintenance doors.
 2. Mist Eliminator: provide an integral, mist and grease filter installed within the inlet side of the enclosure, and 1-inch drain connections located at the base of the enclosure for removing condensate from the unit:
 - a. Enclosure shall have an access door for pad removal.
 - b. Filter pad shall consist of 2-inch of stainless mesh held together with a stainless steel frame.
 3. Dust Filter: provide class F5 dust-filters with a pressure loss of not more than 1.2 in. w.c. The filters shall protect the inside of the housing but do not need to necessarily contribute to odour removal.
 4. UV Bulb Compartment: the UV compartment shall contain an appropriate number of UV lamps as determined by the System manufacturer based on design odor loading and constituents. The lamps shall be guaranteed for one year of operation. Provided all required electrical transformers.
 5. Catalyst Media: provide appropriate type and volume of catalyst material as determined by the System manufacturer based on the odor loading and constituents to be treated and the required exhaust air conditions.
 6. Fan: provide a backward-inclined exhaust fan, top-mounted on the downstream side of the System. Fan shall be 5 hp, rated for 2,500 cfm, 3,500 rpm, with a wheel diameter of 13.25 in., or as selected by the System manufacturer based on the proposed system configuration. Fan shall be rated to NEC Class I, Division 2, Group D, and shall be in accordance with Section 15590, Fans.
 7. Fasteners: all fasteners and metal attachments, such as anchors, brackets and other required attachments shall be constructed of Type 304 Stainless Steel. Fasteners shall be in accordance with Section 05050, Metal Fasteners.
 8. Air Sample Taps: Contractor to provide inlet and exhaust sample taps, 2-inch diameter, with ball valves. One (1) air sample tap shall be located on the System inlet duct, and one (1) air sample tap shall be located on the System exhaust. Exhaust sample tap shall be provided with a down-turned 2-inch diameter tap, routed down and piped to approximately 4-ft above the finished grade in an accessible location, with a 2-inch ball valve. Contractor shall provide Type 316 stainless steel pipe supports for exhaust air sample piping.
- D. Electrical Requirements:

1. Electrical and control accessories: provide all electrical and control accessories required for electrical power supply of the System including cables and junction boxes.
2. The entire System shall be designed and supplied in accordance with the National Electrical Code, latest edition.

E. Controls:

1. Local Control Panel (LCP):
 - a. Control panel construction, wiring, and components shall meet the requirements of Section 17500, Cabinets and Enclosures.
 - b. The panel shall be assembled using NEMA-rated components.
 - c. System shall be controlled by the interior hard-wired control logic provided in the LCP. LCP shall control all components of the System through hardwired connections to field devices.
 - d. The controls shall enable on/off fan operation through the control devices installed on the dead front panel.
 - e. Controls shall be tested prior to shipment to the site. The manufacturer shall verify all settings to ensure proper System operation.
 - f. A Run Status indicator light shall be installed on the dead front panel.
 - g. Reset Pushbutton: When an alarm condition occurs, the alarm indication shall remain energized and the associated alarm contacts shall remain in the alarm state until the reset pushbutton is pressed.
2. Control Interface – Local Control Panel:
 - a. Hand Controls: Provide the following dead front mounted hand controls for each Fan Control Panel:
 - 1) On/Off selector switch for fan.
 - 2) E-stop pushbutton for fan.
 - 3) Provide a black reset pushbutton on the panel dead front door for resetting all alarms.
 - 4) Provide a local disconnect for fan.
 - 5) On/Off selector switch for each bank of UV bulbs.
 - b. Indicator Lights: Provide the following dead front mounted devices for each Fan Control Panel:
 - 1) Run Status indicator light for fan.
 - 2) Motor Fault indicator light for fan.
 - 3) High Pressure indicator light for filter.
 - 4) Run Status indicator light for each bank of UV bulbs.
 - c. Provide the following hardwired input/output signals for communication to the existing Control System. DI = Discrete Input. AI = Analog Input. Where indicated, provide loop power for analog instruments.
 - 1) Filter High Pressure alarm – DI
 - 2) General System alarm – DI
3. Differential Pressure: provide a differential pressure gauge and switch for monitoring and alarm of the dust-filter. The gauge and switch shall be

differential pressure type, suitable for the installed environmental conditions. The switch shall initiate a signal at a pre-set differential pressure indicating cleaning or replacement of the filter is required. Pressure gauges shall be in accordance with 17650, Pressure Gauges. Pressure switches shall be in accordance with 17775, Pressure Switches.

PART 3 – EXECUTION

3.01 MANUFACTURER’S SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions. Field services shall include the following site visits:

Service	Number of Trips	Number of Days/Trip
Installation, Startup, Certification, Testing, and Training	1	5

- B. The Manufacturer shall provide a training session on the maintenance of Odor Control System for the Owner’s personnel. Session shall be held after successful completion of all Field Quality Control Tests.

3.02 INSTALLATION

- A. Contractor shall allow for receipt, handling, and storage of all products specified herein.
- B. The Contractor shall handle, store, and install the System and ancillary components in compliance with manufacturer’s instructions and recommendations. The Contractor shall be responsible for providing all equipment and labor necessary for the installation.

3.03 FIELD QUALITY CONTROL

- A. Startup shall be performed by the Contractor with support from the manufacturer. Startup shall commence following a visual inspection and alignment check of the System by the manufacturer’s technical representative.
- B. All equipment shall be field tested in accordance with the applicable requirements of Section 11000, Equipment General Provisions.
- C. Provide Field Quality Control Tests and Field Test Report:
 - 1. Upon successful startup of the System and appurtenances, including the Engineer’s acceptance of the balancing and alignment reports, Contractor shall conduct performance test on System under actual operating conditions in the presence of the Engineer.
 - 2. H₂S Test Procedures: The test shall be conducted for a six (6) hour period at design airflows. Inlet and exhaust samples shall be taken at 5-minute

intervals and shall be logged for the entire period. H₂S sampling methods shall conform to the following standards:

- a. Inlet and exhaust H₂S concentrations shall be measured and continuously logged using the portable H₂S gas analyzers. For the inlet, an Acrulog 0-50 ppm, or equal, shall be used, and for the exhaust, an Acrulog Low Range (0.05 – 2 ppm), or equal, shall be used for the exhaust.
 - b. H₂S analyzer shall be factory-calibrated prior to the test to ensure reliable test results. Calibration shall be performed both prior to and after the test period and calibration certificates shall be submitted to the Engineer.
 - c. Inlet concentration data shall be collected from the inlet ductwork to the odor control System. Exhaust samples shall be taken from the odor control System exhaust stack.
 - d. Record inlet airflow twice daily for the testing period.
 - e. Should the system performance not meet the above requirements, the System shall have failed the performance test. The OC Supplier shall make any additions or modifications to the system as may be necessary, at no additional cost to the Owner, and the performance tests for that system shall be repeated in its entirety.
 - f. The OC Supplier shall submit a written report to the Engineer summarizing the data collected during the field acceptance tests demonstrating compliance with the system requirements.
3. Odor Panel Test Procedures: On one afternoon during the H₂S testing specified above, collect two (2) samples of foul air from the inlet and two (2) exhaust from the odor control System, for a total of four (4) samples. Each sample shall be collected by pumping indirectly from the source into Tedlar bags using an evacuation chamber and air sample pump. Tedlar bags shall be prepared in accordance with the laboratory's published standards. Each bag sample must be analyzed for D/T and R/T within 24 hours by St. Croix Sensory, Stillwater, MN laboratory. Testing method shall be in accordance with ASTM E679-04(2011).
4. Provide a Field Test Report to the Engineer for approval, summarizing the methods and results of the Field Quality Control Tests.

3.07 EQUIPMENT IDENTIFICATION

- A. Each piece of equipment shall be provided with a stainless steel equipment nameplate in accordance with Section 11000, Equipment General Provisions, which will be securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.

- END OF SECTION -

SECTION 15000

BASIC MECHANICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install to the required line and grade, all piping together with all fittings and appurtenances, required for a complete installation. All piping located outside the face of structures or building foundations and all piping embedded in concrete within a structure or foundation shall be considered exterior piping.
- B. The Contractor shall furnish and install fittings, couplings, connections, sleeves, adapters, harness rods and closure pieces as required to connect pipelines of dissimilar materials and/or sizes herein included under this Section and other concurrent Contracts for a complete installation.
- C. The Contractor shall furnish all labor, materials, equipment, tools, and services required for the furnishing, installation and testing of all piping as shown on the Drawings, specified in this Section and required for the Work. Piping shall be furnished and installed of the material, sizes, classes, and at the locations shown on the Drawings and/or designated in this Section. Piping shall include all fittings, adapter pieces, couplings, closure pieces, harnessing rods, hardware, bolts, gaskets, wall sleeves, wall pipes, hangers, supports, and other associated appurtenances for required connections to equipment, valves, or structures for a complete installation.
- D. Piping assemblies under 4-inch size shall be generally supported on walls and ceilings, unless otherwise shown on the Drawings or ordered by the Engineer, being kept clear of openings and positioned above "headroom" space. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.
- E. The Contractor shall provide taps on piping where required or shown on the Drawings. Where pipe or fitting wall thicknesses are insufficient to provide the required number of threads, a boss or pipe saddle shall be installed.
- F. The work shall include, but not be limited to, the following:
 - 1. Connections to existing pipelines.
 - 2. Test excavations necessary to locate or verify existing pipe and appurtenances.
 - 3. Installation of all new pipe and materials required for a complete installation.
 - 4. Cleaning, testing and disinfecting as required.

1.01 RELATED WORK SPECIFIED ELSEWHERE

1. Division 1, General Requirements
2. Division 2, Sitework
3. Division 5, Metals
4. Division 9, Finishes
5. Division 11, Equipment
6. Division 16, Electrical

2.01 MATERIAL CERTIFICATION AND SHOP DRAWINGS

- A. The Contractor shall furnish to the Owner (through the Engineer) a Material Certification stating that the pipe materials and specials furnished under this Section conform to all applicable provisions of the corresponding Specifications. Specifically, the Certification shall state compliance with the applicable standards (ASTM, AWWA, etc.) for fabrication and testing.
- B. Shop Drawings for major piping (2-inches in diameter and greater) shall be prepared and submitted in accordance with Section 01300 – Submittals. In addition to the requirements of Section 01300 – Submittals, the Contractor shall submit laying schedules and detailed Drawings in plan and profile for all piping as specified and shown on the Drawings.
- C. Shop Drawings shall include, but not be limited to, complete piping layout, pipe material, sizes, class, locations, necessary dimensions, elevations, supports, hanger details, pipe joints, and the details of fittings including methods of joint restraint. No fabrication or installation shall begin until Shop Drawings are approved by the Engineer.

3.01 WARRANTIES

- A. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of eighteen (18) months unless otherwise specified in the individual equipment specifications. The period of such warranties shall start on the date of Substantial Completion. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All specials and every length of pipe shall be marked with the manufacturer's name or trademark, size, class, and the date of manufacture. Special care in handling shall be exercised during delivery, distribution, and storage of pipe to avoid damage and unnecessary stresses. Damaged pipe will be rejected and shall be replaced at the

Contractor's expense. Pipe and specials stored prior to use shall be stored in such a manner as to keep the interior free from dirt and foreign matter.

- B. Testing of pipe before installation shall be as described in the corresponding ASTM or AWWA Specifications and in the applicable standard specifications listed in the following sections. Testing after the pipe is installed shall be as specified in Section 3.09.
- C. ALL EXPOSED EXTERIOR PIPING SHALL HAVE WELDED OR FLANGED JOINTS, UNLESS OTHERWISE SPECIFIED OR SHOWN ON THE DRAWINGS.
- D. The Drawings indicate work affecting existing piping and appurtenances. The Contractor shall excavate test pits as required of all connections and crossings which may affect the Contractor's work prior to ordering pipe and fittings to determine sufficient information for ordering materials. The Contractor shall take whatever measurements that are required to complete the work as shown or specified.

3.01 WALL PIPES

- A. Where wall sleeves or wall pipes occur in walls that are continuously wet on one or both sides, they shall have water stop flanges at the center of the casting or as shown on the Drawings. Ends of wall pipes shall be flange, mechanical joint, plain end, or bell as shown on the Drawings, or as required for connection to the piping. Wall pipes shall be of the same material as the piping that they are connected to. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange. Unless otherwise shown on the Drawings, waterstop flanges shall conform to the minimum dimensions shown below:

<u>Pipe Size</u>	<u>Waterstop Flange Diameter</u>	<u>Waterstop Flange Thickness</u>
4" - 12"	OD + 3.10"	0.50"
14" - 24"	OD + 4.15"	0.75"
30" - 36"	OD + 4.50"	1.00"
42" - 48"	OD + 5.00"	1.25"
54"	OD + 5.90"	1.50"

4.01 SLEEVES

- A. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured, or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.
- B. Sleeves shall be cast iron, black steel pipe, or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be

fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09900 – Painting.

- C. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by Garlock Pipeline Technologies (GPT) or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall be glass reinforced nylon plastic with EPDM rubber seal and 304 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided consisting of low carbon steel, zinc galvanized pressure plates, silicon rubber seals and low carbon steel, zinc galvanized bolts and nuts.
- D. Cast iron mechanical joint adapter sleeves shall be Clow # 1429, as manufactured by the Clow Corp., or equal. Mechanical joint adapter sleeves shall be provided with suitable gasket, follower ring, and bolts to effect a proper seal. In general, sleeves installed in walls, floors, or roofs against one side of which will develop a hydrostatic pressure, or through which leakage of liquid will occur, shall be so sealed. If welded waterstop flanges are employed, welds shall be 360 degree continuous on both sides of flange.

5.01 SOLID SLEEVE COUPLINGS (FOR BURIED SERVICE THROUGH 54-INCH)

- A. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal.
- B. Alternatively, EBAA Iron 3800 Mega-Coupling is acceptable.

6.01 SLEEVE TYPE COUPLINGS (FOR EXPOSED SERVICE AND BURIED SERVICE ABOVE 54-INCH)

- A. Sleeve type, flexible couplings shall be furnished and installed where shown on the Drawings or otherwise required to resist internal operating pressures. In addition to that specified herein, harnessed, sleeve type flexible couplings shall be provided on all exposed pipe 3 inches and larger in diameter that spans any expansion joint in a building or structure.
- B. Materials shall be of high strength steel and couplings shall be rated for the same pressures as the connecting piping.
- C. Gaskets shall be rubber. Bolts and nuts shall be alloy steel, corrosion-resistant and prime coated.
- D. Harnessing for exposed applications shall be by rodding across the sleeve type coupling to the nearest pipe joint on either side of the coupling using threaded rods and rod tabs unless otherwise approved by the Engineer.

- E. Couplings shall be as manufactured by Smith-Blair Model 411, Romac Industries Model 400, Dresser Industries Style 38, or equal as required and shown on the Drawings. All couplings shall be provided without interior pipe stop.
- F. Couplings shall be provided with manufacturer's fusion bonded epoxy painting system.

7.01 FLANGED COUPLING ADAPTERS

- A. Flanged coupling adapters shall be furnished as required and as shown on the Drawings.
- B. Flanged coupling adapters shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping.
- C. All flanged coupling adapters shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs unless otherwise approved by the Engineer.
- D. Flanged coupling adapters shall be manufactured by Smith-Blair Model 911, Romac Industries Model RFCA or equal.
- E. Flanged coupling adapters shall be provided with manufacturer's fusion bonded epoxy painting system.

8.01 DISMANTLING JOINTS

- A. Dismantling joints shall be furnished at locations shown on the Drawings.
- B. Dismantling joints for sizes less than 12-inch shall be of ductile iron or carbon steel construction and shall be rated for the same pressure as the connected piping. Dismantling joints for sizes greater than 12-inches shall be of carbon steel construction and shall be rated for the same pressure as the connected piping.
- C. Flanges for dismantling joints shall match the bolt pattern and pressure rating of the flanges for the connected piping.
- D. All dismantling joints shall be restrained utilizing restraining rods provided by the manufacturer. Restraining rods shall be constructed from ASTM A193 Grade B7 steel. Restraining rods and restraint system shall be installed in strict accordance with manufacturer's recommendations.
- E. Dismantling joints shall be provided with manufacturer's fusion bonded epoxy painting system.
- F. Dismantling joints shall be manufactured by Smith Blair Model 975, Romac Industries Model DJ400, or equal.

9.01 GROOVED COUPLINGS

- A. Grooved end pipe couplings shall be furnished as specified or shown on the Drawings.
- B. Materials shall be of malleable iron and couplings shall be rated for the same pressures as the connecting piping.

- C. Gaskets shall be rubber. Bolts and nuts shall be heat treated carbon steel track bolts and shall be plated.
- D. After installation, buried couplings shall receive two heavy coats of an approved coal tar which is compatible with the finish of the coupling. Exposed couplings shall be painted in accordance with Section 09900 - Painting.
- E. Couplings shall be manufactured by Victaulic Company of America Style 31 or equal.

10.01 TAPPING SLEEVES AND TAPPING SADDLES

- A. Tapping sleeves shall be similar to Mueller Outlet Seal, American Uniseal or Kennedy Square Seal. All sleeves shall have a minimum working pressure of 150 psi. All sleeves larger than twelve (12) inches shall be ductile iron. All taps shall be machine drilled; no burned taps will be allowed.
- B. Tapping saddles may be used on mains sixteen (16) inches and larger where the required tap size does not exceed one-half the size of the main (i.e. 8-inch tapping saddle for use on a 16-inch main). Tapping saddles shall be manufactured of ductile iron providing a factor of safety of at least 2.5 at a working pressure of 250 psi. Saddles shall be equipped with a standard AWWA C-110-77 flange connection on the branch. Sealing gaskets shall be "O" ring type, high quality molded rubber having an approximate seventy durometer hardness, placed into a groove on the curved surface of the tapping saddles. Straps shall be of alloy steel. The tapping saddle shall be the American tapping saddle, U.S. Pipe tapping saddle, or equal. All taps shall be machine cut, no burned taps will be allowed.

11.01 UNIONS

- A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.
- B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.
- C. For PVC and CPVC piping, unions shall be socket weld type with Viton O-ring.

12.01 THERMOPLASTIC TUBING AND FITTINGS

- A. Thermoplastic tubing shall be manufactured from polyallomor tubing. Tubing shall be protected from ultraviolet radiation degradation with a black coating or integral color conforming to ASTM D-1248, Type 1, Class C, Category 3. Fittings and connectors used with thermoplastic tubing shall be the flareless tube type constructed of brass conforming to SAE CA377, SAE CA360 or equal. Brass sleeves shall be used.
- B. Assembly of the thermoplastic tubing shall consist of pushing the tubing into the fitting and hand tightening the nut with final tightening with a wrench. Care shall be taken not to overtighten the nut. Plastic tube racks and bend holders shall be provided for holding the tubing in position. Needle valves used with thermoplastic tubing shall be the globe type constructed with a brass body, stem and seat and Buna-N "O"-ring seals. Installation shall be in accordance with the manufacturer's recommendations. Thermoplastic tubing, shall be the Impolene (polyallomor) system and needle valves, fittings and connectors shall be the

Poly-Flo with 261 UB Universal Nut and Sleeve system as manufactured by Imperial Eastman, or equal.

13.01 HEAT TRACED PIPING

- A. Exposed pipes to be insulated shall also be protected from freezing by heat tracing. Freeze protection heat tracing shall consist of twin 16 AWG copper brass wires with a semiconductor polymer core where electrical resistance varies with temperature. The heat tracing shall have a fluoropolymer outer jacket for corrosion resistance. The heat tracing shall be rated for three (3) watts per foot output, self-regulating with a maximum temperature of 150°F, equal to a Chromalox No. SRL3-1CT383400. Maximum length for tape shall be 300 feet for each circuit. Temperature controller shall be provided to sense pipe temperature to determine on or off condition of the heat tracing. Temperature control shall be equal to a Chromalox No. RTBC-2-384729. The heat tracing system shall operate on 120 VAC. See Drawings for installation detail.

14.01 FLEXIBLE RESTRAINED EXPANSION JOINTS

- A. Restrained expansion joints shall be manufactured of 60-42-10 ductile iron conforming to material and other applicable requirements of ANSI/AWWA C153/A21.53.
- B. Each pressure containing component shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the materials requirements of, and tested in accordance with, ANSI/AWWA C213 and shall meet or exceed the requirements of ANSI/AWWA C550.
- C. Seals shall conform to the applicable requirements of ANSI/AWWA C111/A21.11.
- D. All bolts used in the assemblies shall be stainless steel and shall be coated with a premium quality epoxy.
- E. Flanged ends shall comply with ANSI/AWWA C110/A21.10, with the addition of O-ring groove and O-ring.
- F. Mechanical joint ends shall comply with ANSI/AWWA C153/A21.53.
- G. Restrained expansion joints shall have a minimum pressure rating of 350 psi with a minimum safety factor of 3:1 assembly shall be tested at 350 psi before shipment.
- H. Restrained expansion joints shall provide for self restraint without tie rods and shall provide for expansion and contraction capabilities cast as an integral part of the end connection.
- I. Flexible restrained expansion joints shall allow for 8-inches (+6"-2") minimum expansion.
- J. Flexible restrained expansion joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint having a minimum of 15° deflection per ball.
- K. Restrained expansion joints shall be the Single Ball or Double Ball FLEX-TEND Expansion Joint as manufactured by EBAA Iron Inc., or equal.

PART 3 -- EXECUTION

15.01 INSTALLATION

- A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation as shown on the Drawings, specified or recommended by the pipe manufacturer. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used. Great care shall be taken to prevent any pipe coating from being damaged on the inside or outside of the pipe and fittings. All pieces shall be carefully examined for defects, and no piece shall be installed which is known to be cracked, damaged, or otherwise defective. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work. All piping connections to equipment shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment. At certain applications, Dresser, Victaulic, or equal, couplings may also be used. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Unless otherwise shown or approved, provided a minimum headroom clearance under all piping of 7 feet 6 inches.
- B. Unless otherwise shown or specified, all waste and vent piping shall pitch uniformly at a 1/4-inch per foot grade and accessible cleanouts shall be furnished and installed as shown and as required by local building codes. Installed length of waste and vent piping shall be determined from field measurements in lieu of the Drawings.
- C. All excavation shall be made in such a manner and to such widths as will provide ample room for properly installing the pipe and permit thorough compaction of backfill around the pipe. The minimum trench widths shall be in strict accordance with the "Trench Width Excavation Limits" as shown on the Drawings. All excavation and trenching shall be done in strict accordance with these specifications and all applicable parts of the OSHA Regulations, 29CFR 1926, Subpart P.
- D. ALL EXCAVATION REQUIRED BY THIS CONTRACT SHALL BE UNCLASSIFIED. NO ADDITIONAL PAYMENT WILL BE MADE FOR ROCK EXCAVATION REQUIRED FOR THE INSTALLATION OF PIPE OR STRUCTURES SHOWN ON THE DRAWINGS.
- E. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.
- F. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, or obstructions.
- G. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited

to approximately one hundred (100) feet. The Contractor shall excavate the trenches to the full depth, width and grade indicated on the Drawings including the relevant requirements for bedding. The trench bottoms shall then be examined by the Engineer as to the condition and bearing value before any pipe is laid or bedding is placed.

- H. No pressure testing shall be performed until the pipe has been properly backfilled in place. All pipe passing through walls and/or floors shall be provided with wall pipes or sleeves in accordance with the specifications and the details shown on the Drawings. All wall pipes shall be of ductile iron and shall have a water stop located in the center of the wall. Each wall pipe shall be of the same class, thickness, and interior coating as the piping to which it is joined. All buried wall pipes shall have a coal tar outside coating on exposed surfaces.
- I. JOINT DEFLECTION SHALL NOT EXCEED 75 PERCENT OF THE MANUFACTURERS RECOMMENDED DEFLECTION. Excavation and backfilling shall conform to the requirements of Section 02200 - Earthwork, and as specified herein. Maximum trench widths shall conform to the Trench Width Excavation Limits shown on the Drawings. All exposed, submerged, and buried piping shall be adequately supported and braced by means of hangers, concrete piers, pipe supports, or otherwise as may be required by the location.
- J. Following proper preparation of the trench subgrade, pipe and fittings shall be carefully lowered into the trench so as to prevent dirt and other foreign substances from gaining entrance into the pipe and fittings. Proper facilities shall be provided for lowering sections of pipe into trenches. UNDER NO CIRCUMSTANCES SHALL ANY OF THE MATERIALS BE DROPPED OR DUMPED INTO THE TRENCH.
- K. Water shall be kept out of the trench until jointing and backfilling are completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no water, earth, or other substance will enter the pipes, fitting, or valves. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored as required.
- L. All piping shall be installed in such a manner that it will be free to expand and/or contract without injury to itself or to structures and equipment to which it is connected. All piping shall be erected to accurate lines and grades with no abrupt changes in line or grade and shall be supported and braced against movement, temporary, or permanent. All exposed piping shall be installed with vertical and horizontal angles properly related to adjoining surfaces or pipes to give the appearance of good workmanship. Pipes crossing within a vertical distance of less than or equal to one (1) foot shall be encased and supported with concrete at the point of crossing to prevent damage to the adjacent pipes as shown on the Drawings.
- M. The full length of each section of pipe shall rest solidly upon the bed of the trench, with recesses excavated to accommodate bells, couplings, joints, and fittings. Before joints are made, each pipe shall be well bedded on a solid foundation; and no pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid by the Contractor at his own expense. Pipe shall not be laid in water or when trench conditions are unsuitable for work.
- N. Proper and suitable tools and appliances for the safe convenient handling and laying of pipe shall be used and shall in general agree with manufacturer's recommendations.

- O. AT THE CLOSE OF EACH WORK DAY THE END OF THE PIPELINE SHALL BE TIGHTLY SEALED WITH A CAP OR PLUG SO THAT NO WATER, DIRT, OR OTHER FOREIGN SUBSTANCE MAY ENTER THE PIPELINE, AND THIS PLUG SHALL BE KEPT IN PLACE UNTIL PIPE LAYING IS RESUMED.
- P. During the laying of pipe, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed.
- Q. Ordinarily only full lengths of pipe (as furnished by the pipe manufacturer) shall be used exceptions: closure pieces at manholes and areas where joint deflection is required.
- R. For gravity sewer installations, the Contractor shall use a laser device to maintain the trench and pipe alignment. The laser device shall be re-checked for correct elevation and pipe alignment prior to pipe installation if the device is left in the pipe overnight. Corrected invert elevations at each manhole and any adjustments will be coordinated and approved by the Engineer.
- S. ALL PIPING SHALL HAVE TYPE "A" BEDDING AS SHOWN ON THE DRAWINGS, UNLESS OTHERWISE SPECIFIED HEREIN OR INDICATED ON THE DRAWINGS.

16.01 DUCTILE IRON PIPE

- A. Ductile iron pipe (DIP) shall be installed in accordance with the requirements of the Ductile Iron Pipe Handbook published by the Ductile Iron Pipe Research Association, and AWWA C600.
- B. Where it is necessary to cut ductile iron pipe in the field, such cuts shall be made carefully in a neat workmanlike manner using approved methods to produce a clean square cut. The outside of the cut end shall be conditioned for use by filing or grinding a small taper, at an angle of approximately 30 degrees.
- C. UNLESS OTHERWISE APPROVED BY THE ENGINEER, FIELD WELDING OF DUCTILE IRON WILL NOT BE PERMITTED.

17.01 PVC/CPVC AND HDPE PIPE

- A. Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC) and High Density Polyethylene (HDPE) pipe shall be laid and joints assembled according to the respective manufacturer's recommendation. PVC pipe installation shall comply with applicable sections of the Uni-Bell PVC Pipe Association Recommended Standard Specifications.
- B. Plastic piping shall not be installed when the temperature is less than 60°F except as otherwise recommended by the manufacturer and approved by the Engineer.

18.01 CARBON AND STAINLESS STEEL PIPE

- A. Installation of steel pipe shall be by skilled workmen and shall conform to the applicable sections of AWWA Manual M-11. Joints for steel piping shall be either screwed, welded, or flanged as shown on the Drawings or as specified.

- B. Welding in the field shall be performed only when requested on the shop drawings and permitted by the Engineer for carbon steel pipe. No welding of stainless steel pipe shall be allowed in the field. All field welds shall be radiographically inspected.
- C. Installation of the steel casing pipe shall be by skilled workmen and in accordance with the best standard practice for steel pipe installation. Joints for steel casing pipe shall be butt welded.
 - 1. The boring equipment to be used for installing the jacked casing shall be of such size and capacity to allow the boring to proceed in a safe and expeditious manner. The installation of the casing and boring of the hole shall be done simultaneously to avoid cave-ins or settlement and for safety of traffic above.
 - 2. The Contractor shall check the vertical and horizontal alignment of the casing by survey instrument at least once during each four feet of advance, or as directed by the Engineer. Pits shall be well sheeted and braced as necessary for safe and adequate access for workmen, inspectors and materials and shall be of a size suitable to equipment and material handling requirements.
 - 3. Under no conditions shall jetting or wet boring of encasement under pavement be allowed.
 - 4. After installation of the carrier pipe, each end of the casing pipe shall be made watertight with a brick masonry bulkhead. In addition, a Class B concrete cradle shall be provided from each end of the bulkhead to the first pipe joint outside of the bulkhead.

19.01 COPPER PIPE

- A. Installation of copper pipe shall be by skilled workman in accordance with the manufacturer's recommendations. Use teflon tape at all fittings unless otherwise required for intended service. Install unions at the connections to each piece of equipment to allow removal of equipment without dismantling connecting piping.
- B. Wall sleeves shall be provided for all piping passing through exterior walls and shall be of the same material as the piping to which it is joined. All wall sleeves shall be provided with an acceptable waterstop.
- C. The Contractor shall provide hot and cold water mains with branches and risers complete from point indicated on the Drawings running to all fixtures and other outlets indicated. Mains and branches shall be run generally as shown on the Drawings. The Contractor shall provide all interior water piping, branches, and risers as shown on the Drawing and shall make connections to all plumbing fixtures, hose bibs, wall hydrants, and other points requiring water under this and other Divisions of the Specifications.
- D. All water mains and branches shall be pitched at least one (1) inch in twenty-five (25) feet toward fixtures. The piping installation shall be arranged so that the entire system can be drained through fixture supply connections.
- E. Unions shall be installed at the connections to each piece of equipment to allow for removal of equipment without dismantling connecting piping.

- F. Joints 1-1/4 inches and larger shall be made with silver solder. For joints less than 1-1/4 inches and all valves (regardless of size) use 95/5 solder. Soldered joints shall be prepared with a non-corrosive paste flux in accordance with manufacturer's instructions. All joints shall be thoroughly cleaned with emery cloth and reamed out before assembly. Acid core solder will not be permitted.

20.01 POLYPROPYLENE AND POLYVINYLIDENE FLUORIDE PIPE

- A. The pipe and fittings shall be of the same material for both inner and outer walls of the pipe.
- B. Polypropylene pipe shall be black UV stabilized co-polymer conforming to the requirements of ASTM D-4101. Where used in exterior locations, material shall provide a weathering resistance absent of further coating, covering, or wrapping unless specified herein or shown on the Drawings.
- C. Polyvinylidene fluoride shall comply with ASTM D-3222. The material shall provide a translucence, thus enabling a visual inspection of liquid in the annular space between the inner and outer walls.
- D. Where elastomers are selected by the manufacturer, such selection shall be with regard to the application of the chemical solution to be transported.
- E. Pipe and associated fittings shall be rated for not less than 75 psi at 73°F.
- F. Double-walled pipe and fittings shall be molded and used throughout. Molded ribs shall maintain permanent alignment of the inner and outer walls of the pipe and fittings.
- G. Ends of fittings shall be flush, creating a single plane.
- H. Wall thickness of the inner and outer walls of double-walled pipe shall be identical, providing identical pressure ratings.
- I. Where shown on the Drawings, a leak detection system of the manufacturer's design shall be supplied, complete with vent pipes, manual drain outlet, and electric float switch. Switch shall be rated for 0.080 amps at 120 VAC.
- J. Polypropylene and polyvinylidene fluoride pipe shall be laid and joints assembled by skilled workers according to the respective manufacturer's recommendations. Joints shall be butt fusion welded.
- K. Plastic piping shall not be installed when the ambient temperature is less than 60°F except as otherwise recommended by the manufacturer and approved by the Engineer.
- L. Wall sleeves shall be provided where piping passes through exterior walls. All sleeves shall be provided with an acceptable waterstop.
- M. Double walled pipe shall be Asahi/American or equal. Pipe shall be furnished complete with flanges or other appurtenant fittings by the same manufacturer and made especially for use with the double walled pipe.

21.01 JOINTS IN PIPING

- A. Restrained joints shall be provided on all pipe joints as specified herein and shown on the Drawings. Restrained joints shall be made up similar to that for push-on joints.
- B. Push-on joints include a single rubber gasket which fits into the bell end of the pipe. The gasket shall be wiped clean, flexed and then placed in the socket. Any bulges in the gasket which might interfere with the entry of the plain end of the pipe shall be removed. A thin film of lubricant shall be applied to the gasket surface which will come into contact with the spigot end of the pipe. The lubricant shall be furnished by the pipe manufacturer. The plain end of the pipe, which is tapered for ease of assembly, shall be wiped clean and a thick film of lubricant applied to the outside. The pipe shall be aligned and carefully entered into the socket until it just makes contact with the gasket. The joint assembly shall be completed by entering the pipe past the gasket until it makes contact with the bottom of the socket. The pipe shall be pulled "home" with an approved jack assembly as recommended by the pipe manufacturer. If assembly is not accomplished by reasonable force, the plain end shall be removed, and the condition corrected.
- C. Flanged joints shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places. Bolts or studs shall be uniformly tightened around the joints. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud. Pipes in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot.
- D. Mechanical joints shall be made up with gaskets, glands and bolts. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water; the gland and gasket shall be slid onto the plain end and the end then entered into the socket until it is fully "home" on the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened alternately to bring the gland into position evenly. Excessive tightening of the bolts shall be avoided. All nuts shall be pulled up using a torque wrench which will not permit unequal stresses in the bolts. Torque shall not exceed the recommendations of the manufacturer of the pipe and bolts for the various sizes. Care shall be taken to assure that the pipe remains fully "home" while the joint is being made. Joints shall conform to the applicable AWWA Specifications.
- E. Threaded and/or screwed joints shall have long tapered full depth threads to be made with the appropriate paste or jointing compound, depending on the type of fluid to be processed through the pipe. All pipe up to, and including 1-1/2-inches, shall be reamed to remove burr and stood on end and well pounded to remove scale and dirt. Wrenches on valves and fittings shall be applied directly over the joint being tightened. Not more than three pipe threads shall be exposed at each connection. Pipe, in all lines subject to temperature changes shall be cut short and cold sprung into place to compensate for expansion when hot. Joints in all piping used for chlorine gas lines shall be made up with a glycerine and litharge cement. Joints in plastic piping (PVC/CPVC) shall be laid and joints made with compounds recommended by the manufacturer. Installation shall conform to the requirements of ASTM D2774 and ASTM D2855. Unions required adjacent to valves and equipment.
- F. Soldered joints shall have the burrs removed and both the outside of pipe and the inside of fittings shall be thoroughly cleaned by proper tools recommended for that purpose. Flux

shall be applied to both pipe and inside of fittings and the pipe placed into fittings and rotated to insure equal distribution of flux. Joints shall be heated and solder applied until it shows uniformly around the end of joints between fitting and pipe. All joints shall be allowed to self-cool to prevent the chilling of solder. Combination flux and solder paste manufactured by a reputable manufacturer is acceptable. Unions required adjacent to valves and equipment.

- G. Welded joints shall be made by competent operators in a first class workmanlike manner, in complete accordance with ANSI B31.1 and AWWA C206. Welding electrodes shall conform to ASTM A233, and welding rod shall conform to ASTM A251. Only skilled welders capable of meeting the qualification tests for the type of welding which they are performing shall be employed. Tests, if so required, shall be made at the expense of the Contractor, if so ordered by the Engineer. Unions shall be required adjacent to valves and equipment.
- H. Copper joints shall be thoroughly cleaned and the end of pipes uniformly flared by a suitable tool to the bevels of the fittings used. Wrenches shall be applied to the bodies of fittings where the joint is being made and in no case to a joint previously made. Dimensions of tubing and copper piping shall be in complete accordance with the fittings used. No flare joints shall be made on piping not suited for flare joints. Installations for propane gas shall be in accordance with NFPA 54 and/or 58.
- I. Solvent or adhesive welded joints in plastic piping shall be accomplished in strict accordance with the pipe manufacturer's recommendations, including necessary field cuttings, sanding of pipe ends, joint support during setting period, etc. Care shall be taken that no droppings or deposits of adhesive or material remain inside the assembled piping. Solvent or adhesive material shall be compatible with the pipe itself, being a product approved by the pipe manufacturer. Unions are required adjacent to valves and equipment. Sleeve-type expansion joints shall be supplied in exposed piping to permit 1-inch minimum of expansion per 100 feet of pipe length.
- J. Dielectric isolation such as flange isolation kits, dielectric unions, or similar, shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			•	•	•	•	•	•	•
Galvanized Steel			•	•	•	•	•	•	•
Aluminum	•	•		•	•	•	•	•	•
Cast Iron	•	•	•				•	•	•
Ductile Iron	•	•	•				•	•	•
Mild Steel/ Carbon Steel	•	•	•				•	•	•

Copper	•	•	•	•	•	•			•
Brass	•	•	•	•	•	•			•
Stainless Steel	•	•	•	•	•	•	•	•	
1. "•" signifies dielectric isolation is required between the two materials noted. 2. Consult Engineer for items not listed in table. 3. Provide flange isolation kits for all flanged connections of dissimilar metals and hardware including connections to equipment. 4. Contractor shall include all isolation descriptions with piping submittals.									

- K. Eccentric reducers shall be installed where air or water pockets would otherwise occur in mains because of a reduction in pipe size.
- L. Joints in polypropylene and polyvinylidene fluoride pipe shall be butt fusion weld. All butt welding shall follow the requirements of ASTM D-2657 and the manufacturer's recommendations.

22.01 FLUSHING AND TESTING

- A. All piping shall be properly flushed and tested unless specifically exempted elsewhere in the Specifications or otherwise approved by the Engineer. Air and gas pipelines shall be flushed and tested with compressed air. All other liquid conveying pipelines shall be flushed and tested with water. The Contractor shall furnish and install all means and apparatus necessary for getting the air or water into the pipeline for flushing and testing including pumps, compressors, gauges, and meters, any necessary plugs and caps, and any required blow-off piping and fittings, etc., complete with any necessary reaction blocking to prevent pipe movement during the flushing and testing. All pipelines shall be flushed and tested in such lengths or sections as agreed upon among the Owner, Engineer, and Contractor. Air pipeline test pressures shall be as specified in Section 15013 - Steel Pipe for Low Pressure Process Air Service. The Contractor shall give the Owner and Engineer reasonable notice of the time when he intends to test portions of the pipelines. The Engineer reserves the right, within reason, to request flushing and testing of any section or portion of a pipeline.
- B. The Contractor shall provide water for all flushing and testing of liquid conveying pipelines. Raw water or non-potable water may be used for flushing and testing liquid pipelines not connected to the potable water system. Only potable water shall be used for flushing and testing the potable water system.
- C. Air and gas piping shall be completely and thoroughly cleaned of all foreign matter, scale, and dirt prior to start-up of the air or gas system.
- D. At the conclusion of the installation work, the Contractor shall thoroughly clean all new liquid conveying pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered the pipe during the construction period. If after this cleaning any obstructions remain, they shall be corrected by the Contractor, at his own expense, to the satisfaction of the Engineer. Liquid conveying pipelines shall be flushed at the rate of at least 2.5 feet per second for a duration suitable to the Engineer or shall be flushed by other methods approved by the Engineer.

- E. Compressed/service air and gas piping shall be flushed by removing end caps from the distribution lines and operating one (1) compressor, in accordance with the manufacturer's instructions.
- F. After flushing, all air piping shall be pressure and leak tested prior to coating and wrapping of welded joints. Immediately upon successful completion of the pressure and leak test, welded joints shall be thoroughly cleaned of all foreign matter, scale, rust, and discoloration and coated in accordance with the Specifications.
- G. All process air piping shall be leak tested by applying a soap solution to each joint.
- H. During testing the piping shall show no leakage. Any leaks or defective piping disclosed by the leakage test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
- I. All process air piping shall be pressurized to the test pressure and tested for leaks by applying a soap solution to each joint. The air supply shall be stopped and the pipe pressure monitored. System pressure shall not fall by more than 0.5% of the test pressure over a two-hour test period. Should the system fail to hold the required pressure for two hours, the cause shall be determined and corrected and the test repeated until a successful test of the entire system is obtained.
- J. Field leakage tests shall be performed for all submerged process air piping. The procedure shall consist of operating the system under clear nonpotable water for visual identification of all leaks. All field leakage tests shall be witnessed by the Engineer. All submerged piping shall be installed free of any leaks.
- K. After flushing, all liquid conveying pipelines shall be hydrostatically tested at the test pressure specified. The procedure used for the hydrostatic test shall be in accordance with the requirements of AWWA C600. Each pipeline shall be filled with water for a period of no less than 24 hours and then subjected to the specified test pressure for 2 hours. During this test, exposed piping shall show no leakage. Allowable leakage in buried piping shall be in accordance with AWWA C600.
- L. Any leaks or defective pipe disclosed by the hydrostatic test shall be repaired or replaced by the Contractor, at his own expense, and the test repeated until all such piping shows tight.
 - 1. After flushing, all gas piping shall be leak tested in accordance with all local codes and regulations and in conformance with the recommendations or requirements of any National Institute or Association for the specific service application.

23.01 PAINTING AND COLOR CODING SYSTEM

- A. All exposed piping specified shall be color coded in accordance with the Owner's standard color designation system for pipe recognition and in accordance with Section 15030 – Piping and Equipment Identification Systems. In the absence of a standard color designation system, the Engineer will establish a standard color designation for each piping service category from color charts submitted by the Contractor in compliance with Section 09900 – Painting.

- B. All piping specified in this Section shall be painted in accordance with Section 09900 – Painting, except as follows:
- C. Copper pipe
- D. Stainless steel pipe. Flanges and supports or hangers shall be painted.

- END OF SECTION -

SECTION 15006

DUCTILE IRON PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. All ductile iron pipe and specials shall be marked with the manufacturer's name or trademark, size, weight, thickness class, the date of manufacture, and the word "Ductile".
- B. Ductile iron pipe (DIP) of the sizes shown or specified shall conform to ANSI A21.51 (AWWA C151), Grade 60-42-10 for ductile iron pipe centrifugally cast in metal molds or sand-lined molds. All ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) for thickness design and shall be supplied in 18 or 20 foot nominal lengths or as required to meet the requirements of the Drawings. Fittings and specials shall be cast iron or ductile iron, conforming to the requirements of ANSI A21.10 (AWWA C110) or ANSI A21.53 (AWWA C153).
- C. Minimum Class 53 pipe shall be used for flanged spools.
- D. Reference Section 15000, Basic Mechanical Requirements
- E. Reference Section 15390, Schedules, for pressure rating requirements for specific applications.

PART 2 -- PRODUCT

2.01 DUCTILE IRON PIPE AND FITTINGS

- A. All pipe and fittings shall be lined with a ceramic-filled amine-cured epoxy, Protecto 401 by Induron. Lining shall be 40 mils minimum thickness. The lining shall be applied in accordance with manufacturer's instructions by an applicator approved by the coating manufacturer. Lining shall be applied at the applicator's shop or the pipe manufacturer's plant. All exposed DIP and fittings shall have a shop applied prime coat in accordance with Section 09900 - Painting.
- B. Flanged joints and fittings shall have a minimum pressure rating of 250 psi with 125 lb. American Standard flanges. All flanges and fittings shall conform to the requirements of ANSI B16.1. Flanges shall be ductile iron and shall be of the threaded or screw on type. The face of the flanges shall be machined after installation of the flange to the pipe. No raised surface shall be allowed on flanges. Flanged pipe shall conform to the requirements of ANSI Specification A21.15, (AWWA C115). Pipe lengths shall be fabricated to meet the requirements of the Drawings.
- F. Gaskets shall be the "Ring Gasket" type, 1/8-inch minimum thickness, cloth inserted rubber, red rubber or neoprene and shall be suitable for the service intended. Gaskets for glass lined pipe shall be TORUSEAL flange gasket, or equal. Bolts shall be of the size

and length called for and in accordance with the "American Standard" and comply with the requirements of the ANSI/AWWA Standards. The bolts for flanged joints shall be a minimum ASTM A307; Grade B carbon steel and be in accordance with ANSI A21.10, (AWWA C110). The bolts shall have hexagonal heads and nuts, no washers shall be used.

- END OF SECTION -

SECTION 15020

PIPE SUPPORTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01350 – Seismic Anchorage and Bracing
- B. Division 3, Concrete – Appropriate and Related Sections
- C. Section 05010 – Metal Materials
- D. Section 05035 – Galvanizing
- E. Section 05050 – Metal Fastening
- F. Section 05061 – Stainless Steel
- G. Section 05120 – Structural Steel
- H. Section 05500 – Metal Fabrications
- I. Section 05830 – Bearing Devices and Anchoring
- J. Section 15000 – Basic Mechanical Requirements
- K. Section 15013 – Steel Pipe for Low Pressure Process Air Service

1.03 SUBMITTALS

- A. Applicable and associated cut sheets and drawings for materials and support components shall be submitted with the Shop Drawings in accordance with or in addition to the submittal requirements specified in Section 01300 – Submittals, Section 15000 – Basic Mechanical Requirements, and other referenced Sections above.
 - 1. Catalog cut information on all system components such as pipe supports, hangers, guides, anchors, and channel type supports.
 - 2. Bill of materials

2. Drawings of the piping support systems, locating each support, brace, hanger, guide, component and anchor. Identify support, hanger, guide and anchor type by catalog number and Shop Drawing detail number.

1.04 REFERENCES

STANDARD	TITLE OF STANDARD
ASME B31.1	Power Piping
ASEM B31.2	Fuel Gas Piping
ASEM B31.5	Refrigeration Piping and Heat Transfer Components
ASEM B31.9	Building Services Piping
ASTM F708	Standard Practice for Design and Installation of Rigid Pipe Hangers
MSS SP-58	Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
Seismic Considerations	Refer to Section 01350

PART 2 – PRODUCTS

2.01 GENERAL

- A. The Contractor shall be responsible for furnishing piping support systems as shown on the drawings and as specified herein. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility of providing a pipe support. Standard Details for pipe supports have been included on the Drawings to define minimum requirements as to the types of Contractor designed pipe supports that will be acceptable.
- B. Where a specific location or type of support is shown on the Drawings, the location and type shall be incorporated in the Contractor's pipe support design.
- C. Where special pipe support fabrications are required, products and execution shall be as specified in Section 05500 – Metal Fabrications and other related and referenced Sections of the Specifications.
- D. Design Criteria for Piping Support Systems:
 1. Design pipe supports for dead loads imposed by the weight of the pipes filled with

water, except for air and gas pipelines, plus the weight of insulation. If applicable by location, ice loads per code shall be applied as indicated in the governing building code.

2. Design the pipe supports for all seismic loading requirements and conditions as specified in the governing building code and referenced seismic design codes. Refer to Section 01350 – Seismic Anchorage and Bracing and the structural code drawing for seismic design criteria to be used for this particular project.
3. A minimum safety factor of 2 or as approved by the Engineer, based upon the yield strength of the support material, shall be used for pipe supports, braces, hangers, and guides as well as for beam and column members used in channel-type support systems.
4. The horizontal pipe hanger and/or floor support spacing shall be as recommended by the pipe and/or hanger manufacturer, but shall not exceed 10 feet on center unless indicated otherwise herein or on the Drawings.
5. Seismic and sway bracing shall be provided at maximum 10-foot centers.
6. The design, sizing and spacing of anchor bolts, including concrete anchors, shall be based on withstanding shear and pullout loads imposed by loading at each particular support. The minimum anchor bolt size shall be ½ inches in diameter. Refer to Section 05830 – Bearing Devices and Anchoring.
7. Pipe support design shall not utilize process equipment for thrust restraint or support of piping loads.

2.02 HANGERS AND SUPPORTS

- A. All piping shall be adequately supported and braced by means of steel hangers and/or supports, concrete piers, supplemental lateral bracing components, pre-fabricated brackets, or otherwise as may be required by the location and forces applied per governing code, including gravity and lateral forces from earthquake and/or wind (if exterior). Generally, concrete supports shall be used where pipe centerline is less than 3 feet above floor, and hangers above 6 feet unless specified or shown otherwise. Supports shall be not more than 10 feet on center for steel and cast iron, 5 feet on center for plastic unless otherwise shown on the Drawings or required by the specific manufacturer. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing hangers and supports to the structure. Refer to Standard Detail Drawings.
 1. Metal pipe support materials, where stainless steel pipe is supported, shall be Type 304 stainless steel meeting the requirements of Section 05061 – Stainless Steel.
 2. Metal pipe support materials, where carbon steel, ductile or other ferrous pipe is supported, shall be galvanized carbon steel meeting Section 05120 – Structural Steel and Section 05035 – Galvanizing unless indicated otherwise on the Drawings or in the specifications or by the Engineer.
 3. Metal pipe supports indicated as standard type pipe hangers are designed and detailed for gravity loading only. Resulting lateral loads from wind, earthquake, or

other lateral loads per code, or special loading conditions during construction, shall be applied to the pipe in accordance with the governing building code. Supplemental lateral stiffening members (when necessary) shall be provided along pipe or at gravity supports using appropriate supplemental members and connections when required by calculations. The calculations shall include verification that the main structure and structural components that will support the pipe hangers and other appurtenant components of the facility are structurally adequate to resist all resulting secondary lateral loading from pipe hangers and other non-structural members for gravity and resulting lateral loads, including thrust and movement induced loads for particular piping system.

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

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

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

resist seismic loading and other loading as required by the governing code.

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

2.03 HANGER AND SUPPORT SCHEDULES

A. Process Piping

HANGER	TYPE	APPLICATION
U-Bolts	24	As shown on Contract Drawings
Clevis Hangers	1	As shown on Contract Drawings
	Protection shields: 39 or 40	Insulated pipe
Yoke Type Pipe Clamp	2	Pipe with 4-inches of insulation or less
Pipe Clamps	3, 4, 12	Uninsulated pipe
Riser Clamps	8, 42	Uninsulated pipe
Straps	26	As shown on Contract Drawings
Pipe Rollers and Roller Supports	41, 43	As shown on Contract Drawings
	Protection shields: 39 or 40	Insulated pipe
Trapezes	59	If all pipes to be supported have same invert elevation
	Protection shields: 39 or 40	Insulated pipe
Roller Hanger	44	As shown on Contract Drawings
	Protection shields: 39 or 40	Insulated pipe
Saddle	37	As shown on Contract Drawings
	Protection shields: 39 or 40	Insulated pipe
Adjustable Saddle with U-bolt	38	As shown on Contract Drawings
	Protection shields: 39 or 40	Insulated pipe
Wall Brackets	Light Duty: 31 Medium Duty: 32 Heavy Duty: 33	For 4" and larger piping, use only where indicated on Contract Drawings

Structural Attachments	Welded Beam: 22 Plate Lug: 57 Concrete Inserts and Attachments: Anvil Figure No. 47, 49, and 52	As shown on Contract Drawings
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B. Strut Support Systems

1. System shall permit rigid metal construction without welding or drilling.
2. All members shall be fully adjustable, demountable and reusable.
3. One manufacturer shall furnish system complete with all nuts, bolts, couplers, channels and all other required fittings and mechanical accessories.
4. Channels and accessories shall be galvanized steel with 20 mil PVC coating, all of the same color.
5. All mounting hardware, fasteners and concrete inserts shall be Type 316 stainless steel.
6. Pipe clamps shall be PVC-coated galvanized straps with stainless steel rods, nuts, and flat washers.
7. Verify that the load carrying capacity of the strut system is adequate for weight of pipes and contents and span utilized.

C. HVAC Piping

1. Horizontal Supports
 - a. Overhead Supports for Insulated and Non-Insulated Pipe: MSS SP-58, Type 1 clevis hanger.
 - b. Overhead Supports for Pipes Subject to Movement:
 - 1) Anvil Figure No. 174 for non-insulated pipe.
 - 2) Anvil Figure No. 174 with saddles for insulated pipe.
 - 3) Pipe Clamp Hanger for pipe sizes greater than 30".
 - c. Wall Supports:
 - 1) Wall Supports for Insulated and Non-Insulated Stationary Pipe: MSS SP-58, Type 1 clevis hanger with MSS SP-58, Type 31, 32, 33 or Anvil Figure No. 213 wall brackets.

- 2) Wall Supported Non-Insulated Pipes Subject to Movement: MSS SP-58, Type 44 pipe roll with MSS SP-58, Type 31, 32, 33 or Anvil Figure No. 213 wall brackets.
- 3) Wall Supported Insulated Pipes Subject to Movement: MSS SP-58, Type 44 pipe roll with MSS SP-58, Type 39 saddle mounted on MSS SP-58 Type 31, 32, 33 or Anvil Figure No. 213 wall brackets.

2. Floor Supports

- a. MSS SP-58, Type 36 saddle.
- b. MSS SP-58, Type 38 adjustable saddle.

3. Vertical Supports: MSS SP-58, Type 8 clamp.

D. Plumbing Piping

1. Horizontal Supports

HANGER	TYPE	APPLICATION
Anvil Figure No. 97 Sway Brace	N/A	Overhead supports for steel, wrought or cast iron
Anvil Figure No. 97 CT-99C Plastic Coated	N/A	Overhead supports for copper pipe
Anvil Figure No. 97 with Anvil Figure No. 167 Shield	N/A	Overhead supports for insulated pipe
Anvil Figure No. 174 with Saddles	N/A	Overhead supports for insulated pipe subject to movement
Clevis Hanger	1 Brackets: 31, 32, 33 or Anvil Figure No. 199	Wall supports for steel, wrought or cast iron
Anvil Figure No. CT-99C and rod	Bracket: 31	Wall supports for uninsulated copper pipe
Anvil Figure No. C-97 with rod and Anvil Figure No. 167 shield	N/A	Wall supports for insulated copper pipe

E. Hanger rods shall be machine threaded and based on root diameter. When hanger

rods are over 18-inches in length, lateral bracing shall be provided every fourth hanger. The minimum rod diameter shall be as follows:

PIPE DIAMETER (INCHES)	MINIMUM ROD SIZE (INCHES)
2 and smaller	3/8
2-1/2 to 3-1/2	1/2
4 and 5	5/8
6	3/4
8 to 12	7/8
14 and 16	1
18 and 20	1-1/4
24	1-1/2

PART 3 -- EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

1. Install in accordance with the Contract Documents and the manufacturer's written instructions.
2. No field modifications to equipment shall be made without the written consent of the manufacturer and approval of Engineer.
3. Field verify all dimensions and elevations. Notify Engineer of specific differences
4. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.
5. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
6. Concrete anchor bolts shall be Type 316 SS adhesive anchors.
7. Backpaint aluminum in contact with painted or galvanized steel or concrete with a high-build epoxy coating in accordance with Section 09900, Painting.
8. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.
9. Provide field coatings in accordance with Section 09900, Painting.
10. All piping to be supported from floors, concrete slabs, ceilings or walls shall have supports and parts required for the installation of the piping systems which conform to the requirements of Chapter 1, Section 6 of the ANSI B31.1, except as modified and supplemented by the requirements set forth in these Specifications.
11. All piping shall be rigidly supported from the building structure by approved hangers, inserts, or supports, with adequate provisions for expansion and

contraction. No piping shall be supported from other piping or from metal stairs, ladders, and walkways unless specifically directed by the Engineer.

12. In addition to the hangers and supports spaced as specified above, the Contractor shall furnish and install additional hangers and supports at all valves, fittings and pipe line equipment. Holding devices for valves and other pipe line appurtenances shall be designed and constructed to hold each unit securely.
13. All vertical pipes shall be supported at each floor or at intervals of not more than 10-feet by approved pipe collars, clamps, brackets, or wall rests, and at all points necessary to ensure rigid construction.
14. Spacing of supports for PVC pipe and provision for expansion will be determined by operating temperature, size of pipe, and other conditions. It shall be such as to prevent subsequent visible sagging of the pipe between supports due to plastic deformation or otherwise.
15. In general, adjustable saddle supports shall be used when the height of the centerline of the pipe is 0-6 feet above the floor and hangers or brackets shall be used when the height of the centerline of pipe is greater than 6-feet.
16. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
17. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
18. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units. The Contractor may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that complete details describing location, pipe supports and hydraulic thrust protection are submitted.
19. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
20. The hangers and supports shall be designed to resist or to allow controlled movement caused by operation of equipment.
21. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 is not exceeded.

B. Support Intervals

1. At a minimum, additional supports or anchors will be required at:

- a. All bends on pump discharge line to prevent vertical or horizontal movement resulting from pressure thrusts.
 - b. Each side of all couplings in the horizontal plane to eliminate vertical force on couplings.
 - c. All branch connections to eliminate vertical and horizontal movement.
 - d. Both sides of expansion joints to prevent axial and/or horizontal movement.
 - e. All pipe joints subject to torque along centerline of pipe. Piping shall be supported so that pumps and other equipment may be removed without providing additional pipe support.
 - f. Where depicted on the Contract Drawings, pipe supports shall be of the type indicated.
2. Flanged Ductile Iron Pipe - Support and hanger spacing for pipe 1-1/4 inches and larger shall be 10-feet maximum.
 - a. Additional supports and hangers will be required for grooved end ductile iron pipe and fittings at the Contractor's expense.
 3. Plastic Pipe - Support and hanger spacing and/or braces for plastic piping shall be used at all bends and shall be 4-feet maximum horizontally and vertically, except non-metallic electrical conduit support spacing shall be 3-feet maximum.
 - a. Supports and hangers for plastic piping shall include saddles and bands to distribute load and thus avoid localized deformation of the pipe.
 4. Steel and Wrought Iron Pipe - Support and hanger spacing for steel and wrought iron pipe less than 1-1/4 inches shall be 8-feet maximum; 1-1/4 inches and larger, support spacing shall be 10-feet maximum.
 5. Copper Pipe - Copper pipe 1/2-inch to 1-inch, support spacing shall be 6-feet maximum; 1-1/4-inch and over, support spacing shall be 10-feet maximum.
 6. Cast Iron Pipe - Cast iron soil pipe shall be supported at each length, close to bell.

C. Inserts

1. Provide inserts for suspending hangers from concrete slabs and sides of concrete beams.

D. Hanger and Support Application Schedule

AREA	ACCEPTABLE MATERIALS
EXTERIOR:	
<ul style="list-style-type: none"> Exposed to outdoor conditions Submerged locations unless otherwise specified 	Type 304 stainless steel
INTERIOR:	
Wet Hose-Down Area:	
<ul style="list-style-type: none"> Pump rooms Below-grade vaults, manholes, and handholes 	Type 304 Stainless steel
Corrosive:	
N/A	FRP
Hazardous Areas:	
NEC Class I, Division 1 or 2, Groups C and D	Type 304 Stainless steel or PVC-coated galvanized steel
Unclassified or Non-Corrosive Locations:	
<ul style="list-style-type: none"> Pump Room 	Type 304 Stainless steel

- END OF SECTION -

SECTION 15095
VALVES, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall install all valves as shown on the drawings, including all fittings, appurtenances, and transition pieces.
- C. The Contractor shall be responsible for coordinating connecting piping. Valves with screwed ends shall be made tight with Teflon tape. Unions are required at all screwed joint valves.

1.02 SUBMITTALS

- A. Performance tests shall be conducted in accordance with the latest revision of AWWA C500.
- B. Shop Drawings conforming to the requirements of Section 01300 - Submittals, are required for all valves, and accessories. Submittals shall include all layout dimensions, size and materials of construction for all components, information on support and anchoring where necessary, pneumatic and hydraulic characteristics and complete descriptive information to demonstrate full compliance with the Documents. Shop Drawings for electrically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the electrical power supply and remote status and alarm indicating devices. Electrical control schematic diagrams shall be submitted with the Shop Drawings for all electrical controls. Diagrams shall be drawn using a ladder-type format in accordance with JIC standards. Shop Drawings for pneumatically operated/controlled valves shall include all details, notes, and diagrams which clearly identify required coordination with the compressed air (service air) system and electrical controls.
- C. Operation and maintenance manuals and installation instructions shall be submitted for all valves and accessories in accordance with the Specifications. The manufacturer(s) shall delete all information which does not apply to the equipment being furnished

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. The contractor shall install the valves as indicated on the contract drawings. The equipment supplier shall provide the services of a qualified representative of the manufacturer(s) of the provided equipment (Under a separate contract).
- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.

PART 2 -- PRODUCTS

2.01 FLOOR BOXES

- A. Floor boxes shall be provided for all nut operated or floor accessed valves. Floor boxes shall be of the adjustable, sliding type, cast iron, suitable to withstand heavy traffic, as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., or equal. The covers shall be marked with appropriate designations of piping contents (i.e.: water, sewer) and bases shall be the round type. All nut operated valves in this Section shall be clearly identified by stainless steel or laminated plastic identification tags. The tags shall be permanently affixed to the inside of the floor boxes, under grating, etc. and shall bear the embossed letters which clearly identify each valve by its appropriate designation.
- B. Two (2) valve operating wrenches shall be supplied in 4 foot lengths with tee handles for each size nut supplied. Valve wrenches shall be Model No. F-2520 as manufactured by James B. Clow & Sons, Kennedy Valve Mfg. Co., Figure No. 122, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Except where noted otherwise herein, all valves shall be installing and tested in accordance with the latest revision of AWWA C500. Before installation, all valves shall be lubricated, manually opened and closed to check their operation and the interior of the valves shall be thoroughly cleaned. Valves shall be placed in the positions shown on the Drawings. Joints shall be made as directed under the Piping Specifications. The valves shall be so located that they are easily accessible for operating purposes, and shall bear no stresses due to loads from the adjacent pipe. The Contractor shall be responsible for coordinating connecting piping.
- B. All valves shall be tested at the operating pressures at which the particular line will be used. Any leakage or "sweating" of joints shall be stopped, and all joints shall be tight. All motor operated and cylinder operated valves shall be tested for control operation as directed by the Engineer.
- C. Provide valves in quantity, size, and type with all required accessories as shown on the Drawings.
- D. Install all valves and appurtenances in accordance with manufacturer's instructions. Install suitable corporation stops at all points shown or required where air binding of pipe lines might occur. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer. Unless otherwise approved, install all valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment or other causes.
- E. Valve boxes shall be set plumb, and centered with the bodies directly over the valves so that traffic loads are not transmitted to the valve. Earth fill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face, if less than 4 feet.

3.02 SHOP AND FIELD TESTING

A. Shop and field testing of valves shall be as follows:

1. Certified factory testing shall be provided by the Equipment Supplier, under a separate contact.
2. Certified factory testing shall be provided for all components of the valve and operator system. Valves and operators shall be shop tested in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof-of-design tests. The manufacturer through the Contractor shall submit certified copies of the reports covering the test for acceptance by the Engineer.
3. Shop testing shall be provided for the operators consisting of a complete functional check of each unit. Any deficiencies found in shop testing shall be corrected prior to shipment. The system supplier through the Contractor shall submit written certification that shop tests for the electrical/pneumatic system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.
4. The Equipment Supplier shall conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Preliminary field tests shall be conducted prior to start-up with final field tests conducted during start-up. The factory service representative (provided by the equipment supplier) shall assist the Contractor during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. The service representative shall certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.
5. Preliminary and final field tests shall be conducted at a time approved by the Engineer. The Engineer shall witness all field testing.
6. All costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.
7. Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components. Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.
8. Final field acceptance tests shall be conducted simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Field tests shall

be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures shall be checked.

9. Field testing shall include optimization of opening and closing times of the valves. The Contractor shall provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

- END OF SECTION -

SECTION 15100

VALVE OPERATORS AND ELECTRIC VALVE ACTUATORS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Valve operators and electric valve actuators shall be designed to unseat, open or close, and seat the valve under the most adverse operating condition to which the valves will be subjected.
- B. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric valve actuators.
- C. The valve operators and electric actuators shall be the full and undivided responsibility of the valve manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

1.02 SUBMITTALS

- A. The following items shall be submitted:
 - 1. Certification that the force required to operate all valves is as specified herein.
 - 2. Performance characteristics and descriptive data.
 - 3. Detailed equipment dimensional drawings and setting plans.
 - 4. General lifting, erection, installation, and adjustment instructions, and recommendations.
 - 5. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.
 - 6. The total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations. Exact size, placement, and embedment requirements of all anchor bolts.
 - 7. Details on materials of construction of all components including applicable ASTM designations.
 - 8. Information on bearing types and bearing life.
 - 9. Gear box design and performance criteria and AGMA service factor.

10. Piping schematics.
 11. Motor data sheet indicating motor horsepower; enclosure type; voltage; insulation class; temperature rise and results of dielectric tests; service-rating; rotative speed; motor speed-torque relationship; efficiency and power factor at $\frac{1}{2}$, $\frac{3}{4}$, and full load; slip at full load; running, full load, and locked rotor current values; and safe running time-current curves.
 12. Equipment and motor protective device details. Connection diagrams for motor and all protective devices.
 13. Equipment shop coating systems, interior and exterior.
 14. Panel layout drawings, schematic wiring diagrams, and component product data sheets for control panels.
 15. A list of spare parts and special tools to be provided.
 16. Any additional information required to show conformance with the equipment specifications.
 17. Warranty documentation including statement of duration of warranty period and contact phone numbers and addresses for warranty issues.
- B. Operation and Maintenance Manuals shall be submitted as follows:
1. Two (2) preliminary copies of Operation and Maintenance Manuals, prepared specifically for this Project, shall be furnished for each item of equipment furnished under this Contract. The preliminary manuals shall be provided to the Engineer not less than 60 days prior to the start-up of the respective equipment.
 2. The preliminary manuals shall be reviewed by the Engineer prior to the Equipment Supplier submitting final copies for distribution to the Owner. Following review of the preliminary copies of the Operation and Maintenance Manuals, one (1) copy will be returned to the Equipment Supplier with required revisions noted, or the acceptance of the Engineer noted.
 3. Manuals shall contain complete information in connection with assembly, operation, lubrication, adjustment, wiring diagrams and schematics, maintenance, and repair, including detailed parts lists with drawings or photographs identifying the parts.
 4. Manuals furnished shall be assembled and bound in separate volumes, by major equipment items or trades, and properly indexed to facilitate locating any required information. In addition, manuals should be labeled in the front cover with the project, name, equipment description, and manufacturer contact information.
 5. Engineer and the Owner shall be the sole judge of the acceptability and completeness of the manuals and may reject any submittal for insufficient information included, incorrect references and/or the manner in which the material is assembled.

6. Following the Engineer's review of the preliminary manuals, the Equipment Supplier shall submit five (5) paper copies and two (2) electronic copies of the final Operation and Maintenance Manuals to the Engineer. The manuals shall reflect the required revisions noted during the Engineer's review of the preliminary documents. Failure of the final manuals to reflect the required revisions noted by the Engineer during a review of the Preliminary documents will result in the manuals being returned to the Contractor. Acceptable final Operation and Maintenance Manuals shall be provided not less than two week prior to equipment start-up.

C. Certified Shop Test Records

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

1.03 WARRANTY AND GUARANTEE

- A. The equipment furnished under this Contract shall be guaranteed to be free from defects in workmanship, design and/or materials for a period of one (1) year. The period of such warranties shall start on the date the particular equipment is placed in use by the Owner with corresponding start-up certification provided by the manufacturer's technical representative as specified herein, provided that the equipment demonstrates satisfactory performance during the thirty day operational period after the equipment startup. If the equipment does not perform satisfactorily during the thirty day operational period, the start of the warranty period will be delayed until the equipment demonstrates proper operation. The Equipment Supplier shall repair or replace without charge to the Owner any part of equipment which is defective or showing undue wear within the guarantee period, or replace the equipment with new equipment if the mechanical performance is unsatisfactory; furnishing all parts, materials, labor, etc., necessary to return the equipment to its specified performance level.

- B. The Equipment Supplier shall provide an equipment warranty log book prepared specifically for this project and submit two (2) copies of the document to the Engineer prior to final payment. The equipment warranty log book shall include a summary listing of all equipment warranties provided, date received, and start date and end date of warranty period. A copy of each equipment warranty and equipment start-up certification shall also be provided in the document.
- C. The Equipment Supplier shall guarantee to the Owner that all equipment offered under these specifications, or that any process resulting from the use of such equipment in the manner stated is not the subject of patent litigation, and that he has not knowingly offered equipment, the installation or use of which is likely to result in a patent controversy, in which the Owner as user is likely to be made the defendant.

Where patent infringements are likely to occur, each Equipment Supplier shall submit, as a part of his bid, license arrangements between himself, or the manufacturer of the equipment offered, and the patent owner or the controller of the patent, which will permit the use in the specified manner of such mechanical equipment as he may be bidding.

Each Equipment Supplier, by submitting his bid, agrees to hold and save the Owner and Engineer or its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the work under this contract, including the use of the same by the Owner.

PART 2 -- PRODUCTS

2.01 GENERAL

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

2.02 MANUAL OPERATORS

- A. Unless otherwise specified or shown on the Drawings, manual operator type shall be as follows:
 - 1. Exposed valves 8-inches and larger shall be handwheel operated.
 - 2. Valves with centerline of operator located more than 6-feet above the floor or platform from which it is to be operated shall have a chainwheel operator unless otherwise indicated on the Drawings.

- B. Manual operators shall be rigidly attached to the valve body unless otherwise specified or shown on the Drawings.
- C. All operators shall turn counter-clockwise to open and shall have the open direction clearly and permanently marked.
- D. Valve operators shall be designed so that the force required to operate the handwheel, lever, or chain (including breakaway torque requirements) does not exceed 80 pounds applied at the extremity of handwheel or chainwheel operator. Design pressures for sizing of valve operators shall be the piping test pressure for the piping in which the valve is to be installed.
- E. Handwheels for valves operators shall not be less than 12 inches in diameter. The maximum diameter of any handwheel shall not exceed 24".
- G. Geared manual operators shall be of the worm gear, traveling nut or scotch yolk type. Gear operators shall be of the worm gear or bevel gear type. Gear box designs incorporating end of travel stops in the housing shall be equipped with AWWA input stops. Each gearbox shall require a minimum of 10 turns for 90 degree rotation or full valve stem travel and shall be equipped with a mechanical valve position indicator.
- H. Manual operators on below grade (and vault installed) valves shall be permanently lubricated and watertight under an external water pressure of 10 psi.

2.03 ELECTRIC VALVE ACTUATORS

- A. Electric Actuators shall be open/close service or modulating service as specified herein.
 - 1. Open/Close (non-modulating) valve actuators shall be IQ series as manufactured by Rotork, SA series as manufactured by AUMA, or Series 2000 as manufactured by EIM Controls.
 - 2. Modulating valve actuators shall be Type IQM as manufactured by Rotork, Type SAR as manufactured by AUMA, or Series 2000 Futronic as manufactured by EIM Controls.
- B. Performance Requirements
 - 1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.
 - 2. Torque capacity of the actuators shall be sufficient to operate the valves with the maximum pressure differential, as indicated in the Valve Schedule in Section 15390, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator's maximum rated breakaway of torque.
 - 3. Operating time for full limits of travel shall be not more than 2 seconds per inch diameter of the valve, +/- 50 percent through 20 inches; +/- 30 percent for valves

24 inches and larger. Operating time shall not be less than 60 seconds for all modulating valves.

4. Actuators shall be capable of operating in ambient temperatures ranging from 0 degrees F – 160 degrees F.
 5. For open/close (non-modulating) actuators, the gearing, motor and contactor shall be capable of 60 starts per hour without overheating.
- C. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for weatherproof protection. All external fasteners shall be stainless steel. Compartments shall be provided with moisture and dust-proof rigid cast covers meeting NEMA 6, certified to submergence in 6 ft of water for 30 minutes. The actuator shall be IP68 rated – submergence in 20 feet of water for 72 hours. Actuators located in classified areas shall be suitable for use in Class 1, Division 1, Group D environments.
- D. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the valve disc in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio. For quarter turn applications, overtravel of the operator shall be prevented by internal mechanical stops cast into the actuator.
- E. A mechanical dial position indicator shall be furnished to continuously indicate the position of the valve at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.
- F. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 40 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.
- G. The drive motor shall be specifically designed for actuator service and shall be characterized by high starting torque and low inertia. Motors shall be 460 volts, three phase, 60 Hz AC reversible squirrel cage induction type motors and shall be specifically designed for modulating service as specified herein. Motors shall be totally enclosed, non-ventilated, with NEMA Class F insulation minimum

The electric motor shall have a time rating of at least 15 minutes at 104°F (40°C) or twice the valve stroking time, whichever is longer, at an average load of at least 33% of maximum valve torque. Motor bearings shall be permanently lubricated by premium lubricant. The motor shall have plug and socket electrical connection to facilitate easy removal and replacement. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence of the three-phase power supply connected to the actuator.

The motor shall include single phase protection. A suitable thermal protection device shall be incorporated in the motor or motor starter circuits, connected to a tripping device. Fast acting fuses shall be provided to protect solid state components. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus ten (10) percent of nameplate rating.

- H. A 120 VAC space heater shall be provided in the motor compartment.
- I. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. An adequately sized space heater shall be installed in the control circuit compartment to aid in the prevention of damage resulting in from condensation. The following items shall be located in the control circuit compartment.
 - 1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed valve and when torque is exceeded during valve travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator's assembly to the valve.
 - 2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and "in step" with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six (6) contacts, three (3) normally open and three (3) normally closed, shall be supplied at each end of valve travel. Four (4) additional contacts shall be provided to report end of travel or any desired position between ends of travel.
- J. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be designed to operate from a single 480VAC, 3-phase source. The actuators shall be furnished with fuses inside of the terminal compartment. A quantity of two – ¾ inch NPT conduit entries shall be furnished.
- K. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for .5A at 250VAC.
 - 1. Open, Close, and Stop commands from external dry contacts (utilizing internal 120VAC power supply). The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the valve to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.

2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.
3. Remote Local-Off-Remote selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station (see below). The remote Local-Off-Remote selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the valve actuator control power.
4. Four (4) unpowered contacts shall be provided which can be selected to indicate valve "Opened" and "Closed" position, "Remote" status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.
5. Terminals for 4-20mADC position command and 4-20mADC position feedback as described above for modulating actuators, where indicated.

L. Local Controls

1. Actuators shall be furnished with a Local-Off-Remote selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.
 - a. When the LOR is in the "Local" position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.
 - b. When the LOR is in the "Off" position, the actuator shall not operate.
 - c. When the LOR is in the "Remote" position, the actuator shall be controlled by remote inputs from the PLC or from the remote manual controls station.
2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

M. Local disconnects shall be provided for each valve, provided by others under a separate contract.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall include the following site visits for electric actuators:

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

- B. The manufacturer shall provide a qualified Technical Representative from the manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start-up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment.
- C. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.
- D. The manufacturer's Technical Representative shall provide the following services.
1. Installation: The Technical Representative shall inspect the installed equipment to verify that installation is in accordance with the manufacturer's requirements. Where required by individual equipment specifications, the Technical Representative shall also supervise the installation of the equipment.
 2. Testing: After installation of the equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the Technical Representative shall inspect, operate, test, and adjust the equipment as required to prove that the equipment is in proper condition for satisfactory operation under the conditions specified. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for startup and that nothing in the installation will render the manufacturer's warranty null and void. The report shall include date of final acceptance field test, as well as a listing of all persons present during tests.
 3. Startup: The Technical Representative shall start up the equipment for actual service with the help of the Contractor. In the event that equipment or installation problems are experienced, the Contractor and the representative shall provide the necessary services until the equipment is operating satisfactorily and performing according to the specifications at no additional cost to the Owner. Unless otherwise noted in the signed site visit report, the report shall constitute a certification that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
 4. Training: The Technical Representative shall instruct the Owner's operating personnel in correct operation and maintenance procedures. The instruction shall

demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment. Such instruction shall be scheduled at a time arranged with the Owner at least 2 weeks in advance of the training and shall be provided while the respective Technical Representative's equipment is fully operational. The equipment supplier shall have submitted, and had accepted, the O&M Manuals prior to commencement of training. Training shall be provided to three separate shifts of the Owner's personnel between the hours of 8:00 A.M. and 6:00 P.M. as necessary. The equipment supplier shall provide professional video taping of all training sessions. Completed, labeled tapes shall be provided to the Owner for each type of training session.

5. Services after Startup: The Technical Representative shall return to the project site thirty (30) days after the start up date to review the equipment performance, correct any equipment problems, and conduct operation and maintenance classes as required by the Owner. This follow-up trip is required in addition to the specified services of Technical Representative prior to and during equipment startup. At this time, if there are no equipment problems, the manufacturer shall certify to the Owner in writing that his equipment is fully operational and capable of meeting operating requirements. If the equipment is operating incorrectly, the Technical Representative will make no certification to the Owner until the problems are corrected and the equipment demonstrates a successful thirty (30) days operating period.

D. Services of the Technical Representative will require a minimum of two (2) site visits, one for installation and testing and one for startup and training, and will be for the minimum number of days recommended by the manufacturer and approved by the Engineer but will not be less than the number of days specified in individual equipment sections.

E. The equipment supplier shall include the cost of furnishing the Technical Representative for the minimum number of days specified, and any additional time required to achieve successful installation and operation. The times specified for services by the Technical Representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

F. The equipment supplier shall notify the Engineer at least 14 days in advance of each equipment test or Owner training session.

3.02 INSTALLATION

A. All valve actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable specification sections for valves, and motor controls.

B. Valve actuators shall be factory coated in accordance with the manufacturer's standard paint system.

3.03 SHOP TESTING

A. All equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.

- B. No equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- C. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof shall be forwarded to the Engineer for review.
- D. Shop testing shall include the following additional requirements:
 - 1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
 - 2. Submit written certification that:
 - a. Shop tests for the electrical system and all controls were successfully conducted;
 - b. Electrical system and all controls provide the functions specified and required for proper operation of the valve operator system.
 - 3. Each actuator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical valve load and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at maximum torque setting
 - c. Flash Test Voltage
 - d. Actuator Output Speed or Operating Time
 - e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.
 - f. Verification of actuator torque rating with valve.

3.04 FIELD TESTS

- A. Field testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:
 - 1. Valve actuators shall be field-tested together with the associated valves.
 - 2. Test all valves at the operating pressures at which the particular line will be used.
 - 3. Test all valves for control operation as directed.
 - 4. Field testing shall include optimization of opening and closing times of the valves.

Valve opening and closing times shall be adjusted based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

B. Preliminary Field Tests

1. General: Preliminary field tests shall be conducted prior to start-up and shall include a functional check of the entire valve operator system and all system components.
2. Scope: Preliminary field tests shall demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly.
3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required valve closing time and operation, as specified or otherwise directed.

C. Second Stage Field Tests

1. Second stage field tests shall be conducted in accordance with the latest revision of AWWA C500.
2. Second Stage field tests shall be conducted simultaneously with the start-up and field testing of the pumps.
3. Second stage field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the valves shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.
4. Reliability Testing shall be performed in accordance with Section 11000.
5. Certification of Equipment Compliance: After the reliability tests are completed and passed, submit affidavit according to Section 11000.

- END OF SECTION -

SECTION 15105

CHECK VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The equipment supplier shall furnish two (2) check valves as specified herein and as shown on the Drawings.
- B. The check valves shall be provided with an oil dash pot. Each valve shall be capable of slow opening and full control closure to minimize surge pressures.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 15000 – Basic Mechanical Requirements
- C. Section 15095 – Valves, General
- D. Section 15100 – Valve Operators and Electric Valve Actuators

1.03 DESIGN CONDITIONS

Check Valve Schedule

Number of Units	2
Nominal Diameter (inches)	12
Oil Mounted Dashpot	Yes

1.04 SUBMITTALS

- A. Equipment supplier shall submit the following in accordance with Section 01300 – Submittals, Section 15095 – Valves, General and Section 15100 – Valve Operators and Electric Valve Actuators:
 - 1. Performance testing in accordance with latest version of AWWA C500.
 - 2. Shop Drawings:
 - a. Layout dimensions
 - b. Size
 - c. Materials of construction for all components
 - d. Hydraulic characteristics

3. Descriptive information to illustrate conformance with contract documents.

PART 2 -- PRODUCTS

2.01 APPROVED MANUFACTURER

- A. Check Valves shall be 586CT Pivoting Disc Check Valve as provided by Cla-Val, or approved equal.

2.01 OIL CONTROLLED CLOSING SWING CHECK VALVE

- A. The valves will be installed on the pump discharge to slowly open and close to prevent water hammer. They will be designed with a top mounted buffer to slow opening and full controlled closure. This control component will be a self contained oil system separated by the water line media. It will have a 90% primary adjustable rate and a 10% adjustable slow rate for final 10% closure.
- B. The valve body will be a heavy two piece ductile iron body to meet a 250 psi working and 300 psi test pressure for two hours. The two (2) body halves and body seat shall be O-ring sealed and be bolted together in a manner to sandwich the body seat on a 55° angle. Each body half must have an access covered hole for internal inspection and each body half and disc must be fully machined to accept future attachment of a Bottom Buffer.
- C. The seat ring and disc ring must be of the design that permits replaceability in the field without need for special tools or machining.
- D. The pivot pins in the body and the bushing in the disc lugs must be stainless steel of different hardnesses to prevent galling.
- E. The bushing shall be pressfit to prevent wear.
- F. An indicator shall be provided to show position of the disc.
- G. The area throughout the valve body must be equal to full pipe area. The area thru the seat section shall be 40% larger than the inlet and outlet of the valve to achieve lowest head loss.
- H. The buffer shall be designed to contact the disc during the last 10% of closure and thereafter control the disc closure until the valve is shut in a manner to minimize or prevent water hammer. The rate of hydraulic control and the initial point of buffer contact to the disc closure must be externally adjustable and variable to suit the water column reversal time. The bottom buffer hydraulic system must be self-contained and independent from pipeline media to prevent contamination of the media and protect the cylinder against corrosion.
- I. Valves meet AWWA standards for metal to metal seating.
 1. Valve body will be ductile iron ASTM GR 536 65-45-12

2. Disc shall be ductile iron- ASTM GR 536 65-45-12
3. Seat Ring and disc ring shall be Bronze ASTM B16 C360000
4. Pivot pins shall be stainless steel ASTM A582 T303
5. Pivot pin bushings stainless steel A269 T304
6. Exterior pain shall be Universal metal primer-FDA approved for potable water

PART 3 -- EXECUTION

3.01 MANUFACTURER’S FIELD SERVICES

- A. Manufacturer shall coordinate with Owner and Contractor for field services. For each series of valves, field services shall include the following site visits:

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

- B. The manufacturer shall provide a qualified Technical Representative from the manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment.
- C. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.

3.02 INSTALLATION

- A. Refer to Section 15000 – Basic Mechanical Requirements and Section 15095 – Valves, General.

3.03 SHOP AND FIELD TESTING

- A. Refer to Section 15000 – Basic Mechanical Requirements and Section 15095 – Valves, General.

- END OF SECTION -

SECTION 15109

PLUG VALVES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Equipment Supplier shall furnish four (4) isolation plug valves and two (2) control plug valves with electrical actuation. All plug valves shall be provided by a single manufacturer.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 15000 – Basic Mechanical Requirements
- C. Section 15095 – Valves, General
- D. Section 15100 – Valve Operators and Electric Valve Actuators

1.03 DESIGN CONDITIONS

Location	Size (inch)	Units (no.)	Operation	Design Flow (gpm)	Design Pressure (ft)
Suction Isolation	16	2	Manual	2,035	202
Discharge Isolation	12	2	Manual	2,035	202
Discharge Control	12	2	Electrical Actuation for Open/Close Service	2,035	202

1.04 SUBMITTALS

- A. Equipment supplier shall submit the following in accordance with Section 01300 – Submittals, Section 15095 – Valves, General and Section 15100 – Valve Operators and Electric Valve Actuators:
 - 1. Performance testing in accordance with latest version of AWWA C500.
 - 2. Shop Drawings:
 - a. Layout dimensions
 - b. Size

- c. Materials of construction for all components
 - d. Hydraulic characteristics
- 3. Descriptive information to illustrate conformance with Contract Documents.
- 4. In addition to the above submittals, submittals for electrically operated valves shall include the following:
 - a. Electrical control schematics
 - b. Details, notes, and diagrams
 - c. Status and alarm indicating devices information
- 5. Operation and maintenance manuals in accordance with contract document requirements.

PART 2 -- PRODUCTS

2.01 PLUG VALVES

- A. Plug valves shall be of the non-lubricated, eccentric seating plug type with synthetic rubber-faced plugs as manufactured by DeZurik Company. All valves shall be provided with limit stops and rotate 90° from fully open to fully shut. The minimum working pressure for all valves shall be 150 psi, and the test pressure shall be at least 270 psi for valves up through 12-inch and at least 230 psi for valves 14-inch and larger. Ports shall be 100% area and rectangular. Bearings shall be sleeve type and made of sintered, oil impregnated permanently lubricated type 316 stainless steel, ASTM A743 Grade CF8M through 36" (900mm). The body materials shall be of epoxy coated cast iron or semi-steel, unless specified otherwise. Seats shall have a welded overlay of 90 percent pure nickel and machined to a finish containing no stress cracks. Plug facings shall be of Hycar, or equal and completely suitable for use with domestic sewage.
- B. Adjustable packing shall be Acrylonitrile-Butadiene (NBR) multiple V-ring type, with a packing gland follower. Packing gland shall permit inspection, adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly, except the gland follower. Non-adjustable packing or packing requiring actuator removal to replace the packing, is not acceptable.
- D. Unless otherwise shown, all exposed valves 4-inches in diameter and larger shall have flanged ends conforming to ANSI B16.1-125/150 pound standard with face-to-face dimensions of standard plug valves.
- E. Valves 8-inches in diameter and larger shall be handwheel or floorstand operated where required or indicated on the Drawings through totally enclosed worm gear actuators, unless otherwise specified or shown on the Drawings. Manual operators for plug valves mounted above 6 feet from the operating floor shall be equipped with worm gear chainwheel actuators.

- F. The manufacturer shall certify that the plug valves are capable of operating in continuous duty service under these pressures and flow conditions.
- G. Each valve shall be hydrostatically tested and tested for bubble tightness after the operator has been mounted and adjusted. Copies of the hydrostatic and leakage test certification and certification of conformance shall be submitted to the Engineer prior to shipment.
- H. All internal and external ferrous components and surfaces of the valves, with the exception of stainless steel and finished or bearing surfaces, shall be shop painted with two coats (10 mils min. dry film thickness) of the manufacturer's premium epoxy for corrosion resistance. Damaged surfaces shall be repaired in accordance with the manufacturer's recommendations.

2.02 ELECTRIC ACTUATORS

- A. Refer to section 15100 – Valve Operators and Electric Valve Actuators for requirements.
- B. The actuator shall be capable of opening and closing the valve over an adjustable period of 20 – 120 seconds.
- C. The electric actuators shall control the plug valves in a manner such to match the existing operation of the discharge valves as follows:
 1. When the pump has been turned on and has developed a pressure against the closed control valve which is 10 psi greater than the pressure on the other side of the valve, the valve begins to open.
 2. If the control valve fails to open, either a high pressure switch on the pump side of the valve or a timer shuts down the pump.
 3. If the control valve opens completely before the timer times out, a limit switch deactivates the timer. Once the control valve is open and there are no obstructions to flow in the pipe, the pump cannot develop enough pressure to activate the high pressure switch thus allowing the pump to continue running.
 4. When the pump is switched off, the control valve will close completely before the pump is shut down.
 5. Should there be a power failure the pump will stop immediately and the check valve will slam shut. The discharge valve will continue to automatically shut-down.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. Manufacturer shall coordinate with Owner and Contractor for field services. For each series of valves, field services shall include the following site visits:

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

- B. The manufacturer shall provide a qualified Technical Representative from the manufacturer or supplier of equipment who is regularly involved in the inspection, installation, start up, troubleshooting, testing, maintenance, and operation of the specified equipment. Qualification of the Technical Representative shall be appropriate to the type of equipment furnished and subject to the approval of the Engineer and the Owner. Where equipment furnished has significant process complexity, furnish the services of engineering personnel knowledgeable in the process involved and the function of the equipment.
- C. For each site visit, the Technical Representative shall submit jointly to the Owner, the Engineer, and the Contractor a complete signed report of the results of his inspection, operation, adjustments, and testing. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified.

3.02 INSTALLATION

- A. Refer to Section 15000 – Basic Mechanical Requirements and Section 15095 – Valves, General.

3.03 SHOP AND FIELD TESTING

- A. Refer to Section 15000 – Basic Mechanical Requirements and Section 15095 – Valves, General.

- END OF SECTION -

SECTION 15170

LOW VOLTAGE ELECTRIC MOTORS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Equipment Supplier shall furnish two (2) low voltage electric motors as shown on the Drawings and specified herein. All motors required for this Contract shall comply with this Section unless otherwise noted.

1.02 SUBMITTALS

- A. The following shall be submitted:

- 1. Shop Drawings.
- 2. Spare Parts List.
- 3. Special Tools List.

- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings for electric motors shall include motor data sheets, dimensioned drawings, wiring diagrams (space heaters, temperature devices, etc.) identifying electric characteristics and design, mechanical construction, manufacturer's name, type and pertinent specifications for the use intended, along with the name of the equipment to be driven. For motors rated 50 horsepower or more, submittal of motor data for acceptance shall include, as a minimum, the following:
 - a. Manufacturer's type and frame designation
 - b. Horsepower rating
 - c. Time rating (per NEMA Standards)
 - d. Ambient temperature rating
 - e. Insulation system designation

- f. RPM at rated load
- g. Frequency
- h. Number of phases
- i. Rated-load amperes
- j. Voltage
- k. Code letter (starting KVA per horsepower)
- l. Design letter for integral horsepower induction motors (per NEMA Standards)
- m. Service factor
- n. Temperature rise at full load and at service factor load
- o. Efficiency at 1/4, 1/2, 3/4 and full load
- p. Power factor at 1/4, 1/2, 3/4 and full load
- q. Motor outline, dimensions and weight
- r. Insulation system description
- s. Horsepower required by connected machine at specified conditions (load curves) shall be supplied for all compressors, propeller and positive displacement pumps.

The foregoing data shall also be verified after manufacture and shall be included with the information to be furnished in the operation and maintenance manuals specified.

- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Electric motors shall be manufactured by Baldor/Reliance Electric Company; Nidec Motors; Toshiba Industrial and Power Systems, Inc.; Siemens Energy & Automation, Inc.; General Electric Company; or equal.

2.02 MATERIALS AND CONSTRUCTION

A. Motors shall be built in accordance with the latest standards of NEMA, including, but not limited to MG-1 and MG-2, IEEE, ANSI and to the requirements specified herein.

B. Type

1. Unless otherwise noted, motors specified herein shall be polyphase squirrel cage, NEMA Design B, or single phase capacitor or repulsion start induction motors. Special equipment requiring a motor drive with unusual characteristics shall be equipped with a definite purpose motor to meet the necessary requirements.
2. Unless otherwise shown or specified, all motors 1/2 horsepower or larger shall be three- phase, 60 Hertz, NEMA Design B, squirrel cage induction motors designed for operation at 480 volts or greater as specified herein or shown on the Drawings.
3. Unless otherwise specified in the individual equipment specification for the driven equipment, or as required by the dynamic characteristics of the load as determined by the manufacturer of the machine to be driven, all polyphase squirrel cage motors shall be designed to withstand the starting voltage shown on the Drawings and shall have torque and locked rotor current characteristics as specified for NEMA Design B motors.
4. All motors above 3 horsepower shall have stator windings vacuum impregnated with a polyester insulation compound.

C. Rating

1. Each motor shall develop ample torque for its required service through its acceleration range and throughout its rated load range. The rating of the motors offered shall in no case be less than the horsepower shown on the Drawings or elsewhere specified. Where the Equipment Supplier is proposing to provide equipment larger than the equipment identified on the Drawings, the proposed equipment shall be identified in the submitted bid.
2. Motor ratings shall be based on continuous operation in an ambient temperature. The maximum temperature rise for open and drip proof type motors shall not exceed 90 degrees C, and for totally enclosed type motors shall not exceed 80 degrees C.

D. Insulation

1. Insulation shall be as specified for each particular type or class of motor. The insulation system shall provide a high dielectric strength, long life covering for the windings which may be required to operate in a continually damp and chemically contaminated environment. The insulation shall be resistant to attack by moisture, acids, alkalis, abrasives, and mechanical and thermal shock. Leads shall be sealed with a non-wicking, non-hydroscopic insulation material.

2. Motor insulation resistance may be checked at any time after delivery to the job site or during the warranty period. Encapsulated motor stators may be subjected to insulation testing while completely submerged in water. Any motor not meeting the requirements specified herein will be rejected and shall be promptly replaced at no cost to the Owner.
3. Torque and locked rotor current characteristics for three phase motors shall be NEMA Design B. The locked rotor KVA/HP input at full voltage for 10 horsepower motors and larger shall not exceed that permitted for Code Letter "J", except for specialized equipment requiring a motor drive with special definite characteristics.
4. Unless otherwise specified, non-inverter duty motors shall be furnished with a Class F insulation system. Unless otherwise specified, inverter duty motors shall be furnished with a Class H insulation system. In either case, temperature rise shall be limited to that for Class B insulation. Output torque and speed characteristics of each motor shall be suitable to operate the driven equipment through the full range of acceleration and operating load conditions without exceeding the nameplates current rating, and/or temperature rise.

E. Nameplates

1. The motor manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor frame with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall include as a minimum, Items a through m as listed in Article 1.03 in addition to that required by NEMA standards. The nameplate shall be positioned so as to be readily visible for inspection in the completed machine.

F. Design

1. Motors shall be designed to accelerate and drive the connected equipment under all normal operating conditions without exceeding nameplate ratings.
2. Motors specified for operation with variable frequency drives shall be inverter duty and shall be designed to output 100 percent of nameplate horsepower under continuous duty service without exceeding the temperature rise specified herein when controlled by the actual drives furnished. Inverter duty motors shall be designed to operate down to 10% of full load speed without the need for a line powered cooling fan.
3. Unless otherwise specified, electric motors shall be furnished with service factors in accordance with NEMA MG-1 as follows:

Type of Motor	Service Factor
Inverter Duty	1.0

4. Design selection with respect to the driven machine shall be such that the requirements do not exceed 85 percent of the motors' maximum rating modified by service factor, ambient temperature, enclosure, altitude and electrical service. The electrical service conditions shall be assumed to be 10 percent undervoltage, 5 percent underfrequency, and 3 percent voltage unbalance. Altitude shall be

assumed to be the project site elevation plus 10 percent. Ambient temperature shall be assumed to be 95 degrees F in exterior locations, 104 degrees F (40 degrees C) in interior locations, and 122 degrees F (50 degrees C) within housings or enclosures; except where higher temperatures may be encountered within or on individual items of equipment. The applicable paragraphs of NEMA MG-1 shall be used in making the design selection.

5. Motors used with belt drives shall have sliding bases to provide for belt take up.
6. Terminal boxes shall be of sufficient size to accommodate the required quantity and size of conduits. Gasketed terminal boxes shall be furnished with all splash-proof and totally enclosed motors. NEMA ratings of the terminal boxes shall be suited for the application. Motors located in hazardous locations shall be furnished with terminal boxes suitable for the specific Class, Division, and Group suitable for the application. Terminal boxes shall be sized to accommodate accessory equipment such as motor differential current transformers.

G. Construction

1. Frames, mounting means, and shafts shall meet NEMA Standards for the horsepower, RPM, and enclosure selected. Enclosures shall be selected according to the degree of mechanical protection required and shall not be of aluminum construction. All motors shall have a manufacturer's standard shop machinery finish, consisting of a rust-resisting priming coat of zinc chromate and a finish coat of alkyd machinery enamel.
2. Motors shall have cast iron frames and a heavy gauge steel terminal box, with neoprene gaskets between the frame and the box and between the box and its cover. A grounding lug(s) shall be provided inside the terminal box.
3. Motors weighing more than 50 pounds shall be equipped with at least one lifting eye. All lifting hardware shall be corrosion resistant.
4. Motors located in hazardous locations shall be totally enclosed and suitable for the specific Class, Division, and Group suitable for the application.
5. Motors located in Class I or II, Division 1 hazardous locations shall bear a U.L.-844 label and shall be provided with a breather/drain approved for the hazardous location. The U.L. listed breather/drain shall prevent the entrance of contaminants while allowing moisture to drain out of the motor.
6. Motors shall be totally enclosed fan cooled (TEFC) or totally enclosed blower cooled (TEBC) as recommended by the Equipment Manufacturer. The motor shall be suitable for immersion in water and exceed IP67 standards. Motor design shall allow for a two week submersion in up to 30 feet of water.
7. Motor shall include thermal protective temperature switches encapsulated in each motor winding.
8. Rotors shall be statically and dynamically balanced. Rotor windings shall be one-piece cast aluminum. Where applicable, rotors shall be constructed with integral fins.

H. Power Factor and Efficiency

1. All motors, including vertical hollowshaft motors, in the range of 1-500 horsepower, inclusive, shall be designed specifically for energy efficiency and high power factor. The motor efficiency and power factor shall meet or exceed the values listed in the table below when the motors are tested in accordance with the NEMA preferred test method IEEE 112A, Method B, Dynamometer. Each motor shall meet the minimum guaranteed efficiency value indicated in the table below. All tests shall be performed in accordance with the procedures contained in NEMA Standard MG1-12.58.

TABLE 12-11 FULL-LOAD EFFICIENCIES OF ENERGY EFFICIENT MOTORS ENCLOSED MOTORS								
HP	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	75.5	72	82.5	80	80	77	74	70
1.5	82.5	80	84	81.5	85.5	82.5	77	74
2	84	81.5	84	81.5	86.5	84	82.5	80
3	85.5	82.5	87.5	85.5	87.5	85.5	84	81.5
5	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91	89.5	90.2	88.5	89.5	87.5
25	91	89.5	92.4	91	91.7	90.2	89.5	87.5
30	91	89.5	92.4	91	91.7	90.2	91	89.5
40	91.7	90.2	93	91.7	93	91.7	91	89.5
50	92.4	91	93	91.7	93	91.7	91.7	90.2
60	93	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93	91.7	94.1	93	93.6	92.4	93	91.7
100	93.6	92.4	94.5	93.6	94.1	93	93	91.7
125	94.5	93.6	94.5	93.6	94.1	93	93.6	92.4
150	94.5	93.6	95	94.1	95	94.1	93.6	92.4
200	95	94.1	95	94.1	95	94.1	94.1	93
250	95.4	94.5	95	94.1	95	94.1	94.5	93.6
300	95.4	94.5	95.4	94.5	95	94.1		
350	95.4	94.5	95.4	94.5	95	94.1		
400	95.4	94.5	95.4	94.5				
450	95.4	94.5	95.4	94.5				
500	95.4	94.5	95.8	95				

2.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Each motor shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

PART 3 -- EXECUTION

3.02 DELIVERY, STORAGE, AND HANDLING

- A. Motors shall be properly protected from weather hazards. Motors shall not be allowed to be wrapped tightly in plastic while outdoors. Motors delivered to the site which will not be put in service for a time in excess of 30 calendar days, whether in storage or installed, shall have the shafts rotated a minimum of five (5) rotations every 30 days.
- B. Motors provided with space heaters shall have temporary power applied to the heaters no later than 30 calendar days after delivery to the site until permanent power can be applied to the heaters.
- C. Motors that, in the opinion of the Engineer, have not been properly protected shall be inspected by the manufacturer's representative. Any required electrical corrections for testing shall be made at the Contractor's expense prior to acceptance and/or use.
- D. All motors shall operate without any undue noise or vibration and shall show no signs of phase unbalance.

3.03 TESTING

- A. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. All motors shall be shop tested and inspected in accordance with the equipment manufacturer's standard procedures. The manufacturer's testing and inspection procedures shall demonstrate that the equipment tested conforms to the requirements specified, all other applicable requirements, and shall be approved by the Engineer.
 - b. In addition to the efficiency and power factor testing specified herein, each motor shall be tested to determine compliance with the applicable requirements of the IEEE, ANSI and NEMA. Tests shall be as follows:
 - (1) Motors less than 50 HP
 - (a) Each motor shall be subjected to a standard, short commercial test including the following:
 - i) Running current, no load
 - ii) Locked rotor current

- iii) High potential
- iv) Winding resistance
- v) Bearing inspection

- (2) Motors between 50 and 100 HP
 - (a) Each motor shall be subjected to the above tests and shall be furnished with certified test results.
- (3) Motors larger than 100 HP
 - (a) Each motor shall be furnished with certified test results. Each motor shall be subjected to a complete test consisting of full load heat run, percent slip, running load current, locked rotor current, breakdown torque (calculated), starting torque, winding resistance, high potential, secondary current and voltage at collector rings (wound rotor), efficiencies at 100, 75 and 50 percent of full load, power factors at 100, 75 and 50 percent of full load and bearing inspection. Tests will be witnessed by the Engineer where specifically indicated.
- (4) Test Reports
 - (a) All test results for motors over 100 horsepower shall be submitted to the Engineer for approval. Copies of witnessed test raw data shall be submitted to the Engineer immediately upon completion of such tests.

(EXHIBIT A)

MOTOR TEST RECORD					
Motor Identification Remarks	Location	Specified Horsepower	Nameplate Horsepower	Nameplate Amperage (FLA)	Measured Amperage Under Normal Operating Conditions

- END OF SECTION -

SECTION 15500

BASIC HVAC REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, equipment and material for the complete installation of the heating, ventilation, air conditioning, piping, etc. as indicated on the drawings and specified herein.
- B. Air conditioning systems shall be furnished and installed to operate as a system. The Contractor shall coordinate all requirements between manufacturers to insure unit responsibility and compatibility of the systems.

1.02 SUBMITTALS

- A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work or other mechanical and air conditioning work required, all in accordance with the requirements of Section 01300, Submittals.
- B. Data to be submitted shall include but not be limited to:
 - 1. Catalog data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various parts and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.
 - 2. Complete assembly, and installation drawings with clearly marked dimensions. This information shall be in sufficient detail to serve as a guide for assembly and disassembly and for ordering parts.
 - 3. Weight of all component parts and assembled weight.
 - 4. Electrical characteristics, wiring, diagrams, etc.
 - 5. Sample data sheet of equipment nameplate(s) including information contained thereon.
 - 6. Insulation materials, coating, jackets, detail density, thermal conductivity and thickness of all insulation materials to be furnished.
 - 7. Details of special fasteners and accessories.
 - 8. Type of adhesives, binders, joint cement, mastics.
 - 9. Proposed insulation procedures and installation methods.

- 10. Spare parts list
 - 11. Special tools list
 - C. The Contractor shall obtain from the manufacturer and submit to the engineer copies of the results of all certified shop tests.
 - D. The Contractor shall obtain from the manufacturer and submit to the engineer copies of certified letters of compliance in accordance with the Specifications.
- 1.03 OPERATION AND MAINTENANCE MANUALS
- A. The Contractor shall submit operation and maintenance manual in accordance with the procedures and requirements set forth in the General Conditions and Division 1.
 - B. Operation and Maintenance Manuals shall be submitted for all equipment.
- 1.04 MANUFACTURER'S INSTRUCTIONS
- A. Installation of all equipment shall be in accordance with manufacturer's data.
 - B. All changes from the installation procedures in manufacturers' data shall be submitted for approval in accordance with the requirements for shop drawings.
 - C. Keep all manufacturers' data provided in a secure manner at the job site at all times. Catalog and index this data for convenient reference.
 - D. Manufacturers' data shall be available for the information of the Owner, Engineer, and the use of other trades.
 - E. Turn over all data to the Owner through the Owner's representative at completion of the Work and final testing.
 - F. Furnish Owner, indexed and bound in loose leaf binders, three (3) complete sets of Operating and Maintenance Instructions and pertinent manufacturers' literature and information on all of the apparatus and equipment under this Division of the Specifications.
 - G. Submit all instruction books and manuals in accordance with Division 1.
- 1.05 CODES, PERMITS AND STANDARDS
- A. The Contractor shall obtain and pay for all permits and shall comply with all laws and codes that apply to the Work.
 - B. The Contractor shall be responsible for all added expense due to his choice of equipment, materials or construction methods.
 - C. All work and materials shall be in full accordance with the latest State rules and regulations or publications including those of the State Fire Marshall, the Uniform Plumbing Code, and all local codes. Nothing in the Plans and/or Specifications shall be construed to permit work not conforming to the above codes, rules and regulations.

- D. All equipment, materials and installations shall conform to the requirements of the most recent edition with latest revisions, supplements and amendments of the following, as applicable:

Air Conditioning and Refrigeration Institute (ARI)
Air Diffusion Council (ADC)
Air Moving and Conditioning Association (AMCA)
American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)
American National Standards Institute (ANSI)
American Society for Testing and Materials (ASTM)
American Society of Mechanical Engineers (ASME)
Factory Mutual (FM)
National Electric Code (NEC)
NFPA 90A - Air Conditioning and Ventilation Systems
Occupational Safety and Health Standards (OSHA)
Sheet Metal & Air Conditioning Contractors National Association (SMACNA)
Virginia Building Code – 2018 edition
Virginia Mechanical Code – 2018 edition
Virginia Plumbing Code – 2018 edition
Virginia Energy Conservation Code – 2018 edition
State and local codes, ordinances and statutes
Underwriters Laboratories (UL)

Others as designated in the specifications.

1.06 QUALITY ASSURANCE

- A. All material and equipment shall be the latest design, new, undeteriorated, and the first quality standard product of manufacturers regularly engaged in the production of such material and equipment.
- B. When two or more units of the same class of material or equipment are required, they shall be products of a single manufacturer.
- C. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.
- D. Touch up and/or repaint to match original finishes all factory finished or painted equipment and materials which are scratched or marred during shipment or installation.

1.07 IDENTIFICATION MARKERS

- A. Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color codes:

Yellow/Green: Supply air

Blue: Exhaust, outside, return and mixed air

Nomenclature: Include the following:
 Direction of air flow.
 Duct service (supply, return, exhaust, etc.)

1.08 GASKETS AND CONNECTORS

- A. Provide new gaskets wherever gasketed mating equipment items or pipe connections have been dismantled. Gaskets shall be in accordance with manufacturer's recommendations.
- B. Replace all assembly bolts, studs, nuts and fasteners of any kind which are bent, flattened, corroded or have their threads, heads or slots damaged.
- C. Furnish all bolts, studs, nuts and fasteners for make-up of all connections to equipment and replace any of these items damaged in storage, shipment or moving.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Each item of equipment shall be furnished and installed complete with all supports, mounting frames, duct work, piping, louvers, panels, grilles, electric drive units and controls, mechanical equipment, electrical work, insulation and appurtenances ready for operation.
- B. All equipment and appurtenances shall be anchored or connected to supporting members as specified or as indicated on the Plans.
- C. All mechanisms or parts shall be amply proportioned for the stresses which may occur during operation or for any other stresses which may occur during fabrication and erection. Individual parts furnished which are alike in all units shall be alike in workmanship, design, and materials and shall be interchangeable. All equipment shall be of the manufacturer's top line, industrial-commercial grade.
- D. The Contractor shall ascertain that all chassis, shafts, and openings are correctly located, otherwise he shall cut all new openings required at his own expense. Cutting of new openings shall be coordinated with other trades. Proposed new cutting shall be submitted to the Engineer for review and acceptance prior to cutting.
- E. The Plans shall be taken as diagrammatic. The Contractor shall check the Structural Plans and sections for detail dimensions and clearances. Sizes of ducts and their locations are indicated, but not every offset, fitting, or structural obstruction is shown.
- F. Alignment of ducts may be varied where necessary to account for slight architectural changes or to avoid conflict with the Work of other trades without additional expense to the Owner.
- G. All supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided, unless specifically noted otherwise. Equipment shall be supported on spring-type vibration isolators.

PART 3 – EXECUTION

(NOT USED)

- END OF SECTION -

SECTION 15590

FANS

PART 1 -- GENERAL

1.01 GENERAL REQUIREMENTS

- A. All parts of the equipment furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection and continuous operation. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the unit is to be subjected and shall conform to all applicable sections of these specifications. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these specifications.
- B. All anchor bolts, washers, clips, clamps and fasteners of any type shall be constructed of 316 stainless steel.
- C. All fan motors shall be provided with high premium energy efficient totally enclosed fan cooled type, unless otherwise noted.
- D. Provide exhaust fans which have been tested and rated in accordance with AMCA standard, and bear AMCA Certified Ratings Seal.
- E. Provide motors and electrical accessories complying with NEMA standards.
- F. Fans shall be standard prefabricated units of the type, size and arrangement indicated on the Drawings. All fans shall be rated and constructed in accordance with the Air Moving and Conditioning Association. Special construction materials, coatings and multi-speed fan motors shall be provided as indicated on the Drawings.
- G. Impellers shall be rigidly constructed, accurately balanced dynamically and statically at the speed at which it is scheduled to operate and free from objectionable vibration or noise. Fans with corrosion resistant coatings shall be balanced after being coated.
- H. Fans shall have no overloading characteristics for the horsepower indicated. All points on the fan brake horsepower curve shall not exceed the motor horsepower rating
- I. V-belt drives shall be rated at least 50 percent greater than the rated motor horsepower, and shall have sheaves which can vary the fan speed by 10 percent above or below the rating point. The fan motor shall be mounted on an adjustable heavy mounting plate.
- J. The operating fan speed shall be no greater than 85% of the maximum allowable fan speed for the selected model.
- K. Unless otherwise noted on the Fan Schedule fans shall be manufactured to meet the balance quality and vibration limits of Fan Application Category BV-3 per AMCA Standard 204.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01350 - Seismic Anchorage and Bracing
- B. Section 15500 - Basic HVAC Requirements
- C. Section 15598 – Metallic Ductwork and Duct Accessories
- D. Section 15599 – HVAC Fiberglass Reinforced Plastic Ductwork and Duct Accessories
- E. Section 15990 – HVAC Testing, Adjustment, and Balancing

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work required for all equipment specified in this section in accordance with Section 01300, Submittals.
- B. The Contractor shall submit shop drawings for fan supports, locating and identifying each support, brace, hanger, guide, component and anchor. Fan support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer of Commonwealth of Virginia and shall comply with Section 01350 Seismic Anchorage and Bracing.
- C. Required information shall include:
 - 1. Horsepower, voltage, and rotating speed of motors.
 - 2. Total weight of the equipment plus the approximate weight of the shipped materials.
 - 3. Complete erection, installation, and adjustment instructions and recommendations.
 - 4. Fan performance curve at the operating speed, minimum, and maximum speeds. Provide brake horsepower curve for the operating speed.
 - 5. Details of corrosion resistance coating.
 - 6. Detailed construction information and data sheets for all accessories such as roof curbs, dampers, damper operators disconnect switches, vibration isolators etc.
 - 7. Example equipment nameplate data sheet.
 - 8. Interconnecting wiring diagrams.
 - 9. List of recommended lubricants.

- 10. Special Tools List
- 11. Reports of Certified Shop Tests
- 12. AMCA Approval for Fan Ratings
- 13. Sound data
- 14. Manufacturer's Installation Certification
- 15. Manufacturer's Field Test Results Certification

D. The Contractor shall submit to the Owner a color chart of available colors for the corrosion coating to be applied to fans as indicated in the Contract Documents. The Owner shall select the final color choice.

1.04 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall submit complete operation and maintenance manuals in accordance with the procedures and requirements set forth in Section 01300, Submittals.

1.05 NFPA 820

A. All fans located within three (3) feet of the odor control ductwork and odor control system, under positive pressure, shall be explosion-proof rated to NEC Class I, Division 2, Group D.

1.06 MANUFACTURERS

A. The materials covered by these specifications are intended to be equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Contract Drawings and operated per manufacturer's recommendations.

1.07 CONTRACTOR'S RESPONSIBILITY AND MANUFACTURER'S FIELD SERVICES

A. The services of a qualified manufacturer's Technical Representative shall be provided. The manufacturer Technical Representative's services shall include the following site visits:

Service	Total Days	No. of Trips	Remarks
Installation Checkout	1	1	In accordance with Section 15590
Startup and Testing	3	3	In accordance with Section 15616
Training	1	1	In accordance with Section 01700

B. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any

deficiencies noted.

- C. The times specified are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.

1.08 SPECIAL TOOLS

- B. Furnish all special tools necessary to disassemble, service, repair and adjust the equipment.

PART 2 -- PRODUCT

2.06 ROOF MOUNTED UPBLAST CENTRIFUGAL EXHAUST FANS

- A. Centrifugal fans shall be backwardly inclined, non-overloading blades of aluminum construction. Wheel inlets shall overlap an aerodynamic aluminum inlet cone.
- B. Wheel shall be balanced in accordance with AMCA Standard 204-05.
- C. Provide exhaust fans which are listed by UL and have UL label affixed, and which are designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".
- D. Fans shall be V-belt or direct driven as indicated on the drawings or as contained herein.
- E. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners.
- F. The two piece top cap shall have stainless steel quick release latches to provide access to the motor compartment without the use of tools.
- G. Fans shall have internal terminal box mounted on the exterior for ready wiring.
- H. The motor shall be separated from the exhaust air stream.
- I. Bearings shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum catalogued operating speed.
- J. Belts shall be oil and heat resistant, static conducting.
- K. Drives shall be keyed and securely attached to the wheel and motor shafts.
- L. All drives shall be variable pitched type and shall be sized for 150 percent of the installed motor horsepower.
- M. Centrifugal fans shall be as manufactured by Loren Cook Co., Greenheck Fan Corp, or approved equal.
- N. See Section 2.10 of this specification for additional requirements.

2.07 ROOF MOUNTED CENTRIFUGAL FANS

- A. Centrifugal fans shall be airfoil, non-overloading blades of aluminum construction continuously welded. Wheel inlets shall overlap an aerodynamic aluminum inlet cone.
- B. Wheel shall be balanced in accordance with AMCA Standard 204-05.
- C. Provide supply fans which are listed by UL and have UL label affixed, and which are designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".
- D. Fans shall be V-belt or direct driven as indicated on the Contract Drawings or as contained herein.
- E. The fan shall utilize all aluminum construction.
- F. The aluminum base shall have continuously welded curb cap corners.
- G. Fans shall have adjustable motor mounting plate with threaded studs for positive belt tensioning.
- H. Fans shall have internal terminal box mounted on the exterior for ready wiring.
- I. The motor shall be separated from the exhaust air stream.
- J. Bearings shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum catalogued operating speed.
- K. Belts shall be oil and heat resistant, static conducting.
- L. Drives shall be keyed and securely attached to the wheel and motor shafts.
- M. All drives shall be variable pitched type and shall be sized for 150 percent of the installed motor horsepower.
- N. Centrifugal fans shall be as manufactured by Loren Cook Co., Greenheck Fan Corp, PennBarry, Hartzell, or approved equal.
- O. See Section 2.03 of this specification for additional requirements.

2.08 ADDITIONAL REQUIREMENTS FOR ALL FANS

- A. The following additional requirements shall apply to all fans.
 - 1. Backdraft or motor-operated dampers shall be provided and installed in the openings as indicated on the Contract Drawings.
 - 2. All fans shall be provided with either integral or supplementary spring vibration or sound-absorbing mountings.

3. Where indicated, roof mounted exhaust fans shall be mounted on a prefabricated roof curb.
4. All motors unless indicated otherwise in this Specification or the Contract Drawings shall be TEFC. The break horsepower at any point on the fan curve for the design speed shall not exceed the motor nameplate horsepower. The break horse power shall include all applicable belt drive losses. Using the motor service factor shall be prohibited.
5. All equipment shall be seismically secured and restrained in accordance with the Seismic Restraint Manual, Guidelines for Mechanical Systems, latest edition, as published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) and designed in accordance with the seismic provisions of ASCE-7 and the current Virginia Building Code to the extent that the most stringent provisions are utilized in developing the design seismic forces. See section 01350 for additional details and requirements.
6. All non-fiberglass fans shall receive a corrosion resistant coating. The coating shall be an epoxy coating suitable for protecting the equipment from continuous exposure to air containing hydrogen sulfide 3ppm. The fans in the Supplemental Carbon Facility shall be suitable for exposure to methanol in addition to hydrogen sulfide. The coating shall be applied to all surfaces of the fans including but not limited to fan wheels, propellers, hubs, structural components, housings (interior and exterior), inlet boxes, dampers, screens, lube lines, curb boxes, and curb box adapters. A UV resistant top coat shall be applied to all coating systems that are not rated for UV exposure. The Contractor shall submit and coordinate the available color choices to the Owner for final color selection.
7. Where indicated in the design documents, fans shall exceed the uncertainty requirements of AMCA standard 203 and shall perform within +/- 3% of the flowrate with respect to the static pressure of the fan curve.

2.09 DAMPERS

- A. See the respective sections in Sections 15598 and 15599 for construction requirements.
- B. Dampers shall be coordinated to operate and interface with the fan being furnished.
- C. Dampers shall be sized to fit the specified openings.

2.10 PREFABRICATED ROOF AND WALL CURBS

- A. Prefabricated roof and wall curbs shall be installed where indicated on the Drawings or as specified herein. The curbs shall be fabricated of .064 inch sheet aluminum with all joints heliarc welded. Cants and roof flanges shall be an integral part of the curb. The inside of the curb shall be insulated with rigid glass-fiber thermal and acoustical liner of approximately 3-lb. density and 1-1/2 inch minimum thickness with a neoprene or equal coating for protection from erosion. The lining shall conform to NFPA 90A Standards with a flame spread and fuel contributed rating not exceeding 50. Pressure-treated wood nailers shall be provided at the tops of the curbs. The curbs shall be sized to suit

equipment. Roof curbs shall be a nominal of 12-inches above the height of the roof unless indicated otherwise on the Contract Drawings. The roof curbs shall receive an epoxy corrosion resistant coating on the interior and exterior surfaces that is suitable for the conditions indicated in the Additional Requirements for All Fans section above.

PART 3 -- EXECUTION

3.06 INSTALLATION

- A. Contractor shall install fans in accordance with manufacturer's installation instructions and recognized industry practices to insure that ventilators serve their intended function.
- B. Contractor shall coordinate fan work with work of walls, and ceilings, as necessary for proper interfacing.
- C. Connect ducts to fans in accordance with manufacturer's installation instructions.
- D. The Contractor shall have the Manufacturer's Technical Representative provide in writing that the equipment is installed per the manufacturer's requirements and operates as required by the Contract. The Contractor shall submit the written confirmation to the Engineer for information only.

3.07 FIELD QUALITY CONTROL

- A. Testing: After installation of fans has been completed, test each fan to demonstrate proper operation of units at performance requirements as specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected. See Section 15616, HVAC Testing, Adjusting and Balancing for testing requirements.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched coatings with a coating specified by the equipment manufacturer for repairs.

- END OF SECTION -

SECTION 15598

METALLIC DUCTWORK & DUCT ACCESSORIES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all ductwork, fittings, and accessories as shown on the Drawings and in accordance with the Specifications.
- B. The equipment shall be furnished complete with all accessories, special tools, base attachments, mountings, anchor bolts and other appurtenances as specified or as may be required for a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15500 - Basic HVAC Requirements
- B. Section 15990 – HVAC Testing, Adjustment, and Balancing

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings on all new and modified ductwork, accessories and appurtenances and all fabrication work required for all equipment specified in this section in accordance with Section 01300, Submittals.
- B. The Contractor shall submit shop drawings for supports for new and modified ductwork. The shop drawings shall locate and identify each support, brace, hanger, guide, component and anchor. Ductwork support systems shall be designed and Shop Drawings prepared and seal by a Registered Professional Engineer of the Commonwealth of Virginia and shall comply with Section 01350, Seismic Anchorage and Bracing.
- C. The Contractor shall submit shop drawings for support of multi-section dampers and louvers. The shop drawings shall identify all supports and reinforcement required to allow the multi-section dampers and louvers to be rated for the maximum pressure of the individual damper and louver sections. The support system shall be designed and calculations prepared and sealed by a Registered Professional Engineer of the Commonwealth of Virginia.

1.04 WARRANTY AND GUARANTEE

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

PART 2 -- PRODUCT

2.01 GENERAL REQUIREMENTS

- A. All work shall be constructed and installed in a first class workmanlike manner in accordance with the recommendations given in the latest edition of the Sheet Metal & Air Conditioning Contractors National Association (SMACNA) HVAC Duct Construction Standards and Round Industrial Duct Construction Standards, unless otherwise specified.
- B. All ductwork shall be constructed in accordance with the Schedule of Duct Construction Standards listed on the last page of this section. Transverse duct connections shall be bolted, gasketed connections.
- C. All ducts shall conform accurately to the dimensions indicated on the Drawings, shall be straight and smooth on the inside with neatly finished joints, and shall not be decreased at any point to avoid obstructions. No piping, conduit or structural work shall be installed in or through any ductwork. All ductwork shall be run as close as possible to structural members, walls and ceilings. Duct work shall be as shown on the drawings, subject to such modifications as may be necessary to suit field conditions.
- D. Where existing walls, floors or roofs must be penetrated, the Contractor shall neatly cut the required openings and patch the existing work to provide a neat and finished appearance.
- E. All ducts shall be made reasonably tight throughout and shall have no openings other than those required for the proper operation and maintenance of the systems.
- F. Minimum thickness for metal ducts shall be per SMACNA guidelines, but in no instance shall be less than 20 gauge for steel ducts and 14 gauge for aluminum ducts.
- G. Supports for ducts shall be provided and securely fastened in place at every change in direction and as required to prevent deflection.
- H. Changes in size of ducts shall be by means of a taper transformation piece, the included angle of the taper being not more than 20 degrees.
- I. All duct work joints shall be sealed to achieve a SMACNA Seal Classification Rating as indicated in the ductwork schedule of this specification.
- J. The weight of material used for ducts and stiffeners, the fabrication methods, cross breaking of flat duct surfaces, and assembling of the ductwork shall conform to the Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems published by the Sheet Metal and Air Conditioning Contractors National Association, Inc. Beaded duct construction shall not be used.
- K. All duct panels shall be braced or reinforced as necessary, in addition to the minimum requirements in the ASHRAE Guide, to eliminate vibration and noise and to prevent deflection from the indicted shapes and dimensions.

2.02 STAINLESS STEEL AND ALUMINUM DUCT

- A. Ductwork material shall be as indicated in the duct schedule in Part 3 of this specification.

- B. Stainless Steel: ASTM A480/A480M, Type 316 having a number 2D finish for all applicable ducts and of adequate strength and rigidity to meet the conditions of the service and installation requirements, and shall be properly protected where subject to mechanical injury.
- C. Aluminum: ASTM B209, alloy 1100, 3003, or 5052 for all applicable ducts and of adequate strength and rigidity to meet the conditions of the service and installation requirements, and shall be properly protected where subject to mechanical injury.
- D. Transverse duct connections for rectangular ducts shall be bolted, gasketed connections made with standard Ductmate 35 System as manufactured by Duct Mate Industries, W.D.C.I. or approved equal. All longitudinal seams shall be Pittsburg Z, or better. Duct flange system material shall match the duct material. Gaskets shall be suitable for exposure to hydrogen sulfide 2ppm.
- E. Transverse duct connections for round ducts shall be bolted, gasketed connections in accordance with chapter 12 of SMACNA Round Industrial Duct Construction Standards. Duct connections shall be the same material as the duct. Utilize longitudinal seam ductwork. Gaskets shall be suitable for exposure to hydrogen sulfide 2 ppm and outdoor use.
- F. All ductwork shall be shop fabricated in sections with flanged ends. The Ductmate 35 flange system shall be factory spot welded to the ductwork. No field welding of ductwork shall be permitted. Welding equipment and electrodes shall be of a type specifically suited for welding light gauge 316 stainless steel or aluminum, as applicable, to provide consistently good quality welds.
- G. All duct sections shall be constructed and installed without forming dips and traps.
- H. All ducts shall have a minimum clearance of three (3) inches from all combustible material.

2.03 HANGERS AND SUPPORTS

- A. All ductwork shall be securely hung and anchored to the building structure. Unless otherwise shown or specified, hangers and stiffeners for ducts shall conform with the recommendations given in the SMACNA HVAC Duct Construction standards and SMACNA seismic restraint manual. Ducts shall be supported on trapeze hangers consisting of angles and rods. Use of strap hangers and straps is prohibited.
- B. All hangers, rods, supports, bolts, nuts, washers, inserts, and appurtenances shall be constructed of the same material as the ductwork that it supports.
- C. All ductwork shall be supported from trapeze type hangers. Stainless steel hanger rods shall be minimum 3/8 inch for all ducts with half perimeter up to 72 inches, and 1/2 inch diameter for all ducts with half perimeter larger than 72 inches. Aluminum hanger rods shall be of sufficient diameter to achieve the equivalent strength of the stainless steel hanger rods for the sizes indicated. A pair of rods shall be provided at each duct support point. Maximum hanger spacing shall be 8 feet for ducts with half perimeter up to 72 inches and 6 feet for ducts with half perimeter larger than 72 inches.

- D. Hanger Construction and installation shall conform to SMACNA Standards, except as specified. No sheet metal duct hangers or straps will be allowed.
- E. Support shall be furnished at each fitting. Material of supports shall match duct material.
- F. Seismic & Wind Requirements: All ductwork shall be provided with seismic and wind restraints in accordance with the Seismic Restraint Manual, Guidelines for Mechanical Systems, as published by SMACNA, in accordance with the Virginia Building Code, the indicated design wind speed, and ASCE-7 to the extent that the most stringent provisions are utilized. Material of seismic and wind restraints shall be as specified herein. A calculation signed and sealed by a Professional Engineer of the Commonwealth of Virginia shall be provided verifying that the installed supports meet the seismic and wind requirements. See section 01350, Seismic Anchorage and Bracing and the Structural Design Drawings for additional details and requirements.

2.04 ACCESSORIES

- A. Manual Volume & Backdraft Dampers in Rectangular Stainless Steel or Aluminum Duct:
 - 1. Manufacturer: Provide products of one of the following:
 - a. Greenheck
 - b. Ruskin
 - c. Nailor
 - d. or equal
 - 2. Frame, blade, axle, bearings, jamb seal, and linkage materials: Match ductwork.
 - 3. Blades:
 - a. Opposed blades for volume dampers and parallel blades for backdraft dampers;
 - b. Vinyl edge seals, thermoplastic elastomer seals for corrosive/chemical services.
 - 4. Damper shafts shall be solid hexagonal or square shape.
 - 5. Linkage shall be concealed in damper frame.
 - 6. Provide outside handle, quadrant and approved position indicator and locking device on volume dampers.
 - 7. Reference: SMACNA Standards.
- B. Backdraft Dampers in Round Stainless Steel or Aluminum Duct:

1. Manufacturer: Provide products of one of the following:
 - a. Ruskin
 - b. Greenheck
 - c. Nailor
 - d. Or equal
2. Frame, blade, axle, bearings: Match ductwork
3. Damper shall be of the two blade design mounted on separate axles and shall be suitable for horizontal or vertical installations
4. Blades shall be retained in the closed position by a tensioned spring. The spring shall be field adjustable
5. Seal shall be a vinyl foam

C. Stainless Steel Motorized Dampers:

1. Manufacturer: Provide products of one of the following:
 - a. Ruskin
 - b. Greenheck
 - c. or equal
2. Frame, blade, axle, bearings, jamb seal, and linkage materials: 316 Stainless Steel.
3. Blades:
 - a. Opposed blades (control) and Parallel blades (shut-off)
 - b. Vinyl edge seals, thermoplastic elastomer seals for corrosive/chemical services.
4. Damper shafts shall be solid hexagonal or square shape.
5. Actuators shall be externally mounted to the damper and shall be a minimum of NEMA 2. All actuators shall be enclosed in a NEMA 4X case unless otherwise specified. Actuators located in classified spaces shall be enclosed in a NEMA 7 case unless otherwise specified. See Section 15608-HVAC Electric Control Systems for actuator requirements.
6. Damper leakage rate shall not exceed 3 cfm/sq. ft. at 1" w.g.
7. Reference: SMACNA Standards.

D. Aluminum Motorized Dampers:

1. Manufacturer: Provide products of one of the following:
 - a. Ruskin
 - b. Greenheck
 - c. Or equal
 2. Frame, blade, axle, bearings, jamb seal, and linkage materials: 6063T5 Aluminum
 3. Blades:
 - a. Opposed blades (modulating control) and Parallel blades (2 position shut-off)
 - b. Neoprene blade edge seals and flexible metal compressible jamb seals.
 4. Damper shafts shall be solid hexagonal or square shape.
 5. Actuators shall be externally mounted to the damper and shall be a minimum of NEMA 2. All actuators shall be enclosed in a NEMA 4X case unless otherwise specified. Actuators located in classified spaces shall be enclosed in a NEMA 7 case unless otherwise specified.
 6. Reference: SMACNA Standards.
- E. Sheet Metal Safing: Provide sheet metal safing of the same material as the duct, to close off and seal airtight all unused areas behind louvers.
- F. Screens: ½-inch (13 mm) mesh, with screen material matched duct material, framed with bolt holes unless indicated otherwise.
- G. Registers and Grilles:
1. Manufacturer: Provide product(s) of one of the following:
 - a. Titus (Basis of Design, model numbers scheduled on drawings)
 - b. Anemostat
 - c. Price Industries
 - d. Nailer Industries, Inc.
 - e. Hart and Cooley.
 2. Units shall be factory-fabricated of Type 316 stainless steel construction for stainless steel and FRP ductwork and aluminum for aluminum ductwork. They shall distribute the specified air volume (cubic feet per minute).

3. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance.
 4. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers.
 5. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling.
 6. An additional volume damper shall be installed in duct stub to each air outlet for balancing of air volume.
 7. Supply Registers:
 - a. Supply registers shall be double deflection type, complete with adjustable vertical face bars and a key operated opposed blade damper.
 8. Air extracting devices shall be installed at all collar take-offs to supply registers. The air extracting devices shall have two sets of individually adjustable blades to equalize flow and control volume at collar takeoffs and shall be gasketed around the perimeter.
 9. Exhaust and Return Registers and Grilles:
 - a. Exhaust and return registers shall be furnished with fixed vertical face bars, set straight, and a key operated opposed blade damper.
- H. Duct-Mounted Access Doors and Panels:
1. Provide access doors at all duct connections dampers for access and maintenance of damper motor actuators and linkages.
 2. Fabricate doors and panels airtight and suitable for duct pressure class.
 3. Seal around frame attachment to duct and door to frame with neoprene.
 4. Door and frame to be of same material as duct.
- I. Flexible Connectors unless indicated otherwise shall meet the following requirements:
1. Self-extinguishing material shall meet NFPA 90A, NFPA 701 and UL-214 Standards.
 2. Material:
 - a. Commercial grade neoprene coated woven fiberglass, Proflex by DUCTMATE, or approved equal.

- b. Corrosion/chemical resistant applications shall be of Teflon coated woven fiberglass fabric. Minimum density 18 oz./sq. yd. and rated to 500 F.
- 3. Extra wide edge connectors factory fabricated with a strip of fabric. Material of connectors shall match duct material.
- J. Instrument Test Holes: Material to suit duct material, including screw. Size holes to allow insertion of pitot and other testing instruments, and length to suit duct insulation thickness.
- K. Turning Vanes:
 - 1. Turning vanes shall be double wall turning vanes fabricated from the same material as the duct. Mounting rails shall have friction insert tabs that align the vanes automatically.
 - 2. Tab spacing shall be as specified in Figure 2-3 of the 1995 SMACNA Manual, "HVAC Duct Construction Standards, Metal & Flexible" Second Edition standard. Rail systems with non-standard tab spacing shall not be accepted.
 - 3. Due to tensile loading, vanes shall be capable of supporting 250 pounds when secured according to the manufacturer's instructions.

2.05 DUCT INSULATION

A. Products and Manufacturers:

- 1. Provide insulation as made by one of the following:
 - a. Armacell – AP/Armaflex FS
 - b. Aeroflex – Aerocel
 - c. or equal

B. Insulation

- 1. Type: Elastomeric Closed Cell Foam
- 2. FM Approved
- 3. Application
 - a. 1.5-inch thick where insulation is required. See Part 3 for required insulation installation locations.
- 4. Average thermal conductivity not to exceed 0.28 (Btu-in)/(hr-FT²-°F) at mean temperature of 75° F, temperature range -40° to 220° F; permeability not to exceed 0.20 by ASTM E96; water absorption 3 percent by ASTM D1056 and ozone

resistant. The insulation shall have a flame spread rating of less than 25 and a smoke development of less than 50 per ASTM-E84.

5. Insulation shall be sealed vapor tight using an adhesive at all joints. The adhesive shall have a flame spread of less than 25 and a smoke development of less than 50 when tested per ASTM-E84.

C. Jacket

1. All insulation shall receive a 316 stainless steel jacket for stainless steel ductwork and aluminum for all other duct materials. The jacket shall be a minimum of 0.016 nominal thickness. Exposed insulation ends such as duct discharge points or overlapping insulation shall receive caps made of the same material as the jacketing.
2. Jacketing shall be secured with straps of the same material as the jacketing.

PART 3 -- EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

- A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling.
- B. Prevent end damage and prevent dirt and moisture from entering ducts and fittings. Where possible, store ductwork inside and protect from weather. If necessary to store outside, store above grade and enclose with waterproof wrapping.

3.02 INSTALLATION OF DUCTWORK

- A. Examine areas and conditions under which ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- B. Assemble and install ductwork in accordance with recognized industry practices, Manufacturer's installation instructions, and SMACNA standards to achieve the seal and leakage classes indicated in the Duct Construction Table at the end of this specification.
- C. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth.
- D. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.
- E. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- F. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and

notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment.

- G. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 3" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings.
- H. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- I. Turning vanes shall be installed in all miter elbows to permit air to make the abrupt turns with a minimum of turbulence. The turning vanes shall be quiet and free from vibration when the system is in operation. Vanes shall be installed in all short radius elbows in accordance with SMACNA Duct Construction standards.
- J. The dial regulators for manual volume dampers shall be marked so that the "open" and "shut" positions are clearly identified. The dial regulators on insulated ductwork shall be mounted on an elevated platform which will finish flush with the surface of the insulation. Manual volume dampers shall be located at accessible points and wherever possible some distance from a duct transition or fitting. Care shall be taken during installation to make certain that sheet metal fasteners do not protrude into the duct and interfere with damper operation. Volume dampers shall be provided in each branch duct take off and in both ducts downstream of each trunk duct split.
- K. Duct access doors shall be provided before and after duct mounted coils, within working distance of, and on the fusible link side of all fire dampers, adjacent to volume dampers, on the linkage side of automatic dampers, duct mounted sensors, and at all other apparatus requiring service or inspection in the duct system. Access doors shall be a minimum of 15 x 18 inches; where the size of the duct will not accommodate this size the doors shall be made as large as practical. The doors shall be rigid and airtight, and provided with neoprene gaskets, hinges and sash locks. Whenever space requirements are such that a hinged access door is impractical, a screw fastened lift-out door shall be provided instead.
- L. Test openings shall be installed in the ductwork at the points listed below. The test openings shall be a minimum of 3/8" and shall be sealed by a screw cap and gasket, and shall be installed so that the insulation is not disturbed when the cap is removed. The test openings shall be located as follows in all heating, ventilating, air conditioning, and dehumidification systems:
 - 1. Upstream and downstream of each coil, duct heater, filter bank, or other inline equipment that heats, cools, humidifies, dehumidifies, or filters air.
 - 2. In the outside air, supply, and return ducts adjacent to the respective connections on all AHUs, HVs, DHUs, etc.

3. In the main supply duct on single zone units and in each zone supply duct on multizone units
 4. As indicated on the Contract Drawings
- M. Air filter gauges for measuring the differential pressure through all filter banks shall be supplied and installed; one gauge shall be installed for each bank. The gauge shall be of the inclined tube differential type complete with 1" thick acrylic plastic body, mirror-polished scale, built-in level vial, over pressure safety traps, signal flags, 2 vent valves for zeroing gauge, 2 static pressure taps, two 5-foot lengths of 1/4" stainless steel tubing, 2 compression fittings, mounting hardware, a bottle of red gauge oil and instructions. The gauges shall have a range of 0-1.0 inch water column with minor divisions of .02 inch water column.
- N. The Contractor shall install prefabricated roof curbs before the installation of roofing.
- O. All air outlets shall be with rigid connection to the ductwork.
- P. After the installation is completed, the Contractor shall seal all joints air tight. Sealants and tape shall have a flame spread not greater than 25 and a smoke developed rating of not over 50 per ASTM E-84.

3.03 INSULATION INSTALLATION

- A. Insulation shall be installed on all outdoor ductwork carrying conditioned air, all ductwork carrying conditioned air through unconditioned spaces, and all ductwork carrying unconditioned air through conditioned spaces. Conditioned air is any air that has received any heating, cooling, or dehumidification from HVAC equipment. Conditioned spaces are any spaces that receive conditioned air. Return and exhaust ductwork serving a conditioned space is considered conditioned air.
- B. Ductwork carrying cooled conditioned air passing through spaces that only receive heated conditioned air shall be insulated. Ductwork carrying cooled air for spaces that require year round cooling such as electrical rooms, shall be insulated when passing through spaces that are provided heated conditioned air during the heating season.
- C. Follow manufacturer's installation instructions and recommended adhesives. The installation method shall provide a continuous vapor barrier.
- D. The insulation vapor barrier shall be maintained through all supports, flanges, reinforcement, and penetrations. Where the duct weight would deform the insulation material at supports, the Contractor shall use fiberglass insulation blocks. The blocks shall be the same thickness as the insulation. The vapor barrier shall be maintained using a system approved by the insulation manufacturer for spanning the insulation block.

3.04 DAMPER AND LOUVER INSTALLATION

- A. The Contractor shall install dampers and louvers per the manufacturer's installation instructions.

- B. The Contractor shall install all reinforcement required for multi-section dampers and louvers to all the assembly to withstand the rated velocity and pressure of the individual damper and louver sections.

3.05 EQUIPMENT CONNECTIONS

- A. Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated in the Contract Drawings and Specifications.

3.06 ADJUSTING AND CLEANING

- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

3.07 MATERIAL SCHEDULE

- A. The duct material for each type of service shall be as follows:

DUCT CONSTRUCTION SCHEDULE					
SERVICE	PRESSURE CLASS	DUCT MATERIAL	SEAL CLASS	LEAKAGE CLASS	CONSTRUCTION STANDARDS
Supply Ductwork	+/- 2 inwg.	Stainless Steel	A	12	SMACNA HVAC Duct Construction Standards

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SECTION 15599

HVAC FIBERGLASS REINFORCED PLASTIC (FRP) DUCTWORK AND DUCT ACCESSORIES

PART 1 -- GENERAL

1.1 SUMMARY

- A. This section shall govern the materials, fabrication, and installation of FRP ductwork that is used for the purposes of conveying air associated with heating, ventilation, and air conditioning systems shown on the HVAC Design Drawings. This section shall not govern FRP ductwork associated with any odor control duct or ductwork shown on the Mechanical Design Drawings.
- B. Contractor shall furnish any and all labor, materials, equipment, services and incidentals required to field measure, install, field test, complete and place in satisfactory operation all Fiberglass Reinforced Plastic (FRP) ductwork contained in this Section as shown on contract drawings and as specified herein.
- C. Contractor shall be system supplier, where ductwork Manufacturer's professional engineer shall provide Contractor with complete materials and mechanical engineering necessary to satisfy all ductwork design requirements of this Section.

1.2 RELATED WORK

- A. Section 15500 – Basic HVAC Requirements
- B. Section 15598 – Metallic Ductwork and Duct Accessories
- C. Section 15616 – HVAC Testing, Adjustment, and Balancing

1.3 REFERENCES

- A. The most recently published standards at time contract to manufacture fiberglass ductwork are entered into shall govern requirements imposed on the Manufacturer.
- B. In the event of conflict, inconsistency or ambiguity between these references and the specific project requirements, the following order of precedence shall govern where laminate quality, dimensional accuracy and conformance to this specification are brought into question:
 - 1. This ductwork specification Section.
 - 2. Contract drawings.
 - 3. References within this paragraph 1.3, where:
 - a. ASTM D2563 definitions shall take precedence over ASTM C582 for types and quantity limitations.

- b. ASME RTP-1 Parts NM-2 Design of Integral Body Flanges and NM-12 FRP Flange Design shall take precedence over ASTM D3982, D3299 and D5421.
- C. Building Codes:
 - 1. Virginia Building and Energy Code
- D. Air Movement and Control Association (“AMCA”):
 - 1. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.
 - 2. AMCA 511 - Certified Ratings Program for Air Control Devices.
- E. American Society of Mechanical Engineers (“ASME”):
 - 1. ASME RTP-1 - Reinforced Thermoset Plastic Corrosion Resistant Equipment
- F. American Society for Testing and Materials (“ASTM”):
 - 1. ASTM C582 - Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion Resistant Equipment.
 - 2. ASTM D695 – Standard Test Method for Compressive Properties of Rigid Plastics.
 - 3. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics.
 - 4. ASTM D883 - Standard Definition of Terms Relating to Plastics.
 - 5. ASTM D2471 - Standard Test Method for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins.
 - 6. ASTM D2563 - Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
 - 7. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics By Means of a Barcol Impressor.
 - 8. ASTM D2584 - Standard Test Method for Ignition Loss of Cured Reinforced Resins.
 - 9. ASTM D3299 - Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.
 - 10. ASTM D3982 - Standard Specification for Contact Molded “Fiberglass” (Glass Fiber Reinforced Thermoset Resin) Ducts.
 - 11. ASTM D5421 - Standard Specification for Contact Molded “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Flanges.
 - 12. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 DEFINITIONS

A. General:

1. The term "Manufacturer" where used in this Section, refers to the entity which designs, engineers, fabricates and provides quality control and field inspection services for ductwork provided under this Section.
2. The term "Resin Supplier" where used in this Section, refers to the entity which produces resin for distribution.
3. Acronyms:
 - a. "Bis-A" is "Bisphenol-A"
 - b. "CA" is "Corrosion Allowance"
 - c. "CB" is Corrosion Barrier
 - d. "CoNap" is "Cobalt Napthinate"
 - e. "EVER" is "Epoxy Vinyl Ester Resin"
 - f. "FR" is Fire Retardant
 - g. "MEKP" is "Methyl Ethyl Keytone Peroxide"
 - h. "OS" is Outer Surface
 - i. "PE" is "Polyester"
 - j. "SL" is Structural Layer
 - k. "SS" is "Stainless Steel"
 - l. Standard definitions of terms relating to FRP as described in ASTM D883.

B. Design:

1. ASTM D2563 definitions for types and quantity limitations of visual defects.
2. Minimum dimensions: Where minimum dimensions are specified in reference standards and this Section, the dimensions specified shall include any tolerances allowed by industry standards and shall be interpreted as absolute minimums for purposes of determining compliance with this Section. Such minimum dimensions shall not be construed to be in lieu of engineering calculations or demonstration of design as required of Manufacturer per this Section.
3. Corrosion allowance: Where a corrosion allowance is specified in this Section it shall be interpreted to require that thickness of inner corrosion barrier specified shall be added to minimum structural thicknesses shown within industry standard tables or determined through use of industry standard rules, other design equations, stress analysis and lamination analysis. The thickness and physical properties associated with an inner corrosion barrier that is specified as a corrosion allowance shall not contribute to strength of material and be regarded as sacrificial layers. This additional thickness shall apply to all components possessing an inner corrosion barrier and outer corrosion barrier where such outer barrier is regarded as a wetted or process side surface. Thickness shown within industry standards shall be interpreted to mean structural layer thicknesses.

1.5 SUBMITTALS

A. Detailed Manufacturer shop drawings, including:

1. Ductwork dimensions for each major component and assembly, with all nozzles, joints and accessories located and dimensioned.
 2. Ductwork data table indicating sizes, thickness and weight, piece numbers, diameter, pressure rating, chemical service temperature limit and maximum allowable spans.
 3. Construction details such as reinforcing ribs, transitions, reducers, elbows, access points, turning vanes, louvers, dampers plus FRP buildups, shear collars, flanges, lugs and pedestals used at support locations.
 4. Nozzle schedule with construction details demonstrating conformance to this specification. Schedule shall include nozzle mark number, flange inside and outside diameter, flange and neck thicknesses, attachment overlays, bolt circle diameter, number and diameter of bolt holes and recommended torque limits.
 5. Outside and inside overlay joint details such as width, thickness, taper and material composition plus field trim allowance at field joint locations. Identify shop and field joint locations.
 6. Identification of materials of construction for all components.
 7. Support arrangement, with recommended anchoring and guiding methods.
 8. Location, materials of construction, connection method and dimensions for:
 - a. Gaskets and fasteners.
 - b. Expansion/contraction joints.
 - c. Dampers and louvers.
 - d. Other accessories.
 9. Location of permanent and temporary labeling as required by this Section.
 10. Any and all drawing revisions shall be clearly identified and noted within drawing title block, where a delta symbol with revision number inside triangle shall be placed alongside any and all drawing changes made under the revision so noted. As each drawing revision is released for review, such notations shall be shown in red with prior revision notations shown in black.
- B. Detailed Contractor supplied drawings, including:
1. Support, anchor, guide and restraint FRP dimensions for coordination with Manufacturer's related engineering and shop drawings plus installation by Contractor as required per this Section.
- C. Data requirements, including:
1. Design calculations substantiating support, anchor, guide and restraint FRP shapes required for the ductwork support system.
 2. Manufacturer's ductwork catalogs, descriptive literature and specifications.

3. Manufacturer's design report shall include descriptive language, calculations and stress analysis substantiating materials shown on Manufacturer's drawings, including:
 - a. Ductwork wall thickness.
 - b. Reinforcing ribs and locations.
 - c. Flanges over 36-in diameter or 120-in perimeter in the case of rectangular flanges.
 - d. Support spans plus guide, anchor and restraint locations.
 - e. FRP shear collars for vertical support and/or anchor interface.
 - f. Expansion and contraction, with loads at flexible connectors identified.
 - g. Color stress plots supporting pipe stress analysis where performed.
 - h. Any and all other such ductwork design calculations required to fulfill the requirements of this Section.
 4. ASTM test records demonstrating proof of physical properties used in design calculations.
 5. List showing size and quantity of FRP shop and field joints required for installation.
 6. Specifications and details for:
 - a. Gaskets and fasteners
 - b. Expansion/contraction joints and flexible connectors
 - c. Volume and shutoff dampers and louvers
 - d. Corrosion coating for non FRP components
 - e. Other accessories
 7. Letter from Resin Supplier confirming laminate design specified within this Section and detailed on drawings is suitable for intended service.
 8. Permanent and temporary ductwork labels.
 9. Copy of Manufacturer's AMCA certification, which demonstrate dampers and louvers are certified according to 500-D and 511 standards.
 10. Manufacturer's Certificate of Proper Installation.
- D. Installation, Operation and Maintenance Manual shall include:
1. Instructions for shipping, receiving, handling, storage, installation, FRP field butt wrap joints and flange connections.
 2. Material Safety Data Sheets for all materials included in FRP field butt wrap joint kits.
 3. Copy of Manufacturer's warranty statement for ductwork as required by this Section.
 4. Manufacture's recommend initial ductwork inspection interval.
- E. Contractor's procedures for:
1. Chemical segregation, spill containment and placarding for hazardous material storage and use areas.

2. Managing fiberglass dust and styrene emissions propagated through cutting, grinding and laminating operations conducted during installation.

F. Contractor's field FRP work inspection and testing report:

1. Alignment, pitch and fit up tolerances.
2. Out of round or square tolerances.
3. Resin gel time testing per ASTM D2471.
4. Butt wrap joint tracking checklist, including surface preparation and material utilization.
5. Visual inspection per ASTM D2563.
6. Barcol hardness per ASTM D2583.
7. Acetone sensitivity.

1.6 QUALITY ASSURANCE

- A. All design calculations, drawings and other engineering related submittals provided by Contractor and Manufacturer are to be stamped by a licensed Professional Engineer employed full time or contracted by the Contractor or Manufacturer.
- B. Reference to names of Manufacturers within this specification is for the sole purpose of setting a quality standard desired.
- C. To ensure standardization of appearance, Manufacturer's services, operations, maintenance, and all ductwork and fittings must be completely fabricated by a single Manufacturer. Outsourcing FRP ductwork components and contracting manufacturing labor is not permitted.
- D. Contractor shall provide systems complete and ready for use, do work in accordance with all federal, state and local codes and ordinances and arrange for all permits, inspections, tests and registrations necessary for satisfying safety, environmental and other requirements.
- E. This specification Section and related contract drawings provide a general description for ductwork, but do not include sufficient detail for design, fabrication, installation and startup. Contractor shall provide such equipment and services so that systems are complete and ready for operation.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer shall properly prepare and protect ductwork from damage under normal circumstances.

- B. Ductwork shall be shipped complete, with no fiberglass related laminating work, assembly or fabrication permitted outside of Manufacturer's facility other than field joints shown on drawings.
- C. Ductwork shipped horizontally shall be mounted on padded cradles of sufficient size to prevent damage and adequately support the ductwork circumference. Suitable skid or dunnage shall be provided for ductwork shipped in other orientations. Cradles, skids and dunnage shall stay with ductwork for protection prior to installation.
- D. Sufficiently cross brace openings to maintain roundness or squareness within standard tolerances. Plug or cover all openings to prevent entrance of undesirables such as dirt, water or debris.
- E. Protect all flange faces with securely fastened durable flat blinds, ensuring that blind covering material extends to or beyond flange edges. Blind material and attachment method shall not cause abrasion or delamination to any flange surfaces or bolt holes during shipping, storage or installation.
- F. Accessories not reliably attached to ductwork for transportation purposes and cradled or skidded shall be properly packaged and shipped to prevent damage. No nesting of smaller ductwork inside larger is permitted. No components or accessories are allowed to be shipped inside ductwork.
- G. Load ductwork on truck with sufficient clearances all around to eliminate potential adjacent interferences. Firmly secure and protect all freight to prevent shifting or other movement during transportation. Nozzles, lugs, brackets or other projections shall not be used for securing, lifting or rotating ductwork.
- H. Manufacturer shall properly package butt wrap field joint materials and supplies:
 - 1. Each fiberglass butt and wrap field joint shall be individually packaged in a water proof container and labeled, with all reinforcement precut by the Manufacturer and properly sequenced in the package.
 - 2. Labeling shall designate size, location keyed to drawings and laminate sequence.
 - 3. One (1) extra kit per joint type and size shall be provided.
 - 4. Resin and Catalyst (hardener) shall be packaged and properly labeled in Department of Transportation (DOT) approved five (5) gallon or smaller pails. Separate pails must be provided for Inner Corrosion Barrier, Structural Layer and Outer Surface resin, Finish Coat resin and Paste used to fill allowable gaps at fit up of joints.
 - 5. An extra 35% more resin shall be supplied than theoretically required given butt and wrap kit resin to glass ratios.
 - 6. Resin shipped for field work shall have a minimum three (3) month shelf life, with non-consumed resin removed from the jobsite upon completion of the installation.

7. A sufficient quantity of cups, brushes, stir sticks and rollers required shall be supplied by Manufacturer and bulk packaged. Cups and brushes shall be solvent resistant, whereas all materials shall be suitably sized for work to be performed.
- I. Skids and cradles shall be configured and oriented during transport for ease of offloading and handling at site with crane or lift truck.
- J. Store all field butt wrap joint materials and related supplies furnished by Manufacturer in an area that is dry, between 35 and 75°F for maximum shelf life, properly protected from humidity and away from any direct sunlight and potential source of ignition or fire.

1.8 SEQUENCING AND SCHEDULING

- A. Contractor shall make and submit to Manufacturer any and all field measurements confirming ductwork requirements plus support, anchor, guide and restraint details prior to Manufacturer's development of design, engineering calculations and drawings as required under Part 1.5 Submittals. Such information furnished by Contractor shall include identification of ductwork piece numbers, field joints and trim locations.
- B. Where Contractor directly procures and supplies material interconnected with ductwork, Contractor shall coordinate:
 1. As built outside diameter of ductwork FRP buildups with Contractor supplied support, anchor, guide and restraint steel products such that padded steel is fabricated to provide full contact with ductwork buildups as shown on Manufacturer's drawings.
 2. Results of Manufacturer thermal expansion and contraction plus seismic calculations with Contractor supplied steel products plus expansion joint and flexible connector manufacturers to assure ductwork system design compatibility such that loads are properly restrained and/or absorbed.
 3. Fit-up of Contractor supplied dampers and louvers, gaskets, fasteners and other such materials.
- C. Delivery of ductwork shall be planned such that existing or new openings shall be utilized for installation. Ductwork shall not be cut or otherwise modified to facilitate installation or accommodate obstructions.

1.9 WARRANTY

- A. Manufacturer's standard warranty shall warrant in writing that their products are free from defects in design, material and workmanship under normal use and service for a period of two (2) years commencing from date work under paragraphs 3.2 below is complete.

1.10 TOLERANCES

- A. All tolerances pertaining to measurements such as laminate thickness, glass content, Barcol hardness, flange face flatness and perpendicularity, ductwork roundness or squareness, location of fittings and accessories and overall dimensions shall meet the

more stringent requirements of referenced industry standards or as referenced within this Section.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Contractor shall be responsible for determining and communicating to Manufacturer restrictions that may prevent proper installation of ductwork, including clearances required during handling, setting, anchoring, accessories installation and piping.

2.2 FIBERGLASS DUCTWORK

- A. Provide all ductwork in accordance with this Section as shown on contract drawings and specified herein.
- B. FRP ductwork shall be designed and fabricated in accordance with ASTM D3982 and other references within this Section, unless otherwise permitted or required by this Section.
- C. Acceptable Manufacturers include:
 - 1. An-Cor Industrial Plastics of North Tonawanda, NY USA
 - 2. Kenway Corporation of Augusta, ME USA
 - 3. Perry Fiberglass of Avon Lake, OH USA
 - 4. Troy Dualam of Brockville, ON CANADA
- D. Manufacturer's ductwork system design shall include the following requirements:
 - 1. Design calculations supporting ductwork component thicknesses, including all steel, expansion joint and flexible connector interface considerations provided by Contractor, applicable loads individually or in combination per requirements of this Section, federal, state and local building codes and best engineering practices.
 - 2. Physical properties used in all design calculations shall be developed and demonstrated following industry standard protocol.
 - 3. Ductwork wall thicknesses shall be suitably designed for all loads and spans with or without reinforcing ribs.
 - 4. All ductwork shall be designed and fabricated to span support spacing as required. Buckling between supports shall be taken into consideration through stress analysis.
 - 5. Ductwork wall thickness shall be suitably designed with reinforcing ribs incorporated where necessary to achieve span within acceptable deflection limits.

6. Maximum allowable deflection for any size ductwork or span shall be limited to the lesser of 1/2-in or 1/2-percent of span under worst case operating and weather conditions.
 7. Thermal expansion and contraction calculations shall be made, with results used to adequately design ductwork to absorb related loads or communicate with expansion joint manufacturers for proper joint design. Material properties used in calculations shall be derived in accordance with ASTM D695 and D696.
 8. Ductwork systems equal to or larger than 48-in diameter for round and 168-in perimeter for rectangular shall be analyzed using formal Pipe Stress Analysis (PSA), such as Caesar II, ALGOR PipePak or equal. Stress shall be fully evaluated at all critical locations, including flanges, elbows, tees, wyes, hangers, supports, anchors and restraints.
 9. Flanges over 36-in diameter and 120-in perimeter in the case of rectangular flanges shall be designed per ASME RTP-1 NM-2 Design of Integral Body Flanges and NM-12 FRP Flange Design as is applicable. As a minimum, rectangular ductwork flange dimensions shall correspond to those of round ductwork having the same diameter as the longest side of the rectangular ductwork and rounded up if not equal.
- E. Manufacturer's design calculations supporting ductwork component thicknesses must include all applicable loads individually or in combination, where required by Part 1.3 References, design criteria listed below and best engineering practices:
1. Design pressure: As indicated in ductwork schedule in Part 3 of this submittal
 2. Wind: 100mph (for outdoor ductwork only)
 3. Expansion and contraction associated with temperature differential:
 - a. 0°F to 100°F
 4. Accumulation of snow, ice and/or water on ductwork: 30 lb/sq.ft
 5. Seismic: See specification 01350 – Seismic Anchorage and Bracing
 6. Mechanical link seal force
- F. Ductwork construction shall be as follows:
1. Shop manufactured and assembled to fullest extent without need for permitted transportation thereby minimizing field assembly and field FRP butt wrap joints. A list showing size and quantity of FRP shop and field joints required for installation shall be submitted for approval.
 2. Reinforcing ribs:
 - a. Ribs must be installed at point of ductwork manufacture and located so as not to interfere with supports, hangers, anchors, restraints and other such interconnected or adjacent equipment, accessories, materials and building structures.
 - b. No pultruded, extruded, formed, milled or welded plastic, metallic or wood structural shapes or mechanical fasteners are allowed.

- c. Rib construction shall be detailed on shop drawings.
3. Flange connections:
- a. All connections to expansion joints, flexible connectors, fans, dampers, louvers, registers, grillwork, hatches, covers, tank vents, scrubber inlets, condensate drain piping, instrumentation or other equipment shall be flanged with 6-in projection where flange is not on a straight run of ductwork. Auxiliary equipment directly screwed into fiberglass ductwork is not allowed. Such flanged connections shall be full faced for proper seating with ductwork flanges.
 - b. Custom filler pieces or spacer rings will not be allowed between mating flanges.
 - c. Flanges shall be hand lay-up construction using Type I or II laminate composition per ASTM C582, with flat full face flange on straight Section or integrally molded construction. No filament winding, rotational molding, resin transfer, vacuum infusion, compression molding or casting of flanges is permitted. Flange face shall be textured by lightly hand sanding with block sander to remove surface gloss imparted by mold surface.
 - d. Flanges on straight run sections shall have no voids or filler material where pipe joins flange lay-up.
 - e. Nozzles incorporating ASTM D5421 flange requirements shall be integrally molded per ASTM D5421 Figure 1 Type A and flush type per ASTM D3299 Figure 7, where installation shall follow ASTM D3299 Figure 6 and 7 with structural overlay placed as All Exterior material.
 - f. Cutout reinforcement shall be provided per ASTM D3299 Article 7.3.2.2 and good engineering practices for all nozzle and branch connections.
 - g. All bolt holes shall be shop drilled by Manufacturer using calibrated template and back spot faced or otherwise formed for flat and parallel seating of SAE or ASME B18.22.1 Type A Narrow washer seat, with all flange exterior and machined surfaces resin finish coated. All sharp edges, corners and projections shall be removed. Randomly match drilling flanges in Manufacturer's shop or field drilling of any kind is not allowed.
 - h. Gussets shall be provided for nozzles 4-in and smaller and be Plate-Type or Conical-Type per ASTM D3299 Figures 4 or 5.
 - i. Flange flatness, warpage, perpendicularity and cant tolerances specified within this Section shall be strictly adhered to. Flange faces refaced or machined to meet tolerances shall have the Corrosion Barrier fully included.
 - j. All flange bolts shall be torqued to values as recommended by Manufacturer.
4. Round ductwork:
- a. Reinforcing ribs:
 - i. Ribs shall be laminated and formed to a suitable shape over core material. Rib core material shall impart a laminate shape suitable for stiffening ductwork consistent with design calculations submitted and not contribute to strength of material in calculations.
 - ii. Rib core materials shall be closed cell foam half round or trapezoidal shape with laminate overlay to meet design submitted.
 - b. Fittings:
 - i. All fittings such as elbows, laterals, tees and reducers shall have the same internal dimensions as the adjacent ductwork.
 - ii. Fitting thickness and laminate composition shall be equal to design of ductwork cylindrical sections composed of Type I or II laminates per ASTM C582 that meet design basis of this Section. Minimum thickness for reducer and

transition fittings shall be equal to or greater than the wall thickness of the ductwork constructed of the same Type laminate that is adjoined to the larger fitting opening.

- iii. Standard Round Elbows up to 48-inch diameter shall have smooth radius with a centerline radius equal to 1-1/2 times the ductwork diameter. Short radius round elbows, where the centerline radius is less than 1-1/2 times the ductwork diameter, are not permitted.
 - iv. Mitered Elbows are permitted for ductwork 54-inch diameter and greater. Standard dimensions shall be as shown in ASTM D3982 Figure 4.
 - v. The length of concentric and eccentric reducers shall be five (5) times the difference in diameter and not as shown in ASTM D3982 Figure 4.
 - vi. Branch connections shall be perpendicular or 45 degrees per ASTM D3982 Figure 4.
 - vii. End caps for sizes ranging from 36" to 96" diameter shall be ASME dish with crown radius equal to duct diameter, knuckle radius equal to 6% of crown radius and straight flange.
- c. Flange connections:
- i. Flange construction and dimensions shall meet ASTM D5421 for tank vent, condensate drain piping and instrumentation connections and D3982 for all other connections.
 - ii. Flanges on smaller end of reducers and transitions shall have a minimum of 6-in straight section to accommodate bolting, as shown for reducers in ASTM D3982 Figure 4 Standard Duct Dimensions.
 - iii. Flanges on all sweep elbows shall have a minimum of 6-in straight section to accommodate bolting and not as shown for elbows in ASTM D3982 Figure 4 Standard Duct Dimensions.
 - iv. Minimum flange thicknesses shall be 5/8-in for less than or equal to 8-in diameter and 3/4-in for 10-in to 36-in diameter. Thicknesses for flanges greater than 36-in diameter shall not less than 3/4-in thick. Minimum flange thickness shall be measured at bolt hole in washer seating area.
5. Rectangular ductwork and transitions:
- a. All rectangular ductwork, fittings, transitions and other such structures shall have integrally molded corners with radiuses. Corner radii for adjoining walls of less than or equal to 24-inch shall be 1/2-inch, 1-inch for adjoining walls between 24-inch and 48-inch and 1 1/2-inch for greater than 48-inch adjoining wall lengths. In no case shall rectangular or rectangular to round components or systems be fabricated from flat panels, with or without quartered pipe sections in corners, and joined by butt wrap joints. Care shall be exercised to assure corner radii thicknesses are maintained as a minimum, with additional plies added if required.
 - b. Reinforcing ribs:
 - i. Ribs shall be laminated structural shapes such as angle, channel, tees or tube material and laminated to ductwork. Complete rib structural shape laminate and attachment method utilized shall contribute to strength of material in calculations. Adhesives may be used in place of laminating structural shapes to ductwork where Manufacturer in-house test data, design calculations and drawing details are submitted demonstrating reliability.
 - ii. As an alternate to laminated structural shapes, ribs may be laminated and formed to a suitable shape over core material. Rib core material shall impart a laminate shape suitable for stiffening ductwork and not contribute to strength

- of material in calculations. Rib core materials shall be closed cell foam half round or trapezoidal shape with laminate overlay to meet design submitted.
- iii. Rib shape shall be suitable for stiffening ductwork consistent with design calculations submitted.
- c. Flange Connections:
 - i. Flanges on smaller end of reducers and transitions shall have a minimum of 6-in straight section to accommodate bolting, as shown for reducers in ASTM D3982 Figure 4 Standard Duct Dimensions.
 - ii. Minimum flange thicknesses shall be 5/8-in for less than or equal to 28-in perimeter and 3/4-in for 36-in to 120-in in perimeter. Thicknesses for flanges greater than 120-in in perimeter shall not less than 3/4-in thick. Minimum flange thickness shall be measured at bolt hole in washer seating area.
 - iii. Bolt hole location and size shall be designed by the Manufacturer, shall straddle major centerlines and not exceed 4 1/2-in space between hole centerlines.
 - d. Turning vanes:
 - i. Mitered elbows shall have Hand Lay-up quarter round shaped turning vanes with 3:1 tapered leading edges, with a radius equal to that of the centerline radius of the elbow.
 - ii. Each turning vane shall be composed of an all random strand mat construction, with a C-Glass Veil on both sides of the curved vane. A sufficient number of turning vanes shall be provided such that they are spaced no greater than 6-in apart. Each turning vane shall protrude through the fitting wall on both sides a minimum of 1.5-in, with a fiberglass overlay equal in thickness to the fitting wall laid up onto the entire projecting portion of the vane and the adjoining fitting wall a minimum of 1.5-in forming a seal and reliable attachment.
 - iii. Turning vane thicknesses shall be determined by design calculations given all design criteria and deflection limits defined above. Minimum vane thickness shall be 3/8-in.
 - e. Tops of all outdoor exposed rectangular ductwork, fittings, transitions and other structures shall be sloped 1/4-in per foot to shed water. Slope shall be shown on shop drawing submittal.
6. Access hatches shall be 12-in and 24-in diameter, where the larger size that can be accommodated on the ductwork shall be provided. One (1) hatch shall be located on the upstream side of each bank of turning vanes, damper, louver and fan. Hatches shall be flanged as specified within this Section and provided with flat or domed cover.
7. FRP Threaded couplings and nipples:
 - a. Shall be installed following the same requirements as specified within this Section for nozzles of the same size or as indicated in the Design Drawings.
 - b. Outside surface of fittings that receive secondary attachment overlay shall be ground smooth with a contour providing mechanical lock and primed with Atridge 2 secondary bonding agent prior to fitting installation.
 - c. Thermoplastic and metallic couplings and nipples are not allowed.
8. FRP shop and field butt wrap joints.
 - a. All ductwork joints shall be butt wrap per ASTM D3982 Article 9.2 Joints. The butt wrap minimum width including tapered edges shall be the greater of 6-in or sixteen (16) times butt wrap thickness. Bell and spigot joints may be used for alignment

purposes only, whereas no adhesives are used and step from bell end to inserted spigot shall taper 6:1 with smooth butt wrap transition between joined Sections. All outer surfaces of joint overlays are to be coated with resin finish coat containing paraffin wax.

- b. All gaps between mating edges of ductwork and fittings must be limited to the thickness of the adjoining material, not to exceed 3/8-inch, and maximum offset of lesser of 1/4-inch or two (2) times edge thickness divided by three (3) prior to application of paste and butt wrap joint material. Paste used to fill gaps shall not protrude more than 1/8-inch past inner surface of ductwork, fitting or transition wall.
 - c. For round ductwork, joint minimum thickness and laminate composition shall be equal to design of ductwork cylindrical sections composed of Type I or II laminates per ASTM C582 that meet design basis of this Section. For rectangular ductwork, joint minimum thickness and laminate composition shall be equal to the thicker component being adjoined. Joint minimum thickness and laminate composition for reducer and transition connections shall equal the ductwork adjoined to the larger fitting opening.
 - d. At least one (1) field butt wrap joint shall be provided for each change in direction and elevation, with a minimum of 6-in field trim included and shown on drawings by Manufacturer at each field joint location. Field joints shall also be located at dimension "H" from duct flange faces per ASTM D3982 Figure 4 Standard Duct Dimensions. Duct flanges mating with dampers, fans, flex connectors and other related equipment shall be properly aligned and reliably bolted together with no undue stresses prior to applying butt wrap joint material.
 - e. Adhesive joints are not permitted.
 - f. An inside overlay shall be provided for all accessible shop and field joints for ductwork greater than or equal to 20-in diameter for round or 72-in perimeter for rectangular ductwork. All accessible nozzle and branch connections shall be inside overlaid. Inside overlay composition and thickness shall be equal to Inner Corrosion Barrier specified, where width shall be 6-in minimum.
9. No joints in axial direction of ductwork straight run sections are permitted.
10. Ductwork support:
- a. All ductwork supports, anchors, guides and restraints shall be engineered and supplied by the FRP Manufacturer and coordinated with the Contractor. Contractor shall work with the Manufacturer to determine number, location and configuration of such supplied materials, so that proper support, restraint, fit-up and thermal expansion and contraction is accounted for in FRP ductwork system design provided by Manufacturer.
 - b. All support materials shall match the construction of the ductwork. Materials thicknesses shall be calculated by the FRP Manufacturer and submitted with the stress analysis. FRP support materials shall include but not be limited to threaded rods, nuts, channels, angles, and plates. Support components that cannot be fabricated from FRP such as beam clamps, concrete anchors that extend beyond the concrete surface such as studs, or other components exposed to the atmosphere in the space shall be 316 stainless steel and field coated with a corrosion resistant coating suitable for exposure to the chemicals and concentrations listed in section 2.3.B of this specification.
 - c. Maximum support spacing shall be equal to or less than limits set forth in ASTM D3982 Table 1 Typical Spacing, unless otherwise engineered by Manufacturer

given design loads and support spans specified herein, on contract drawings or Contractor field dimensions.

- d. Vertical riser sections of ductwork shall be supported by FRP pedestals laminated to backside of elbow sections or FRP shear collars or lugs designed to abut braced steel support rings where required. Riser clamps shall not be used to support FRP ductwork.
- e. Ductwork shall be reinforced at each support, hanger, anchor and restraint with a minimum 1/4-in FRP buildup. This reinforcement shall cover and extend 3-in beyond the support bearing surface. Buildups shall be flat, smooth and fully in contact with the support. A 1/4-in neoprene pad shall be placed between FRP and support and adhered to support. Contractor shall provide supports with sufficient dimensions to accommodate FRP collar and neoprene pad given ductwork tolerances specified in this Section.
- f. Supports shall provide a minimum of 180 degrees of uniform complete contact with round ductwork and full contact with bottom and top of rectangular ductwork. Minimum support widths for round ductwork shall be 2-in wide for duct less than or equal to 10-in, 3-in wide for duct 12-in to 20-in, 4-in wide for duct 22-in to 36-in, 8-in wide for duct 38-in to 48-in and 12-in wide for duct 50-in to 60-in diameter. Minimum support widths for rectangular ductwork shall correspond to those of round ductwork having the same diameter as the longest side of the rectangular duct when rounded up if not equal.
- g. Ductwork shall be supported to allow removal of inline devices without adding temporary support, where such devices may include dampers, louvers, expansion joints, flexible connectors and fans.
- h. Ductwork shall be supported within 12-in of duct free end where connected to flexible connections, expansion joints or equipment.

G. Ductwork Signage:

1. Each fabricated duct Section shall be temporarily labeled with a piece number corresponding to drawings for installation coordination. Labels shall be able to withstand weather and durable enough to stay affixed to the duct until such time installation is complete and they can be removed.
2. Manufacturer to furnish the following data on a water proof permanent label laminated directly on the side of ductwork near access hatches or other a prominent locations:
 - a. Manufacturer's name.
 - b. Date of manufacture.
 - c. Pressure and temperature rating.
 - d. Corrosion Barrier resin, cure system and surface veil type.

H. FRP workmanship:

1. No layout markings, scratches, dings, sharp resin cured glass fiber projections, sharp edges or corners, major color variation or significant resin finish coat inconsistencies will be permitted.
2. All cut or machined edges and exterior surfaces shall be de-burred, chamfered, smooth and resin finish coated.

3. Resin finish coat work shall be free of defects such as but not limited to pinholes, excessive or inadequate film build, dry spots, drips, runs, sagging, and foreign inclusions. Any such defects shall be removed from the coat and the coat reapplied. The finish coat must appear uniform.

I. Manufacturer shall clean ductwork inside and out prior to packaging for shipment, removing any and all mold release materials, temporary fabrication layout lines, dirt, dust, debris and other such undesirables.

2.3 LAMINATE MATERIALS

A. Ductwork laminate construction shall be suitable to convey chemically laden odorous air typically found in and around wastewater treatment facilities. Chemicals present include Hydrofluosilicic Acid, Hydrogen Fluoride, and Sodium Tetrafluoride. These odorous compounds in the air conveyed may reach as high as 100 percent relative humidity.

B. Laminate construction for ductwork shall have Class I flame spread rating for Structural Layer and Outer Surface with Class II Inner Corrosion Barrier per ASTM E84.

LAMINATE SPECIFICATION	LS620 AMENDED
Inner Corrosion Barrier (CB):	
Laminate Type	I
Resin Content	70 to 75%
Resin	Brominated Bis-A EVER
Synergist for Fire Retardancy	None ¹
Fire Retardant per ASTM E84	Class II ¹
Cure	MEKP/CoNap
Contact Molding Process	Hand Lay-up or Spray-up
Inner Surface (Veil)	(1) Synthetic Polyester 10 mils (0.010")
Interior Layer (Chop Mat)	86 mils 1.5 oz/sf
Inner Corrosion Barrier Thickness	96 mils (0.106")
CB is a Corrosion Allowance	Yes ¹
Visual Quality Standard	ASTM D2563 Level II
Bubble Defect Density Limits	4/sq in ¹
Maximum Percent Repair	3%
Structural Layer (SL):	
Laminate Type	Hand Lay-up, Spray-up or Filament Wound
Reinforcement Content	25 to 80%
Resin	Brominated Bis-A EVER
Synergist for Fire Retardancy	Antimony as Required
Fire Retardant per ASTM E84	Class I
Cure	MEKP/CoNap
Filament Winding Wind Angle(s)	As Required
Bedding Layer Following CB	22 mils (0.022") 1.5 oz/sf
Pigment	Yes ¹

LAMINATE SPECIFICATION	LS620 AMENDED
Minimum Thickness	Per Spec & Design
Outer Surface (OS):	
Resin	Brominated Bis-A EVER
Synergist for Fire Retardancy	Antimony as Required
Fire Retardant per ASTM E84	Class I
Cure	MEKP/CoNap
Contact Molding Process	Hand Lay-up or Spray-up
Resin Rich Wax Coating	Yes
UV Light Protection	Yes
10 mil Glass Veil	Yes ¹
Pigment	Yes
Minimum Thickness	15 mils (0.015")
Visual Quality SL and OS:	
Standard	ASTM D2563 Level II
Bubble Defect Density Limits	10/sq in 1/16" or 4/sq in up to 1/8" ¹
Maximum Percent Repair	10.0%

C. Laminate design and construction shall include the following requirements:

1. Inner Surface shall be Hand Lay-up process incorporating surface veil specified in this Section and have 90% resin content.
2. Interior Layer shall be laminated utilizing the Hand Layup or Spray-up process. The chop reinforcement shall be random strand glass fiber chopped from continuous roving whereas the fiber will be of the same size and weight as 1-1/2 ounce per square foot random strand mat, with 70 to 75% resin content.
3. Inner Corrosion Barrier shall be regarded as a Corrosion Allowance. This layer sequence shall not be considered as contributing to the components strength when calculating the thickness of the Structural Layer. This design requirement applies to all components and attachment joint inside overlays. The Inner Corrosion Barrier shall be clear, whereas no catalyst colorant, pigment, paint or other additives are allowed that shall interfere with visual inspection. Additives such as surfactants and antifoaming agents are permitted for improved reinforcement wet out and air bubble release when such additives are named within resin supplier letter(s) confirming laminate design suitability for intended service.
4. Structural Layer shall be Hand Layup and/or Spray-up for all components, whereas Filament Winding may be utilized only for round ductwork with such wind angle determined by Manufacturer. Where Filament Winding is utilized, a nominal 22 mil layer of 1-1/2 ounce per square foot chopped strand glass or equivalent thickness of chop shall be applied as a bedding layer for first pass filament winding glass strands between the cured Inner Corrosion Barrier and Structural Layer.

5. Structural Layer shall have a minimum thickness as calculated by Manufacturer given application and 28 to no more than 80% reinforcement content, with structural thickness no less than minimums specified within ASTM D3982 Table 1 for Hand Lay-up and Spray-up or 0.20-in for round Filament Wound ductwork.
6. All laminate thicknesses for ductwork shall be calculated such that 10:1 factor of safety for internal and 5:1 for external pressure has been provided, with strain limited to 0.001 for Hand Lay-up laminates. Strain for Filament Wound laminates shall be limited to 1/10 of strain at failure, where strain at failure must be proven by Manufacturer per ASTM D638 tensile and ASTM D2584 glass content testing methods. Laminate designs used for proof of allowable strain used in calculations submitted shall be representative of same laminate sequence and resin to glass ratio as used for ductwork shown on drawings submitted.
7. Safety factors for combined loads shall be 10:1 for sustained loads and 5:1 for intermittent loads, where intermittent are combined individual loads or individual combined with sustained loads. As a minimum, loadings to be considered are defined in paragraph 2.02 E above. The greater laminate thicknesses as determined by paragraph 2.3 D.6 and D.7 herein shall be used.
8. The minimum longitudinal tensile strength shall be 9,000 psi for all Structural Layer laminate construction.
9. The outer most sub-layer of the Structural Layer and Outer Surface shall be pigmented and include ultra violet light inhibitor plus a 10 mil A-Glass veil containing 90 percent resin by weight.
10. The Outer Surface shall be coated with a 5 mil unreinforced resin rich layer containing paraffin wax and include pigment plus ultra violet light inhibitor.
11. Pigment color shall be submitted for approval.
12. Painting is not allowed for any FRP surface.
13. The resins specified within the laminate specifications shall be as supplied by AOC, Ashland, Interplastic or Reichhold. Only one (1) resin supplier's products are allowed for all ductwork.
14. Only Uni-axial stitched glass reinforcements are allowed where required with Filament Winding in order to meet the requirements of this Section. Reinforcing such as random strand mat stitched to woven roving shall not be permitted.
15. Vacuum infusion and other such closed or contained laminating process shall not be permitted.

D.

2.4 MANUFACTURER INSPECTION AND QUALITY CONTROL

- A. Quality control shall include a process and a final inspection by Manufacturer. Final inspection prior to shipment shall include checks for laminate visual quality, resin cure,

dimensional verification, review of certified test results for tests such as Barcol hardness, cutouts review and corrective action taken for any non-conformity reports generated.

B. Manufacturer tolerances:

1. ASTM D3982 Section 8, identified within this Paragraph for convenience:
 - a. Overall lengths are limited to plus or minus 1/4-in.
 - b. Cut ends of round ductwork shall be square within plus or minus 1/8-in for less than 24-in diameter, 3/16-in for between 24-in and 48-in and 1/4-in for greater than 48-in diameter.
 - c. Flanges:
 - i. Face flatness plus or minus 1/32-in for less than or equal to 18-in diameter and plus or minus 1/16-in for greater than 18-in diameter.
 - ii. Warp shall be plus or minus 3 degrees.
 - iii. Face perpendicularity to axis of duct shall be plus or minus 1/2 degree.
 - iv. Flange angularity plus or minus 1 degree for less than or equal to 24-in diameter, 3/4 degree for greater than 24-in to less than or equal to 48-in and 1/2 degree for greater than 48-in diameter.
 - v. Offset shall be plus or minus 1/8-in.
 - vi. Cant shall be plus or minus 1/2 degree.
2. Other tolerance requirements:
 - a. Minimum thicknesses shall be minus 0.00-in plus 20% of thicknesses specified or otherwise designed per requirements of this Section.
 - b. Out of flatness is limited to the lesser of plus or minus 1/2-in or 1/2% of span.
 - c. Out of roundness is limit to the greater of plus or minus 1/8-in or 1% of ductwork inside diameter, not to exceed 3/4-in.
 - d. Angles of all fittings shall be plus or minus 1 degree, up to and including 24-inch diameter, plus or minus 3/4 degree for greater than 24-inch to less than or equal to 48-inch and plus or minus 1/2 degree for greater than 48-inch diameter.
 - e. Gap for fit-up at shop and field joint is limited to the thickness of the adjoining material, not to exceed 3/8-in, and maximum offset of lesser of 1/4-in or two (2) times edge thickness divided by three (3) prior to application of paste and butt wrap joint material.

C. The Manufacturer shall provide adequate lead time to the Contractor, who will in turn notify the Owner, Owner's Engineer and Owner's or Engineer's designated agent at the Engineer's direction, for coordination of optional participation in major component inspection prior to assembly, test witnessing and Manufacturer's final inspection.

D. The Engineer reserves the right to inspect and reject any and all equipment being manufactured that does not fully and completely meet the requirements of this Section. Fabrication and inspection records shall be made available upon request. The Owner, Owner's Engineer and Owner's or Engineer's designated agent will have adequate, open and safe access to the Manufacturer's facility at all times during regular business hours for purpose of inspecting equipment being manufactured for them.

E. The Manufacturer shall make any and all inspection tools readily available to parties that may participate in inspection. Such tools shall be in a good state of repair and properly calibrated for accurate measurement. Ductwork shall be oriented for safe entry.

- F. Final acceptance by Engineer or Contractor is not in lieu of nor is it intended to compromise Manufacturer's warranty in any way as required by this Section.

2.5 EXTERIOR INSULATION

- A. Insulation for FRP duct shall follow the same requirements as metallic duct. See Specification 15598 – Metallic Ductwork and Duct Accessories section 2.5-Duct Insulation for insulation requirements.

2.6 ACCESSORIES

- A. All gaskets and fasteners required for flanges, nozzles and access points with mating parts supplied by Manufacturer shall be furnished by Manufacturer, where:

1. Gasket material shall be EPDM with a shore A hardness of 60 to 70. Gaskets shall be full face, predrilled to match flange bolt pattern plus single piece construction up to 36-in diameter and dovetail vulcanized construction for sizes greater than 36-in diameter. Minimum gasket thickness shall be 1/8-in for flanges less than or equal to 6-in, 3/16-in for flanges greater than 6-in and up to 18-in and 1/4-in for flanges equal to or greater than 20-in diameter. As a minimum, rectangular ductwork gasket material specifications shall correspond to those of round ductwork having the same diameter as the longest side of the rectangular ductwork and rounded up if not equal.
2. Fastener material shall be 316 stainless steel and be field coated with a corrosion resistant coating as required in the supports section of this specification. The fasteners shall be properly sized to fit gasketed or non-gasketed connections. Washers shall meet SAE or ASME B18.22.1 Type A Narrow washer seat requirements. Lock washes are not permitted.

- B. Expansion joints and flexible connectors.

1. Manufacturer: Provide products of one of the following:
 - a. Holz Rubber Company Inc.
 - b. Approved Equal
2. Joints shall consist of an elastomeric reinforced flexible material with integral molded flanges. The molded flanges shall be secured to the duct or fan connections using a 3/8" metal backing plate. The backing plate and fasteners shall be field coated with a corrosion resistant coating.
3. The joint flexible material shall be Neoprene and suitable for exposure to air containing chemicals as indicated in section 2.3(B) of this specification. Alternate materials as recommended by the manufacturer shall require Engineer approval.
4. The joint body style shall be suitable for constant vacuum service.
5. The joint body thickness shall be suitable for the pressure class of the applicable ductwork. The pressure class shall be indicated in the Duct Construction Schedule at the end of this specification. The nominal body thickness shall not be less than 1/8".

6. The face to face length of the joint shall be determined by the stress and support analysis. The joint shall be able to handle the axial and lateral movements indicated in the calculations.
7. All fasteners shall be type 316 stainless steel including nuts, bolts, and washers. Lock washers shall not be used. All hardware shall be field coated with a corrosion resistant coating.

C. Manual Volume and Manual Isolation Dampers

1. Manufacturer: Provide products of one of the following:
 - a. Swartwout, Division of Phillips Industries
 - b. Belco Manufacturing
 - c. Ershigs
 - d. Approved Equal
2. All round FRP dampers shall be the butterfly type and all rectangular FRP dampers shall be of the opposed blade type. FRP fabrication shall meet the corrosion requirements specified in this section 2.3(B) of this specification
3. Fabrication:
 - a. Frame and blade: premium vinyl ester. Blade shall fully encapsulate shaft. Blades that bolt to a single side of the shaft will not be accepted.
 - b. Shaft: premium vinyl ester for all manually actuated dampers below 30 inches in diameter. The shaft shall be glassed into the damper blade with center significantly thicker than center perimeter with an even taper from center to perimeter. For all dampers 30 inches in diameter and larger, the shaft shall be type 316 stainless steel encased in FRP material. Rectangular damper shafts shall correspond to those of round ductwork having the same diameter as the side of the rectangular parallel with the blades.
 - c. Bearings and bushings: Teflon
 - d. Pins and all hardware: Type 316 stainless steel (Contractor shall field coat with corrosion resistant coating)
 - e. Shaft seals: EPDM
 - f. Provide all round dampers with a blade stop consisting of FRP angles with full circumference EPDM seals.
 - g. All dampers shall have flanged ends. Provide type 316 stainless steel bolts, nuts, and washers. (Contractor shall field coat with corrosion resistant coating)
 - h. All dampers >24" diameter shall be provided with gear operators with an epoxy coating. The coating shall be suitable for exposure to air as described in section 2.3.B of this specification. Dampers 24" and smaller shall be supplied with hand quadrants actuators fabricated of type 316 stainless steel with a 5-stage locking quadrant indicator. All volume dampers shall have a fully adjustable slot with an extra hole drilled in the handle for the Contractor to "drill and pin-in place" once the system is balanced so the handle cannot vibrate loose. Rectangular damper shafts shall correspond to those of round ductwork having the same diameter as the side of the rectangular parallel with the blades.
 - i. All isolation dampers provided shall bear the AMCA seal. Dampers must have been tested in an AMCA lab for performance (pressure drop) and leakage. Test results shall be submitted and confirmed by the Engineer.

- j. Assembly shall be rated for flame spread less than 25 and a smoke development of less than 50 per ASTM E-84
- D. Motorized Dampers:
- 1. Manufacturer: Provide products of one of the following:
 - a. MK Plastics Corporation
 - b. Swartwout Corporation
 - c. Polymil Products, Inc.
 - d. Approved Equal
 - 2. Dampers shall be fiberglass with air foil blades. Damper shall be of pultruded construction and comply with ASTM-D4385-84A, ASTM E-84, and ASME/ANSI RTP1-1989. Damper blades shall be minimum of ¼ inch thick of a hollow airfoil shape and contain a slot for insertion of blade seal. Blade seal shall be silicon rubber extruded to provide a double seal. Adhesive seals are not acceptable. Bearings shall be Teflon based material.
 - 3. Damper shall be low leakage class based on AMCA 500/511 (3 cfm/sq.ft maximum leakage rate at 1 inch w.c.)
 - 4. Dampers shall bear the AMCA seal.
 - 5. Material used in construction shall be a flame retardant vinyl ester based resin.
 - 6. All materials used shall be corrosion resistant and appropriate for exposure to air containing chemicals as indicated in section 2.3.B of this specification. All hardware and misc parts that are not FRP shall be type 316 stainless steel. Any non-fiberglass fasteners located in the air stream shall be fully encapsulated in the FRP material. The Contractor shall field coat all non-encapsulated metallic components with a corrosion resistant coating.
 - 7. Actuators shall be externally mounted to the damper and shall be a minimum of NEMA 2. All actuators shall be enclosed in a NEMA 4X enclosure unless otherwise specified. Actuators located in classified spaces shall be enclosed in a NEMA 7 case unless otherwise specified. See section 15598-2.4.D - Actuators for additional actuator requirements.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Caution should be exercised when placing ductwork, with special attention paid to nozzles and other such projections that interface with adjacent area or could get entangled and damaged during handling.
- B. All FRP butt wrap work must be done at temperatures between 60 and 90 degrees Fahrenheit and humidity less than 80%, without exposure to wind, rain, snow, direct sunlight and any other wet and extreme temperature conditions beyond these ranges

permitted. Temporary weather tight temperature and humidity controlled shelters shall be provided by Contractor where needed during field butt wrap joining procedures.

- C. Ductwork shall be stabilized and isolated from any and all movement during FRP butt and wrap field joint work.
- D. Hazardous materials, fiberglass dust, and styrene emissions propagated through cutting, grinding and laminating operations shall be managed per procedures provided.
- E. Turning Vanes shall be installed in all miter elbows to permit air to make the abrupt turns with a minimum amount of turbulence. The turning vanes shall be quiet and free from vibration when the system is in operation.
- F. The dial regulators for manual dampers shall be marked so that the “open” and “shut” positions are clearly identified. The dial regulators on insulated ductwork shall be mounted on an elevated platform which will finish flush with the surface of the insulation. Manual volume dampers shall be located at accessible points and wherever possible some distance from a duct transition or fitting. Care shall be taken during installation to make certain that fasteners do not protrude into the duct and interfere with damper operation.
- G. Access doors shall be provided at all apparatus requiring service or inspection in the duct system.
- H. Test openings shall be installed in the ductwork at the points listed below. The openings shall be sealed by a screw cap and gasket, and shall be installed so that the insulation is not disturbed when the cap is removed. The test openings shall be located as follows in all heating, ventilating, air conditioning, and dehumidification systems:
 - 1. Upstream and downstream of each coil
 - 2. In the outside air duct adjacent to HVAC equipment
 - 3. In the return air duct adjacent to HVAC equipment
 - 4. In the main supply duct on single zone units and in each zone supply duct on multizone units
 - 5. Upstream and downstream of each filter bank
 - 6. Where indicated on Design Drawings
- I. See specification 15598 – Metallic Ductwork and Duct Accessories section 3.3-Insulation Installation for insulation installation location requirements.

3.2 FIELD INSPECTION AND PERFORMANCE TESTING

- A. Contractor shall inspect ductwork for conformance to laminate quality, thicknesses, major dimensions and tolerances per this Section upon receipt and notify Engineer in writing of nonconformities that will inhibit timely completion of installation. Unless otherwise acknowledged by Engineer in writing, Contractor shall not proceed until nonconformities are corrected by Manufacturer.

B. Contractor shall perform a process installation inspection, with required reporting per paragraph 1.05 G.

C. Manufacturer's Field Services:

1. Provide qualified Manufacturer's Technical Representative to perform FRP butt wrap training for Contractor ductwork installers. Manufacturer's Technical Representative shall provide a minimum of one (1) day training or one (1) day per ten (10) field FRP butt wrap joints, whichever is more, but not to exceed five (5) days of training. Training shall be consecutive days.

2. The manufacturer Technical Representative's field services shall include the following site visits for installation in accordance with Section 01751 – Starting and Placing Equipment in Operation:

Service	Total Days	No. of Trips	Remarks
Installation Checkout	1	1	In accordance with Section 01751

D. Ductwork system shall be free from deflection, pulsation, vibration, chatter, leakage or any other such condition when system is in or out of service.

E. See specification 15616 – HVAC Testing, Adjustment, and Balancing for additional testing and balancing requirements.

3.3 CLEANING

A. Ductwork shall be thoroughly cleaned inside and out by Contractor prior to being put into service.

B. All temporary labeling used to identify piece numbers for installation shall be removed where not a part of permanent labeling.

C. Ductwork cleaning process shall use materials that will not harm ductwork, be performed after ductwork installation and before Manufacturer's field inspection services required per this Section.

	DUCT CONSTRUCTION SCHEDULE		
SERVICE	PRESSURE CLASS	LEAKAGE CLASS	DUCT MATERIAL
Exhaust and Odor Control	+/- 2 inwg.	12	FRP

END OF SECTION

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SECTION 15990

HVAC TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. This Section specifies the requirements and procedures for testing, adjusting, and balancing the HVAC systems. Requirements include measurement and establishment of the fluid quantities of the HVAC systems as required to meet design specifications, and recording and reporting the results.
- B. The following HVAC systems shall be tested, adjusted and balanced:
1. Supply air systems, all pressure ranges, including new and existing systems
 2. Exhaust air systems
 3. Outside air systems, including new and existing systems
 4. Air Heating systems
 5. Verify HVAC Master Control Station (HMCS) operation
- C. This Section does not include specifications for materials for patching HVAC systems, or specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.

1.02 DEFINITIONS

- A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes the balance of air distribution, water distribution, the adjustment of total system to provide design quantities, the electrical measurement, and the verification of performance of all equipment and automatic controls.
1. Test: To determine quantitative performance of equipment.
 2. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).
 3. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
 4. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

5. Report Forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
6. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets or supply outlets on air terminals and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
7. Main: Duct containing the system's major or entire fluid flow.
8. Submain: Duct containing part of the systems' capacity and serving two or more branch mains.
9. Branch Main: Duct serving two or more terminals.
10. Branch: Duct serving a single terminal.

1.03 SUBMITTALS

- A. Prior to balancing, the Contractor shall perform Equipment Testing as indicated in section 3.1. Prior to performing System Testing, the Contractor shall have the system balanced as indicated in section 3.1.
- B. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.
- C. The Contractor shall submit a detailed testing procedure which shall include:
 1. Step by step instructions as to how the tests will be performed including but not limited to temporary layout modifications, procedures for testing instrument functionality, steps required to prove that the Control Strategy has been properly implemented, and steps required to compensate for ambient air temperature versus normal operating temperature such as thermostat setpoint adjustment. The steps shall indicate all actions to be taken, the expected result of the actions, and what the expected result verifies in regards to proving that the unit operates as designed.
 2. A list of any additional or temporary equipment necessary to perform the tests.
 3. Provide a checklist of items that will be checked during the test as listed in Section 3.1. Each item shall be initialed by the Contractor's Testing and Balancing Technician conducting the test. The Contractor's Testing and Balancing Engineer shall sign and date the bottom of the test sheet verifying all results.
- D. The Contractor shall submit the signed results of the equipment testing to the Engineer for approval. The equipment manufacturer's representative shall be present for all testing. The results shall include a letter from the manufacturer's representative stating that the equipment has been installed per the manufacturer's installation requirements and is in satisfactory working order.

- E. The Contractor shall submit an adjusting and balancing procedure which shall include:
1. Standard procedure the Contractor will use for balancing the systems.
 2. Tables specific to the equipment for this project for recording the required information from Part 3 – Execution.
 3. Flow diagrams specific to the systems present on this project. The flow diagrams shall contain at a minimum:
 - a. A diagrammatic representation of the system
 - b. All duct or pipe sizes
 - c. All inline equipment such as fans, pumps, duct heaters, filters, and strainers
 - d. All air inlet and outlet grilles and registers
 - e. All dampers, valves, or flow control equipment
 4. A list of the equipment the balancing technician will use to balance the system
- F. Submit completed adjusting and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. The adjusting and balancing reports shall contain at a minimum
1. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - a. General Information and Summary
 - b. Technician Qualifications and Certificates
 - c. Completed Adjusting and Balancing Report including procedure
 - d. Temperature Control System Settings
 - e. Calibration Certificates of all Instruments Used
 2. Report Contents: Provide the following minimum information, forms and data:

- a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name, address, telephone number, and signature of the Certified Test and Balance Engineer.
- b. Calibration Certificates: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to the date of the start of balancing.
- c. Flow Diagrams
- d. Balancing Datasheets
- e. Balancer Comments: The Balancer shall provide comments, suggestions, and corrective actions to any issues that occur during balancing including excessive noise, excessive vibration, or an inability to meet design conditions.

1.04 QUALITY ASSURANCE

- A. Test and Balance Personnel Qualifications: The personnel responsible for testing, adjusting, and balancing the specified systems shall have at least three years' experience in testing and balancing systems similar to this project and shall be an employee of the installer or an independent testing and balancing agency.
- B. Codes and Standards:
 - 1. NEBB, "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 - 2. ASHRAE Handbook, 1984 Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.
- C. Contractor shall provide all necessary instrumentation, tools, ladders, and labor etc. to complete all air balancing, tests and adjustments.
- D. Instrumentation shall be in accordance with NEBB, AABC, or SMACNA requirements and shall be calibrated to the accuracy standards demanded by these organizations.
- E. All testing, adjusting, and balancing of air systems shall be performed in compliance with the standard procedure manual published by the testing, adjusting, and balancing organization affiliated with NEBB, AABC, or SMACNA Organization. Testing, adjusting, and balancing technician shall hold current certification by one of these organizations. Submit certification to Engineer for approval.
- F. Contractor shall be solely responsible for the protection and safeguarding of his work and shall provide every protection against accidents, injury, and damage to persons and property.

- G. Contractor shall keep dust, dirt, and debris to an absolute minimum and reinstall all removed ceiling components to their original positions at the end of each day.
- H. Contractor shall be fully responsible for removal and reinstallation of ceiling system and replacement of any component damaged.

1.05 SEQUENCING AND SCHEDULING

- A. Systems shall be fully operational prior to beginning procedures.

1.06 RELATED SECTIONS

- A. Section 15500 - Basic HVAC Requirements
- B. Section 15590 - Fans
- C. Section 15598 – Metallic Ductwork and Duct Accessories

PART 2 - MATERIALS

(NOT USED)

PART 3 - EXECUTION

3.01 HVAC TESTING

- A. Equipment to be tested shall include at a minimum all fans, duct heaters, unit heaters, CRAC units, H&V units, dehumidifiers, and electric control systems. The specific requirements for equipment indicated below shall be performed in addition to any requirements of the Manufacturer for startup and initial operation.
- B. The equipment manufacturer's representative shall be present for all testing.
- C. Fans:
 - 1. Pre Startup Inspection:
 - a. Verify proper equipment mounting and setting
 - b. Verify that control, interlock and power wiring is complete
 - c. Verify alignment of motors and drives
 - d. Verify proper belt tension
 - e. Verify proper duct connections and accessories
 - f. Verify that lubrication is completed
 - g. Verify that equipment is in good condition and free from damage

- h. Verify that all packing materials, temporary stops, and temporary supports used during shipping have been removed
 - i. Verify that equipment and associated ducts are free from debris
 - j. Verify that equipment is installed per the Manufacturer's requirements
2. Equipment Test:
- a. Prior to energizing motor, verify and record voltage of power supply
 - b. Bump motor to verify direction of rotation
 - c. Run the fan for 1 hour of continuous trouble free operation. Any issues or stops required for tuning or repairs shall cause the test to be restarted from the beginning of this procedure.
 - d. Monitor heat build-up in bearings
 - e. Monitor for any abnormal noises or vibration
 - f. Check motor loads against nameplate data
 - g. Record fan sound levels ten (10) feet from the surface of the fan in five (5) minute intervals during 1 hour run period. The sound levels shall not be used for any sound rating verification. The sound levels shall be used for information by the owner to identify areas that will require hearing protection.
3. System Test:
- a. Verify the system operates per the respective equipment specification 15590-Fans including all modes of operation, interlocks, alarms, and safeties.

D. Ductwork

- 1. All openings in the ductwork shall be temporarily sealed and the ductwork shall be pressurized and leak tested to demonstrate that the installation meets the specified SMACNA leakage class requirements. The Contractor shall follow SMACNA procedures for testing as outlined in SMACNA's HVAC Air Duct Leakage Test Manual.

- E. At the completion of all of the individual equipment testing, the Contractor perform a HVAC System Run Test. The Run Test shall consist of operating the entire HVAC system as a whole using automatic controls for a period of not less than 15 consecutive days with no significant disruptions, repairs, reprogramming, or outages. Any issues during this period shall reset the testing period until it passes.

3.02 ADJUSTMENT AND BALANCING REQUIREMENTS

- A. Identify and list size, type, and manufacturer of all equipment to be balanced, including air terminals and all end user equipment.
- B. Test and record motor voltages, running amperes, shaft rpm and power factor including motor nameplate data, and starter heater ratings for each unit listed above.
- C. Air Equipment Balancing
 - 1. The Contractor shall start the fan and verify that the fan amperage and speed are within the design requirements. The Contractor shall then proportionally balance the air distribution system using the dampers at the air terminals. When the system is proportionally balanced, the Contractor shall adjust the fan speed to achieve the total design flowrate of the system. Fan speed adjustment shall be accomplished by adjusting variable pitch drives or by replacing the fan sheaves. The Contractor shall then take final readings for the total system flow as well as readings for each air terminal.
 - 2. For all ducted air systems, the Contractor shall measure the flow rate in cfm at each air inlet, at the fan, and at each outlet for each system. The Contractor shall provide this information in the report to demonstrate that the system as installed meets the seal class rating as indicated in section 15598 - Metallic Ductwork and Duct Accessories and section 15599 – Fiberglass Ductwork and Duct Accessories.
 - 3. Test and record the following:
 - a. Fan system static pressure.
 - b. All fan speeds.
 - c. Air quantity delivered by each grille and register.
 - d. Pressure drop across each piece of inline equipment such as a duct heater or filter bank. Filters shall be new and clean at time of testing and balancing.
 - e. Final damper and air extractor positions for all dampers and extractors
 - 4. Distribution:
 - a. Adjust volume dampers, control dampers, etc., to provide the proper design CFM in ducts.
 - 5. Air Terminals:
 - a. Identify each air terminal as to location and determine required flow reading.
 - b. Test and adjust each air terminal to within flow rate tolerance of design requirements as listed below. Under no circumstances shall the balancing impact the pressurization of spaces that are required to have a specific pressurization:
 - i. Diffusers and Supply Registers: 0% to +10%

ii. Return Registers: 0% to -10%

iii. Exhaust Registers: 0% to -10%

6. Verification:

- a. At the completion of the balancing work, the Contractor shall check and record the flow rate and static pressure at all supply, return, and exhaust air points to show final balanced conditions. The Contractor shall provide in the report a table with a summation of readings comparing the required cfm, final cfm, and final static pressure for each supply, return, and exhaust terminal and all final damper positions.
 - b. Verify design cfm at fans as described above.
 - c. If the air systems are not properly balanced, the Contractor shall re-balance and recheck all data.
- D. The testing and balancing activities described in this Section shall culminate in a report to be provided in quadruplicate (4), individually bound and also provided electronically to the Engineer for approval. Neatly type and arrange data. Include with the data, the dates tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation. The intent of the report is to provide a reference of actual operating conditions for the Owner's operations personnel.
- E. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been made at the Project Site by the permanently employed technicians or engineers of the TAB Firm.

3.03 PERFORMING TESTING, ADJUSTING, AND BALANCING

- A. Perform testing and balancing procedures on each system identified in accordance with the detailed procedures outlined in the referenced standards.
- B. Cut insulation and ductwork for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- C. Patch insulation, ductwork, and housings using materials identical to those removed.
- D. Seal ducts, test, and repair leaks created during the testing and balancing procedures on the hydronic and air systems.
- E. Seal insulation to re-establish integrity of the vapor barrier at all locations where the vapor barrier was disturbed during the testing and balancing procedures.
- F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

- G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.04 RECORD AND REPORT DATA

- A. Record all data obtained during testing, adjusting, and balancing in accordance with standard practices and the specific requirements identified in this section.
- B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

- END OF SECTION -

SECTION 16000

BASIC ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.
- B. Reference Section 17000, Control and Information System Scope and General Requirements for scope of work details as they relate to the Division 17 Subcontractor.
- C. The electrical scope of work for this project primarily includes, but is not limited to, the following:
 - 1. Provide conduit, wiring, termination, identification and documentation for the equipment provided under this Contract including, but not limited to:
 - a. New Variable Frequency Drives.
 - b. New Raw Sewage Pumps.
 - c. New Cooling Blowers for the New Raw Sewage Pumps.
 - d. New Odor Control Unit
 - e. New Disconnect Switches.
 - f. New instrumentation.
 - g. New Light Fixtures.
 - 2. Provide control modifications and adjustments to the existing Variable Frequency Drive to allow them to be used with the new Raw Sewage Pumps.
 - 3. Provide electrical demolition as needed to safely remove equipment from the facility as shown on the Drawings. Relocate existing control panels and devices as shown on the Drawings.
 - 4. Provide temporary electrical power as may be needed to support the Sequence of Construction outlined in Division 1.

5. Other electrical work as specified herein and indicated on the Drawings; or as needed for a complete and operable system.
- D. All material and equipment must be the product of an established, reputable, and approved manufacturer; must be new and of first-class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.
- E. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.
- F. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.
- G. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.
- H. All electrical components and systems, including electrical equipment foundations, shall be designed to resist operational forces as well as lateral sway and axial motion from seismic and thermal forces.

1.02 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.
- B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.03 LOCAL CONDITIONS

- A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs,

both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, Section 01300, Submittals and the requirements of the individual specification sections, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Operation and Maintenance Manuals
 - 3. Spare Parts List
 - 4. Proposed Testing Methods and Reports of Certified Shop Tests.
 - 5. Reports of Certified Field Tests.
 - 6. Manufacturer's Representative's Certification.
- B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.
- C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.
- D. Some individual Division 16 specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
- E. Seismic support design for all nonstructural electrical components (conduit, raceways, freestanding equipment, etc.) shall be in accordance with all applicable federal, state and local building code requirements and Section 01350 – Seismic Anchorage and Bracing.

1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:
 - a. Insurance Rating Organization having jurisdiction
 - b. The serving electrical utility company
 - c. The currently adopted edition of the National Electrical Code (NEC)
 - d. The National Electric Manufacturers Association (NEMA)
 - e. The Institute of Electrical and Electronic Engineers (IEEE)
 - f. The Insulated Cable Engineers Association (ICEA)
 - g. The American Society of Testing Materials (ASTM)
 - h. The American National Standards Institute (ANSI)
 - i. The requirements of the Occupational Safety Hazards Act (OSHA)
 - j. The National Electrical Contractors Association (NECA) Standard of Installation
 - k. National Fire Protection Association (NFPA)
 - l. International Electrical Testing Association (NETA)
 - m. All other applicable Federal, State and local laws and/or ordinances.
2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 PERMITS AND INSPECTIONS

- A. The Contractor shall reference the General Conditions and Section 01010, Summary of Work.

1.07 TEMPORARY LIGHTING AND POWER

- A. The Contractor shall reference the General Conditions and Section 01520, Maintenance of Utilities Operation.

1.08 TESTS

- A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.
- B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.
- C. Refer to each individual specification section for detailed test requirements.
- D. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.
- E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.

1.09 INFRARED INSPECTION – PARAGRAPH NOT USED

1.10 PROTECTIVE DEVICE SETTING AND TESTING – PARAGRAPH NOT USED

1.11 POWER SYSTEM STUDIES – PARAGRAPH NOT USED

1.12 SCHEDULES AND FACILITY OPERATIONS

- A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment must be coordinated with the Owner/Engineer so as not to affect proper facility operations.
- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.
- C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.
- D. Reference Section 01520 of the Specifications for construction sequencing and specific operational constraint information.

1.13 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage.

1.14 WARRANTIES

- A. Unless otherwise specified in an individual specification section, all equipment and electrical construction materials furnished and installed under Division 16 shall be provided with a warranty in accordance with the requirements of Section 11000, Equipment General Provisions and the General Conditions.

1.15 TRAINING

- A. Unless otherwise specified in an individual specification section, all training for equipment furnished and installed under Division 16 shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

PART 2 -- PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.
- C. All equipment and materials shall be new, unless indicated or specified otherwise.
- D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming to this requirement.

2.02 SUBSTITUTIONS

- A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition.

2.03 CONCRETE

- A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified.
- B. The Contractor shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3" excess concrete beyond the edges of the equipment.
- C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not or provided by others under this Contract. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-

inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

PART 3 -- EXECUTION

3.01 CUTTING AND PATCHING

A. Coordination

1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.

B. Damage

1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.

C. Existing Equipment

1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole and the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

3.02 EXCAVATION AND BACKFILLING – PARAGRAPH NOT USED

3.03 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

- END OF SECTION -

SECTION 16111

CONDUIT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Under this Section, the Contractor shall furnish and install all conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein and as required.
- B. The Drawings indicate the general location of conduits both exposed and concealed; however, the Contractor shall install these conduits in such a manner to avoid all interferences.
- C. Reference Section 16000 – Basic Electrical Requirements, and Section 16195 – Electrical Identification.
- D. All Contractor personnel installing PVC coated rigid conduit shall be trained as specified herein.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Conduit identification methods and materials.
 - 3. Evidence of training (e.g. Certificates of Completion) for all Contractor personnel that will install PVC coated rigid conduit. Training shall be as specified herein.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 CONDUITS

- A. Unless specified otherwise herein, or indicated on the Drawings, all conduits shall be rigid, heavy-walled aluminum. Minimum size conduit shall be 3/4 inch unless otherwise indicated on the Standard Details. Unless specified otherwise herein or indicated on the Drawings, all encased conduits shall be PVC Schedule 40, minimum size 1 inch. The Contractor, at his option, for ease of installation to accommodate saddle size, may increase the size of encased conduits to 2-inch. However, no combining of circuits/conductors will be permitted in these larger conduits.

All components of the conduit system shall be of the same material of construction. Rigid aluminum conduit systems shall include fittings, couplings, connectors, and other components compatible with and approved for such systems. Coated conduit systems shall include factory coated fittings couplings, connectors, and other components compatible with and approved for coated conduit systems.

Reference the "Conduit Uses" portion of this specification for additional information regarding conduit.

B. Rigid Aluminum Conduit

1. Aluminum conduits shall be rigid type, heavy walled as manufactured by Allied Tube and Conduit Corporation, Wheatland Tube Company, Jones & Laughlin Steel Company, or approved equal.
2. Rigid aluminum conduit shall be manufactured of 6063 alloy in temper designation T1. Fittings shall be of the same alloy.
3. Rigid aluminum conduit shall be listed by Underwriters' Laboratories to U.L. Standard 6A shall be manufactured to ANSI Standard C80.5.
4. Each length of conduit shall be shipped with a coupling on one end and a color coded thread protector at the other end.

C. Flexible Metal Conduit

1. Flexible metal conduit (FMC) shall be galvanized steel, single strip. FMC shall be UL listed. FMC shall be used to connect all indoor vibrating equipment, installed in dry locations, above reflected ceilings to lighting fixtures, and other applications as accepted by the Engineer. FMC shall be Galflex Type RWS as manufactured by Southwire, Type BR as manufactured by Electri-Flex, or equal.

1. Liquid-tight flexible conduit (LFMC) shall be galvanized steel, single strip, with a copper strip interwoven and suitable as a grounding means. LFMC shall be UL listed. LFMC shall have an extruded moisture and oil-proof PVC jacket. LFMC shall be Titan Type UL as manufactured by Southwire, Liguatite Type "LA" as manufactured by Electri-Flex, Anaconda Type UA as manufactured by Anamet Electrical, Inc., or equal.
2. PVC coated or stainless steel watertight connectors shall be used with liquid-tight flexible metal conduit on both ends. LFMC shall be used to connect all vibrating equipment installed outdoors, in wet or damp areas, and other applications as directed by the Engineer.

E. Rigid Nonmetallic Conduit

1. Rigid nonmetallic conduit shall be Schedule 40 polyvinyl chloride (PVC), 90°C, UL rated and shall conform to NEMA TC-2. Fittings and conduit bodies shall conform to NEMA TC3.
2. Rigid non-metallic conduit shall be as manufactured by Carlon, Triangle Conduit and Cable, Cantex, Inc., or equal.

F. PVC Coated Metallic Conduit

1. PVC coated rigid steel conduit shall be furnished and installed as specified herein and indicated on the Drawings. The product shall be rigid galvanized steel conduit covered with a bonded 40 mil (minimum) thickness PVC jacket and coated inside with urethane. The conduit shall comply with NEMA RN-1 and shall be "Plasti-Bond Red" as manufactured by Robroy Industries, "OCAL-Blue" as manufactured by Thomas and Betts, Perma-Cote Supreme by Perma-Cote Industries, Kor Kap equivalent, or equal.

G. Electrical Metallic Tubing

1. Electrical metallic tubing shall meet ANSI C80.3 and shall be UL listed. The conduit shall be furnished and installed in accordance with Article 358 of the NEC. Electrical metallic tubing shall be manufactured by LTV Steel Tubular Products Company, "Electrunite", Triangular PWC, Inc., Allied Tube and Conduit Corporation, or equal.
2. The conduit shall be cold-rolled steel tubing with a zinc coating on the outside and protected on the inside by a zinc, enamel, or equivalent corrosion-resistant coating and conforming to the requirements of ANSI C 80.3, latest edition.

H. Conduit Fittings

1. Fittings for all conduit types shall conform to UL 467 and UL 514 as applicable.
2. Fittings for electrical metallic tubing shall be rain-tight and concrete-tight, and shall be plated steel hexagonal threaded compression type.

3. Set screw or indentor type connectors shall not be used. Fittings for conduit installed in wet locations and underground shall provide a watertight joint. Fittings for rigid conduit shall be threaded.
4. Fittings or bushings shall be installed in easily accessible locations.
5. Where exposed conduits pass across structural expansion joints, approved weatherproof telescopic type expansion fittings shall be used. Fittings shall be OZ/GEDNEY Type AX, Crouse-Hinds Type XJG, or equal, watertight, and permit movement up to 4 inches. Each fitting shall be equipped with approved bonding jumpers around or through each fitting.

Where embedded conduits pass through expansion joints, approved watertight, concrete-tight deflection/expansion fittings shall be used. Fittings shall compensate for movement of $\frac{3}{4}$ -inch from the normal in all directions. Fittings shall be OZ/GEDNEY Type DX, Crouse-Hinds Type XD, or equal.

6. Conduit fittings ("condulets") shall be used on exposed conduit work for changes in direction of conduit runs and breaking around beams. "Condulets" shall be cast ferrous alloy, galvanized or cadmium plated, as manufactured by Crouse-Hinds, OZ/Gedney, Appleton Company, or equal. Coated fittings and boxes shall be used with coated conduit in all chemically aggressive areas or where called for on the Drawings. Covers shall be of a design suitable for the purpose intended. In damp areas, the outside condulets shall be made watertight. Install all condulets with the covers accessible. Use proper tools to assemble conduit system to prevent injury to the plastic covering. No damage to the covering shall be permitted.
7. Conduit fittings shall be cast type of non-ferrous metal or malleable iron thoroughly coated inside and outside with metallic zinc or cadmium after all machining has been completed. Cast fittings shall be provided with heavy threaded hubs to fit the conduit required. Covers shall be of the same material as the fittings to which they are attached and shall be screwed on with rubber or neoprene gaskets between the covers and fittings. Cast fittings 1-1/2 inches and above shall be of the "mogul" type.
8. PVC coated fittings shall be used with PVC coated conduit. All conduit nipples, elbows, couplings, boxes, fittings, unions, expansion joints, connectors, bushing, and other components of the raceway system shall be factory coated to maintain the corrosion-resistant integrity of the conduit system. The coated conduit and its respective components shall all be provided by the same manufacturer. Coated conduit shall be used in all areas specified herein or indicated on the Drawings.

PART 3 -- EXECUTION

3.01 CONDUIT AND FITTINGS

- A. Unless otherwise specified herein or indicated on the Drawings, the minimum size conduit shall be $\frac{3}{4}$ inch for exposed work and 1 inch for conduit encased in concrete or mortar.
- B. Conduit home runs for lighting circuits are not necessarily indicated on the Drawings; however, the circuit numbers are shown. Conduit shall be furnished and installed for these

lighting circuits and shall be installed as required to suit field conditions, subject to review and acceptance by the Engineer.

- C. Conduit shall be installed concealed unless otherwise indicated or specified. Conduit may be run exposed on walls only where concealing is not practical, or at the direction of the Engineer.
- D. Where exposed, maintain a minimum distance of 6 inches from parallel runs of flues or water pipes. Conduit runs shall be installed in such locations as to avoid steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water or steam pipes.
- E. A non-metallic raceway containing instrumentation cable (if specifically allowed herein) where installed exposed shall be installed to provide the following clearances:
 - 1. Raceway installed parallel to raceway conductors energized at 480 through 208 volts shall be 18 inches and 208/120 volts shall be 12 inches.
 - 2. Raceway installed at right angles to conductors energized at 480 volts or 120/208 volts shall be 6 inches.
- F. Where practical, exposed raceways containing instrumentation cable shall cross raceway containing conductors of other systems at right angles.
- G. For floor mounted equipment, conduit may be installed overhead and dropped down, where underfloor installation is not practical. Groups of conduits shall be uniformly spaced, where straight and at turns. Conduit shall be cut with a hacksaw or an approved conduit-cutting machine and reamed after threading to remove all burrs. Securely fasten conduit to outlets, junction and pull boxes to effect firm electrical contact. Join conduit with approved couplings. Conduits shall be freed from all obstructions.
- H. Empty conduit systems shall be furnished and installed as indicated on the Drawings and shall have pull ropes installed. The polyethylene pull ropes shall be ¼" diameter, minimum. Not less than 12 inches of slack shall be left at each end of the pull rope.
- I. Each piece of conduit installed shall be free from blisters or other defects. Each piece installed shall be cut square, taper reamed, and a coat of galvanizing and conducting compound shall be applied to the threads. Galvanizing compound shall be CRC Zinc-It or equal. Threads on conduits shall be painted with a conducting compound prior to making up in a fitting. Conduit connections shall be made with standard coupling and the ends of the conduit shall butt tightly into the couplings. Where standard coupling cannot be used, Erickson three-piece couplings shall be used. Where conduits are installed in concrete, concrete-tight three-piece couplings shall be used.
- J. Conduit threaded in the field shall be of standard sizes and lengths.
- K. All bends shall be made with standard factory conduit elbows or field bent elbows. Field bending of conduit shall be done using tools approved for the purpose. Heating of conduit to facilitate bending is prohibited. Field bends shall be not less than the same radius than a standard factory conduit elbow. Bends with kinks shall not be acceptable.

The equivalent number of 90° bends in a single conduit run are limited to the following:

1. Runs in excess of 300 feet: 0
2. Runs of 300 feet to 201 feet: 1
3. Runs of 200 feet to 101 feet: 2
4. Runs of 100 feet and less: 3

All conduit for fiber optic cable shall have a minimum bending radius of 16 inches. Final bending radius shall be determined by the fiber optic cable manufacturer.

- L. Unless otherwise specified herein, indicated on the Drawings, or required by the NEC, conduit shall be supported every 8 feet (minimum) and shall be installed parallel with or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Conduits shall be supported within 1 foot of all changes in direction. Supports shall be approved pipe straps, wall brackets, hangers or ceiling trapeze. Pre-formed channels for interior dry areas shall be zinc chromated galvanized steel or aluminum. For outdoor service or indoor damp/wet process areas, the pre-formed channels shall be aluminum or Type 316 stainless steel. All fasteners, clamps, straps, and anchors shall be Type 316 stainless steel. Perforated strap hangers shall not be used.
- M. All conduit supports shall be designed in accordance with Section 01350 – Seismic Anchorage and Bracing.
- N. In no case shall conduit be supported or fastened to another pipe or installed to prevent the removal of other pipe for repairs. Fastenings shall be by expansion bolts on concrete; by machine screws, welded threaded studs, or spring-tension clamps on steelwork. Powder actuated fasteners may only be used to make connections where the use of this equipment complies with safety regulations and for structures in Seismic Design Categories A or B, unless the fasteners are approved for seismic use. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited. Threaded C-clamps may be used on rigid steel conduit only. Conduits or pipe straps shall not be welded to steel.
- O. The load applied to fasteners shall not exceed 1/4 of the proof test load. Fasteners attached to concrete ceilings shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joints shall not cut the main reinforcing bars. Holes not used shall be filled. Spring steel fasteners may only be used to support lighting branch circuit in EMT conduits to structural steel members. Conduits shall be fastened to all sheet metal boxes and cabinets with two (2) locknuts where required by the National Electrical Code to ensure adequate bonding for grounding. Where insulated bushings are used, or where bushings cannot be secured firmly to the box or enclosure, a bonding jumper shall be installed to maintain suitable grounding continuity. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the National Electrical Code.
- P. Conduit installed in concrete floor slabs or walls shall be located so as not to affect the designed structural strength of the slabs. Conduit shall be installed within the middle

one-third of the concrete slab except where necessary to not disturb the reinforcement. The outside diameter of conduit shall not exceed one-third of the slab thickness, and conduits shall be spaced no closer than three (3) diameters except at cabinet locations. Curved portions of bends shall not be visible above the finish slab. Where embedded conduits cross expansion joints, suitable expansion/deflection fittings and bonding jumpers shall be provided. Conduit larger than 1-inch trade size shall be parallel with or at right angles to the main reinforcement. When at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Conduits shall not be stacked more than two (2) diameters high in floor slabs. Embedded conduits shall be placed in accordance with the latest edition of ACI-318.

- Q. Install polyvinyl chloride (PVC) coated steel conduits when entering or exiting concrete except under electrical equipment where the conduit is not subject to physical abuse. Also install PVC coated steel conduit when transitioning between grade and a structure or an equipment stand. Extend stub-ups at least 12 inches above and below grade or finish floor. Conduits extending through the concrete floor shall be installed using straight runs (for vertical penetrations) or factory elbows (for conduits installed within the slab) of PVC coated rigid steel conduit.
- R. Aluminum conduits shall not be in contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole cast straps with clamp-backs to space the conduit $\frac{1}{4}$ " away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar. Where contact cannot be avoided, aluminum conduits in contact with or embedded in concrete or ground shall be properly cleaned, prepped, and coated with a minimum of two coats of a bitumastic based paint as supplementary corrosion protection as required by the NEC. All penetrations shall meet or exceed the UL design standards. Aluminum conduit shall transition to PVC coated steel conduit where entering a concrete encasement, floor or ductbank.
- S. All conduit extending through the floor behind panels or into control centers or similar equipment may be PVC Schedule 40 and shall extend a minimum of 6 inches above the floor elevations, where practicable, with no couplings at floor elevations.
- T. Unless specifically identified on the Drawings as "Direct Buried," all conduits in the earth, including conduits below slabs-on-grade, shall be concrete encased. Joints in conduit shall be staggered so as not to occur side by side. Rigid non-metallic (PVC) conduit shall be connected to PVC coated rigid steel conduit at the point where it leaves the ground, with the transition to metal conduit occurring inside the concrete encasement.
- U. No more than three (3) 90 degree bends will be allowed in any one conduit run. Where more bends are necessary, a conduit or pull box shall be installed. All bends in 3/4-inch conduit shall be made with a conduit bender, and all larger sizes shall have machine bends. Joints in threaded conduit shall be made up watertight with the appropriate pipe thread sealant or compound applied to male threads only; and, all field joints shall be cut square, reamed smooth, and properly threaded to receive couplings. No running threads are permitted. All conduit ends at switch and outlet boxes shall be fitted with an approved locknut and bushing forming an approved tight bond with box when screwed up tightly in place.

- V. Conduits stubbed up through concrete floors for connections to freestanding equipment and for future equipment shall be provided with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Screwdriver operated threaded flush plugs shall be installed in conduits from which no equipment connections are made.
- W. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings. Changes in outlet locations required to serve the equipment furnished by other Contractors on the Project shall be brought to the attention of the Engineer.
- X. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings, designed for this purpose, at each end. Discs shall not be removed until it is necessary to clean the conduit and install the conductors. Before the conductors are installed, insulated bushings shall be installed at each end of the conduit.
- Y. Where "all-thread" nipples are used between fittings and electrical equipment, they shall be so installed that no threads are exposed.
- Z. Connections from rigid conduit to motors and other vibrating equipment, limit switches, solenoid valves, level controls, and similar equipment, shall be made with short lengths of liquid-tight flexible metal conduit. These conduits shall be installed in accordance with the NEC and shall be furnished and installed with appropriate connectors with devices which will provide an excellent electrical connection between the equipment and the rigid conduit for the flow of ground current. Flexible metal conduit and liquid-tight flexible metal conduit length shall be three (3) feet, maximum.
- AA. Flexible metal conduit or liquid-tight flexible metal conduit installed between rigid metal conduit and motor terminal box and/or any other apparatus shall have a green insulated grounding conductor running through the flexible conduit. This conductor shall be terminated to the nearest pull box, motor terminal box, or any other apparatus ground terminal. Flexible metal conduit and liquid-tight flexible metal conduit shall be grounded and bonded per NEC Articles 348 and 350, respectively.
- AB. Conduits installed within or underneath floor slabs, underground direct-buried or concrete encased conduits, and all conduits installed in areas subject to liquid inadvertently entering the conduit system shall be sealed or plugged at both ends in accordance with NEC Article 300-5(g). This requirement applies to both conduits containing conductors and "spare" conduits. Where practicable, the interior of the conduit shall be sealed as well as around the conductors by using conduit sealing bushings: Type CSB as manufactured by O/Z Gedney, or equal. Where the conduit fill does not allow the use of these bushings, the conduits shall be tightly caulked or plugged.

Conduit passing through the walls and floors of buildings below grade shall be installed with appropriate watertight fittings to prevent the entrance of ground water around the periphery of the conduits. For vertical conduit penetrations through openings in concrete floors, the fittings shall be Type FSK Floor Seals as manufactured by OZ/Gedney. For conduit penetrations through openings in concrete walls, the fittings shall be Type WSK Thruwall seals as manufactured by OZ Gedney. Conduits shall be sloped away from the buildings toward splice boxes, handholes and/or manholes to provide drainage away from the building

wall.

Conduits passing through sleeves in interior walls and floors shall be tightly caulked.

- AC. Weatherproof, insulated throat "Meyers" hubs shall be used on all conduit entries to boxes and devices without integral hubs in process areas to maintain NEMA 4X integrity. The Contractor shall furnish and install "Meyers" hubs on all conduit entries into non-cast enclosures such as metallic or non-metallic control panels, control component enclosures, wireways, pull boxes, junction boxes, control stations, and similar type equipment when this type of equipment is located in process areas requiring NEMA 4X integrity. This specified requirement for "Meyers" hubs does not apply to any area of the plant facilities where NEMA 4X integrity is not required.
- AD. The use of two (2) locknuts, one on each side of the enclosure, and a grounding bushing shall be required at all conduit terminations where hub type fittings are not required; such as electrical rooms, control rooms, and office areas.
- AE. Conduit installation shall be arranged to minimize cleaning. No horizontal runs of conduit will be permitted in brick or masonry walls.
- AF. Install non-metallic conduits in accordance with manufacturer's instructions where specified herein or indicated on the Drawings.
- AG. Join non-metallic conduit using cement as recommended by the manufacturer. Clean and wipe non-metallic conduit dry before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for twenty (20) minutes (minimum).
- AH. All PVC coated conduit shall be installed in accordance with manufacturer's instructions. The Contractor shall use tools that are specifically suited for coated conduit systems. The use of pipe wrenches and other such tools on PVC coated RGS conduit is prohibited. The Engineer and Owner reserve the right to reject any installation of coated conduit that does not meet the requirements of the Section or the manufacturer's instructions. The Engineer and Owner also reserve the right to reject any installation that exhibits damage due to the improper use of tools. All rejected installations shall be replaced by the Contractor at no additional cost to the Owner. The use of PVC coated conduit repair compounds to repair damages or improper installation is prohibited.
- AI. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. The Contractor shall furnish evidence of such training as specified herein. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract for all coated conduit installation personnel. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.
- AJ. Conduits shall not penetrate the floors or walls inside liquid containment areas unless specifically accepted by the Engineer.
- AK. All conduits that are buried or encased in concrete that transition from the ground to any stationary structure or equipment shall be equipped with a longitudinal expansion coupling

capable of at least four inches of expansion. Conduits with encasement that is rigidly tied to the stationary structure in accordance with the Standard Details shall not be required to have expansion couplings.

AL. Raceways shall not be installed concealed in water-bearing walls and floors.

3.02 CONDUIT USES AND APPLICATIONS

- A. No PVC conduit shall be installed exposed unless specifically accepted in writing by the Engineer. Where PVC conduit is allowed to be installed exposed, the conduit shall be Schedule 80.
- B. PVC Schedule 40 conduit shall be furnished and installed in concrete slabs (for slab-on-grade construction) and in walls when the conduit is shown to be encased. Rigid steel conduit shall be installed in all elevated slabs when the conduits are shown to be encased.
- C. PVC Schedule 40 conduit shall be installed in reinforced concrete encasement. Conduit shall be "direct buried" only if specifically indicated on the Drawings.
- D. All instrumentation wire and cable for analog signals shall be installed in rigid aluminum conduit or PVC coated rigid steel conduit to suit the application. This applies to all conduit installations including exposed, concealed in concrete encasement, and all other applications.
- E. Except as otherwise specified herein, all conduit shall be rigid aluminum.
- F. Electrical metallic tubing may be furnished and installed in the following areas:
 - 1. Pre-fabricated power centers and generator enclosures.
- G. Other conduit uses not specifically listed above shall be brought to the attention of Engineer for a decision.

3.03 CONDUIT IDENTIFICATION

- A. The identification system for the conduits furnished and installed under this Contract shall match the existing identification system used at the facility.

3.04 TESTING

- A. Field tests
 - 1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling tape.

- END OF SECTION -

SECTION 16123

BUILDING WIRE AND CABLE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, ready for service, all cables and wires indicated on the Drawings and as specified herein or required for proper operation of the installation, with the exception of internal wiring provided by electrical equipment manufacturers. The work of connecting cables to equipment, machinery, and devices shall be considered a part of this Section. All hardware, junction boxes, bolts, clamps, insulators, and fittings required for the installation of cable and wire systems shall be furnished and installed by the Contractor.
- B. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300, Submittals, the Contractor shall obtain from the wire and cable manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of Field Tests
 - 3. Wiring Identification Methods
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.
2. Cable pulling calculations (if required).
3. Wiring identification methods and materials.

1.04 IDENTIFICATION

A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.05 CABLE PULLING CALCULATIONS – PARAGRAPH NOT USED.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable covered by this Specification is intended to be standard equipment of proven performance. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.
- B. The wire and cable manufacturer shall be ISO 9000 registered.

2.02 600 VOLT POWER WIRE AND CABLE

- A. 600 volt cable and wire shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.
- C. 600 volt individual power wire and cable shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent with SIMPull jacket, or equal. Multi-conductor power cables shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent, or equal.

2.03 600 VOLT CONTROL CABLE

- A. 600 volt control cable shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations. The individual conductors of the multiple conductor cable shall be color coded for proper identification. Color coding shall be equal to ICEA S-68-514, Method 1, E2. Cables shall meet requirements of IEEE-383.
- B. Conductors shall be stranded copper per ASTM B-8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.

- C. 600 volt individual conductor control wire shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent with SIMPull jacket, or equal. Multi-conductor control cable shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent, or equal.

2.04 LIGHTING AND RECEPTACLE WIRE AND CABLE

- A. The lighting and receptacle branch circuit wire shall consist of solid, copper conductors with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.
- B. Conductors shall be solid copper per ASTM- B-33. Minimum size wire shall be No. 12 AWG.
- C. Lighting and receptacle cables and wire shall be Okoseal-N as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent with SIMPull jacket, or equal.

2.05 INSTRUMENTATION CABLE

- A. The instrumentation cable for analog signals shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 90°C insulation rating.
- B. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.
- C. The instrumentation cable shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Cerro Wire and Cable equivalent, Southwire Company equivalent, or equal.

2.06 FIBER OPTIC CABLE – PARAGRAPH NOT USED

2.07 CABLE PULLING LUBRICANTS

- A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 -- EXECUTION

3.01 600V CABLE INSTALLATION

- A. The cable and wires shall be installed as specified herein and indicated on the Drawings.
- B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

- C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.
- D. Splices shall not be allowed in the underground manhole and handhole systems. If splices are required, the Contractor shall obtain approval in writing from the Engineer prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits. Reference Section 16130 for additional requirements regarding control wiring.
- E. Wire and Cable Sizes
 - 1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured at the load does not exceed 2-1/2%.
 - 2. Minimum wire size within control panels, motor control centers, switchboards and similar equipment shall be No. 12 AWG for power and No. 14 AWG for control.
- F. Number of Wires
 - 1. The number of wires indicated on the Drawings for the various control, indication, and metering circuits were determined for general schemes of control and for particular indication and metering systems.
 - 2. The actual number of wires installed for each circuit shall, in no case, be less than the number required; however, the Contractor shall add as many wires as may be required for control and indication of the actual equipment selected for installation at no additional cost to the Owner. The addition of conductors shall be coordinated with and approved by the Engineer to avoid violations of the NEC regarding conduit fill.
 - 3. All spare conductors shall be terminated on the terminal blocks mounted within the equipment.
- G. Wiring Identification
 - 1. In addition to color coding, all wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.
 - 2. Wire identification shall be by means of a heat shrinkable sleeve. Sleeves shall have a white background with black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit

the required text. The use of handwritten text for wire identification shall not be permitted.

3. Sleeves shall be suitable for the size of wire on which they are installed. When installation is complete, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.
4. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
5. Sleeves shall be white polyolefin as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.
6. Where sleeves are not available in the size required for the wire, the Contractor shall use an adhesive label with a white background and black text. Text size shall be in accordance with the requirements listed above.
7. Adhesive labels, for the case when sleeves are not suitable for the wire size, shall be white permanent vinyl as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.
8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous shall be accomplished by means of a tag installed around the bundled group of conductors. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the 'FROM' and 'TO' column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton equivalent, Panduit equivalent, or equal.

H. Cable Installation

1. All interior cable not protected by a compartment enclosure shall be installed in conduit.

I. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Engineer shall be used.
2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

J. Training of Cable

1. The Contractor shall furnish all labor and material required to train cables around cable vaults within buildings and in manholes and handholes in the outdoor underground duct system. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. Instrumentation cable shall be racked separate from all other AC and DC wiring to maintain the required separation specified herein. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing. Reference Section 16118.

K. Connections at Control Panels, Limit Switches, and Similar Devices

1. Where stranded wires are terminated at panels, and/or devices, connections shall be made by solderless lug, crimp type ferrule, or solder dipped.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make 7-strand, No. 12 AWG, wire terminations impractical, the Contractor shall terminate external circuits in an adjacent junction box of proper size complete with terminal strips and shall install No. 14 AWG stranded wires from the device to the junction box in a conduit. The #12 AWG field wiring shall also be terminated in the same junction box to complete the circuit.

L. Pulling Temperature

1. Cable shall not be flexed or pulled when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the work day for which the cable is removed from the protected storage. Any remaining cable reels shall be returned to storage at the completion of the workday.

M. Color Coding

1. Conductor insulation shall be color coded as follows:
 - a. 480/277V AC Power
 - Phase A - BROWN
 - Phase B - ORANGE
 - Phase C - YELLOW
 - Neutral - GREY
 - b. 120/208V or 120/240V AC Power
 - Phase A - BLACK
 - Phase B - RED
 - Phase C - BLUE
 - Neutral - WHITE

- c. 24VDC Power
 - Positive Lead - RED
 - Negative Lead – BLACK
 - d. 125VDC Power
 - Positive Lead – RED (2 Strips of tape)
 - Negative Lead – BLACK
 - e. DC Control
 - All wiring – BLUE
 - f. 120VAC Control
 - Single conductor 120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This conductor shall be color coded YELLOW.
 - g. 24VAC Control
 - All wiring - ORANGE
 - h. Equipment Grounding Conductor
 - All wiring - GREEN
2. Conductors No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape in accordance with the requirements listed above.
 3. Low voltage feeder and branch circuit conductors shall be identified in accordance with the NEC. The method utilized for conductor identification for each nominal voltage system shall be permanently posted at each feeder or branch circuit distribution equipment assembly. Reference Articles 200, 210, and 215 of the NEC.

3.02 INSTRUMENTATION CABLE INSTALLATION

- A. The Contractor shall install all cable or conductors used for instrumentation wiring (4-20 mA DC, etc.) in rigid galvanized steel or PVC coated rigid galvanized steel conduit. The use of asbestos cement or PVC conduit shall not be permitted. Analog signal wires shall exclusively occupy these conduits. No other wiring for AC or discrete DC circuits shall be installed in these conduits.
- B. All shielding shall be continuous and shall be grounded at one point only, or in accordance with the instrumentation equipment manufacturer's recommendations.
- C. Where instrumentation cables are installed in panels, manholes, handholes, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these

cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.

- D. Additional pullboxes shall be furnished and installed for ease of cable pulling and the cable manufacturer's recommended conduit fill factor shall be followed. Where required or specifically directed by the Engineer, the Contractor shall moisture seal the cables at all connections with OZ Gedney Type "CSB", or equal, sealing bushings.
- E. Special instrument cable shall be as specified or recommended by the manufacturer of the equipment or instruments requiring such wiring. Installation, storage, terminations, etc., shall be per manufacturer's recommendations.
- F. All cable insulation and jackets shall have adequate strength for it to be pulled through the conduit systems. All conductors shall be color coded and all wires shall be suitably tagged with permanent markers as specified herein.

3.03 FIBER OPTIC CABLE INSTALLATION – PARAGRAPH NOT USED

3.04 TESTING

- A. The following tests are required:

- 1. Shop Test

- a. Cable and wiring shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.

- 2. Field Tests

- a. Field testing shall be done in accordance with the requirements specified in the General Conditions and NETA acceptance testing specifications (ATS) latest edition.
- b. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.
- c. After installation, all wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:
 - i. For 600V power cable larger than #6 AWG, apply 1,000 VDC from a Megaohmmeter for one (1) minute for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Resistance shall be no less than 100 Megaohms. Insulation testing is not required for power cables #6 AWG and smaller
 - ii. For 600V control cable, apply 1,000 VDC from a Megaohmmeter for one (1) minute for all 600V wires and cables installed in lighting,

control, power, indication, alarm and motor feeder circuits. Resistance shall be no less than 100 Megaohms.

- iii. 600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megaohms or greater.
- d. Low voltage wires and cables shall be tested before being connected to motors, devices or terminal blocks.
- e. Voltage tests shall be made successively between each conductor of a circuit and all other conductors of the circuit grounded.
- f. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.
- g. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

- END OF SECTION -

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SECTION 16130

BOXES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all pull, junction and outlet boxes for power, lighting and control as required for a complete electrical installation as shown on the Drawings and specified herein.
- B. Coordination
 - 1. The Contractor shall review installation procedures under other Divisions and coordinate them with the Work specified herein.
 - 2. The Contractor shall notify others in advance of the installation of the Work included herein to provide them with sufficient time for the installation and coordination of interrelated items that are included in the Contract and that must be installed in conjunction with the Work included in this Division.
- C. Boxes shall conform to all applicable Federal, UL and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.
- D. Reference Section 16000, Basic Electrical Requirements.

1.02 TESTING

- A. No testing is required for the equipment covered by this Section

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete assembly, layout, and installation drawings for each box with clearly marked dimensions.

1.05 IDENTIFICATION

- A. Each junction and pullbox shall be identified with the box name as indicated on the Contract Drawings or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 16195, Electrical – Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL, JUNCTION, AND OUTLET BOXES

- A. Exposed Indoor Wet Process and Outdoor Areas

- 1. Exposed outlet boxes for outdoor and indoor wet process areas used for lighting fixtures, switches, and receptacles shall be of cast, rust-resisting metal provided with integral conduit hubs and rubber or neoprene gasketed covers of similar metal.
- 2. Junction and pull boxes shall be of NEMA 4X 316 stainless steel construction and of ample size to house the required devices. Junction and pull boxes shall be gasketed and have hinged covers. Door latches shall be all stainless steel, fast operating clamp assemblies that do not require bolts or screws to secure.

- B. Concealed

- 1. Outlet boxes for concealed work shall be a minimum of 4 inches square and 2 inches deep consisting of zinc coated pressed steel provided with knockouts for the conduit required. Boxes shall be provided with approved covers or plaster rings where necessary. Boxes with eccentric or concentric knockouts shall not be used.
- 2. Boxes for housing receptacles, switches and similar devices shall be of the deep type.

C. Exposed Indoor Dry Locations

1. Pull and junction boxes for indoor exposed use in dry locations shall be aluminum with neoprene gasketed screwed-on covers and of all welded construction. Boxes with eccentric or concentric knockouts shall not be used.

D. Miscellaneous

1. The Contractor shall furnish and install enclosures for housing interfacing and transition equipment, or other equipment requiring an enclosure. The Contractor shall be responsible for mounting the enclosure. The enclosures shall be a low profile type, weatherproof, and lockable. The enclosures shall be furnished and installed in complete compliance with the NEC and with all state and local codes. The single door enclosure shall be finished with light gray epoxy paint and shall be manufactured by Hoffman, Rittal, The Austin Company, or equal.
2. All boxes shall be UL listed and labeled.
3. For boxes shown or required in hazardous locations, boxes shall be furnished and installed in accordance with the Class, Division, and Group suitable for the application.

E Galvanizing

1. The inside and outside surface of the boxes and covers shall be hot dipped or electro-galvanized after fabrication.

F. Box Sizes

1. The minimum size of boxes shall be in accordance with the NEC. No box shall be filled to more than 40% of capacity.

G. Barriers

1. Galvanized steel or aluminum barriers shall be provided in junction or pull boxes to isolate conductors of different voltages and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power (480 and 120 volts)
 - b. Control wiring
 - c. Instrumentation wiring (twisted, shielded pairs or triads)
2. Barriers shall be provided in multi-gang outlet boxes when the voltage between switches exceeds 300 VAC.

- I. Where control wires must be interconnected in a junction box, terminal strips, consisting of an adequate number of screw type terminals shall be installed. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected. Approximately 20 percent of the total amount of terminals provided shall consist of spare terminals. Terminals shall be lettered and/or numbered to conform with the wiring labeling scheme diagrams.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Outlet Boxes

1. All outlet boxes required for supporting lighting fixtures shall be provided with fixture studs of sizes suitable for supporting the weight of the fixtures connected thereto. Fixture studs shall not be less than 3/8 inches in diameter and shall be either integral with the box or of the type which is inserted and supported from the back of the box. In no case shall the support of a fixture be dependent upon bolts holding the stud to the box.
2. Outlet boxes for concealed work shall be arranged and located so that tile, where required, may be cut in straight lines to fit closely around the boxes, and so placed that the cover or device plate shall fit flush to the finished wall surface.

B. Junction and Pull Boxes

1. All junction boxes and pull boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Wooden plugs are not permitted for securing boxes to concrete. Sidewalk-type boxes shall be cast into concrete structures and shall be flush with concrete surfaces after installation.

- END OF SECTION -

SECTION 16141

WIRING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish and install all switches and receptacles for lighting and miscellaneous power applications of the type and at the locations as specified herein, specified in other Sections, and as shown on the Drawings.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include, but not be limited to:
 - 1. Product data sheets.

1.04 IDENTIFICATION

- A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Use the products of a single manufacturer for each type of wiring device.

- C. Use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:
 - 1. Where the selected plate manufacturer does not manufacture a suitable finish plate.
 - 2. For heavy-duty receptacles rated at more than 30A.
 - 3. Where non-standard plates are required, specified, or shown.
- D. The receptacles, switches, device plates, and other appurtenances shall comply with the requirements of these Specifications. Receptacles installed in toilet, locker, and bathrooms shall be of ground fault interrupter type to meet the minimum NEC requirements. Ground fault circuit interrupter receptacles shall also be furnished and installed as specified herein, indicated on the Drawings, and required by the NEC.
- E. Wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Section 16123, Building Wire and Cable.
- F. Provide specification grade devices which shall be as manufactured by Appleton, Crouse-Hinds, Leviton, Harvey Hubbell Co., Bryant Electric Company, Pass & Seymour, or equal.

2.02 WIRING DEVICES

- A. Wiring devices shall be in accordance with the following for nonhazardous areas:
 - 1. Wall Switches, Single Pole, 20 A, 120-277V equivalent to Hubbell No. 1221, Pass & Seymour No. 20AC1, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3031, Hubbell equivalent, Pass & Seymour equivalent, or equal.
 - 2. Wall Switches, Double Pole, 20 A, 120-277V equivalent to Hubbell No. 1222, Pass & Seymour No. 20AC2, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3032, Hubbell equivalent, Pass & Seymour equivalent, or equal.
 - 3. Wall Switches, Three-Way, 20 A, 120-277V equivalent to Hubbell No. 1223, Pass & Seymour No. 20AC3, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3033, Hubbell equivalent, Pass & Seymour equivalent, or equal.
 - 4. Wall Switches, Four-Way, 20 A, 120-277V equivalent to Hubbell No. 1224, Pass & Seymour No. 20AC4, Leviton equivalent, or equal.
 - 5. Convenience Receptacles 20 A, 125V, duplex polarized with grounding connection equivalent to Hubbell No. 5362, Pass & Seymour equivalent, Leviton equivalent, or equal.
 - 6. Hubbell Cat. No. GF-5362, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, 120V, duplex, ground fault circuit interrupting type.

B. Special Purpose Receptacles shall be rated to carry, at least where required the full load amperes and voltage of the unit connected thereto. These receptacles shall be provided with grounding poles and shall be equivalent to the following:

1. Hubbell Cat. No. HBL-5661, Pass & Seymour No. 5871, Leviton equivalent, or equal, for 20A, 250VAC, 1-phase service.
2. Hubbell Cat. No. HBL-9330, Pass & Seymour No.3801, Leviton equivalent, or equal, for 30A, 250VAC, 1-phase service.
3. Hubbell Cat. No. 9430, Pass & Seymour No. 5740, Leviton equivalent, or equal, for 30A, 208/120V, 3-phase service.
4. Hubbell Cat. No. 9450, Pass & Seymour No. 5750, Leviton equivalent, or equal, for 50A, 208/120V, 3-phase service.
5. Hubbell Cat. No. 9460, Pass & Seymour No. 5760, Leviton equivalent, or equal, for 60A, 208/120V, 3-phase service.
6. Hubbell Cat. No. 9330, Pass & Seymour No. 5930, Leviton equivalent, or equal, for 30A, 208V, single-phase service.
7. Hubbell Cat. No. 9315, Pass & Seymour equivalent, Leviton equivalent, or equal, for 30A, 277V, single-phase service.
8. Hubbell Cat. No. 23CM10, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, single, 125V, polarized with grounding connection, twist lock type. Matching plug shall be Hubbell Cat. No. 23CM11, Pass & Seymour equivalent, Leviton equivalent, or equal.
9. Crouse-Hinds "Arktite" Series, Appleton equivalent, Killark equivalent, or equal, 30A, 3P, 600 Volt, twist lock, weatherproof, power receptacle and box with matching plug.

C. For hazardous areas the following shall be provided:

1. Wall Switches, single pole, 20 A, 120 V equivalent to Crouse Hinds Cat. No. EFD3591 or EFDC3591 (as required); Appleton No. EDS175F1 or EDSC175F1, Killark equivalent, or equal.
2. Convenience Receptacles 20 A, 120-250 VAC, 2 wire, 3 pole equivalent to Crouse Hinds Cat. No. CPS152-201, Appleton No. CPE1-2375, Killark equivalent, or equal.

D. Plugs for hazardous and non-hazardous receptacles shall be provided:

1. Plugs and respective cable shall be provided for equipment furnished under other Divisions (steam cleaners, welders, etc.)as necessary.

2.03 DEVICE PLATES

A. Wall plates with gaskets for flush-mounted receptacles and switches shall be made of Type 316 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on

the rear so as to lie flat against the wall. Wall plates shall be equivalent to Hubbell Series 9600, Pass & Seymour series 93000, Leviton equivalent, or equal.

- B. Device plates for outdoor installations and indoor wet process area installations shall be Appleton Type FSK, Crouse-Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be "in-use" style. "In-use" weatherproof covers shall be rugged, minimum 3 ¼" depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," or equal.
- C. Device plates for indoor dry process areas with surface mounted boxes shall be Crouse-Hinds DS32, or equal for switches, and Crouse-Hinds DS23 or equal for receptacles.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Switch boxes shall be of unit construction and of sizes as required to adequately house the number of switches required. No sectional type switch boxes shall be permitted.
- B. Where more than one (1) switch occurs at one (1) point, gang plates shall be used.
- C. All device plates shall be set true and plumb, and shall fit tightly against the finished wall surfaces and outlet boxes.
- D. All devices shall be flush-mounted in finished areas, unless otherwise noted.
- E. In all areas where thermal or acoustic insulation is applied to the ceiling or walls, outlet boxes shall be set to finish flush with the finished surface of the insulation.
- F. For the below-named items, mounting heights from finish floor, or finish grade to top is applicable. Mounting heights shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):
 - 1. Single-pole light switches 48 inches.
 - 2. Duplex receptacles in dry areas, 16 inches
 - 3. Duplex receptacles in pump rooms, 48 inches
- G. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14 point font.

3.02 CIRCUITING

- A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit.

- END OF SECTION -

SECTION 16170

GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:
- D. Reference Section 16000, Basic Electrical Requirements.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of certified field tests.
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.

2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.03 EQUIPMENT GROUNDING CONDUCTORS

- A. A green, insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.04 EQUIPMENT GROUNDS

- A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panel boards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

2.05 EXOTHERMIC WELDS

- A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.

B. Ground Grid

1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be exothermically welded to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system.
2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
3. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
4. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

A. Field Tests

1. Field testing shall be performed in accordance with the requirements specified in the NETA acceptance testing specifications (ATS), latest edition.
2. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.

3. Continuity tests for the grounding electrode conductor shall also be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

- END OF SECTION -

SECTION 16190
SUPPORTING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install structural stainless steel supports for mounting and installing all electrical, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.
- B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

- A. Materials used in accordance with this Section shall be as specified herein.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all conduit sleeves, anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.
3. The Contractor shall furnish leveling steel channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling steel channels shall be provided for installation in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain coverage of the reinforcement bars while not exceeding the maximum mounting heights requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel. Where supports or hangers are required for heavy electrical equipment units exceeding fifty pounds, a proposed support detail shall be submitted to the Engineer for review and approval. Where required, additional sections shall be provided for a safe installation. Supports and hangers shall be aluminum or stainless steel as required to suit the application and shall be compatible with the balance of the installation.

2. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars where possible, to facilitate removal of ceiling panels.
3. For interior dry areas, a bracket and channel type support of zinc chromated galvanized steel construction shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.
4. For outdoor service or in indoor damp/wet process areas, the support system shall be made of Type 316 stainless steel. The materials of construction shall be coordinated with the process/chemical area in which the support system will be installed. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Nominal 1-5/8" x 3/4" (minimum) channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.
5. All hardware (bolts, nuts, washers, etc.), regardless of installation location, shall be Type 316 stainless steel.
6. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework. Wherever this occurs, a provision shall be made for ready access to the wiring for connections to the equipment by means of boxes with screw covers.
7. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.
8. Actual designs for supporting framework should take the nature of a picture frame of channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; he shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
9. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

- END OF SECTION -

SECTION 16195

ELECTRICAL - IDENTIFICATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull/junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this section include, but are not limited to, the following:
 - 1. Operational instructions and warnings.
 - 2. Danger signs.
 - 3. Equipment/system identification signs.
 - 4. Nameplates.

1.02 SIGNS

- A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, black with white lettering.

2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

- A. Conduit identification shall be as specified in Section 16111, Conduit.

2.05 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section 16123, and Building Wire and Cable.
- B. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.06 BOX IDENTIFICATION

- A. Pull, junction and device box identification shall be as specified in Section 16130 – Boxes.

PART 3 -- EXECUTION

3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four

(4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.
- B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

- END OF SECTION -

SECTION 16440

DISCONNECT SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.
- B. Reference Section 16000, Basic Electrical Requirements.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Spare Parts List
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.
 - 3. Assembled weight of each unit.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.04 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The equipment shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment, and with all spare parts as recommended by the equipment manufacturer.
- B. One (1) complete set of spare fuses for each ampere rating installed shall be furnished and delivered to the Owner at the time of final inspection.
- C. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.05 IDENTIFICATION

- A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Switches shall be manufactured by the Square D Company, Cutler-Hammer, the General Electric Company, or Siemens Energy and Automation, Inc.

2.02 DISCONNECT SWITCHES

- A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable.
- B. Switches shall be NEMA Type HD, single-throw, externally operated, fused or non-fused as required. Switches of the poles, voltage, and ampere ratings shown shall be furnished in NEMA 1A (gasketed) enclosures in indoor dry areas, and in NEMA 4X Type 316 stainless steel enclosures for damp/wet indoor process areas. Enclosures for outdoor applications shall be NEMA 4X Type 316 stainless steel. Switches located in hazardous areas shall be suitable for the Class, Division, and Group to suit the application.

- C. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.
- D. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.
- E. Disconnect switches shall be furnished with a factory installed internal barrier kit that helps prevent accidental contact with live parts and provides "finger-safe" protection when the door of the enclosed switch is open.
- F. Fused disconnect switches shall be furnished for motor operated valve and gate actuators where shown on the Drawings. The Contractor shall coordinate the supply of these fused switches with the specific requirements of the actuator. Fuses with fast fault clearing times may be required for modulating valve actuators.

PART 3 --EXECUTION

3.01 INSTALLATION

- A. All disconnect switches shall be mounted five (5) feet above the floor, at the equipment height where appropriate, or where shown otherwise.
- B. The Contractor shall furnish and install fuses of various types as required with the continuous ampere ratings as required or shown on the Drawings.

- END OF SECTION -

SECTION 16481

INDIVIDUAL MOTOR CONTROLLERS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install separately mounted, individual motor controllers for 120 volt single phase, and 208 and 480 volt three phase motors as specified herein and indicated on the Drawings. Individual motor controllers specified in this Section include magnetic motor starters, and manual motor starters.
- B. Reference Section 16000, Basic Electrical Requirements and Section 16902, Electric Controls and Relays.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Spare Parts and Special Tools List.
 - 3. Reports of Certified Shop and Field Tests.
 - 4. Operation and Maintenance Manuals.
 - 5. Manufacturer's Field Startup Report.
 - 6. Manufacturer's Representatives Installation Certification.
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shop drawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and

Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

2. Product data sheets.
 3. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of individual motor controller.
 4. Custom wiring diagrams for each individual motor controller. Standard wiring diagrams that are not custom created by the manufacturer for the individual motor controllers for this project are not acceptable. One wiring diagram which is typical for an equipment group (e.g. reuse water pump) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.
 5. Bill of material list for each individual motor controller.
 6. Nameplate schedule for each individual motor controller.
 7. Manufacturer's installation instructions.
 8. Time-current curves for each type and size protective device if requested by the Engineer.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.
- E. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for individual motor controller. These final drawings shall be plastic laminated and securely placed inside each individual motor controller unit door and included in the O&M manuals.
- 1.04 OPERATION AND MAINTENANCE MANUALS
- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.05 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The equipment shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. The Contractor shall furnish the following minimum spare parts:
 - 1. One (1) solid state overload relay for each type, size, and rating used.
 - 2. One (1) motor circuit protector & motor contactor for each type, size, and rating used.
 - 3. One (1) spare control power transformer for each type and size used.
 - 4. Two (2) spare fuses for each size and type used.
- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- E. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- F. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.06 IDENTIFICATION

- A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section 16195, Electrical - Identification.

1.07 CONSTRUCTION SEQUENCING

- A. The Contractor shall reference Section 01520, Maintenance of Operations During Construction, of these Specifications.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. Individual motor controllers specified in this section shall be as manufactured by Eaton, the General Electric Company, the Square D Company, Siemens Energy and Automation, Inc., or Allen-Bradley.

2.02 INDIVIDUAL MAGNETIC MOTOR STARTERS

- A. Individual magnetic motor starters shall be combination type complete with motor circuit protectors (MCP's). Starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be furnished with a minimum of two spare auxiliary contacts.
- B. Provide starters in NEMA 1A (gasketed) enclosures when located in clean, dry, conditioned spaces only. NEMA 1A (gasketed) enclosures shall be finished with corrosion resistant epoxy or acrylic paint. Starters to be furnished and installed in indoor damp or wet areas and outdoor locations shall be in NEMA 4X Type 316 stainless steel enclosures. Starters to be provided in all outdoor locations shall be in NEMA 4X Type 316 stainless steel enclosures. Individual motor starters located in hazardous areas shall be suitable for the Class, Division, and Group to suit the application.
- C. Furnish and install manual reset overload relays in each phase sized in accordance with the NEC. Provide cover mounted overload reset button with metal (not plastic) shaft and pilot devices as indicated and required. Starters shall be provided with all coils and controls for 120 VAC operation, unless otherwise indicated on the Drawings.
- D. A control power transformer shall be furnished and installed for each motor controller. The minimum control power transformer VA requirements are as follows:

Size 1	75 VA
Size 2	75 VA
Size 3	200 VA
Size 4	300 VA
Size 5	500 VA

Additional transformer capacity shall be provided when required. The motor controller manufacturer is advised to review the total Contract Documents for additional requirements for space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings.

- E. Each starter shall be supplied with a manual reset overload relay. Manual reset shall be accomplished by a door mounted overload reset pushbutton. The relays shall be solid state type, with at least one isolated normally open and one isolated normally closed auxiliary contact that operates when a trip condition has occurred. Relays shall be self-powered,

have a visible trip indicator, have a trip test function, and have selectable Class 10 or 20 operation. Overload relays shall be set for Class 10 operation unless otherwise directed by the Engineer. Overload relay shall have phase loss protection built in to trip the unit and protect the motor against single phasing. The Contractor shall provide the overload relay model with the correct current range for each application. Overload relay shall have adjustable current range dial. Eutectic alloy and bi-metallic type overload relays shall not be used.

- F. Unless otherwise indicated, the pilot devices shall be mounted on the covers of the respective enclosures. Pushbuttons, selector switches, and pilot lights shall be 30.5 mm, heavy-duty, oil tight type with provisions to maintain the NEMA ratings of starter enclosures. Legend plates indicating switch positions shall be provided for each pilot device. Pilot lights shall be LED push to test type.
- G. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105°C. Wire color coding shall be as specified in Section 16123, Building Wire and Cable.
- H. Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid state equipment (e.g. programmable logic controller) wired as part of the control circuit.
- I. Where specified in these Contract Documents, indicated on the Drawings, or as required, interposing relays shall be furnished for the motor control circuits. Coil voltage shall be as specified, indicated on the Drawings, or as required. The contact ratings of the relays shall be coordinated with the burden of the motor starter coil. If the burden or other electrical requirements exceed the contact rating of general purpose, plug-in relays, machine tool type relays with adequate contact ratings shall be provided.
- J. Individual magnetic motor starters shall be as manufactured by Eaton using NEMA rated Freedom Series starters and contactors, the General Electric Company equivalent, the Square D Company equivalent, or Siemens Energy & Automation, Inc. equivalent.

2.03 INDIVIDUAL MANUAL MOTOR STARTERS

- A. Individual manual motor starters in enclosures as specified above shall be furnished and installed for outdoor and indoor exposed work. Furnish and install manual motor starters in outlet boxes with flush wall plates as required for concealed work.
- B. Furnish and install manual motor starters with pilot lights and overload heater elements of correct rating based on motor nameplate data.
- C. Manual motor starters shall be equipped with either a push button or toggle operator with reset device or mechanism accessible without opening the enclosure.
- D. Individual manual motor starters for motors one (1) horsepower and less shall be Eaton Type MS, the General Electric Company equivalent, the Square D Company equivalent, Allen-Bradley equivalent, or Siemens Energy & Automation, Inc. equivalent.

- E. Individual manual motor starters for integral horsepower motors shall be Eaton Type B100 or B101, the General Electric Company equivalents, the Square D Company equivalents, Allen-Bradley equivalent, or Siemens Energy and Automation, Inc. equivalents.

2.04 AUXILIARY CONTROL RELAYS

- A. Provide auxiliary control relays as required to suit the application and as shown on the Drawings. Control relays shall be as specified in Section 16902 - Electrical Controls and Relays. The number of contacts shall be as shown and as required to suit the application plus two spare normally open (N.O.) and two spare normally closed (N.C.).

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. All individual motor starters shall be installed as indicated on the Drawings and as recommended by the equipment manufacturer.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.
 - 2. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA acceptance testing specifications, latest edition.

3.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified manufacturer's factory-trained technical representative who shall adequately supervise the installation and startup of the RVSS equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.
- B. The manufacturer's technical representative shall perform all startup and field acceptance testing as specified herein.
- C. The Contractor shall provide training for the Owner's personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Owner's personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for two (2) sessions of two (2) hours each. Training shall not take place until after the motor controllers have been installed and tested. Training shall be

conducted at times coordinated with the Owner.

- D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
 - 1. One (1) trip of two (2) working days during installation of the motor controllers.
 - 2. One (1) trip of two (2) working days to perform startup and field acceptance testing of the motor controllers.
 - 3. One (1) trip of one (1) working day to perform training as specified herein.
- E. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

- END OF SECTION -

SECTION 16495

VARIABLE FREQUENCY DRIVE SYSTEMS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test and place in satisfactory operating condition four variable frequency drives (VFD), for pumps No. 1, 2, 3 and 4, as specified herein and indicated on the Drawings.
- B. The Contractor shall collect motor and pump data as needed by the Manufacturer to verify the proper sizing and application of the selected drive unit.
- C. References:
 - a. Specification Sections:
 - Section 16000, Basic Electrical Requirements,
 - Section 16902, Electric Controls and Relays
 - b. Codes and Standards
 - National Fire Protection Association - NFPA 70 - US National Electrical Code.
 - National Electrical Manufacturers Association - NEMA 250 - Enclosures for Electrical Equipment.
 - Underwriters Laboratory Inc. – UL 508.
 - Institute of Electrical and Electronics Engineers, Inc. - IEEE 519 - IEEE Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.
 - 2. Certified Shop Tests and Reports
 - a. Submit description of proposed testing methods, procedures, and apparatus.

- b. Factory test the complete variable frequency drive system in accordance with IEEE and NEMA standards with these Specifications. In addition, the variable frequency drive system shall be tested for efficiency as defined in this Specification.
- c. Variable frequency drive system components, including power transistors, GTOs, SCRs, IGBT's, diodes shall be 100 percent inspected and tested using manufacturer standard test procedures. Printed circuit boards shall be tested using the manufacturers standard 'run-in' test method.
- d. After the specified inspections and tests have been successfully completed, the variable frequency drive system shall undergo an 8 hour system load test where the VFD operates on an appropriately sized dynamometer.
- e. Submit factory bench-test data to indicate that the manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy.

3. Field Tests

- a. Field testing shall be done in accordance with the requirements specified herein, in the General Conditions and NETA acceptance testing specifications.

B. Acceptance of a shop test does not relieve Contractor from requirements to meet field installation tests under specified operating conditions, nor does the inspection relieve the Contractor of responsibilities.

C. Certification on materials and records of shop tests necessary for the inspector to verify that the requirements of the Specifications are met, shall be made available to the inspector.

D. Submit signed and dated certification that all the factory inspection and testing procedures described herein have been successfully performed by the Contractor prior to shipment.

1.03 SUBMITTALS

A. In accordance with the procedures and requirements set forth in General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:

- 1. Shop Drawings
- 2. Programming Guides/Manuals
- 3. Operation and Maintenance Manuals
- 4. Spare Parts List
- 5. Special Tools List
- 6. Shop Test Plan

7 Reports of Certified Shop and Field Tests

- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Drawings submitted by the manufacturer shall be complete and documented to provide the Owner with operations and maintenance capabilities.
- D. Shop drawings for each VFD shall include but not be limited to:
1. Layout drawings of the variable frequency drive system that include all cabinet or enclosure dimensions, access details, and weights.
 2. Layout drawings of panels or enclosures showing size, arrangement, color, and nameplates. Drawings shall include the physical arrangement of door mounted devices located on the variable frequency drive enclosure. Sufficient detail shall be provided for locating conduit stub-ups. General "catalog data sheet" layout drawings which are not specific to the systems specified herein are not acceptable.
 3. Custom schematic and interconnection wiring diagrams of all electrical work, including terminal blocks and identification numbers, wire numbers and wire colors. Standard schematics and wiring diagrams that are not custom created by the manufacturer for the variable frequency drives for this project are not acceptable.
 4. Complete single line diagrams indicating all devices comprising the variable frequency drive system including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system. Electrical ratings of all equipment and devices shall be clearly indicated on these single line diagrams.
 5. Complete Bills of Material and catalog data sheets for all equipment and devices comprising the variable frequency drivesystem.
 6. Confirmation of spare parts and special tools requirements as specified herein.
 7. Documented data regarding output reactors and filters, if provided.
- E. The shop drawing information shall be completed and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "Soft Cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are to provide are acceptable and shall be submitted.

- F. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for each VFD. These final drawings shall be plastic laminated and securely placed inside each VFD and starter door and included in the O&M manuals.
- G. Product Data shall include, but not be limited to:
 - 1. Functional diagrams that identify major system functional blocks and interfaces.
 - 2. Special requirements or restrictions of the motor-load combination that may result from operation on the variable frequency drive system.
- H. Programming Guides and Manuals shall be submitted. If the variable frequency drive systems require computer software or configuration, provide copies of all programming guides/manuals.

1.05 OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions, Section 01300, Submittals.

1.06 TOOLS, SUPPLIES, AND SPARE PARTS

- A. The VFD's and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished by the Contractor to the Owner.
- B. The Contractor shall furnish the following spare parts:
 - 1. One (1) set of all power and control fuses for each variable frequency drive.
 - 2. One (1) fully functional main control circuit board for each size variable frequency drive supplied.
 - 3. One inverter power semiconductor for each rating supplied.
 - 4. One spare keypad for each type provided.
 - 6. One I/O Module for each type provided.
 - 7. One full set of replacement Enclosure Filters for each unique type of drive provided.
 - 8. One copy of the VFD Manufacturer's most recent Drive software (Connected Components Workbench) shall be provided to the Owner, as well as a USB cable for PC-to-VFD connection.
- C. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

- D. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.
- E. Spare parts lists, included with the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- F. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified manufacturer's factory-trained technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and the Owner's operating personnel in its maintenance and operation as outlined herein and in the General Conditions. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
 - 1. One trip of two (2) working days during installation and start-up/configuration of the equipment.
 - 2. Two (2) subsequent trips to support the commissioning of additional units as described in the Construction Sequence.
 - 3. One trip of one (1) working day during the warranty period.
- B. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Resident representative on each day he is at the project.
- C. The factory-trained service representative shall make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust equipment as necessary until it has been field tested by the Contractor and the results of these tests have been accepted by the Engineer.

1.08 IDENTIFICATION

- A. Nameplates and Escutcheons shall be provided as indicated on the Drawings.

1.09 TRAINING

- A. The Contractor shall provide training for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section.
- B. Provide the services of an experienced, factory trained technician or service engineer of the variable frequency drive manufacturer at the jobsite for minimum of 1/2 day for training of

Owner personnel, beginning at a date mutually agreeable to the Contractor and the Owner. The technician shall be on duty at the site for at least 4 hours and shall be available 24 hours per day when required to provide advice concerning special problems with equipment and systems.

1.10 WARRANTY

- A. Contractor shall warrant that the material and workmanship of all components and the operation of the variable frequency drive system and auxiliary equipment is in accordance with the latest design practices and meets the requirements of this Specification.
- B. Warranty work shall include, but not be limited to, the following:
 - 1. Replace components found to be faulty and make changes in equipment arrangement or adjustments necessary to meet the equipment or functional requirements or this Specification.
 - 2. Warranty shall include system rewiring and substitution and rebuilt or additional equipment required during trial operation or subsequent operation of the unit during the period of this warranty.
 - 3. Warranty shall be in effect for a period of 24 months following final acceptance of the system.

1.11 CONSTRUCTION SEQUENCING AND CONSTRAINTS

- A. The Contractor is advised that the Work specified in this Section shall be performed on an operating facility. Work shall be sequenced and performed in a manner that minimizes disruptions to the Owner's facility. Pumps 1, 3, and 4 shall always remain in service and operational during construction.
- B. Only pump No. 2 shall be removed and replaced with a new drive. The new VFD shall be installed and fully tested prior acceptance. The Contractor shall allow for a minimum of one week of operating time on the tested pump.
- C. Work shall be scheduled and coordinated with the Owner. The Contractor shall notify the Owner a minimum of five (5) working days prior to removing any equipment from service. No equipment shall be removed from service without the approval of the Owner.
- D. The Contractor shall be responsible for returning the pumping equipment and related devices to a fully operational status as documented prior to the start of Construction. The Contractor shall have personnel on site during the VFD commissioning capable of troubleshooting electrical and control problems that may have been introduced by the installation of the new VFD equipment.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance. Equipment shall be designed, constructed, and installed in accordance with

the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

- B. The Contractor shall obtain the VFD from Schneider Electric who shall also manufacture the enclosure and major equipment components. Subcontracting of wiring will not be acceptable.
- C. The VFD in enclosure shall be Schneider Electric, Altivar 660. If this model is obsolete, the corresponding updated model by Schneider Electric, will be the only acceptable substitute. The VFDs shall be provided with harmonic distortion suppression equipment, and all other equipment specified herein and indicated on the Drawings for a complete and operable system.
- D. Motor control circuits shall be wired in accordance with the requirements specified herein and/or indicated on the Drawings.
- E. Variable frequency drive manufacturer shall be responsible for the successful application and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining all load, torque, speed and performance requirements from the respective sources and integrating these into a variable frequency drive system that fulfills the requirements of this Specification.
- F. The Contractor and variable frequency drive system manufacturer are cautioned regarding the review and compliance with the total Contract Documents. Typical examples are circuit breakers, motor circuit protectors, magnetic starters, relays, timers, control and instrumentation products, pilot devices including pushbuttons, selector switches and pilot lights, enclosures, conduit, disconnect switches, terminal boxes, and other equipment.

2.02 PRODUCT REQUIREMENTS

- A. Variable speed drives shall be adjustable frequency, adjustable voltage, pulse width modulated (PWM) design. The units shall be microprocessor controlled, fully digitally programmable, and capable of precise and repeatable speed regulation of three phase 480 volt AC NEMA Design B induction motors. Variable frequency drives for other than NEMA Design B induction motors (e.g. NEMA Design C) shall be coordinated with the requirements of that respective load.
- B. Drive units shall perform continuous self-diagnostics as well as load and drive self-check on startup.
- C. All drives shall have permanently mounted programming and display modules. These modules shall provide programming access to all drive parameters, display all fault codes to assist with diagnostics and provide a display of output speed in percent or load.
- D. This specification describes variable speed motor control which includes the design, fabrication, testing, installation, and support requirements for variable frequency drive systems for 3-phase, squirrel cage rotor, induction motors driving pumps.
- E. Each variable frequency drive to be a complete alternating current electric drive system including hardware, software, technical data, and spare parts necessary to accomplish

variable speed operation of an induction motor and load combination in accordance with the requirements as indicated on the Drawings and as described in these Specifications.

- F. Variable frequency drive system manufacturer shall be responsible for the design and performance of the entire drive system and shall either manufacture all items of equipment or supply them using coordinated specifications furnished to the original equipment manufacturers to insure compatibility and performance in accordance with this Specification. Variable frequency drive manufacturer shall coordinate with suppliers of the drive motors and driven equipment.
- G. Variable frequency drive system shall be suitable for operation as part of a 480 VAC, 3-phase, 60 Hertz power distribution system. The complete variable frequency drive system shall withstand the mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage.
- H. The variable frequency drive system shall be suitable to operate, at times, on a limited power source engine-generator set. The system shall be provided with equipment and devices to prevent waveform distortion as specified herein.
- I. Provide control and sequence logic as specified herein and indicated on the Drawings. Control and sequence logic shall be designed such that the motor-load combination can be operated in the manual mode upon control and sequence logic failure, including all necessary personnel and equipment safety interlocks.
- J. Design each variable frequency drive motor drive speed control system so that through simple programming by either factory engineers or Owner's trained operating personnel, specific control and protection functions can be attained.

2.03 DESIGN REQUIREMENTS

- A. The variable frequency drive system shall meet the requirements of this Specification without derating any of the induction motor operating parameters including service factor and nameplate horsepower. The variable frequency drive system manufacturer shall specifically identify special requirements or restrictions of the motor-load combination that may result from operation on the variable frequency drive system.
- B. The variable frequency drive shall consist of an 18-pulse diode semiconductor rectifier system, direct current link, and pulse width modulated inverter supplied with harmonic correction. The inverter shall invert the direct current voltage into an alternating current voltage at a frequency which shall be proportional to the desired speed. This alternating current voltage and frequency shall both vary simultaneously at a constant "Volts-Per-Hertz" ratio to operate the induction motor at the desired speed.
- C. Variable frequency drive shall operate from fixed frequency power supply and convert this input power into variable speed induction motor shaft power as required by this Specification. Provide each variable frequency drive with an input disconnecting means as indicated on the Drawings which shall be lockable. Include the necessary drive controllers and input/output contactors to accomplish the intended control of the variable frequency drive system.

- D. The overall drive system efficiency shall be a minimum of 95 percent when operating the specified motor-load combination at rated voltage, frequency, and current.

This efficiency shall be calculated as follows:

$$\text{Efficiency (\%)} = \frac{\text{Power (Load)}}{\text{Power (Supply)}} \times 100$$

- E. Power (Load) is the total 3-phase power delivered to the motor, measured at the output terminals of the drive system, including output filters or transformers. Power (Supply) is the total electrical power delivered to the drive system, measured at the input terminals of the variable frequency drive including input filters, line reactors, isolation transformers, or other harmonic distortion suppression equipment. Include power input required for auxiliary equipment (e.g., controls, fans, air conditioning, pumps) for complete system operating in this Power (Supply) total.
- F. Variable frequency drive shall provide smooth, stepless changes in motor speed and acceleration over the entire operating speed range from minimum to maximum speed (revolutions per minute). The variable frequency drive shall be provided with maximum and minimum frequency limits.
- G. Variable frequency drive system to maintain a desired output frequency (setpoint) with a steady state accuracy of 0.5 percent of rated frequency of 60 Hertz for a 24 hour period.
- H. Variable frequency drive to have an automatic current limit feature to control motor currents during startup and provide a "soft start" torque profile for the motor-load combination. The variable frequency drive shall also limit current due to motor winding or motor lead phase-to-phase short circuit or phase-to-ground short circuit. The current limit protection setting shall be field adjustable.

Variable frequency drive shall be furnished with programmable electronic overload and torque limits.

- I. Drive system shall achieve a desired output frequency (setpoint) with a repeatability of 0.1 percent of rated frequency of 60 Hertz.
- J. Drive system to be capable of operating the specified load continuously at any speed within the operating speed range of 10 percent to 100 percent of rated speed. The minimum and maximum continuous operating speeds shall each be adjustable within this speed range. The variable frequency drive shall provide for field adjustment of these setpoints.
- K. Drive system controls to be microprocessor-based and have controlled linear acceleration capability to ramp up the speed, revolutions per minute, of the motor-load combination from the minimum selected operating speed to the maximum selected operating speed in a minimum of 30 seconds. Provide two (2) field-adjustable speed setpoints for the variable frequency drive to skip equipment resonant frequencies. Provide controlled linear deceleration capability. The acceleration and deceleration time limits shall be field adjustable to values up to 120 seconds.

- L. Voltage or current unbalance between phases of the variable frequency drive output voltage shall not exceed 3 percent of the instantaneous values. The variable frequency drive system shall continuously monitor the output voltages and generate an alarm condition when the unbalance exceeds 3 percent. The system shall detect and generate a separate alarm for loss of any output phase voltage (single phasing). Phase unbalance shall be as defined by NEMA Standard MG-1.
- N. Variable frequency drive system to operate continuously without interruption of service or damage to equipment during transient input voltage variations of plus or minus 10 percent for a duration of 15 cycles. Unacceptable voltage fluctuations on the supply bus shall cause under or overvoltage protection to trip and remove supply voltage from the drive system. Variable frequency drive output voltage regulation shall be plus or minus 2 percent.

The variable frequency drive system shall be furnished with line surge protection.

- O. VFDs shall be provided for the motors described below:

- 1. Pump No. 1, 2, 3 and 4

Horsepower:	200 HP
Voltage:	460 V
FLA	217 A
RPM	1785
S.F	1.00
Inverter Duty Rated	

- P. The audible noise (sound pressure) level of a motor when operated from no load to full load with the variable frequency drive described herein shall not increase more than 5 decibels (dbA), at 5 feet in any direction from the motor, above its noise level when operated from a utility power source without the variable frequency drive.
- Q. Variable frequency drive shall generate an output that will not elevate the voltage levels at the motor terminals above the rating of the motor winding insulation ratings for output cable lengths of up to 250 feet. Variable frequency drives shall be provided with output reactors where indicated on the Drawings or where necessary to prevent elevated voltage levels at the motor terminals.
- R. VFD circuitry shall be designed such that the cooling fans only run when the VFD is producing and output. Designs that allow the VFD cooling fans to run continuously when the VFD is energized but not producing an output are not acceptable.

2.04 OPERATING CONDITIONS

- A. The following operating conditions are applicable for all equipment of this Specification.
 - 1. Humidity: 0-95 percent.
 - 2. Ambient Temperature: 0 degrees Celsius to plus 40 degrees Celsius.
 - 3. Altitude: up to 3,300 feet

4. Power Supply: 480 volts, 3-phase, 60 Hertz.
5. Available Short Circuit Duty: 65,000 kAIC.

2.05 SYSTEM FEATURES AND CHARACTERISTICS

- A. Controls and indicators to accomplish operation and maintenance shall be located on the variable frequency drive equipment assembly as specified herein and indicated on the Drawings. A Human Machine Interface (HMI) shall be furnished to provide controls and indicators to accomplish maintenance and operational functions as specified herein and shown on the Drawings. The HMI shall be password protected after startup to lock out unauthorized personnel from making changes. As a minimum, each VFD shall provide indication of the following:
 1. Input Voltage
 2. Output Voltage
 3. Output Current
 4. Output Frequency
 5. Output Speed: 0-100%
 6. Alarm Read-out: Display
- B. Each VFD shall be provided with automatic and manual controls as shown on the Drawings and as required to comply with all Specifications.
- C. Variable frequency drive system shall provide a 4-20 mADC output signal that is proportional to the drive output frequency for use as speed feedback or control and remote speed indication.
- D. Variable frequency drive system shall accept a 4-20 mADC input command signal to control the output frequency in the automatic and/or manual control modes as specified herein or indicated on the Drawings. The system shall accept the input increase/decrease command with a resolution that permits incremental changes in speed, revolutions per minute, equal to or less than 0.1 percent of rated speed.
- F. Variable frequency drive shall be furnished with a multiple attempt restart feature.
- G. Furnish a door mounted speed potentiometer where shown on the Drawings.
- H. Provide a circuit breaker with shunt trip coil and current-limiting fuses (if required) for each variable frequency drive. Provide each variable frequency drive with its respective drive controller for each motor.
- I. Include in each variable frequency drive system an automatic trip feature which will remove the drive output from the motor and allow it to decelerate safely. This automatic system shall trip and indicate the fault only upon the following conditions:

1. Output voltage unbalance (trip threshold field set).
 2. Open phase.
 3. Motor overload.
 4. Motor stator winding fault (phase-to-ground, phase-to-phase).
 5. Loss of input power to the variable frequency drive or unacceptable voltage variation.
 6. High variable frequency drive equipment temperature.
 7. Variable frequency drive system failure as determined by the manufacturer.
 8. Component failure.
 9. Overcurrent.
 10. Undercurrent.
- J. Provide each variable frequency drive system with transmitted and received radio interference protection. In addition, provide protection against starting a rotating motor, both directions (coasting to zero speed and backspin). In the event that a motor automatic restart feature (catch the motor "on-the-fly") is provided in the drive controller as standard, this feature shall be capable of being disabled.
- K. Variable frequency drive design shall include on-line diagnostics, with an automatic self-check feature that will detect a variable frequency drive failure which in turn affects motor operation and generates an alarm contact output rated for 125 VDC suitable for interfacing with the control system.
1. Diagnostics shall operate a visual alarm indicator that is visible on the variable frequency drive equipment cabinets without opening the cabinet doors.
 2. Diagnostics shall provide an easily readable output that will isolate a failure.
 3. Provide an event and diagnostic recorder to printout in narrative English of the specific fault(s) and the sequence in which the faults occurred. An indication of the "First Out" failure is a minimum for fault sequence detection.
 4. Provide a normally open dry contact for each alarm function to enable remote indication.

2.06 ENCLOSURES

- A. Unless otherwise specified or indicated on the Drawings, the variable frequency drive enclosures shall be NEMA 1, force ventilated, dead-front, with front accessibility. Design enclosures for bottom entry of cables. Design variable frequency drive system so that rear cabinet access is not required for operations, maintenance, and repair tasks. Other enclosure requirements are:

1. Treat metal surfaces and structural parts by phosphatizing prior to painting.
 2. Apply a gun-metal gray undercoat to enclosures which is equal to zinc chromate.
 3. Finish exterior of the enclosures in ANSI-61 gray enamel or furnish in a color to match the complete line-up of equipment as indicated on the Drawings and accepted by the Engineer.
 4. The doors shall have full length piano type hinges.
 5. Brace each door to prevent sag when fully open.
- B. Furnish each variable frequency drive system with the control and indicating devices as specified herein and as indicated on the Drawings. Furnish main circuit breakers with an external operating handle interlocked with the door so that the door cannot be opened unless the disconnect switch is in the OFF position. Power supply to the motor from both the variable frequency drive and the bypass starter shall be capable of being positively locked in the OFF position. The disconnect switch shall be interlocked so that equipment cannot be energized when the door is open.
- C. Electrical bus, including ground bus, shall be tin-plated copper. Power and control wiring shall be copper, color coded and identified in accordance with these Specifications.
- D. Equipment shall be of modular construction allowing normal maintenance and repair to be done with ordinary hand tools. Design and install power electronic component assemblies so that, where practicable, components can be individually removed and replaced.
- E. Site Specific Requirements – VFD units are being supplied for installation into an existing facility. Cabinet dimensions are to match those indicated on the Drawings.

Cabinet shall be designed such that to accommodate both top and bottom cable entry. Provide space such that field cables can be routed between cabinets.

The Contractor shall field mount terminal blocks, as needed, to extend control wires that are not of sufficient length to reach the Manufacturer provided termination points.

2.08 HARMONIC DISTORTION SUPPRESSION

- A. A comprehensive pre-equipment-selection harmonic study shall be prepared by the Contractor. The results of this pre-equipment selection study shall be submitted to the Engineer as part of the submittals specified herein. Should this study confirm the harmonic output of the proposed equipment meets the harmonic limits specified herein.
- B. The harmonic distortion values resulting from operation of all or any variable frequency drive-driven motor-load combinations operating at full load shall be as defined in IEEE Standard 519.
1. Maximum allowable total harmonic voltage distortion (THD): 5 percent of the fundamental.

2. Maximum allowable individual frequency harmonic voltage distortion: within the limits of IEEE standard 519.
 3. Maximum allowable total demand distortion (TDD): within the limits of IEEE Standard 519-1992, Table 10.3.
 4. Maximum allowable individual frequency harmonic demand distortion: within the limits of IEEE Standard 519-1992, Table 10.3.
 5. The harmonic distortion levels shall be specific to the "Point of Common Coupling" (PCC). The PCC shall be the primary side of Utility Transformer XFMR1 as indicated on the Drawings.
- C. System single line diagrams and field access to the plant site will be provided to the Contractor for the purpose of providing this study. Contractor shall obtain from others other information that may be necessary to perform this study. Input data and other pertinent information used in harmonic study shall be coordinated by the Contractor with the following:
1. Input data/information/results of the short circuit fault analysis specified herein.
 2. Electrical system configuration and electrical equipment shop drawing submittal data including, but not being limited to new non-linear loads, new linear loads, and new capacitors.
- D. Preparation of this pre-equipment selection study does not relieve the requirement for the Contractor to perform and submit the results of a second, final comprehensive study prepared by a recognized independent authority acceptable to the Owner after equipment installation.
- E. In addition, the Contractor shall field measure actual harmonic distortion and verify with tests performed by an independent authority acceptable to the Owner after satisfactory full-load operation.
- F. As part of the specified harmonic studies and other work for this project, identify and correct resonance conditions in the electrical distribution system at no additional cost to the Owner. Shop drawings, data, location of the respective equipment and its connection to the electrical distribution system shall be acceptable to the Engineer.
- G. Reference Section 16000, Basic Electrical Requirements for information gained from the electric utility company during the design period which could be used for the purpose of the harmonic study. Inclusion of this information, however, does not relieve the Contractor nor his suppliers of the responsibility of obtaining all the necessary information required to perform the harmonic study.
- H. The VFDs shall be provided with an input isolation transformer connected to an 18 pulse diode front-end, a 24 pulse IGBT front-end with input isolation transformer.

2.09 MOTOR PROTECTION

- A. As shown on the Drawings.

2.10 MISCELLANEOUS

- A. Encapsulate critical components in ceramic or metal.
- B. Auxiliaries, including fans, that are required for rated load operation at maximum ambient temperature, shall be 100 percent redundant. A new and unused spare replacement fan(s) or air conditioning unit(s), shipped in original carton, may be acceptable.
- C. Circuit boards and electrical components shall meet the corrosion protection requirements specified in these Specifications. Varnished or epoxy encapsulated circuit boards and tropicalized contactors suitable for corrosive environments shall be furnished.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. The VFD's shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.
- B. Install VFD's to allow complete door swing required for component removal.

3.02 PAINTING

- A. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same coating as used for factory finishing coats.

3.03 FIELD TESTS

- A. Upon completion of the installation, and at a time approved by the Engineer, the Pump No 2 as a system will be tested by operating it as a unit with all related equipment, electrical and controls, and other ancillary facilities.
- B. The equipment will be placed in continuous operation as prescribed or required and witnessed by the Engineer or his assigned representative and the Owner or his assigned representative.
- C. The tests shall prove that the equipment and appurtenances are properly installed, meet their operating cycles and are free from defects such as overheating, overloading, and undue vibration and noise. Operating field tests shall consist of the following:
 - a. Check equipment for excessive vibration and noise as specified herein.
 - b. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.
 - c. Recheck as applicable, after unit has run under load for a minimum of 24 hours.
- D. Operate all systems of the Pump No 2 under Owner's direction demonstrating all modes of operations. This shall include, when practical, simulation of extreme conditions so as to

check the response of instrumentation and control devices, bypass functions, pumping cycles, etc. Contractor in coordination with the Owner shall be responsible for the complete operation of the systems of the pumping station, including equipment, valves, level instruments, switches, proper equipment devices, electrical systems, controls and associated components furnished and/or installed under this Contract.

- E. If any component of the System fails to operate in accordance with the Contract Documents during reliability testing, provide all necessary repairs, maintenance, replacement of parts, corrections, adjustments, and other actions necessary to restore proper operation of the systems. Required adjustments to equipment shall be made by a qualified manufacturer's representative. After the System is restored to proper operating conditions, restart the test. No credit will be given for operating time prior to system failures when calculating test durations. Examples of System failures include, but are not limited to the following:
 - a. Wet well overflows, level monitoring system malfunction or high level alarms.
 - b. Equipment failures and/or malfunctions.
 - c. Instrumentation failures or malfunctions.
 - d. Power distribution system malfunction
 - e. Loss of power to equipment and/or devices.
 - f. Controls malfunctions.
 - g. SCADA malfunctions
- F. Upon successful completion of field testing, the Pump No 2 shall be delivered to the Owner for utilization.
- G. Until final field tests are acceptable to the Engineer, the Contractor shall make all necessary changes, re-adjustments, and replacements at no additional cost to the Owner.
- H. Defects which cannot be corrected by installation adjustments will be sufficient grounds for rejection of any equipment.
- I. All costs in connection with field testing of equipment such as lubricants, temporary instruments, labor, equipment, etc., shall be borne by the Contractor. Power, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied by the Owner unless otherwise specified in the individual equipment specifications.
- J. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

- END OF SECTION -

SECTION 16500

LIGHTING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.
- B. Lighting shall be in accordance with the latest requirements of the Illuminating Engineering Society, and all lighting fixtures shall have the Underwriters Laboratories, Inc. label of approval.
- C. All wiring shall be placed in conduit and shall comply with the Specifications for conduit, outlet boxes, pull and junction boxes, wires and cables, grounding, and other Sections as set forth in these Specifications and as noted herein.
- D. Reference Section 16000, Basic Electrical Requirements, and Section 16170, Grounding and Bonding.

1.02 CODES AND STANDARDS

- A. The equipment specified herein shall comply with the following codes and standards, where applicable.
 - 1. Underwriter's Laboratories, Inc. (UL):
 - a. UL 844 – Luminaires for Use in Hazardous (Classified) Locations
 - b. UL 1598 – Luminaires
 - 2. American National Standards Institute (ANSI):
 - a. ANSI C62.41 – Guide for Surge Voltages in Low-Voltage AC Power Circuits
 - 3. National Electrical Code (NEC), latest edition.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall Submit shop drawings as follows:
 - 1. Manufacturers catalog data including complete catalog number, photometric data, and descriptive literature

1.04 LIGHTING CONTROLS

- A. The lighting systems shall be controlled as indicated on the Drawings.

1.05 WARRANTY

- A. The manufacturer's warranty shall in no event be for a period of less than five (5) years from date of delivery of fixtures to the project site and shall include repair labor, travel expense necessary for repairs at the jobsite, shipping costs, expendables used during the course of repair, or complete replacement of the failed lighting unit.
- B. Warranty for LED fixtures shall be provided for the entire fixture and shall include all parts and accessories. Submittals received without written warranties as specified shall be rejected in their entirety.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 FIXTURES

- A. Each fixture shall bear the Underwriters Laboratories, Inc. label. All lighting fixtures shall be furnished complete with lamps of the size and type as indicated on the Drawings and all fittings and hardware necessary for a complete installation. Lighting fixtures shall have all parts and fittings necessary to completely and properly install the fixtures.
- B. Fixture leads shall be as required by NEC and shall be grounded by the equipment grounding conductor in the conduit.
- D. Fixtures for use in hazardous locations shall be UL 844 Listed.
- E. Fixtures specified to be damp or wet locations rated shall be UL 1598 listed.
- F. Fixtures shall be as specified in the fixture schedule on sheet E-9.

2.03 LED DRIVERS

- A. Drivers shall have a voltage range of 120 +/- 10% at a frequency 60Hz.
- B. All drivers shall be designed to a power factor >90% with a total harmonic distortion THD <20% at full load.
- C. Case temperature shall be rated for -40°C through +80°C.
- D. Drivers shall have overheat protection, self-limited short circuit protection and overload protected.
- E. Drivers shall be furnished with a fused primary.
- F. Drivers shall have an output current ripple <30%
- G. Drivers shall be manufactured by Advance, Universal or equal.
- H. Drivers shall be UL Listed for damp location, UL1012, UL935, ROHS.
- I. Drivers shall meet FCC 47 Sub Part 15.
- J. All drivers shall be provided with ANSI/IEEE C62.41 Category C (10kV/5kA) surge protection.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Lighting fixtures shall be located symmetrically with building lines as shown on the Drawings. The Contractor shall furnish and install the lighting fixtures to allow "convenient" access for maintenance such as cleaning, relamping, and other activities. The fixtures shall be installed to be accessed by a 12 ft. (max.) ladder. Where fixtures are shown in locations on the Drawings where maintenance would be difficult, the Contractor shall notify the Engineer for direction.
- B. The Contractor shall provide and install all inserts, conduit, structural supports as required, lamps, wiring, and any other items required for a complete system. Contractor shall properly adjust and test, to the satisfaction of the Engineer, the entire lighting system. The Contractor shall provide pigtails and flexible conduit connected to an outlet box where necessary or required resulting in a neat and complete installation.
- C. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like. Before final acceptance, all fixtures and devices shall be cleaned of all dust, dirt or other material, be fully re-lamped (except LED fixtures) and in operating condition to the satisfaction of the Engineer.
- D. The Contractor shall furnish and install all boxes for lighting fixtures such that the box is not the sole support of the fixture. The boxes shall be offset to allow maintenance such

that access to wiring within the box can be attained without having to consider supporting (holding) the fixture.

- E. All lighting units, when installed, shall be set true and be free of light leaks, warps, dents, and other irregularities. All hangers, cables, supports, channels, and brackets of all kinds for safely erecting this equipment in place, shall be furnished and erected in place by the Contractor.
- F. The Contractor shall support each fixture securely. Each fixture shall be secured to the building structure. The Contractor shall not secure fixtures to the work of other trades, unless specified or noted otherwise, and shall not support fixtures from plaster. The Contractor shall furnish and install all steel members and supports as required to fasten and suspend fixtures from the structure.
- G. In all mechanical equipment areas, the Contractor shall install lighting fixtures on the ceiling after all piping and equipment therein has been installed. Exact locations for such fixtures may be determined by the Engineer on the site during the course of the work.
- H. Upon completion of work, and after the building area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, and lamps.
- I. Relamping access of fixtures including LED fixtures shall require no special tools. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of special tools. No fixture part that may be removed, for maintenance, shall be held in place by metal tabs that must be bent to remove said part.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1.

- END OF SECTION -

SECTION 16902

ELECTRIC CONTROLS AND RELAYS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.
- B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.
- C. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings.
- D. Reference Section 16000, Basic Electrical Requirements and Section 16195, Electrical Identification.
- E. The Contractor shall furnish and install, as specified herein and indicated on the Drawings, all motor control components and wiring for all motor-operated equipment furnished under this Section and all other Sections as indicated. The Contractor shall review the entire Contract Documents to be totally familiar with his responsibilities.
- F. The Contractor shall furnish and install all external power and control wiring to control panels of prewired packaged equipment, unless indicated otherwise.
- G. Control wiring requirements are indicated in electrical schematics and descriptions on the Drawings, and in equipment manufacturer's equipment data. The Contractor shall furnish and install all control wiring in accordance with these Contract Documents. The Contractor shall provide all control circuits and wiring for a particular item of equipment in accordance with requirements as set forth by the manufacturer of the particular item of equipment.
- H. As specified herein and indicated on the Drawings, furnish and install instrumentation wiring and connections to instrumentation equipment furnished under all Contracts of this Specification. Unless indicated otherwise, motor control switches, pilot lights, relays, and other control equipment for mounting in instrumentation panels shall be furnished, installed, and wired by the Contractor.
- I. Where pumps provided by others are furnished with solenoid valves or other devices for control, the Contractor shall wire these valves or devices.
- J. Unless otherwise specified herein or indicated on the Drawings, motor controllers shall be wired to drop out and remain dropped out on loss of power to the line side of the controller. Operator action shall be required to restart the motor unless the motor is intended to automatically restart.

- K. Motor control components and control wiring shall conform to NEMA Specifications ICS-1970 (Revised, 1975), Industrial Controls and Systems.
- L. Where devices are installed on the doors of NEMA 4, 4X, or 3R enclosures, devices shall be selected and installed to maintain the NEMA rating of the enclosure.
- M. Wiring in all starters, panels, junction boxes, and similar equipment shall be brought out to numbered terminal strips for interconnection. The Contractor shall be responsible for documenting terminal numbers for all starters, controls, panels, and similar equipment provided under the Contract. At the completion of the project, the Contractor shall submit a complete set of record drawings showing and/or listing all terminals in boxes, panels, starters, and similar equipment in a single, complete bound package for the equipment and control supplied under the Contract.
- N. The Contractor is responsible for coordinating the electrical work under the Contract with all equipment starters, controls, and instruments provided by others. The Contractor shall verify and coordinate with process equipment power supply and voltage, process equipment control power supply and voltage, and details of installation and interconnection. Coordination shall include distribution of approved electrical shop drawings to the General Contractor's equipment suppliers.
- O. Electrical control schematic diagrams drawn using a ladder-type format in accordance with JIC standards shall be submitted for all electrical equipment which is being provided under the Contract.
- P. Where space or strip heaters are provided within the enclosures for electrical equipment, the Contractor shall make connections to these heaters from an appropriate power source and operate the heaters with temperature control as necessary until the equipment is installed and operated according to its intended use.
- Q. Control stations shall be furnished and installed at each motor and at all other controlled devices (e.g. solenoid valves) as specified herein and indicated on the Drawings.

1.02 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
- B. Each submittal shall be identified by the applicable specification section.

1.03 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

- B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. The electrical control and relay systems and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.
- E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same part number.

PART 2 -- PRODUCTS

2.01 CONTROL COMPONENTS

- A. Pilot Devices
 - 1. Pushbuttons (PB) and selector switches (SS) shall be Type E34 as manufactured by Eaton Corporation, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company Type CR104P, The Square D Company equivalent, or Allen-Bradley equivalent. Pushbuttons and selector switches shall be 30.5 mm, heavy-duty, oil tight NEMA 4X corrosion resistant with legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Pushbuttons and selector switches shall be non-illuminated. Pushbuttons shall

include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release.

2. Pushbuttons and selector switches for all electrical equipment shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
3. Pushbuttons, selector switches, and other pilot devices for pump control panels shall be as specified herein and as shown on the Drawings.
4. Engraved nameplates shall be securely fastened to the front of each pushbutton station, disconnect switch, and motor starter remotely located from the motor control center. If adequate space is not available, the nameplate shall be mounted below the push button station. Nameplates shall be as specified in Section 16195, Electrical Identification. Identify all switches, control stations, and motor controllers as to their respective equipment.
5. Pilot lights shall be Type E34 as manufactured by Cutler- Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company Type CR104P, The Square D Company equivalent, or Allen-Bradley equivalent. Pilot lights shall be of the proper control voltage, LED type, push to test, heavy-duty, corrosion-resistant NEMA 4X with legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Pilot light lens colors shall be as follows:

Red	-	"Run", "On", "Open"
Green	-	"Off", "Closed"
Amber	-	"Alarm", "Fail"
White	-	"Control Power On"
6. Pilot lights for all electrical panels shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.
7. Pilot lights for pump control panels shall be round with custom engraved legend plates for each pilot light.

B. Control and Timing Relays

1. Control Relays (CR) shall be Type DP3 as manufactured by Eaton Corporation, Type CR420 as manufactured by General Electric Company, Potter-Brumfield equivalent, The Square D Company equivalent, Siemens Energy and Automation Inc. equivalent, or Allen-Bradley equivalent. Relays shall be general purpose plug-in type with coil voltage as shown on the Drawings and sealed 10 ampere contacts. All relays shall have three SPDT contacts rated 120/240 VAC and 28 VDC minimum. Machine tool relays shall be provided when the contact burden exceeds 10 amperes. The relays shall be furnished with an internal pilot light for positive indication of coil energization. The relays shall be furnished with a manual operator to manually switch the contacts to simulate normal operation. Miniature type or "ice cube" relays are not acceptable.

2. Timing Relays (TR) shall be the general purpose plug-in type, Type TR as manufactured by Eaton Corporation, Type TUC as manufactured by Diversified Electronics The Square D Company equivalent, Siemens Energy and Automation Inc. equivalent, or Allen-Bradley equivalent. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with two SPDT timed output contacts. Contact ratings shall be the same as for control relays as specified above.

C. Control Stations

1. Control Stations (CS) shall be as manufactured by Eaton Corporation, General Electric Company, The Square D Company equivalent, Siemens Energy and Automation Inc., or Allen-Bradley equivalent. Control stations shall be furnished and installed complete with pushbuttons, selector switches, and other pilot devices as specified herein or indicated on the Drawings. Stop pushbuttons shall be furnished with a lock-out device as specified herein and indicated on the Drawings.
2. Control station enclosures shall be cast aluminum with gasketed cover for all indoor dry areas. Control station enclosures shall be NEMA 4X stainless steel with gasketed cover for all indoor damp/wet process areas. Control station enclosures shall be NEMA 4X stainless steel with gasketed cover for all outdoor applications.
3. Control stations located in hazardous locations shall be suitable for the Class, Division, and Group to suit the application. The pilot devices shall be the factory sealed type mounted in enclosures as specified above.

D. Motor Starters

1. Open type motor starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be able to withstand 20 million operations. Each starter shall be furnished with a minimum of two spare auxiliary contacts in addition to the hold-in contact. Starters shall be provided with coils for 120 VAC operation, unless otherwise indicated on the Drawings.
2. The motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment.
3. Each starter shall be supplied with a manual reset overload relay. Manual reset shall be accomplished by a door mounted overload reset pushbutton. The relays shall be solid state type, with at least one isolated normally open and one isolated normally closed auxiliary contact that operates when a trip condition has occurred. Relays shall be self-powered, have a visible trip indicator, have a trip test function, and have selectable Class 10 or 20 operation. Overload relays shall be set for Class 10 operation unless otherwise directed by the Engineer. Overload relay shall have phase loss protection built in to trip the unit and protect the motor against single phasing. The Contractor shall provide the overload relay model with the correct current range for each application. Overload relay shall have adjustable current range dial. Eutectic alloy or bi-metallic type overload relays shall not be used.

4. Open type magnetic motor starters shall be Eaton Corporation Type AN16 or AN56 using NEMA rated Freedom Series contactors, General Electric Company equivalents, The Square D Company equivalents, Siemens Energy and Automation Inc. equivalents, or Allen-Bradley equivalent.

E. Miscellaneous

1. Selected motors are indicted as requiring elapsed time indicators. Provide Eagle Signal Type HK210A6, General Time Catalog #ED27NR, Allen-Bradley equivalent, or equal, elapsed time indicators for 120 VAC volt operation mounted flush in the respective motor starter compartment door. Where clearance is not obtainable for compartment door closing, mount timers in a separately mounted enclosure, with each timer nameplated. Wire elapsed time indicator to operate when the respective motor operates.
2. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or cabinet subpanel. Terminals shall be tubular screw type with pressure plate for wire size #22 - #8 AWG.
3. Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30A. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20A. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. There shall be a sufficient quantity of terminals for the termination of all spare field conductors.
4. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system may be acceptable.

The terminal blocks shall be as manufactured by Phoenix Contact, Inc., Wieland, Inc., or equal.
5. Alarm horns shall be as manufactured by Federal Signal Corporation, Edwards Signaling Company, EST (Edwards Systems Tech), or equal. Alarm horns shall be made for surface, flush, or semi-flush mounting on walls, panels, enclosures, or on square outlet boxes. Alarm horn sound output level shall be of 100 dB (nominal) at 10 feet.

PART 3 -- EXECUTION

3.01 CONFIGURATION OF CONTROLS AND EQUIPMENT

- A. All controls including wiring, control switches, pushbuttons, indicating lights, control interlocks and similar devices, shall be provided at the control voltages specified herein or indicated on the Drawings. Each motor starter shall be provided with a control power transformer mounted in the starter unit. Primary wiring to the control power transformer

shall be tapped to two (2) poles on the load side of the circuit breaker or fusible switch. Both primary wires shall be fused with 10- ampere, slow-blow fuses. The fuse on the ungrounded secondary side shall be capable of handling 100 percent to 125 percent of the rated control transformer secondary current. Control power transformers shall be provided with volt-ampere (VA) ratings equal to a minimum of 125 percent of the volt-ampere (VA) load connected to the transformer.

- B. All equipment, cabinets, and devices furnished under the Contract shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
- C. All equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided.
- D. All switches shall have double-pole, double-throw, contacts rated at a minimum of 600 VA, unless specifically noted otherwise.
- E. Materials and equipment used shall bear a U.L. label wherever such labeling of equipment and materials are available.
- F. Unless otherwise specified or indicated on the Drawings, all equipment shall be designed, furnished, and installed so that in the event of a power interruption, the equipment must be restarted manually after a power failure.
- G. All power terminals shall be insulated and identified.
- H. All instruments shall operate at 10 to 125 degrees F unless otherwise specified.
- I. Internal wiring within all starters, panels, instruments, junction boxes and similar equipment, shall be brought out to numbered terminal strips for interconnection and field wiring.
- J. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance with the component manufacturer's and industries' standard practices. All internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings, Specifications, and supplier's data.
- K. Unless otherwise noted, the Contractor shall provide all interconnecting wiring and conduit for complete control systems. The Contractor shall make all connections to equipment devices, instruments, and all components requiring electrical connection.
- L. The shield on each instrumentation cable shall be continuous from source to destination and shall be grounded as directed by the manufacturer of the instrumentation equipment. In no case shall more than one ground point be employed for each shield. All analog control

functions shall utilize 4-20 mADC control signals, unless otherwise specified. All analog transmission shall take place within shielded twisted cables which are not susceptible to interference or noise.

- M. Lightning/surge protection shall be provided to protect the instrumentation and control system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and shall be maintenance free and self-restoring. Equipment shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and, where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the enclosure or in a separate NEMA 4 junction box coupled to the enclosure.

3.02 FIELD TESTS

- A. The Contractor shall conduct field tests prior to operation of the equipment. The Engineer shall witness all field testing. Field testing shall be conducted at a time approved by the Engineer. Field tests shall be conducted for all hardware components and shall include a functional check of all items. Field tests shall include a functional check of all instruments and control equipment. All equipment shall be connected and fully operational for field testing. Field tests shall demonstrate that the controls perform according to the Contract requirements and that all equipment, valves, switches, controls, alarms, interlocks, indicating lights, and similar equipment function properly. Based on the results of field tests, the Contractor shall make any required corrections to equipment and controls and shall make any adjustments required to the control logic and control settings to achieve the specified operation or operation otherwise directed by the Engineer. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. The Contractor shall make modifications and adjustments to the controls as directed by the Engineer for optimizing operation of the overall system. All costs in connection with field tests of equipment provided under the Contract, shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of all motor starters and controls during the tests.

- END OF SECTION -

SECTION 17000

CONTROL AND INFORMATION SYSTEM SCOPE AND GENERAL REQUIREMENTS

PART 1 -- GENERAL

1.01 SCOPE

- A. The Contractor shall provide, through the services of an instrumentation and control system subcontractor, all components, system installation services, as well as all required and specified ancillary services in connection with the Instrumentation, Control and Information System. The System includes all materials, labor, tools, fees, charges and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system as shown and/or specified. The system shall include all measuring elements, signal converters, transmitters, local control panels, digital hardware and software, operator workstations, remote telemetry units, signal and data transmission systems, interconnecting wiring and such accessories as shown, specified, and/or required to provide the functions indicated.
- B. The scope of the work to be performed under this Division includes but is not limited to the following:
1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.
 2. Furnish and install process instrumentation and associated taps and supports as scheduled or shown on the Drawings, unless otherwise noted or supplied by equipment vendors.
 3. Furnish and install local control panels, field panels and associated cabinets and panels as shown on the Drawings and as specified in Division 17.
 4. Furnish and install digital control system hardware and software as specified in Division 17.
 5. Provide system testing, calibration, training and startup services as specified herein and as required to make all systems fully operational.
- C. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

- A. Control equipment provided under this Division of work must interface to controls and device provided under other Divisions of work. The Division 17 subcontractor shall coordinate with equipment suppliers to ensure the proper selection of electrical interfaces, accurate instrument drawings and meaningful testing procedures.

1.03 INSTRUMENTATION AND CONTROL SYSTEM SUBCONTRACTORS

- A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for water and wastewater treatment facilities, remote telemetry systems for water supply/distribution systems, and remote telemetry systems for wastewater collection systems. The instrumentation subcontractor shall be capable of demonstrating the qualifications described in Paragraph 1.03D.
- B. The Instrumentation and Control Subcontractor shall be responsible for all work under Division 17 except as described below. The work assigned to the Instrumentation and Control Subcontractor shall be performed by a single subcontractor with the qualifications as described in this Section.
- C. The work scope includes:
 - 1. Modifications to the existing Pump Control Panel, as required.
 - 2. Application programming for the Pump Control Programming.
 - 3. Application programming for the local operator interface display (LOI).
 - 4. Application program testing.
 - 5. Coordination of controls between the VFDs and the existing Pump Control Panel.
 - 6. Complete Operations and Maintenance Manuals for equipment and software included under the I&C Subcontractor's scope of work.
 - 7. Configuration of the alarm dialer.
 - 8. Start-up support services – Minimum 40 man hours (5x8 Hour Days).
 - 9. Operations and Maintenance Training – Minimum 24 instructor hours (6 x 4 Hour Days).
- D. Acceptable Instrumentation and Control Subcontractor shall be as listed below:
 - 1. M.C. Dean.

1.04 ENVIRONMENTAL CONDITIONS

- A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.
- B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (i.e., for dust).
- C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.
- D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets,

interconnecting hardware, and fasteners shall be aluminum, type 316 stainless steel, or metal alloy as otherwise suitable for chemical resistance within chemical feed/storage areas shown on the installation detail drawings.

PART 2 -- PRODUCTS

2.01 NAMEPLATES

- A. All items of equipment listed in the instrument schedule, control panels, and all items of digital hardware shall be identified with nameplates. Each nameplate shall be located so that it is readable from the normal observation position and is clearly associated with the device or devices it identifies. Nameplates shall be positioned so that removal of the device for maintenance and repair shall not disturb the nameplate. Nameplates shall include the equipment identification number and description. Abbreviations of the description shall be subject to the Engineer's approval.
- B. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic plastic having white numbers and letters not less than 3/16-inch high on a black background.
- C. Nameplates shall be attached to metal equipment by stainless steel screws and to other surfaces by an epoxy-based adhesive that is resistant to oil and moisture. In cases where the label cannot be attached by the above methods, it shall be drilled and attached to the associated device by means of stainless steel wire.

PART 3 -- EXECUTION

3.01 CLEANING

- A. The Contractor shall thoroughly clean all soiled surfaces of installed equipment and materials.
- B. Upon completion of the instrumentation and control work, the Contractor shall remove all surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

3.02 FINAL ACCEPTANCE

- A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:
 - 1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.
 - 2. Completion of the Availability Demonstration.
 - 3. Completion of all specified control system training requirements.
 - 4. Completion of all punch-list items that are significant in the opinion of the Engineer.

B. Final acceptance of the System shall mark the beginning of the extended warranty period.

- END OF SECTION -

SECTION 17138

AUTOMATIC ALARM DIALER MODIFICATIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall remove alarm functions as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements

1.03 TOOLS, SUPPLIES, AND SPARE PARTS

NONE

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.01 REQUIREMENTS

- A. Remove auto dialer alarms as shown below.
- B. Add **new auto dialer alarms** as shown below.

- *Italicized “Inputs”, “Alarms”, etc. denote existing*

Input	Alarm	Signal Source	Action
1	<i>AC Fail</i>	<i>Dialer</i>	
2	<i>Wet Well No. 1 - High Level</i>	<i>Move from Bubbler to PLC</i>	
3	<i>Wet Well No. 2 - High Level</i>	<i>Move from Bubbler to PLC</i>	
4	<i>Sump High Level</i>	<i>Sump Pump CP</i>	
5	<i>Pump No. 1 - Failure</i>	<i>VFD Cabinet</i>	
6	<i>Pump No. 2 - Failure</i>	<i>VFD Cabinet</i>	
7	<i>Pump No. 3 - Failure</i>	<i>VFD Cabinet</i>	
8	<i>Pump No. 4 - Failure</i>	<i>VFD Cabinet</i>	
9	<i>Discharge Valve No. 1 - Fail</i>	<i>PLC</i>	
10	<i>Discharge Valve No. 2 - Fail</i>	<i>PLC</i>	
11	<i>Discharge Valve No. 3 - Fail</i>	<i>PLC</i>	
12	<i>Discharge Valve No. 4 - Fail</i>	<i>PLC</i>	
13	<i>Seal Water Pump Fail</i>	<i>Seal Water CP</i>	Remove
14	<i>Comminutor</i>	<i>Comminutor CP</i>	
15	<i>Air Tank Low Press</i>	<i>Air Comp CP</i>	Remove
16	<i>Wet Well Exh Fan Fail</i>	<i>HVAC CP</i>	
17	<i>Carbon Monoxide</i>	<i>Gas Detection Panel</i>	
18	<i>Low Oxygen</i>	<i>Gas Detection Panel</i>	
19	<i>Hydrogen Sulfide</i>	<i>Gas Detection Panel</i>	
20	<i>LEL</i>	<i>Gas Detection Panel</i>	
21	<i>Fuel Tank Leak</i>	<i>Fuel Tank Panel</i>	
22	<i>Fire Alarm Signal</i>	<i>Fire Alarm CP</i>	
23	General Odor Control Unit Alarm	Odor Control Unit CP	Add at Spare
24	<i>Spare</i>		

- END OF SECTION -

SECTION 17500

CABINETS AND ENCLOSURES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the control enclosures, with all spare parts, accessories, and appurtenances as specified herein and as shown on the Drawings.
- B. Control enclosures shall be assembled, wired, and tested in the instrumentation subcontractor's own facilities, unless specified otherwise. All components and all necessary accessories such as power supplies, conditioning equipment, mounting hardware, signal input and output terminal blocks, and plug strips that may be required to complete the system shall be provided.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Refer to Division 16 for additional requirements for cable, circuit breakers, disconnect switches, etc.

1.03 GENERAL INFORMATION AND DESCRIPTION

- A. The cabinet itself and all interior and exterior equipment shall be identified with nameplates. The equipment shall be mounted such that service can occur without removal of other equipment. Face mounted equipment shall be flush or semi-flush mounted with flat black escutcheons. All equipment shall be accessible such that adjustments can be made while the equipment is in service and operating. All enclosures shall fit within the allocated space as shown on the Drawings.
- B. Either manufacturer-standard or custom cabinetry may be furnished subject to the requirements of the Contract Documents and favorable review by the Owner.
- C. Due consideration shall be given to installation requirements for enclosures in new and existing structures. The Contractor shall examine plans and/or field inspect new and existing structures as required to determine installation requirements, and shall coordinate the installation of all enclosures with the Owner and all affected contractors. The Contractor shall be responsible for all costs associated with installation of enclosures, including repair of damage to structures (incidental, accidental or unavoidable).

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. Provide touch up paint matching the cabinet color.

PART 2 -- PRODUCTS

2.01 CABINETS AND PANELS

- A. Cabinets and panels shall be formed or welded construction, reinforced with Unistrut, Powerstrut, or equal to facilitate mounting of internal components or equipment. Sufficient access plates and doors shall be provided to facilitate maintenance and testing of the cabinet's equipment. Doors shall be removable. Cabinets and panels with any dimension 36 inches or greater shall be provided with removable lifting lugs designed to facilitate safe moving and lifting of the panel during installation. All doors shall be fitted with common-keyed locks.
- B. Cabinets and panels shall be minimum 14 USS gauge. Cabinets and panels with any dimension greater than 36 inches shall be 12 USS gauge.
- C. Cabinets shall be NEMA 4X stainless steel where located outside or as indicated on the Drawings. Cabinets not otherwise designated shall be NEMA 12.
- D. Cabinets and panels shall have doors on the front and shall be designed for front access. NEMA 12 cabinets shall be fitted with three-point door latches. Door latches for NEMA 4X cabinets shall be all stainless steel, fast operating clamp assemblies that do not require bolts or screws to secure.
- E. Panels and cabinets located outside fence-secured areas shall be fitted with padlockable latch kits.
- F. All cabinets and panels shall be provided with drawing pockets for as-built panel drawings. One copy of the appropriate panel as-built drawings shall be furnished and left in the pocket of each panel.
- G. Panels with any dimension greater than 36 inches that contain a programmable controller (PLC or DCU) shall be provided with a folding laptop programmer shelf on the inside of the door.
- H. Cabinets and panels shall be prefabricated cabinets and panels by Hoffman or Rittal. The Contractor may optionally provide cabinets that are custom-fabricated by the instrumentation subcontractor or by a reputable panel fabrication shop acceptable to the Engineer.

2.02 TERMINAL BLOCKS

- A. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the cabinet subpanel. Terminals shall be of the screw down pressure plate type as manufactured by Phoenix Contact, Wieland, Square D, or equal.
- B. Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30 amps.
- C. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20 amps.

2.03 SIGNAL CONVERTERS

- A. Signal converters shall be provided as required to provide control functions and to interface instrumentation and controls, equipment panels, motor control centers and other instrumentation and controls supplied under other Divisions to the controls provided herein.
- B. General Requirements – Converters shall be of the miniature type, utilizing all solid state circuitry suitable for mounting within new or existing cabinetry. Where sufficient cabinet space is not available, sub panels or supplemental enclosures shall be provided. Power supply shall be 120V, 60 hertz where required by the converter. Repeatability shall be 0.1% of span, deadband shall be 0.1% span, maximum. Where specific converters are not listed, but are required to interface with the process control system, they shall comply with the general requirements stated herein.
- C. Current to Current Isolators – Current to current isolators shall be furnished where necessary to provide an isolated current loop, calculations or signal amplification between the plant process control system and instrumentation and control loops. Isolators shall be sized such that resistance of existing loops shall not exceed maximum rated resistance. Isolators shall be as manufactured by AGM, Moore Industries, Rochester Instrument Systems (RIS), or equal.

2.06 CONTROL PANEL RELAYS

- A. Interposing Relays – Where required to interface between motor control centers, equipment controls, and control panels, interposing relays and associated control wiring circuitry shall be furnished and installed to provide the monitoring and/or control functions specified herein. Interposing relays shall be miniature type, DPDT, minimum 10 amp, 120 VAC contact rating. Relay coils shall be 120 VAC or 24 VDC as required. Relays shall be Type KU as manufactured by Square D, Potter & Brumfield, Allen-Bradley, or equal.
- B. Timing Relays – Timing Relays (TR) shall be the general purpose plug-in type, Type JCK as manufactured by Square D Company, Cutler-Hammer/Westinghouse Electric Corporation equivalent, Allen-Bradley equivalent, or equal. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with a minimum of two SPDT timed output contacts and instantaneous contacts where required. Contact ratings shall be the same as for interposing relays as specified above.
- C. Relays switching power to line voltage devices such as valve motors, solenoids, and motor driven equipment shall be in accordance with Section 16902 Electronic Controls and Relays.

2.07 PILOT DEVICES

- A. As described in Section 16902 Electronic Controls and Relays.

2.08 SURGE PROTECTION

- A. Provide surge/lightning protection as indicated. Surge protective Devices shall be UL 1449 and constructed as a replaceable module. Modules shall mount on a terminal block secured to a standard DIN rail. It shall be possible to replace the surge module without rewiring. Units shall provide line to line and line to ground protection. Protection level shall be < 1.5 kV, unless otherwise indicated.
- B. Modules shall include a visible status indicator displaying the health of the unit.
- C. Units shall be Phoenix Flashtrab/Plugtab, or an approved equal.
- D. Units shall be selected based on application as listed below:
 - 1. Line Voltage – Nominal voltage 240v, 3 conductor protection, impulse protection to 50 kA.
 - 2. Analog Input – Nominal voltage 24 Vdc, impulse protection to 25 kA.
 - 3. Discrete input – Nominal voltage 24 Vdc, impulse protection to 25 kA.
- E. Communications surge protection shall be specifically designed for the data traffic be handled with surge protection rating adequate for use with the equipment.

2.07 INTRINSICALLY SAFE COMPONENTS

- A. Instrumentation and devices rated for use in Hazardous Areas shall be installed in accordance with Vendor certified control drawings. Intrinsically safe relays and/or barriers shall be provided as indicated on the Drawings; and as required to meet the installation requirements of the devices provided.
- B. General Requirements:
 - 1. IS Relays and Barriers shall be modular units built for DIN rail mounting.
 - 2. IS Relays and barriers shall be mounted in suitably sized enclosures with a hinged door to allow access.
 - 3. Enclosures shall be solidly grounded.
- C. Intrinsically Safe Relays – Used to interface 110 VAC digital inputs (or outputs) to field devices located in Hazardous Areas. GEMS SafePak or approved equal.
- D. Intrinsically Safe Barrier (Analog) – Used to interface a 4-20 mA input or output (2-wire) with an approved Intrinsically Safe device mounted in a hazardous area. Stahl Series 9001 IS Barrier or approved equal.
- E. Intrinsically Safe Barrier (Digital) – Used to interface a 20-35 Vdc wetted digital input with an approved Intrinsically Safe device mounted in a hazardous area. Stahl Series 9001 IS Barrier or approved equal.
- F. Intrinsically Safe Isolator – Used with a remote powered (e.g. 4-wire) intrinsically safe field device connected to analog input in an unclassified area. Stahl Series 9164, or approved equal.

PART 3 -- EXECUTION

3.01 FABRICATION

- A. Enclosures shall provide mounting for power supplies, control equipment, input/output subsystems, panel-mounted equipment and appurtenances. Ample space shall be provided between equipment to facilitate servicing and cooling.
- B. Enclosures shall be sized to adequately dissipate heat generated by equipment mounted inside the panel. If required, one or more of the following shall be provided to facilitate cooling:
 - 1. Louvered openings near the bottom and top (NEMA 12 cabinets only).
 - 2. Thermostatically controlled, low noise internal air blowers (initial setpoint 75°F) to circulate air within the enclosure, maintaining a uniform internal temperature.
 - 3. Thermostatically controlled, low-noise cooling fans to circulate outside air into the enclosure, exhausting through louvers near the top of the cabinet (NEMA 12 cabinets only). Air velocities through the enclosure shall be minimized to assure quiet operation.
 - 4. All openings in cabinets and panels shall be fitted with dust filters.
- C. Enclosures shall be constructed so that no screws or bolt heads are visible when viewed from the front. Punch cutouts for instruments and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges.
- D. The temperature inside each enclosure containing digital hardware (i.e., cabinet, panel or console) shall be continuously monitored and shall generate an alarm to the nearest PLC if the temperature rises to an adjustable, preset high temperature.
- E. Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system will be acceptable.
- F. Wiring shall comply with accepted standard instrumentation and electrical practices. Power, control and signal wiring shall comply with Division 16 of the specifications. For each pair of parallel terminal blocks, the field wiring shall be between the blocks.
- G. Separate terminal strips shall be provided for each type of power and signal used within each cabinet.
- H. All wiring shall be bundled and run open or enclosed in vented plastic wireway as required. Wireways shall be oversized by a minimum of 10%; overfilled wireways shall not be acceptable. All conductors run open shall be bundled and bound at regular intervals, not

exceeding 12 inches, with nylon cable ties. Care shall be taken to separate electronic signal, discrete signal, and power wiring.

- I. A copper 120 VAC ground bus shall be installed in each cabinet, and shall be connected to the building power ground. A separate, isolated copper ground bus shall be installed in each cabinet for the logic (24 VDC) ground. Both ground buses shall be clearly labeled as to voltage and function.
- J. Interior panel wiring and field wiring shall be tagged at all terminations with machine-printed plastic sleeves. The wire numbering system and identification tags shall be as specified in Section 16123 - Building Wire and Cable. Where applicable, the wire number shall be the ID number listed in the input/output schedules.
- K. Wires shall be color coded as follows:
 - Equipment Ground - GREEN

 - 120 VAC Power - BLACK
 - 120 VAC Power Neutral - WHITE

 - 120 VAC Control (Internally Powered) - RED
 - 120 VAC Control (Externally Powered) - YELLOW

 - 24 VAC Control - ORANGE

 - DC Power (+) - RED
 - DC Power (-) - BLACK
 - DC Control - BLUE

 - Analog Signal – BLACK/WHITE or BLACK/RED
- L. Enclosures shall be provided with a main circuit breaker and a circuit breaker on each individual branch circuit distributed from the panel. Main breaker and branch breaker sizes shall be coordinated such that an overload in a branch circuit will trip only the branch breaker but not the main breaker.
- M. Enclosures with any dimension larger than 36 inches shall be provided with 120-volt duplex receptacles for service equipment and fluorescent service lights. Power to these devices shall be independent from the PLC power supply and its associated uninterruptible power system.
- N. Where applicable, enclosures shall be furnished with red laminated plastic warning signs in each section. The sign shall be inscribed "WARNING - This Device Is Connected to Multiple Sources of Power". Letters in the word "WARNING" shall be 0.75 inch high, white.
- O. The interconnection between equipment and panel shall be by means of flexible cables provided to permit withdrawal of the equipment from the cabinet without disconnecting the plugs.

3.02 PAINTING

- A. All steel enclosures shall be free from dirt, grease, and burrs and shall be treated with a phosphatizing metal conditioner before painting. All surfaces shall be filled, sanded, and finish coated by spraying a 1-2 mil epoxy prime coat and smooth, level, high grade textured finish between flat and semi-gloss shine. The colors shall be selected by the Owner from a minimum of six color samples provided. Refer to Division 9 for additional requirements.
- B. Materials and techniques shall be of types specifically designed to produce a finish of superior quality with respect to adherence, as well as impact and corrosion resistance.
- C. Panels fabricated from stainless steel shall not be painted.

3.03 INSTALLATION

- A. Refer to Section 17000 for additional requirements.

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SECTION 17600

UNPOWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The instrumentation subcontractor shall furnish, install, test and place in operation process instrumentation (flow elements, pressure switches, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process controls as shown on the Drawings and as specified. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.
- C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17500 – Enclosures, General
- C. Section 17698 – Instrumentation and Control System Accessories
- D. Section 17700 – Powered Instruments, General
- E. Section 17800 – Analytical Instruments, General
- F. Unpowered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 17050.
- B. In addition to the above requirements, the instrumentation subcontractor shall provide spare parts as specified in individual instrument specification sections.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified, instruments shall be provided with enclosures to suit specified environmental conditions. Field-mounted devices shall be rugged and mounted on walls or pipe stanchions.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and Shop Drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
- B. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
- C. Embedded pipe supports and sleeves shall be Schedule 40, Type 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
- D. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
- E. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.

3.02 ADJUSTMENT AND CLEANING

- A. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.

- B. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.
- C. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation and control system.
- D. Field instrument calibration requirements shall conform to the following:
1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
 2. Each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
 3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
 4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
 5. Upon completion of calibration, devices shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.

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SECTION 17650
PRESSURE GAUGES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure gauges, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17600 – Unpowered Instruments, General
- C. Section 17910 – Instrument Schedule

PART 2 -- PRODUCTS

2.01 PRESSURE GAUGES

- A. All gauges shall be designed in accordance with the ASME B40.1 entitled, "Gauges, Pressure, Indicating Dial Type - Elastic Element".
- B. All gauges shall be direct reading type. Snubbers shall be provided on all gauges. Gauge full-scale pressure range shall be selected such that the maximum operating pressure shall not exceed the approximately 75% of the full-scale range.
- C. Features
 - 1. Mounting: ½" NPT, lower stem mount type
 - 2. Accuracy: 0.5% full scale
 - 3. Case: Solid front, black phenolic material
 - 4. Dial: White background and black letters
 - 5. Glass: Shatterproof
 - 6. Blow-out protection: Back
 - 7. Pressure element: stainless steel bourdon tube
 - 8. Movement: Stainless steel, Teflon coated pinion gear and segment
 - 9. Gaskets: Buna-N
- D. Liquid-filled or equivalent mechanically-damped gauges shall be used if the gauges are installed with pumps, or where gauges are subjected to vibrations or pulsation. Filling fluid shall be silicone unless oxidizing agents such as sodium hypochlorite are present, where halocarbon shall be used.

- E. Gauge size shall be 2" for line sizes up to 3" and 4½" for line sizes of 4" or greater.
- F. Diaphragm seals and isolating ring seals shall be furnished in accordance with the requirements specified under Section 17698 - Instrumentation and Control System Accessories.
- G. The complete gauge assembly and appurtenances shall be fully assembled and tested prior to field mounting. A ½" isolation stainless steel ball valve shall be provided for each gauge assembly.
- H. Pressure and vacuum gauges shall be Ashcroft Duragauge Model 1279, Ametek-U.S. Gauge Division, H.O. Trerice Co., WIKA Instrument Corporation, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600, Part 3.

- END OF SECTION -

SECTION 17700

POWERED INSTRUMENTS, GENERAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The instrumentation subcontractor shall furnish, install, test and place in operation powered process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface all instrumentation, panels, controls and process equipment control panels with the process control system as shown on the Drawings and as specified. Powered instruments are those instruments that require power (120 VAC or 24 VDC loop power) to operate. The Contractor may elect to install primary elements (flowmeters, etc.) on process lines provided that the instrumentation subcontractor provides full on-site supervision during installation. Mounting of associated transmitters, indicators, power supplies, brackets and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of process instrumentation on process lines shall be provided under this Contract. The instrumentation subcontractor shall supervise installation of equipment provided under this Division where installation is provided by others.
- C. Tapping and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. The Contractor shall ensure that the location, supports, orientation and dimensions of the connections and tapping for instrumentation furnished under this Division are such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 – Control and Information System Scope and General Requirements
- B. Section 17500 – Enclosures, General
- C. Powered instruments furnished with mechanical equipment shall be furnished, installed, tested and calibrated as specified elsewhere in the Contract Documents.

1.03 TOOLS, SUPPLIES AND SPARE PARTS

- A. Tools, supplies and spare parts shall be provided as specified in Section 17050.
- B. In addition to the above requirements, the instrumentation subcontractor shall provide one remote handheld configuration device for communication with all "smart" instruments furnished under this Contract. The devices shall be capable of performing configuration, test, and format functions from anywhere on the 4-20 mA signal loop for a particular transmitter or by direct connection. The configuration device shall be Fischer & Porter Model 50HC1000, Rosemount Model 375, or equal.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings, or as required.
- B. Equipment installed in a hazardous area shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electrical Code.
- C. All field instrumentation for outdoor service shall be provided with enclosures which are suitable for outdoor service, as follows:
 - 1. Where the manufacturer's enclosures are suitable for outdoor service, they shall be provided with instrument sunshades. Sunshades shall be Style E as manufactured by O'Brien Corporation, or equal. Where possible, these instruments shall be mounted in a north facing direction.
 - 2. Where the manufacturer's standard enclosures are not suitable for outdoor service, instruments shall be mounted in Field Panels in accordance with Section 17520, Field Panels, or may be furnished with Vipak instrument field enclosures as manufactured by O'Brien Corporation, equivalent by Intertec, or equal. It shall not be necessary to provide the manufacturer's NEMA 4 or 4X enclosures for instruments that will be subsequently mounted in separate field panels.
- D. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
- E. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in Subsection 3.01 (B) herein. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable (except for speed and valve position). Isolated outputs shall be provided for all transmitters.

- F. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass or PVC coated copper-free cast aluminum NEMA 4X construction.
- G. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.
- H. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture and fungus. Solid-state components shall be conservatively rated for long-term performance and dependability over ambient atmosphere fluctuations. Ambient conditions shall be -20 to 50 degrees C and 20 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
- I. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.
- J. All non-loop-powered instruments and equipment shall be designed to operate on a 60 Hz AC power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
- K. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
- L. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. General

1. Equipment shall be located so that it is accessible for operation and maintenance. The instrumentation subcontractor shall examine the Drawings and shop drawings for various items of equipment in order to determine the best arrangement for the work as a whole, and shall supervise the installation of process instrumentation supplied under this Division.
2. Electrical work shall be performed in compliance with all applicable local codes and practices. Where the Contract Documents do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

1. Field equipment shall be wall mounted or mounted on two-inch diameter pipe stands welded to a 10-inch square by 1/2-inch thick base plate unless shown adjacent to a wall or otherwise noted. Materials of construction shall be aluminum or 316 stainless steel. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than 1/2-inch by use of phenolic spacers. Expansion anchors in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
2. Embedded pipe supports and sleeves shall be schedule 40, 316 stainless steel pipe, ASA B-36.19, with stainless steel blind flange for equipment mounting as shown on the Drawings.
3. Materials for miscellaneous mounting brackets and supports shall be 316 stainless steel construction.
4. Pipe stands, miscellaneous mounting brackets and supports shall comply with the requirements of Division 5 of the specifications.
5. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring

1. Electrical, control and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.02 ADJUSTMENT AND CLEANING

A. General

1. The instrumentation subcontractor shall comply with the requirements of Division 1 of these Specifications and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserves the right to witness any test, inspection, calibration or start-up activity. Acceptance by the Engineer of any plan, report or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.
2. The instrumentation subcontractor shall provide the services of factory trained technicians, tools and equipment to field calibrate, test, inspect and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor

shall bear all costs and provide all personnel, equipment and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

3. At least 60 days before the anticipated initiation of installation testing, the Contractor shall submit to the Engineer a detailed description, of the installation tests to be conducted to demonstrate the correct operation of the instrumentation supplied hereunder.

B. Field Instrument Calibration Requirements

1. The instrumentation subcontractor shall provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument supplied under this Contract to its specified accuracy in accordance with the manufacturer's specification and instructions for calibration.
2. If the manufacturer's recommendations require calibration, each instrument shall be calibrated at 0, 25, 50, 75 and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five (5) times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracy's as set forth by the National Institute for Standards and Technology (NIST).
3. The instrumentation subcontractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. The Contractor shall submit proposed calibration sheets for various types of instruments for Engineer approval prior to the start of calibration. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures described herein, name of person performing the calibration, a listing of the published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required and corrections made.
4. If doubt exists as to the correct method for calibrating or checking the calibration of an instrument, the manufacturer's printed recommendations shall be used as an acceptable standard, subject to the approval of the Engineer.
5. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices from being subjected to overvoltages, incorrect voltages, overpressure or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.
6. After completion of instrumentation installation, the instrumentation subcontractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

- END OF SECTION -

SECTION 17775

PRESSURE SWITCHES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation the pressure switches, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17000 - Control and Information System Scope and General Requirements
- B. Section 17700 - Powered Instruments, General
- C. Section 17910 – Instrument Schedule

PART 2 -- PRODUCTS

2.01 PRESSURE SWITCHES

- A. Pressure, vacuum, and differential pressure switches shall be single or dual action with an adjustable setpoint for the process requirement and/or as specified herein. Switches shall be diaphragm or piston operated and activate S.P.D.T. snap action switches on increasing or decreasing pressure. Minimum differential shall be less than 10 percent of the range. Deadband shall be adjustable. Allowable surge pressure shall be a minimum 1.5 times the range. Each pressure switch shall have visible scale.
- B. Pressure switches shall have a contact rating of 10 amperes at 120 volts AC. Pressure switches shall be in NEMA 4X enclosures. Switches shall have a repeatable accuracy of 1 percent of range. Pressure switches shall be isolated from the process fluid by a diaphragm seal or an isolation ring in locations as shown on the Contract Drawings and/or as specified. Wetted parts materials shall be compatible with the process fluid for corrosion resistance. Pressure switches shall be manufactured by ASCO, SOR, Inc., Ashcroft, or equal.

PART 3 -- EXECUTION

3.01 REQUIREMENTS

- A. Refer to Section 17600 Part 3.

- END OF SECTION -

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SECTION 17910

INSTRUMENT SCHEDULE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all instrumentation as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17920 – Control System Input/Output Schedule
- B. Section 17950 – Functional Control Descriptions

PART 2 -- INSTRUMENT SCHEDULE

Level Switches (Suspended Float) - Section 17670			
Tag Number	Service Description	State/Span	Remarks
LSH-103	COOLING BLOWER INTERLOCK		Mount on pump motor.
LSH-104	COOLING BLOWER INTERLOCK		Mount on pump motor.

Pressure Switches- Section 17675			
Tag Number	Service Description	State/Span	Remarks
PSH-103	PUMP NO. 3 – DISCHARGE PRESSURE	0 – 150 psi	
PSH-104	PUMP NO. 4 – DISCHARGE PRESSURE	0 – 150 psi	
PSHD-103	PUMP NO. 3 – PRESSURE DIFFERENTIAL	0 – 30 psid	
PSHD-104	PUMP NO. 4 – PRESSURE DIFFERENTIAL	0 – 30 psid	

- END OF SECTION -

SECTION 17920

CONTROL SYSTEM INPUT/OUTPUT SCHEDULE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, test, install and place in satisfactory operation all control system inputs and outputs for new pumps 3 and 4 as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 17900 – Schedules and Control Descriptions
- B. Section 17910 – Instrument Schedule
- C. Section 17950 – Functional Control Descriptions

PART 2 -- CONTROL SYSTEM INPUT / OUTPUT SCHEDULE

Tag Number	Service Description	State/Span	Type	Remarks
RI-101	Pump 1 - Running Status		DI	
YI-101	Pump 1 - In Auto		DI	
XL-101	Pump 1 - In Bypass		DI	
XA-101	Pump 1 - VFD Fault		DI	
MAH-101	Pump 1 - Motor Moisture Alarm		DI	
TAH-101	Pump 1 - Motor Overtemp Alarm		DI	
HS-111	Pump 1 - Reset		DI	
PSHD-101	Pump No. 1 - Discharge Pressure Reached		DI	
PSH-101	Pump No. 1 - High Discharge Pressure		DI	
ZLO-101	Pump No. 1 - Discharge Valve Open Status		DI	
ZLC-101	Pump No. 1 - Discharge Valve Closed Status		DI	
ZCO-101	Pump No. 1 - Discharge Valve - Open Cmd		DO	
ZCC-101	Pump No. 1 - Discharge Valve - Closed Cmd		DO	
RC-101	Pump 1 - Run Command		DO	
SI-101	Pump No. 1 - Speed Feedback		AI	
SIC-101	Pump No. 1 - Speed Command		AO	
RC-111	Pump 1 - Cooling Blower - Run Command		DO	
RI-111	Pump 1 - Cooling Blower - Running Status		DI	
YI-111	Pump 1 - Cooling Blower - In Auto		DI	
RL-102	Pump 2 - Running Status		DI	
YI-102	Pump 2 - In Auto		DI	
XL-102	Pump 2 - In Bypass		DI	
XA-102	Pump 2 - VFD Fault		DI	
MAH-102	Pump 2 - Motor Moisture Alarm		DI	
TAH-102	Pump 2 - Motor Overtemp Alarm		DI	
HS-112	Pump 2 - Reset		DI	

Tag Number	Service Description	State/Span	Type	Remarks
PSHD-102	Pump No. 2 - Discharge Pressure Reached		DI	
PSH-102	Pump No. 2 - High Discharge Pressure		DI	
ZLO-102	Pump No. 2 - Discharge Valve Open Status		DI	
ZLC-102	Pump No. 2 - Discharge Valve Closed Status		DI	
ZCO-102	Pump No. 2 - Discharge Valve - Open Cmd		DO	
ZCC-102	Pump No. 2 - Discharge Valve - Closed Cmd		DO	
RC-102	Pump 2 - Run Command		DO	
SI-102	Pump No. 2 - Speed Feedback		AI	
SIC-102	Pump No. 2 - Speed Command		AO	
RC-112	Pump 2 - Cooling Blower - Run Command		DO	
RI-112	Pump 2 - Cooling Blower - Running Status		DI	
YI-112	Pump 2 - Cooling Blower - In Auto		DI	
RI-103	Pump 3 - Running Status		DI	
YI-103	Pump 3 - In Auto		DI	
XL-103	Pump 3 - In Bypass		DI	
XA-103	Pump 3 - VFD Fault		DI	
MAH-103	Pump 3 - Motor Moisture Alarm		DI	
TAH-103	Pump 3 - Motor Overtemp Alarm		DI	
HS-113	Pump 3 - Reset		DI	
PSHD-103	Pump No. 3 - Discharge Pressure Reached		DI	
PSH-103	Pump No. 3 - High Discharge Pressure		DI	
ZLO-103	Pump No. 3 - Discharge Valve Open Status		DI	
ZLC-103	Pump No. 3 - Discharge Valve Closed Status		DI	
ZCO-103	Pump No. 3 - Discharge Valve - Open Cmd		DO	
ZCC-103	Pump No. 3 - Discharge Valve - Closed Cmd		DO	
RC-103	Pump 3 - Run Command		DO	
SIC-103	Pump No. 3 - Speed Command		AO	
RC-113	Pump 3 - Cooling Blower - Run Command		DO	
SI-103	Pump No. 3 - Speed Feedback		AI	
RI-113	Pump 3 - Cooling Blower - Running Status		DI	
YI-113	Pump 3 - Cooling Blower - In Auto		DI	
RI-104	Pump 4 - Running Status		DI	
YI-104	Pump 4 - In Auto		DI	
XL-104	Pump 4 - In Bypass		DI	
XA-104	Pump 4 - VFD Fault		DI	
MAH-104	Pump 4 - Motor Moisture Alarm		DI	
TAH-104	Pump 4 - Motor Overtemp Alarm (Add)		DI	
HS-114	Pump 4 - Reset		DI	
PSHD-104	Pump No. 4 - Discharge Pressure Reached		DI	
PSH-104	Pump No. 4 - High Discharge Pressure(Add)		DI	
ZLO-104	Pump No. 4 - Discharge Valve Open Statu		DI	
ZLC-104	Pump No. 4 - Discharge Valve Closed Status		DI	
ZCO-104	Pump No. 4 - Discharge Valve - Open Cmd		DO	
ZCC-104	Pump No. 4 - Discharge Valve - Closed Cmd		DO	
RC-104	Pump 4 - Run Command		DO	
SI-104	Pump No. 4 - Speed Feedback		AI	
SIC-104	Pump No. 4 - Speed Command		AO	
RC-114	Pump 4 - Cooling Blower - Run Command		DO	
RI-114	Pump 4 - Cooling Blower - Running Status		DI	
YI-114	Pump 4 - Cooling Blower - In Auto		DI	
LI-105	Wet Well Level No. 1		AI	

Tag Number	Service Description	State/Span	Type	Remarks
LY-105	Wet Well No. 1 - High Level Alarm (to Dialer)		DO	
LI-110	Wet Well Level No. 2		AI	
LY-110	Wet Well No. 2 - High Level Alarm (to Dialer)		DO	
FI-100	Station Discharge Flow		AI	
	Pump 1 - Fail Status Indicator (In VFD)		DO	
	Pump 2 - Fail Status Indicator (In VFD)		DO	
	Pump 3 - Fail Status Indicator (In VFD)		DO	
	Pump 4 - Fail Status Indicator (In VFD)		DO	
	Discharge Valve Fail - Pump No. 1 (to Dialer)		DO	
	Discharge Valve Fail - Pump No. 2 (to Dialer)		DO	
	Discharge Valve Fail - Pump No. 3 (to Dialer)		DO	
	Discharge Valve Fail - Pump No. 4 (to Dialer)		DO	

Notes:

1. Input/Output types are as follows:

- DI - Discrete Input
- DO - Discrete Output
- AI - Analog Input
- AO - Analog Output
- RS485 - Serial Communications Link

- END OF SECTION -

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SECTION 17950

FUNCTIONAL CONTROL DESCRIPTIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The scope of this phase of work includes the replacement of four (4) VFD units and the replacement of two (2) Sewage Pumps. The Pump Control Panel is a PLC based pump control cabinet and is presently programmed for operation of the existing equipment. The Instrumentation and Control Subcontractor shall coordinate the new PLC I/O, modify the PLC/HMI code, perform testing and other activities as needed to integrate the new equipment into the existing control system. As modified, the overall pump control scheme shall operate as described in this section.
- B. The Contractor shall install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING COMPLETE FUNCTIONING SYSTEMS AS DESCRIBED HEREIN.
- C. Together with the control system input/output schedule, the equipment specifications (including functional descriptions for local equipment control panels), and the Drawings, the functional control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.
- D. THE FUNCTIONAL DESCRIPTIONS CONTAIN REQUIREMENTS FOR FURNISHING AND INSTALLING LABOR AND MATERIALS THAT MAY NOT APPEAR ELSEWHERE IN THE CONTRACT DOCUMENTS.
- E. All equipment and services required in equipment local control panels provided to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor through individual equipment suppliers.
- F. Unless specifically stated otherwise, all interconnecting wiring between all instruments, panels, controls, and other devices listed in the functional descriptions as required to provide all functions specified herein shall be furnished by the Contractor under Division 16. The Contractor shall provide all cable and conduit required to carry all signals listed in the process input/output schedules. Special cables that are required for interconnection between sensors or probes and transmitters or signal conditioners shall be furnished with the instrumentation devices by the equipment supplier.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01520 – Maintenance of Utility Operations During Construction
- B. Section 17138 - Automatic Alarm Dialer Modifications

- C. Section 17910 – Instrument Schedule
- D. Section 17920 – Control System Input/Output Schedule

PART 2 -- FUNCTIONAL CONTROL DESCRIPTIONS, GENERAL

2.01 DEFINITIONS

- A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR, etc.).
- B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).
- C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as overtorque, overtemperature, low oil pressure, high vibration, etc.
- D. OUT-OF-SERVICE indicates that the device is unavailable for automatic operation. Conditions for OUT-OF-SERVICE include device not in AUTO, device has an unreset alarm, or removed from service by the operator.

2.02 CONVENTIONS

- A. Operator Workstation graphic display symbols and indicator lights on all MCC's, control panels, starter enclosures, etc. shall conform to the following color convention:

<u>Condition</u>	<u>Color</u>
Running/On/Open	Red
Auto/Remote	White
Stopped/Off/Closed	Green
Fail/Alarm	Amber
Generic Status	Blue or White

2.03 PROCESS CONTROL

- A. Where setpoints, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions, the instrumentation subcontractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.
- B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:
 - 1. For alarms and control actions derived from analog input signals, use adjustable time delays and deadbands.

2. For alarms and control actions derived from discrete input signals, use adjustable time delays.
 3. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for deadbands shall be 5% of span (range 0-100%).
 4. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.
- C. Setpoint controls shall be by floating point control or PID control algorithms unless otherwise noted. Where only proportional control is specified, tuning constants shall be used to reduce the Integral and Derivative functions to zero. All setpoints, sequence times, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the Operator Interface Unit on the front of the PLC panel.
- D. All PLC-controlled equipment shall be provided with adjustable start delays in the PLC control logic. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in MCCs and equipment control panels. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.
- E. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.
- F. EQUIPMENT FAILURE SHALL BE GENERATED THROUGH THE PLC FOR ANY DRIVE, MOTOR, ETC. FOR WHICH A RUN COMMAND HAS BEEN ISSUED, BUT FOR WHICH THE PLC IS NOT RECEIVING A RUN STATUS SIGNAL. THE FAILURE SHALL BE LOGGED AS "FAIL TO START" or "FAIL TO OPEN" ALARM.
- G. Instrument failure shall be generated via the Operator Workstations for any instrument which is generating a signal which is less than 4 mA or greater than 20 mA.
- H. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment train is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.
- I. It shall be possible to remove certain alarms from the alarm generator in the PLC to prevent nuisance alarms from certain equipment (for example, receiving the pump failure alarm when the pump is merely out of service). Removal of these alarms shall require the highest level of system security clearance.
- J. When commands are given by or through the PLC to start or stop equipment, etc., and a conditional interlock must be satisfied prior to final execution of the command, such as a timer or interlock to other equipment, a message shall be displayed which indicates the wait condition. This feature shall be provided as an integral part of all control programs.
- K. The functional descriptions include descriptions of program displays (sometimes referred to as programming displays) which are displays created for the ease of making changes

to the monitoring and control programs. Program displays shall include all displays described in the functional descriptions and additional displays as required to provide a convenient operating interface for changing program variables. Program displays shall be furnished for analog inputs for selecting logging interval, frequency, and printing and for selecting totalization interval (where applicable). Program displays shall be provided for enabling/disabling inputs and outputs, enabling/disabling alarms, for forced parameters (where applicable), and for logging status change and alarms. Program display shall be provided for selecting setting timers, setpoints, deadbands, PID timing constants, sequences, etc. as described for the control programs in the functional descriptions. Program display format shall be consistent, compact, and organized according to the functional descriptions and process equipment. Program displays shall be password-protected either by a common password or by a unique password if desired.

- L. The functional descriptions include descriptions of graphic displays which are displays created for the presentation of operating information with control capability as specified or as requested by the Engineer during start-up. Graphic displays shall include all displays described in the functional descriptions and additional display as required to provide clear and complete operating interfaces for plant operations. Graphic displays shall comply with Owner preference in terms of content, extent of information per display, and graphic representations of the process. The Instrumentation Supplier shall conduct interviews with the Owner and/or the Engineer prior to creation and submittal of the process graphic displays and during checkout/start-up to determine Owner preferences for display content and during checkout/start-up layout.

PART 3 -- FUNCTIONAL CONTROL DESCRIPTIONS

3.01 CATTAIL PUMP STATION OVERVIEW

A. Process Overview

The Cattail Pump Station lifts sewerage from the Leesburg Sewer Trunk Line to a force main feeding the Leesburg Wastewater Treatment plant. The station contains four pumps rated to pump in excess of 8,000 gallons per minute.

The wastewater passes through two parallel grinder pumps as it travels to a separable two chamber wet well. The grinders are powered and operated from a grinder control panel located on the motor level of the pump station. Included in the Grinder (Comminutor) control system is a bubbler system to automate the start of the grinders and provide an alarm when the comminutor is obstructed.

Manually operated gates are used to divert the influent flow to the two-chambered wet wells. The pumps are installed in the dry-well with the pump suction piping extends through wall.

The discharge of each pump combines in a common discharge header and enters the 20" force main. Prior to entering the forcemain and upstream of an isolation plug valve, flow is conveyed through a doppler flow meter.

Support systems at the pump station include a Fire Alarm System, backup power system, seal water and compressed air supplies; and drainage sump pumps. In addition, a

ventilation system with flow monitoring and a gas detection sensors are used to prevent the buildup of gasses in the occupied spaces of the station.

A remote alarm system is used to notify operations personnel of abnormal conditions at the pump station.

Control work under this project includes the replacement of the remote dialing system and the pumps controls. Support systems are remaining in place, but will interface to a new remote alarming system.

3.02 CATTAIL PUMPING CONTROLS

B. Process Overview

1. This project includes two (2) extended shaft dry pit centrifugal pumps for conveying waste water into the 20" discharge force main. Each pump is equipped with a 200 HP motor, which is driven by a VFD unit capable of varying the flow out of the pump. Each VFD unit is equipped with a bypass starter for activating the pump at fixed speed in the event the VFD is unavailable for service. The operator may place a VFD in BYPASS mode using the panel mounted hand switch.
2. Each dry pit submersible pump shall be equipped with a check valve and a motor operated discharge valve on the discharge of each pump. Additionally, each pump will be installed with a suction (16-inch) and discharge (12-inch) isolation plug valve for manual isolation. The existing centrifugal pumps are equipped with a check valve and an air operated discharge valve, which will be removed prior to installation of the new pumps and valves.
3. A PLC based control panel shall operate the pump based on the level in the wet well. A submersible pressure transducer located in each wet well chamber shall be used to provide a control signal for the pump sequencing logic executing in the Pump Control Panel PLC.

C. Control Equipment

1. Locally Mounted Controls:

Due to the potential for flooding in the dry pit areas, electrical equipment installed in the lower pump station elevations is minimized. Manual controls for the pumps are located on the VFD cabinets located on the motor level. Similarly, there will be no disconnect switches for the main pump motors.

Controllers for the cooling blowers and disconnects for the electrically operated valves shall be installed adjacent to the equipment.

In addition, each pump shall be equipped with the following devices:

- a. Differential pressure switch installed across the discharge valve.

- b. High Discharge Pressure Switch.
 - c. Discharge valve position switches.
2. VFD Cabinet Controls (Pumps No. 1, 2, 3 and 4):

VFDs for the centrifugal pumps include the following panel mounted controls:

- a. POWER ON indicating lamp.
- b. OFF Status indicating lamp.
- c. Common FAIL indicating lamp.
- d. ON Status indicating lamp.
- e. BYPASS/NORMAL Status selector switch.
- f. IN BYPASS Status indicating Lamp.
- g. Elapsed Run Time meter.
- h. HAND-OFF-AUTO Selector Switch.
- i. Speed Control Potentiometer.
- j. VFD Keypad.

High discharge pressure, discharge valve fail to open and low pump output alarms shall be handled by the PLC as described in a latter paragraph.

- 2. Submersible pressure transducers PT-1 and PT-2 (existing) shall measure the water elevation in Wet Well No. 1 and Wet Well No. 2, respectively. The water elevations shall be monitored by the Pump Control Panel PLC for use in managing the operation of the pumps.
- 3. A low-level float switch shall be provided in each wet well to signal low pump submergence condition to the Emergency Float Pump Control Panel and to the PLC.
- 4. The existing ultrasonic flowmeter measures the station discharge flow. The PLC shall monitor the station flow rate.
- 5. Pumps shall include integral sensors for monitoring moisture in the pump stator and high temperature conditions in the motor windings.

D. Pump Control Panel – Control Description

- 1. Pumps 3 and 4 functions shall be integrated into the existing pump control panel. The pump control panel has been provided with the necessary input and output capacity to accommodate new pumps 3 and 4.

2. The Pump Control Panel PLC shall monitor the status of the HAND-OFF-AUTO hand switch at the VFD control cabinet. In AUTO mode, the pump shall operate based on the logic described in this section. The PLC shall monitor the level in the Wet Wells and control the number and speed of the pumps.
3. Pumps shall be called to run based on the elevations shown in the table below. Upon a call to run, an additional pump shall be added to the pumping sequence. The starting pump shall ramp up to 75% speed and running pumps shall ramp down to 75% speed. After the pump speeds have ramped to an intermediate position, the PLC shall adjust the pump speeds to maintain a constant level in the wet wells. A PID algorithm shall be used to maintain the level and the set point shall be obtained from the most relevant pump start set point (e.g. 1 pump running, PID set point = Lead Start Set point).
4. After the start of a pump, additional pump starts shall be inhibited for a time period, initially set to 180 second. This will allow the water elevation to stabilize prior to additional pump calls.
5. A similar procedure will be implemented for dropping of pumps on falling water levels. Pump speeds will be adjusted to an intermediate level followed by PID control of the water elevation.
6. Initial settings shall be as described in Table 17950 -1.

Description	Initial Set Point	Comments
High Level Alarm	197.2'	All pumps continue to run.
Standby Pump Start	195.7'	
Standby Pump Stop	193.7'	
Lag-Lag Pump Start	192.9'	
Lag Pump Start	192.2'	
Lag-Lag Pump Stop	191.8'	
Lead Pump Start	189.4'	
Lead Pump Stop	187.1'	
Low Level Alarm	186.6'	All pump stop.

7. Flushing Cycle – A flushing cycle is required when the maximum daily flow does not exceed 3 MGD. The flushing cycle is initiated from the Local Operator Interface (LOI) display on the Pump Control Panel or by a repeat cycle timer adjustable from 0 – 48 hours. Upon initiation of the pump down cycle the station pumps shall respond as follows:
 - a. All pumps shall stop until the Flushing Start elevation is reached in the wet well. See table 17950-2.
 - b. The Lead Pump shall then be brought on at 100% speed.

- c. If after a time delay, initially set at xxx seconds, the water has not dropped below an elevation of .5 feet below the Flushing Start set point, then an additional pump shall be started.
- d. If the High Level alarm set point is reached, a pump shall be added to the sequence.
- e. Pumps continue to run until the Flushing Stop set point is reached.
- f. Initial set points shall be as indicated in Table 17950-2.

Table 17950-2 Initial Set Points for Flushing Mode Controls		
Description	Initial Set Point	Comments
Start Flush	196.7'	Start flushing operation.
Stop Flush	188.2'	Resume level control.

8. Lead/Lag Sequence – Each pump shall have a Lead/Lag assignment selector on the LOI display. Selections shall be OUT OF SERVICE, LEAD, LAG, LAG-LAG, STANDBY and ALTERNATE. Pumps marked as OUT OF SERVICE will not be started by the automatic sequence. Pump that have failed or are not in AUTO, shall be automatically moved to the OUT OF SERVICE state and removed from the LEAD /LAG sequence.

In ALTERNATE Mode, the Pumps shall automatically sequence through the LEAD/LAG stack as follows:

- a. When a unit is dropped from the pumping sequence, the LEAD pump is stopped. The LEAD pump is moved to STANDBY and all other pumps advance in the stack (e.g. LAG-LAG moves to LAG.)
 - b. A timer shall be started each time the LEAD/LAG stack changes. If more than 48 hours pass without a change in the LEAD Pump, the LEAD pump shall be stopped, the LEAD/LAG stack shall automatically advance and a replacement for the LEAD Pump shall start.
9. Start Sequence – When a pump is called from the Pump Control Panel, the VFD control cabinet shall be sent a start signal and an initial pump speed command. When the differential pressure switch indicates sufficient pressure is available across the discharge control valve, the PLC shall initiate opening of the related pump's discharge valve.

The conditions listed below shall be monitored and alarmed. The alarms shall be inhibited by a programmable time delay set to allow sufficient time between the pump call to start and the establishing flow through a fully open discharge valve.

- a. Discharge Valve not fully open as indicated by the valve limit switches.
- b. High discharge pressure at the pump discharge.
- c. Failure to develop a pressure differential across the pump.

Pumps that enter the alarmed state shall be stopped and held in an OUT OF SERVICE state until the reset button is pressed at the Pump Control Panel LOI.

10. Pump Protection – Pumps shall be provided with Moisture Detection alarms and Motor Winding High Temperature alarms. The Moisture Detection alarm shall be displayed on the Pump Control Panel HMI as a warning for a leakage condition.

A Motor High Winding Temperature alarm cause the pump to shut down and issue an alarm to the Pump Control Panel.

11. Power Fail

The following power shall be monitored at the Pump Control Panel. Alarms shall be displayed at the Pump control Panel LOI.

- a. AC Power Fail (to Pump Panel).
- b. DC Power Fail.
- c. UPS Fail.

Upon resumption of power, the pump shall be restarted with a time delay between each pump start. VFD units shall be configured to restart after power failure without a manual reset.

3.03 REMOTE ALARMING

1. Remote alarming shall be provided via an existing automated dialer system as described in Section 17138. The PLC shall be provided with dry contact outputs for transmitting remote alarms to the dialer.

2. Alarms shall include:
 - a. Wet Well No. 1 – High Level Alarm
 - b. Wet Well No. 2 – High Level Alarm
 - c. Pump No. 1 Discharge Valve – Failure
 - d. Pump No. 2 Discharge Valve – Failure
 - e. Pump No. 3 Discharge Valve – Failure
 - f. Pump No. 4 Discharge Valve – Failure
 - g. Pump No. 1 Failure (Common Alarm)
 - h. Pump No. 2 Failure (Common Alarm)
 - i. Pump No. 3 Failure (Common Alarm)

j. Pump No. 4 Failure (Common Alarm)

- END OF SECTION -

CATTAIL BRANCH SPS UPGRADE - PHASE III LEESBURG, VIRGINIA



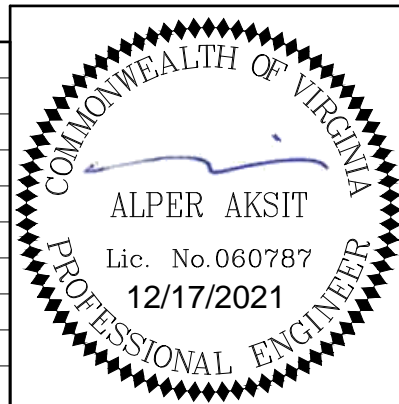
TOWN OF LEESBURG
DEPARTMENT OF UTILITIES
CONTRACT NO. 500640-FY22-20

GENERAL NOTES:

1. DRAWINGS CONTAINED HEREIN WERE DEVELOPED FROM FIELD OBSERVATIONS AND AVAILABLE INFORMATION AND MAY NOT INDICATE ACTUAL CONDITIONS IN DETAIL OR DIMENSION. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING ACTUAL EXISTING CONDITIONS PRIOR TO FABRICATION OR BEGINNING ANY WORK. SHOULD CONDITIONS BE DISCOVERED THAT PREVENT EXECUTION OF THE WORK AS INDICATED, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY IN WRITING AND AWAIT DIRECTION FROM THE ENGINEER BEFORE PROCEEDING WITH WORK.
2. THE PUMP STATION SHALL REMAIN IN OPERATION DURING CONSTRUCTION, UNLESS APPROVED BY THE TOWN IN ACCORDANCE WITH SPECIFICATION SECTION 01520.
3. ALL WORK SHALL BE COORDINATED WITH BRIAN BAILEY, TOWN OF LEESBURG UTILITY PLANT MANAGER.
4. PRIOR TO BEGINNING ANY WORK, THE CONTRACTOR SHALL SUBMIT A PLANNED SEQUENCE OF CONSTRUCTION, IN ACCORDANCE WITH SPECIFICATION SECTION 01520.



VICINITY MAP
1" = 400'



DESIGNED BY _____ A. AKSIT
DRAWN BY _____ M. BROCATO
CHECKED BY _____ J. HISE
APPROVED BY _____ J. HISE



HAZEN AND SAWYER
1 SOUTH STREET, SUITE 1150
BALTIMORE, MARYLAND 21202

PROJECT NO.
31111-056

DATE:
DECEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

GENERAL
COVER AND GENERAL NOTES

G-1

SHEET
1 OF 57

20211217 1:32P O:\31111-BAL\31111-056\GIS\CAD-BIM\GEN\G-1 COVER AND GENERAL NOTES.dwg By:MBROCATO Last Saved By: mbrocato

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2	BED SET - REVISED	12/21	JTH
1	BID SET	11/21	JTH

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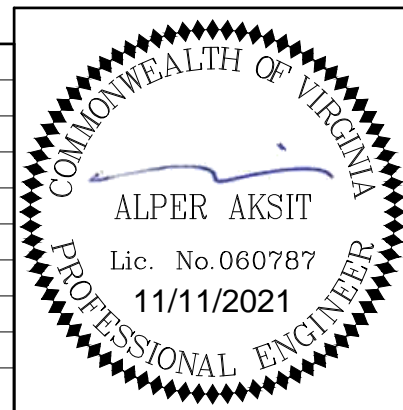
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DESIGNED BY	A. AKSIT
DRAWN BY	M. BROCATO
CHECKED BY	J. HISE
APPROVED BY	J. HISE

Hazen

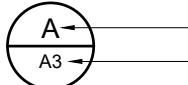
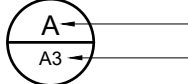
HAZEN AND SAWYER
1 SOUTH STREET, SUITE 1150
BALTIMORE, MARYLAND 21202

PROJECT NO.	31111-056
DATE:	NOVEMBER 2021

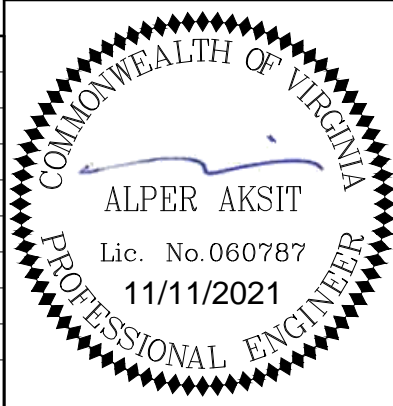
CATTAIL BRANCH SPS LEESBURG, VIRGINIA	G-2
GENERAL INDEX OF DRAWINGS	

SHEET 2 OF 57

20211111 11:04A 0:\31111-bat\31111-056\GIS\CAD-BIM\GEN\G-3 LEGEND AND ABBREVIATIONS.dwg By:MBROCATO Last Saved By: mbrocato

LINETYPES	SECTION KEYING	ABBREVIATIONS			
<p>———— PROPOSED ITEMS</p> <p>———— EXISTING ITEMS</p> <p>----- HIDDEN ITEMS</p> <p>/////// DEMOLITION ITEMS</p> <p>----- CENTER LINE</p> <p>===== EX. ROAD</p> <p>———— EX. BUILDING</p> <p>~~~~~ EX. TREES</p> <p>— X — EX. FENCE</p> <p>— SD — EX. STORM DRAIN</p> <p>— SS — EX. SEWER</p> <p>— FM — EX. FORCEMAIN</p> <p>— UGE — EX. UG ELECTRIC</p> <p>— UGT — EX. UG TELEPHONE</p> <p>— W — EX. WATER</p> <p>● EX. BOLLARAD</p>	<p>DRAWINGS ARE CROSS REFERENCED IN THE FOLLOWING METHOD:</p> <p>(A) A SECTION CUT ON DRAWING A3 IS IDENTIFIED AS FOLLOWS:</p>  <p>SECTION LETTER DRAWING WHERE SECTION IS SHOWN</p> <p>(B) THE SECTION SHOWN ON DRAWING A6 IS IDENTIFIED AS FOLLOWS:</p>  <p>SECTION LETTER DRAWING FROM WHERE SECTION CUT IS SHOWN</p>	<p>ALT ALTERNATE</p> <p>APPROX APPROXIMATE</p> <p>ARV AIR RELEASE VALVE</p> <p>BLDG BUILDING</p> <p>BLK BLOCK</p> <p>BM BENCH MARK</p> <p>BO BLOW OFF</p> <p>BOC BACK OF CURB</p> <p>BOT BOTTOM</p> <p>CF CUBIC FEET</p> <p>CI CAST IRON</p> <p>CIP CAST IRON PIPE</p> <p>CL CENTER LINE</p> <p>CMP CORRUGATED METAL PIPE</p> <p>CO CLEANOUT</p> <p>COMM COMMUNICATIONS</p> <p>CONC CONCRETE</p> <p>CY CUBIC YARD</p> <p>DET DETAIL</p> <p>DIA DIAMETER</p> <p>∅ DIAMETER</p> <p>DIM DIMENSION</p> <p>DIP DUCTILE IRON PIPE</p> <p>DISCH DISCHARGE</p> <p>DR DRIVE</p> <p>DWG DRAWING</p> <p>EA EACH</p> <p>ELEV ELEVATION</p> <p>ELEC ELECTRIC/ELECTRICAL</p> <p>EOP EDGE OF PAVEMENT</p> <p>EQ EQUAL</p> <p>EQPT EQUIPMENT</p> <p>EX EXISTING</p> <p>FEMA FEDERAL EMERGENCY MANAGEMENT AGENCY</p> <p>FH FIRE HYDRANT</p> <p>FM FORCE MAIN</p> <p>FP FLOOD PLAIN</p> <p>FT FEET</p>	<p>HDD HORIZONTAL DIRECTIONAL DRILLING</p> <p>HDPE HIGH DENSITY POLYETHYLENE</p> <p>HORZ HORIZONTAL</p> <p>IDA INTENSE DEVELOPMENT AREA</p> <p>IN INCH</p> <p>INV INVERT</p> <p>LF LINEAR FEET</p> <p>LDA LIMITED DEVELOPMENT AREA</p> <p>LOD LIMITS OF DISTURBANCE</p> <p>LN LANE</p> <p>MAX MAXIMUM</p> <p>MFR MANUFACTURER</p> <p>MH MANHOLE</p> <p>MIN MINIMUM</p> <p>MISC MISCELLANEOUS</p> <p>NTS NOT TO SCALE</p> <p>OD OUTSIDE DIAMETER</p> <p>PVC POLYVINYL CHLORIDE</p> <p>PG PAGE</p> <p>QTY QUANTITY</p> <p>RCA RESOURCE CONSTRUCTION AREA</p> <p>RCP REINFORCED CONCRETE PIPE</p> <p>RD ROAD</p> <p>REF REFERENCE</p> <p>REQD REQUIRED</p> <p>ROW RIGHT OF WAY</p> <p>RSF REINFORCED SILT FENCE</p> <p>R/W RIGHT OF WAY</p>	<p>SCE STABILIZED CONSTRUCTION ENTRANCE</p> <p>SHC SEWER HOUSE CONNECTION</p> <p>SF SQUARE FEET</p> <p>SPEC SPECIFICATION</p> <p>SS SANITARY SEWER</p> <p>SSMH SANITARY SEWER MANHOLE</p> <p>ST STREET</p> <p>STA STATION</p> <p>STD STANDARD</p> <p>TYP TYPICAL</p> <p>UG UNDERGROUND</p> <p>VERT VERTICAL</p> <p>W/ WITH</p> <p>W/O WITHOUT</p> <p>WUS WATERS OF THE US</p> <p>WY WAY</p> <p>YD YARD</p> <p>YR YEAR</p>	

1	BID SET	11/21	JTH				
NO	ISSUED FOR	DATE	BY				



DESIGNED BY _____ A. AKSIT
DRAWN BY _____ M. BROCATO
CHECKED BY _____ J. HISE
APPROVED BY _____ J. HISE

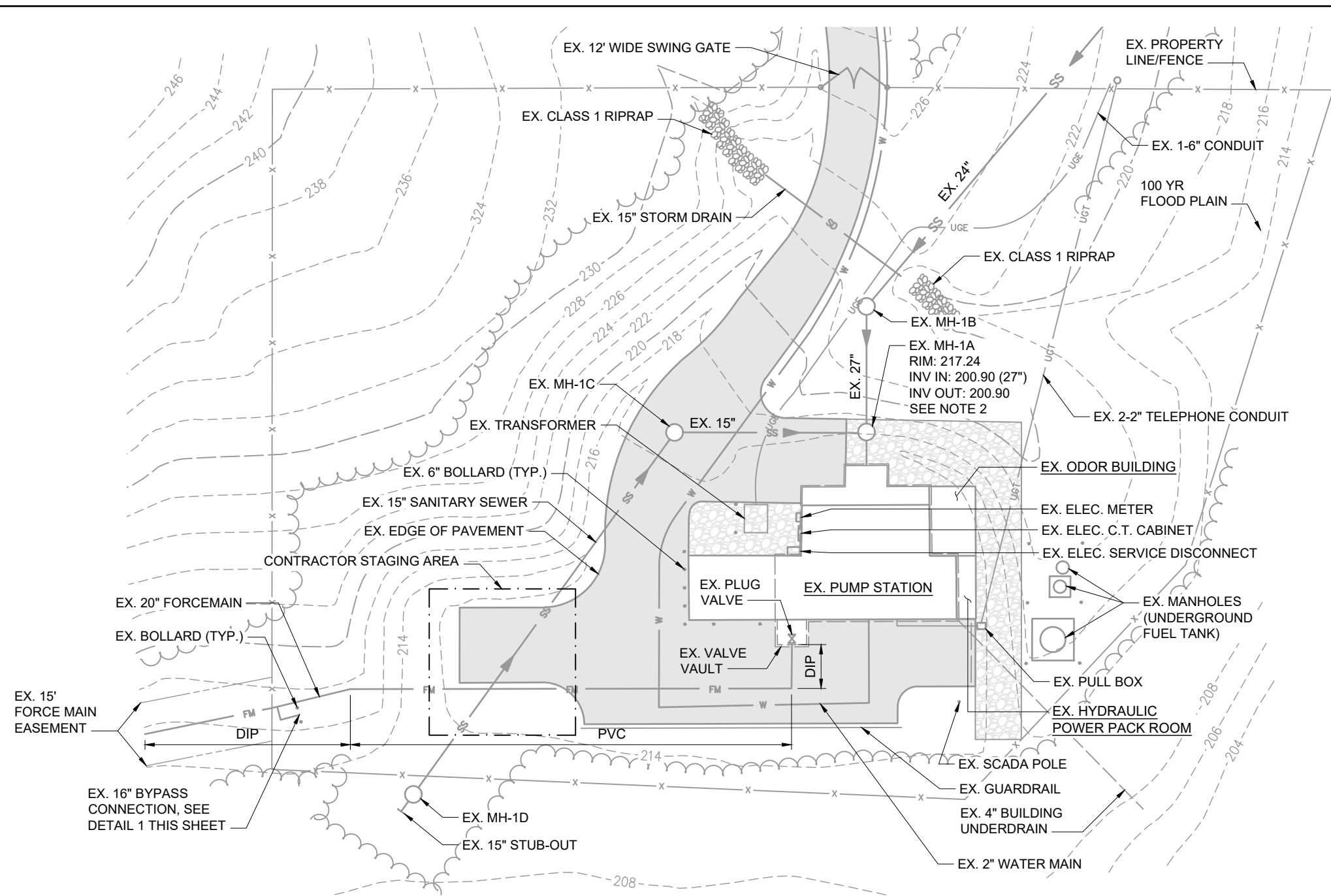


PROJECT NO. 31111-056
DATE: NOVEMBER 2021

CATTAIL BRANCH SPS LEESBURG, VIRGINIA
GENERAL LEGEND AND ABBREVIATIONS

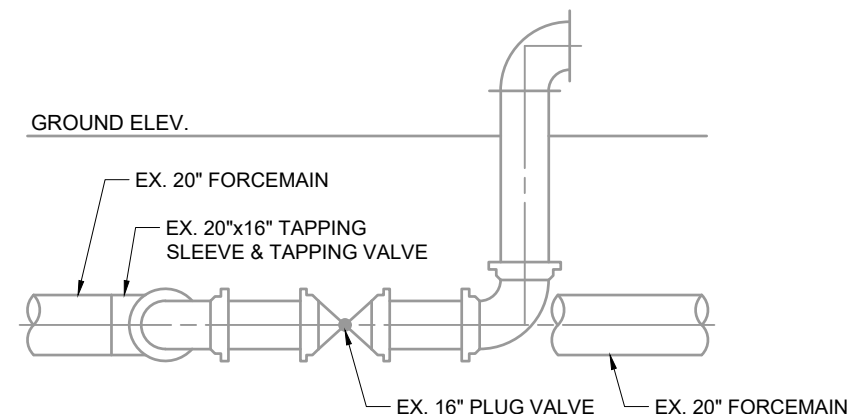
G-3
SHEET 3 OF 57

20211111 11:04A O:\311111-bat\311111-056\GIS\CAD-BIM\CIVIL\C-1 EXISTING SITE PLAN.dwg By:MBROCATO Last Saved By: mbrocato



NOTES:

1. THE INFORMATION SHOWN IS BASED ON AS-BUILT INFORMATION TAKEN FROM PLANS DATED JUNE 21, 1996 PREPARED BY BLACK & VEATCH. CONTRACTOR SHALL FIELD VERIFY WHERE NECESSARY.
2. AS-BUILT INFORMATION TAKEN FROM PLANS DATED MAY 2, 1996 PREPARED BY HAROLD A. LOGAN - ASSOC. P.C. AND OR THE TOWN OF LEESBURG.
3. THE CONTRACTOR SHALL SUBMIT A BYPASS PUMPING PLAN PRIOR TO CONSTRUCTION TO THE TOWN AND ENGINEER. AT A MINIMUM, THE PLAN SHALL INCLUDE SEQUENCE OF BYPASS, LOCATION OF PUMPS AND PIPING, AND ESTIMATED LENGTH OF TIME FOR BYPASS. REFER TO SECTION 01520 - MAINTENANCE OF PLANT OPERATIONS FOR CONSTRAINTS AND REQUIREMENTS.



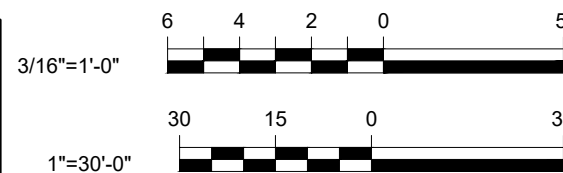
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1. BOLLARDS AND THRUST BLOCKS NOT SHOWN FOR CLARITY.

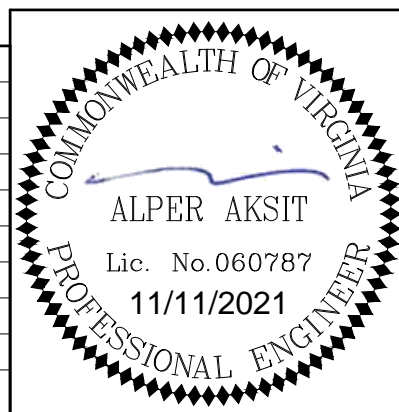
BYPASS PUMPING CONNECTION SECTION VIEW

DETAIL	1
3/16" = 1'-0"	C-1

EXISTING SITE PLAN
1" = 30'



1	BID SET	11/21	JTH
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APPROVED BY	J. HISE

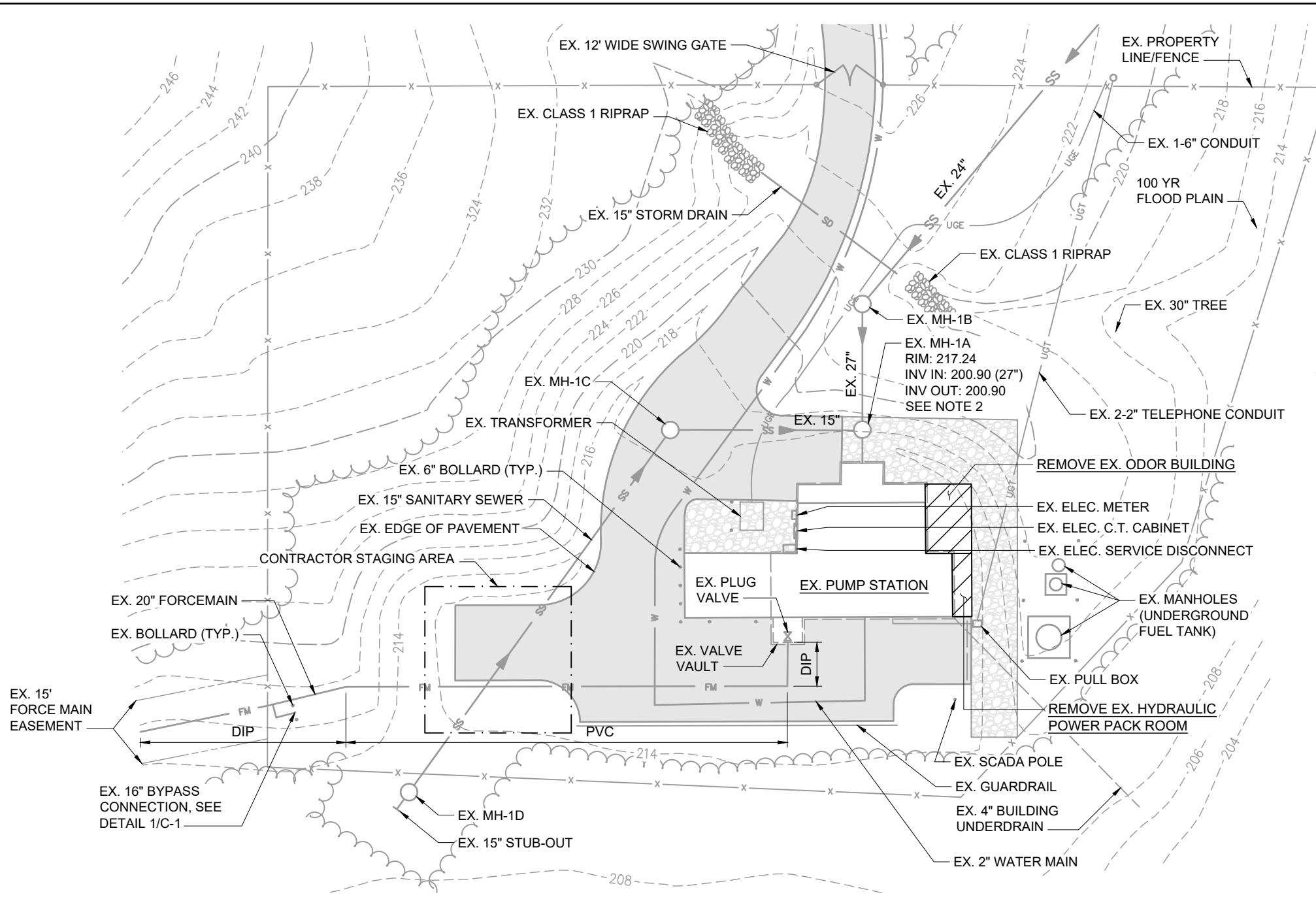


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1 SOUTH STREET, SUITE 1150
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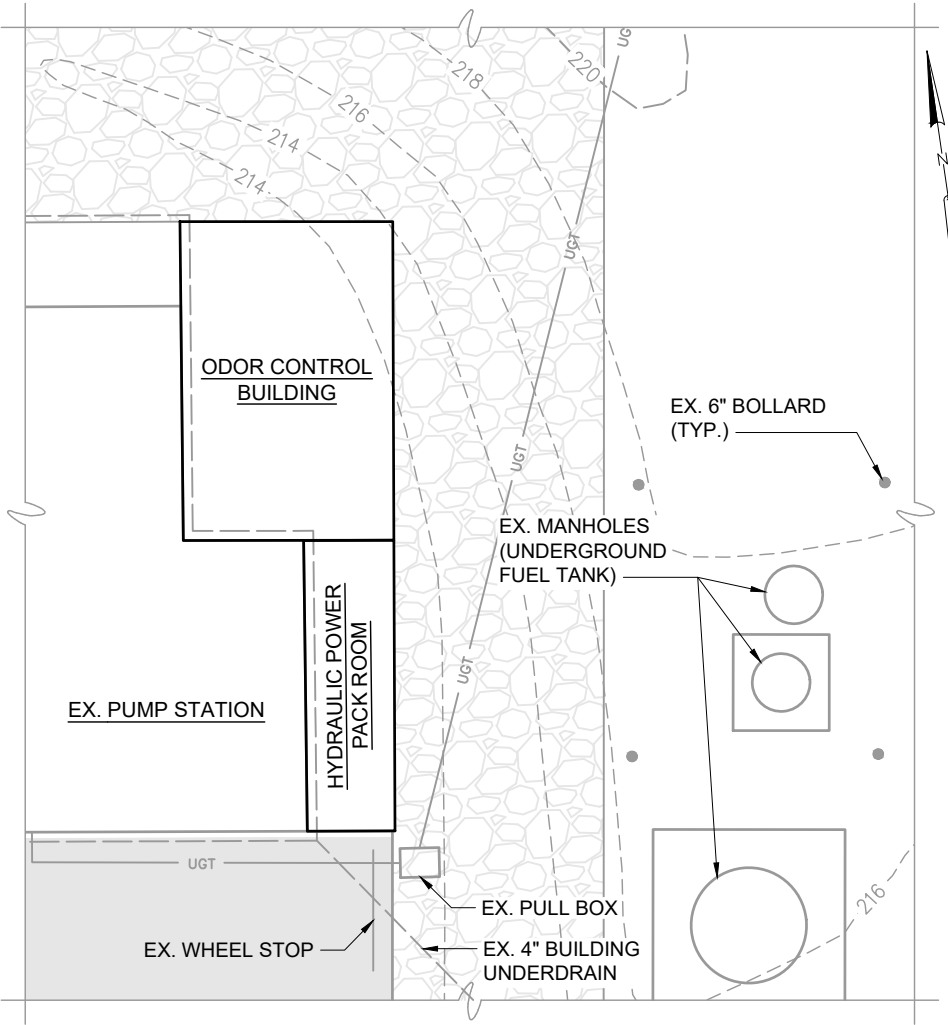
PROJECT NO.	31111-056
DATE:	NOVEMBER 2021

CATTAIL BRANCH SPS LEESBURG, VIRGINIA
CIVIL EXISTING SITE PLAN

20211111 11:05A O:\311111-bat\31111-056\GIS\CAD-BIM\CIVIL\C-2 DEMOLITION & PROPOSED SITE PLANS.dwg By:MBROCATO Last Saved By: mbrocato



EXISTING SITE PLAN
1" = 30'

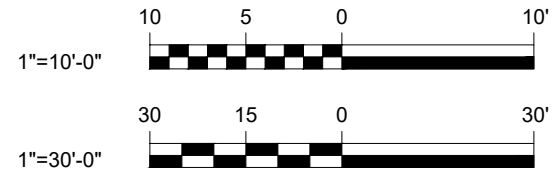
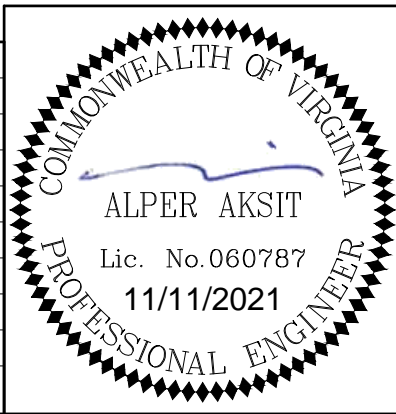


PROPOSED SITE PLAN
1" = 10'

NOTES:

1. THE INFORMATION SHOWN IS BASED ON AS-BUILT INFORMATION TAKEN FROM PLANS DATED JUNE 21, 1996 PREPARED BY BLACK & VEATCH. CONTRACTOR SHALL FIELD VERIFY WHERE NECESSARY.
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1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY A. AKSIT
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	C-2
DATE: NOVEMBER 2021		
CIVIL		SHEET 5 OF 57
DEMOLITION & PROPOSED SITE PLANS		

ROOM FINISH SCHEDULE

NO.	DESCRIPTION	FLOOR		BASE		WALL-NORTH		WALL-EAST		WALL-SOUTH		WALL-WEST		CEILING			REMARKS
		SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	SUBSTRATE	FINISH	HEIGHT	
100	ODOR CONTROL ROOM	CONC	SEALER	PLYWD	1X4 WOOD	PLYWD	-	PLYWD	-	PLYWD/ST	-/---	PLYWD/ST	-/---	PLYWD	-	VARIES	
101	HYDRAULIC PUMP ROOM	CONC	SEALER	PLYWD	1X4 WOOD	PLYWD	-	PLYWD	-	PLYWD	-	ST	-	PLYWD	-	VARIES	

FINISH LEGEND	NOTES
----------------------	--------------

CONC	CONCRETE	PT	PAINT	RUB	4" RUBBER	1. DO NOT PAINT EXISTING EXPOSED STONE FACADE. 2. STAIN ALL INTERIOR & EXTERIOR WOOD TRIM. 3. CONFIRM ALL INTERIOR AND EXTERIOR PAINT AND STAIN COLORS WITH CLIENT.
ES	EXPOSED STRUCTURE	PLYWD	1/2" PLYWOOD	ST	EXISTING STONE	

DOOR SCHEDULE

NO.	FRAME		DOOR					DETAILS			FINISH	HDWR NO	THRSHLD	REMARKS
	TYPE	MATL	TYPE	MATL	WIDTH	HEIGHT	THICKNESS	HEAD	JAMB	SILL				
100	F-1	HM	A	HM	3'-0"	6'-8"	1 3/4"	H-1	J-1	S-1	PT	2	AL	SEE DETAIL 1 ON A-5
101	F-1	HM	A	HM	6'-0"	7'-2"	1 3/4"	H-1	J-1	S-1	PT	1	AL	SEE DETAIL 1 ON A-5

DOOR LEGEND	NOTES
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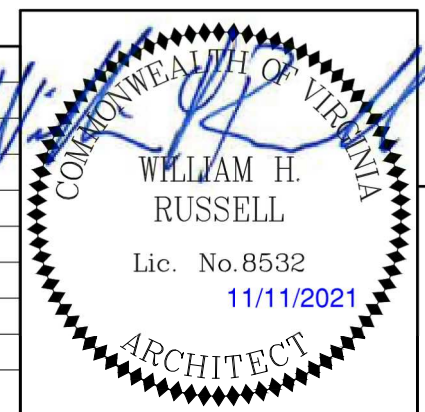
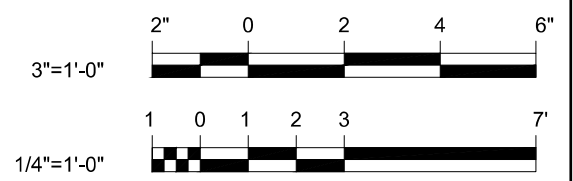
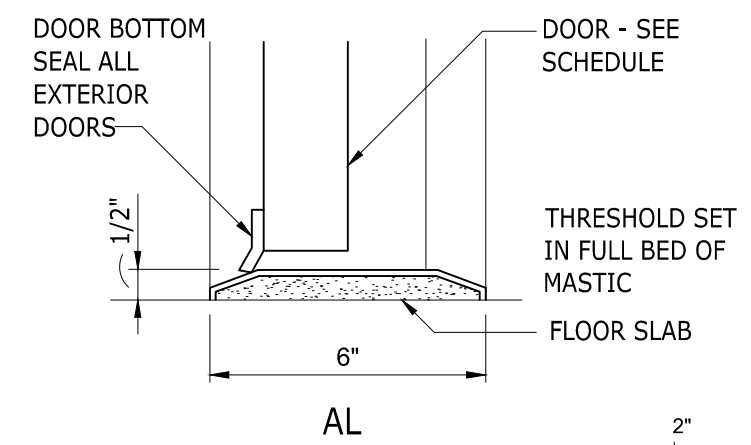
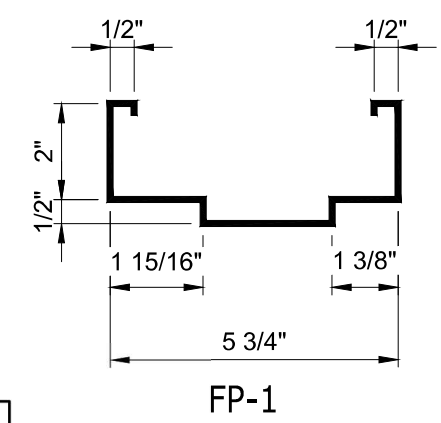
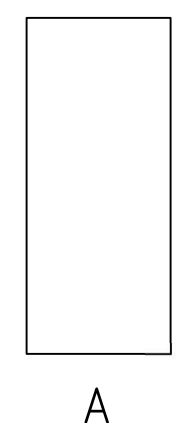
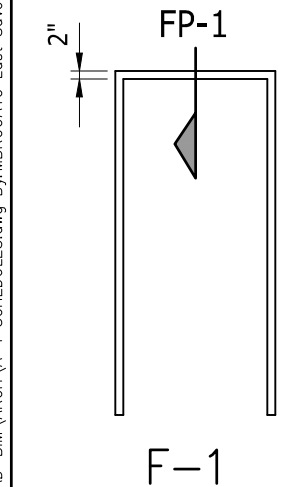
HM	HOLLOW METAL	PT	PAINT	1. DOOR NO. 101 IS LEFT HAND REVERSE DOOR ACTIVE LEAF, RIGHT HAND DOOR INACTIVE LEAF		
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FRAME TYPES 1/4" = 1'-0"

DOOR TYPES 1/4" = 1'-0"

FRAME PROFILES 3" = 1'-0"

THRESHOLD TYPES 3" = 1'-0"



1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY

DESIGNED BY	W. RUSSELL
DRAWN BY	M. TAWADROUS
CHECKED BY	W. RUSSELL
APPROVED BY	J. HISE

Hazen

HAZEN AND SAWYER
1 SOUTH STREET, SUITE 1150
BALTIMORE, MARYLAND 21202

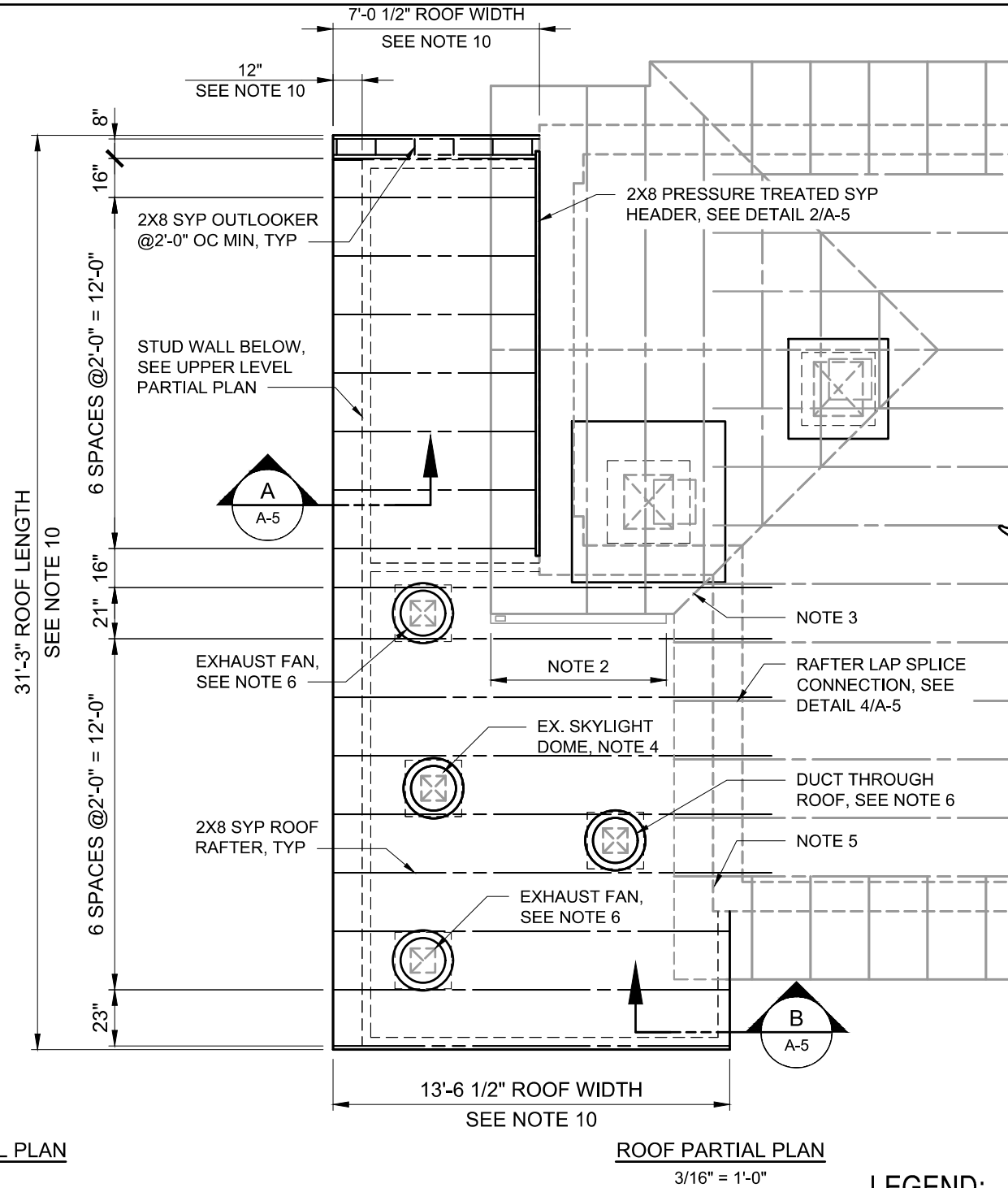
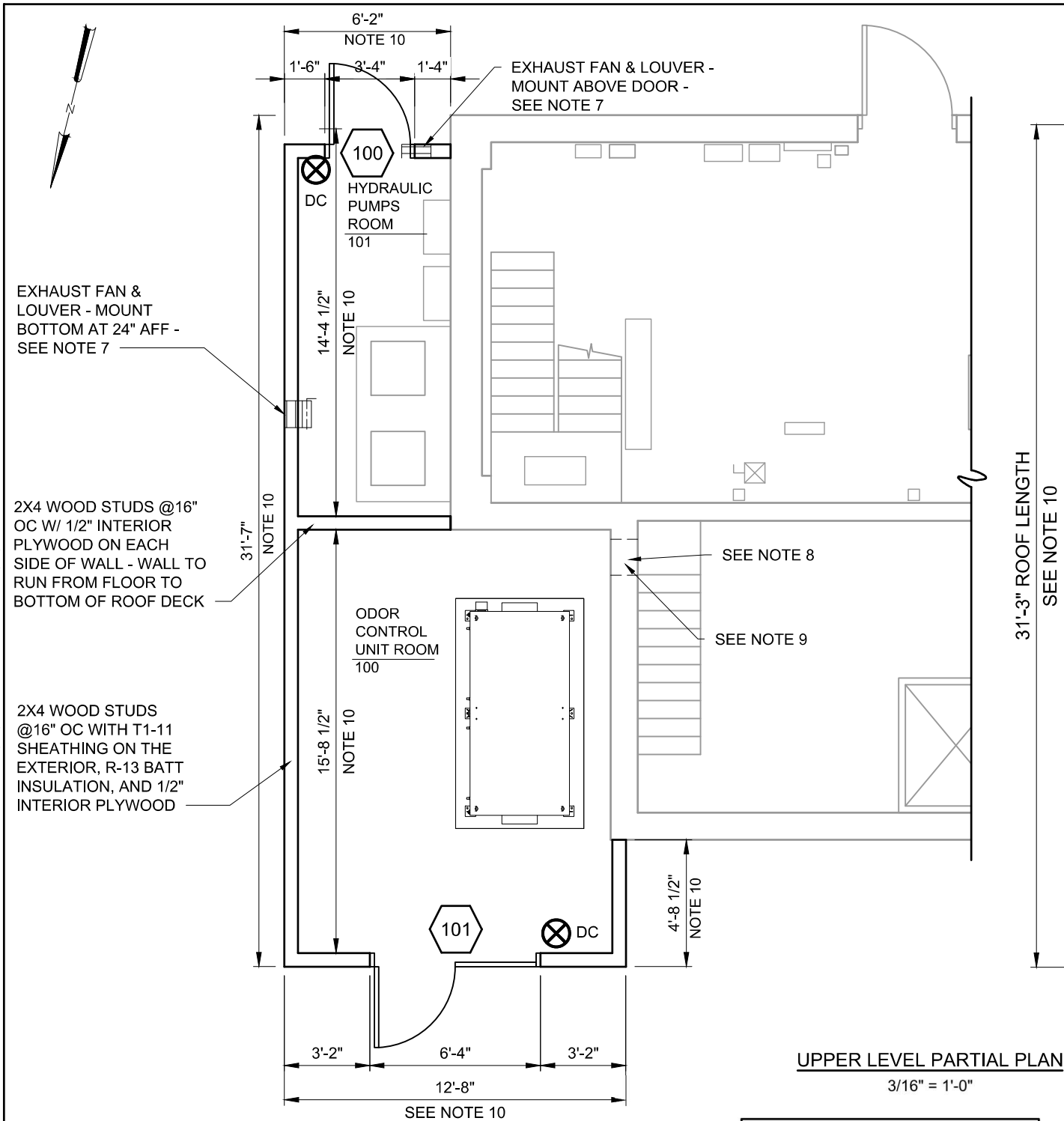
PROJECT NO.	31111-056
DATE:	NOVEMBER 2021

CATTAIL BRANCH SPS LEESBURG, VIRGINIA
ARCHITECTURAL SCHEDULES

A-1
SHEET 6 OF 57

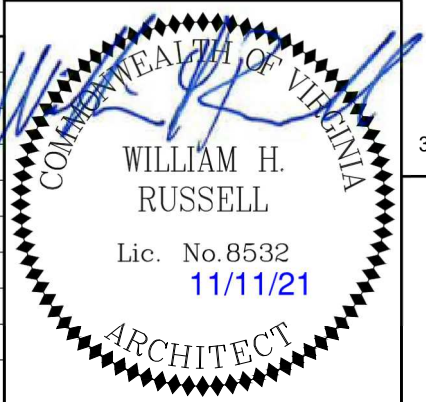
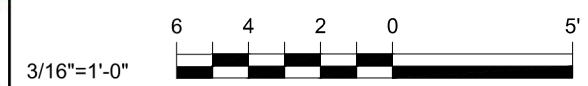
20211111 3:31P 0: 31111-bal\31111-056\GIS\CAD-BIM\ARCH\A-1 SCHEDULES.dwg By: MBROCATO Last Saved By: jbutch

20211111 3:32P O:\31111-ba\31111-056\GIS\CAD-BIM\ARCH\A-2 UPPER LEVEL AND ROOF PARTIAL PLANS.dwg By:MBROCATO Last Saved By: jbutch



- NOTES:**
- COORDINATE REPLACEMENT ADDITION WITH EXISTING ROOF SLOPES AND EXISTING REMAINING STRUCTURE.
 - REMOVE, STORE & REINSTALL EXISTING GUTTER & DOWNSPOUT AFTER ADDITION IS BUILT. REUSE OR REPLACE EXISTING FLASHING BETWEEN EXISTING STONE AND PROPOSED SHINGLE ROOF. INSTALL METAL SPLASH BLOCK ATTACHED TO ROOF AT DOWNSPOUT DISCHARGE.
 - WEAVE EXISTING SHINGLES AND REPLACEMENT SHINGLES IN ROOF VALLEY.
 - REMOVE, STORE & REINSTALL EXISTING SKYLIGHT DOME. BLOCK OUT ROOF PENETRATION WITH 2X8 FRAMING AT MINIMUM, COORDINATE ADDITIONAL BLOCKING AS REQUIRED FOR ATTACHMENT OF ROOF CURB AND/OR FLASHING.
 - SEE ELEVATION FOR NOTE ON INSTALLING REPLACEMENT SHINGLES UNDER EXISTING SHINGLES.
 - SEE DETAIL 3/A-5 FOR FLASHING DETAIL TO ROOF SHINGLES. BLOCK OUT ROOF PENETRATION WITH 2X8 FRAMING AT MINIMUM, COORDINATE ADDITIONAL BLOCKING AS REQUIRED FOR ATTACHMENT OF ROOF CURB AND/OR FLASHING.
 - PROVIDE 2X4 BLOCKING FOR EXHAUST FAN - TRIM INSIDE OF FRAME WITH 1/2" PLYWOOD.
 - SEAL PIPE HOLES WITH METAL PANELS ON BOTH SIDES OF WALL.
 - CORE DRILL NEW OPENING FOR PIPE. SEE SHEET H-6.
 - COORDINATE WOOD STUD LOCATIONS WITH STRUCTURAL CONCRETE SLAB DIMENSIONS. COORDINATE EDGE OF ROOF WITH EXISTING ROOF SLOPE.
 - FIELD VERIFY ALL DIMENSIONS.

- LEGEND:**
- 100 DOOR NUMBER - SEE DRAWING NO. A-1
 - DC FIRE EXTINGUISHER - DRY CHEMICAL



NO	BID SET	ISSUED FOR	DATE	BY
1	BID SET		11/21	JTH
	ISSUED FOR		DATE	BY

DESIGNED BY <u>W. RUSSELL</u>	Hazen HAZEN AND SAWYER 1 SOUTH STREET, SUITE 1150 BALTIMORE, MARYLAND 21202	PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	A-2
DRAWN BY <u>M. TAWADROUS</u>		DATE: NOVEMBER 2021		
CHECKED BY <u>W. RUSSELL</u>		ARCHITECTURAL	SHEET 7 OF 57	
APPROVED BY <u>J. HISE</u>		UPPER LEVEL AND ROOF PARTIAL PLANS		

20211111 3:37P C:\Users\mbrocato\appdata\local\temp\AcPublish_29884\A-3 ELEVATIONS.dwg By:MBROCATO Last Saved By: jbutch

WOOD CONSTRUCTION NOTES:

1. REFER TO SPECIFICATION SECTION 06100 - ROUGH CARPENTRY FOR ADDITIONAL WOOD CONSTRUCTION REQUIREMENTS NOT LISTED HEREIN.
2. ROOF SHEATHING SHALL BE EXTERIOR TYPE GRADE CD OR BETTER WITH A PANEL SPAN RATING OF 24/16 AT MINIMUM.
3. ROOF RAFTERS SHALL BE SOUTHER YELLOW PINE NO. 1 GRADE WITH A MAXIMUM MOISTURE CONTENT OF 19 PERCENT.
4. WALL SIDING SHALL BE EXTERIOR TYPE GROUP 1 RATED FOR 16" ON CENTER SPAN AT MINIMUM.
5. WALL CORNERS SHALL BE A 4-STUD CONSTRUCTION TYPE.

WOOD FASTENER NOTES:

1. CONNECTIONS NOT SPECIFICALLY NOTED AND/OR DETAILED HEREIN SHALL BE FASTENED IN ACCORDANCE WITH CHAPTER 23 OF THE VIRGINIA CONSTRUCTION CODE.
2. ATTACH RAFTERS TO TOP PLATES WITH MODEL H10A HURRICANE TIES BY SIMPSON STRONG-TIE.
3. ATTACH RAFTERS TO PRESSURE TREATED HEADER WITH MODEL LRU28Z RAFTER HANGERS BY SIMPSON STRONG-TIE.
4. PRESSURE TREATED LEDGER SHALL BE FASTENED TO EXTERIOR STONE USING 5/8" GALVANIZED THREADED ROD ANCHORS SPACED AT 18 INCHES ON CENTER, THROUGH-BOLT FASTENERS THROUGH EXISTING BUILDING CMU WALL, PROVIDE 1/4" OVERSIZED GALVANIZED FENDER WASHERS/PLATES AT EACH END.
5. RAFTERS SPLICED WITH EXISTING ROOF RAFTERS SHALL LAP A MINIMUM OF 12 INCHES AND SHALL BE FASTENED WITH 6-#8 SCREWS PER RAFTER LAP SPLICE.
6. FASTEN ROOF SHEATHING WITH 8d COMMON NAILS, GALVANIZED AT 6 INCHES ON CENTER AND 3 INCHES FROM ENDS/CORNERS. PROVIDE TWO (2) MODEL PSCL PANEL SHEATHING CLIPS BY SIMPSON STRONG-TIE, EQUALLY SPACED BETWEEN EACH SUPPORT.
7. FASTEN WALL SIDING WITH 6d COMMON NAILS, GALVANIZED, SPACED AT 6 INCHES ON CENTER AND 3 INCHES FROM ENDS.
8. WALL STUDS SHALL BE END NAILED WITH 2-16d COMMON NAILS MINIMUM TO TOP PLATES AND TOE NAILED WITH 4-8d COMMON NAILS MINIMUM TO BOTTOM PLATES.
9. ANCHORAGE OF FLOOR PLATES TO CONCRETE FOUNDATION IS DETAILED ON DRAWING A-5.

DUCTWORK THRU ROOF - SEE MECH DRAWINGS

REMOVE, STORE & REINSTALL EXISTING GUTTER AND DOWNSPOUT - ADD METAL SPLASH PAN ATTACHED TO ROOF AT DOWNSPOUT DISCHARGE

REWORK EXISTING FLASHING AGAINST STONE DORMER OR MATCH EXISTING FLASHING AFTER ROOF REPLACEMENT

FIBERGLASS SHINGLES MATCH EXISTING ROOF SLOPE

EXHAUST FAN - SEE HVAC DRAWINGS

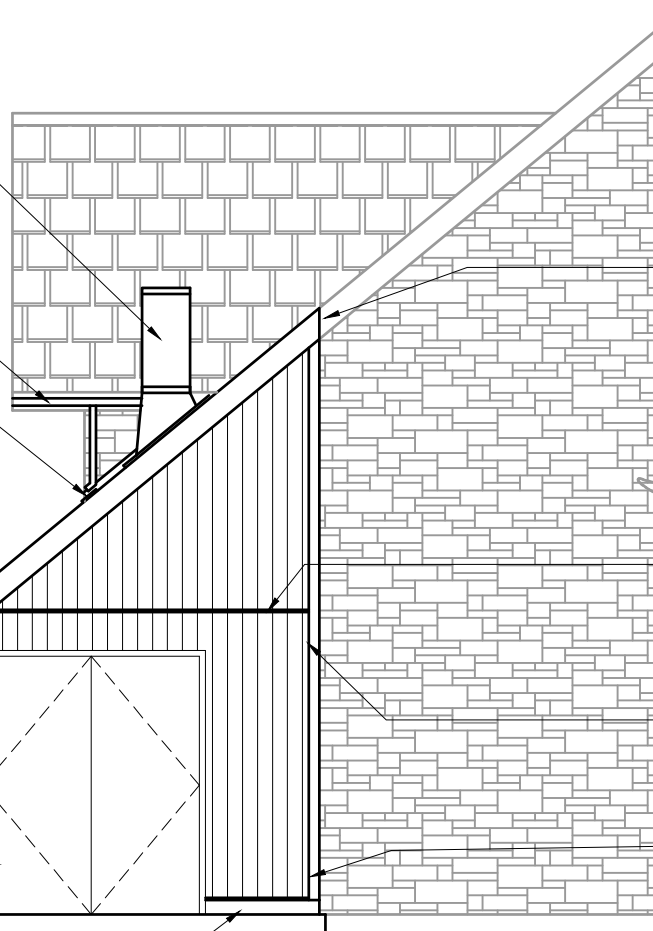
1X8 WOOD FASCIA BOARD ON EXTERIOR OF SIDING

4" X 4" GUTTER, AND 3" X 5" DOWNSPOUTS - MATCH EXISTING DOWNSPOUT AND GUTTER COLOR - PROVIDE CONCRETE SPLASH BLOCK AT DOWNSPOUT DISCHARGE

1X4 WOOD TRIM ON BOTH SIDES OF CORNER

DOOR AS SCHEDULED

T1-11 SHEATHING ON 2X4 STUDS



PARTIAL NORTH ELEVATION

3/16" = 1'-0"

TIE EXISTING AND PROPOSED WOOD FASCIA TRIM TOGETHER

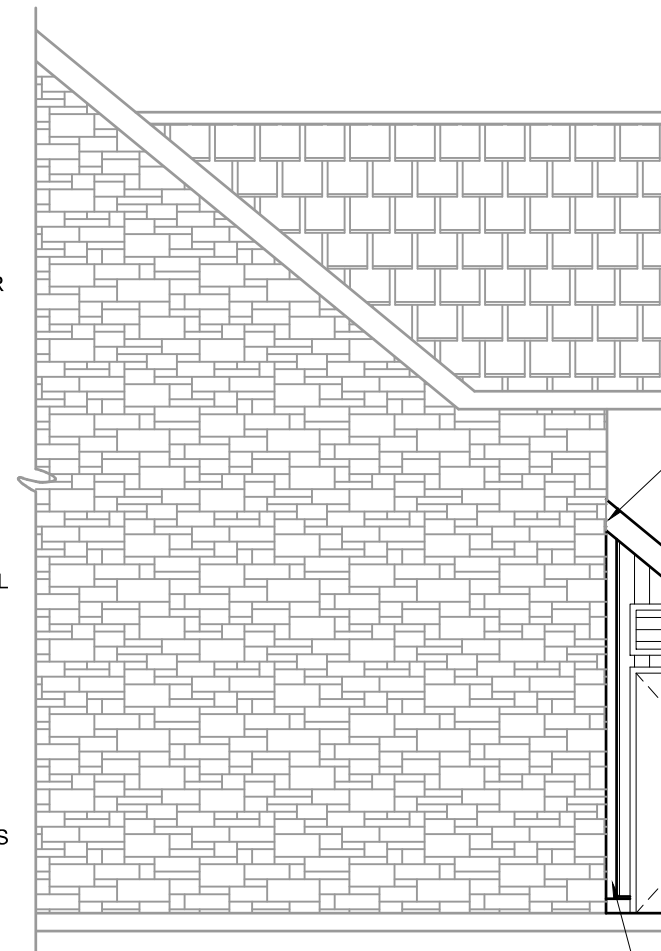
METAL Z-FLASHING BETWEEN PLYWOOD SHEETS - SEE DETAIL ON A-5

1X4 WOOD TRIM - INSTALL SEALANT BETWEEN EDGE OF WOOD TRIM AND STONE WALL

1X4 WOOD TRIM ON BOTH SIDES OF CORNER

STAIN ALL EXTERIOR WOOD TRIM AND T1-11 WOOD SIDING - CONFIRM STAIN COLOR WITH CLIENT BEFORE PROCEEDING

1X6 PRESSURE TREATED WOOD BASE W/ ANGLED TOP - SEE DETAIL ON A-5



PARTIAL SOUTH ELEVATION

3/16" = 1'-0"

1 X WOOD FASCIA ON BACK SIDE OF ROOF

FIBERGLASS SHINGLES MATCH EXISTING ROOF SLOPE

SUPPLY FAN - SEE HVAC DRAWINGS

EXHAUST FAN - SEE HVAC DRAWINGS

1X2 WOOD TRIM - 4 SIDES

1 X 8 WOOD FASCIA BOARD ON EXTERIOR OF SIDING

4" x 4" GUTTER, AND 3" x 5" DOWNSPOUTS - MATCH EXISTING DOWNSPOUT AND GUTTER COLOR - PROVIDE CONCRETE SPLASH BLOCK AT DOWNSPOUT DISCHARGE

1X4 WOOD TRIM ON BOTH SIDES OF CORNER

T1-11 SHEATHING ON 2X4 STUDS

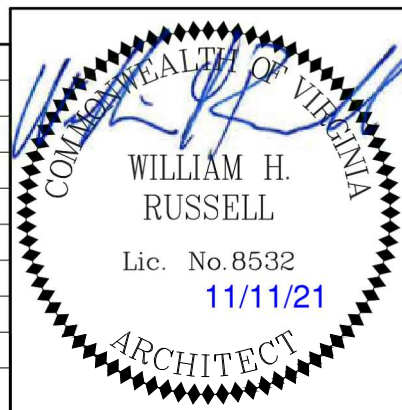
1X6 PRESSURE TREATED WOOD BASE W/ ANGLED TOP - SEE DETAIL ON A-5

DOOR AS SCHEDULED

1X4 WOOD TRIM ON TWO SIDES OF CORNER- INSTALL SEALANT BETWEEN EDGE OF WOOD TRIM AND STONE WALL



1	BID SET	11/21	JTH
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DESIGNED BY	W. RUSSELL
DRAWN BY	M. TAWADROUS
CHECKED BY	W. RUSSELL
APPROVED BY	J. HISE

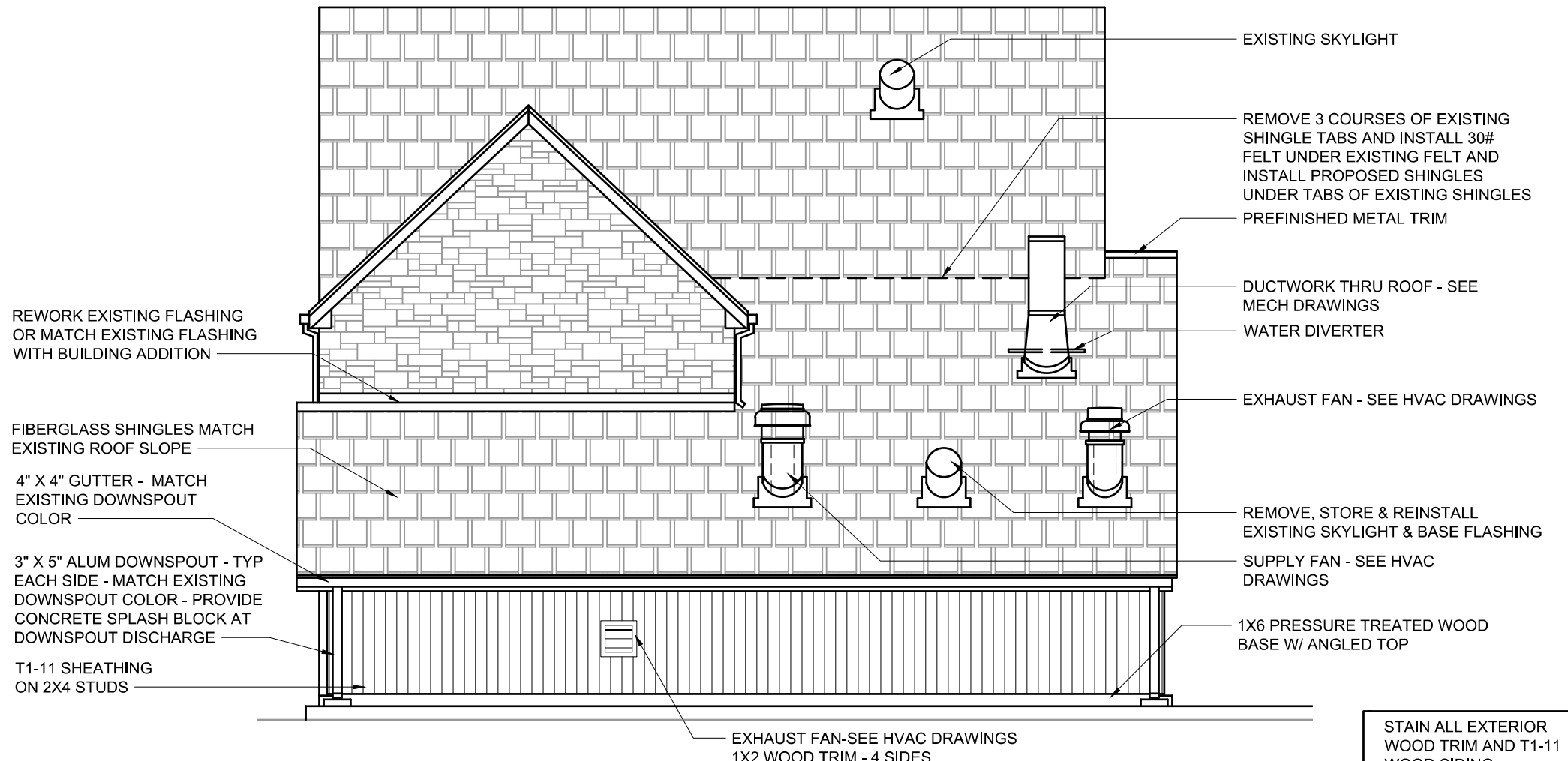
Hazen

HAZEN AND SAWYER
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BALTIMORE, MARYLAND 21202

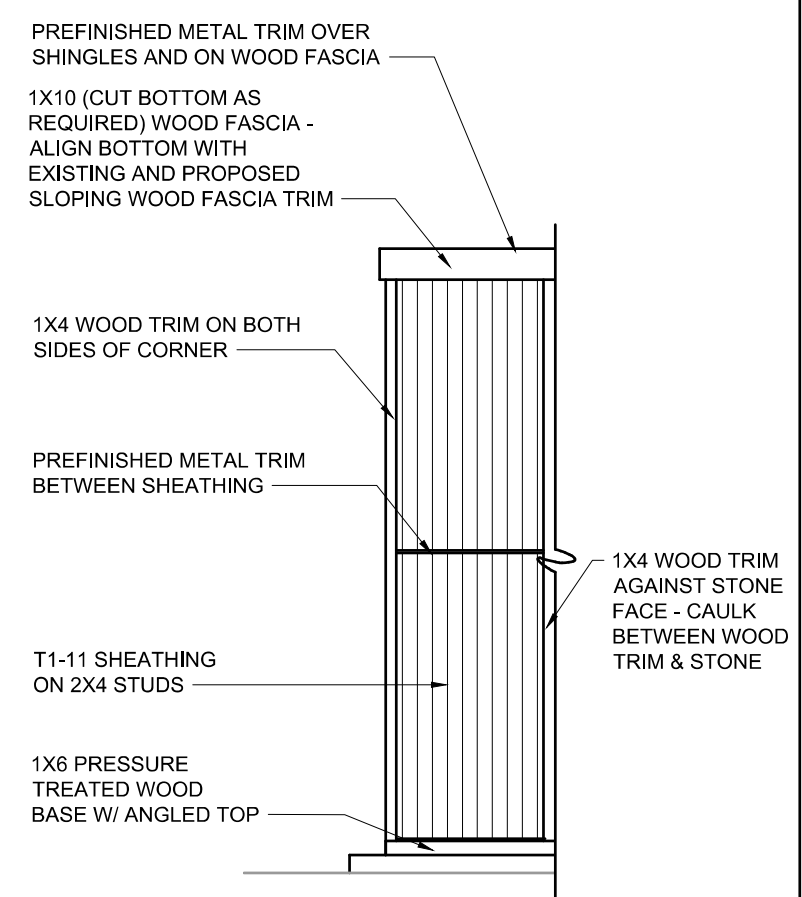
PROJECT NO.	31111-056
DATE:	NOVEMBER 2021

CATTAIL BRANCH SPS LEESBURG, VIRGINIA	A-3
ARCHITECTURAL ELEVATIONS	SHEET 8 OF 57

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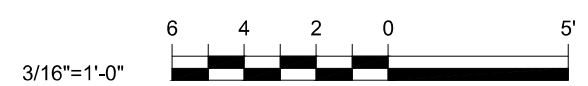


WEST ELEVATION
3/16" = 1'-0"

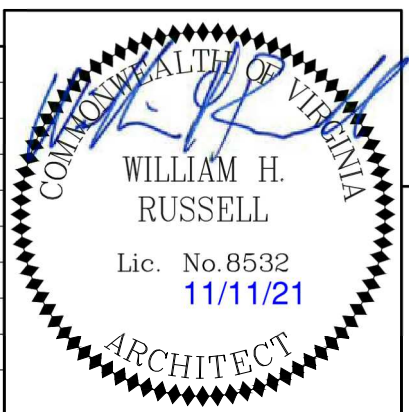


PARTIAL EAST ELEVATION
3/16" = 1'-0"

STAIN ALL EXTERIOR WOOD TRIM AND T1-11 WOOD SIDING - CONFIRM STAIN COLOR WITH CLIENT BEFORE PROCEEDING



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 DRAWN BY M. TAWADROUS
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 APPROVED BY J. HISE

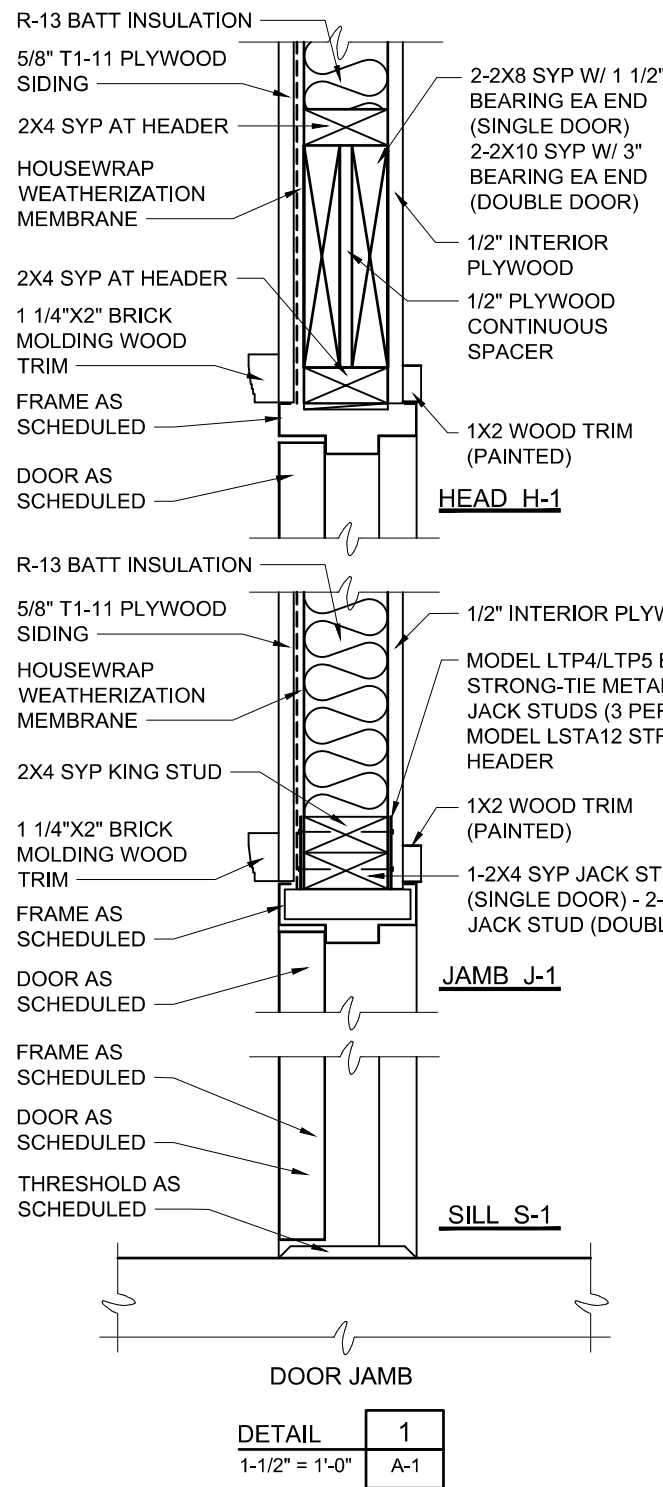
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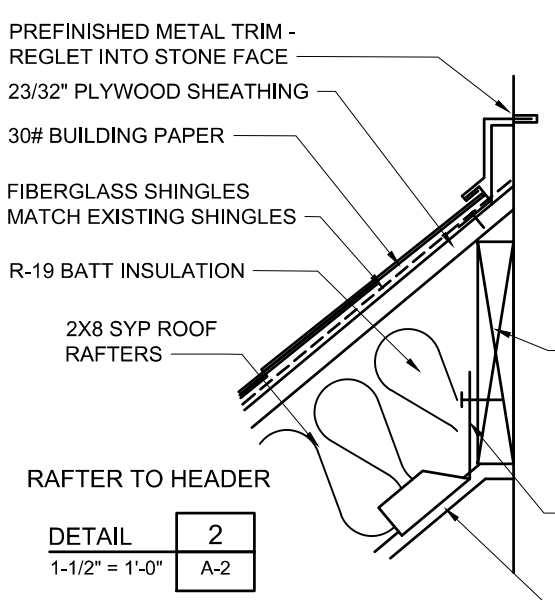
CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA
 ARCHITECTURAL
 ELEVATIONS

A-4
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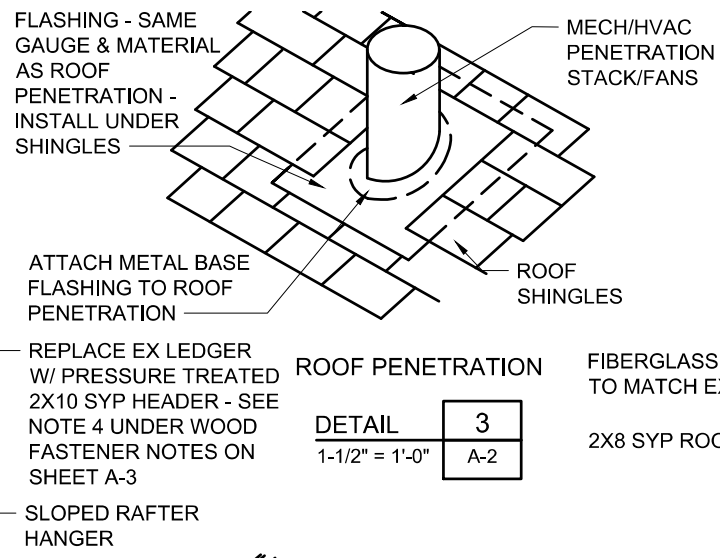
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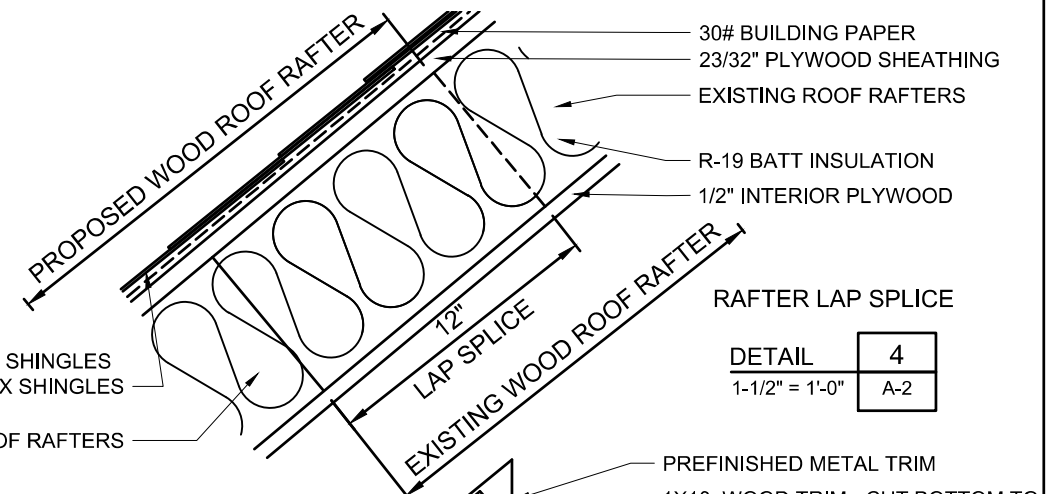
DETAIL 1
1-1/2" = 1'-0" A-1



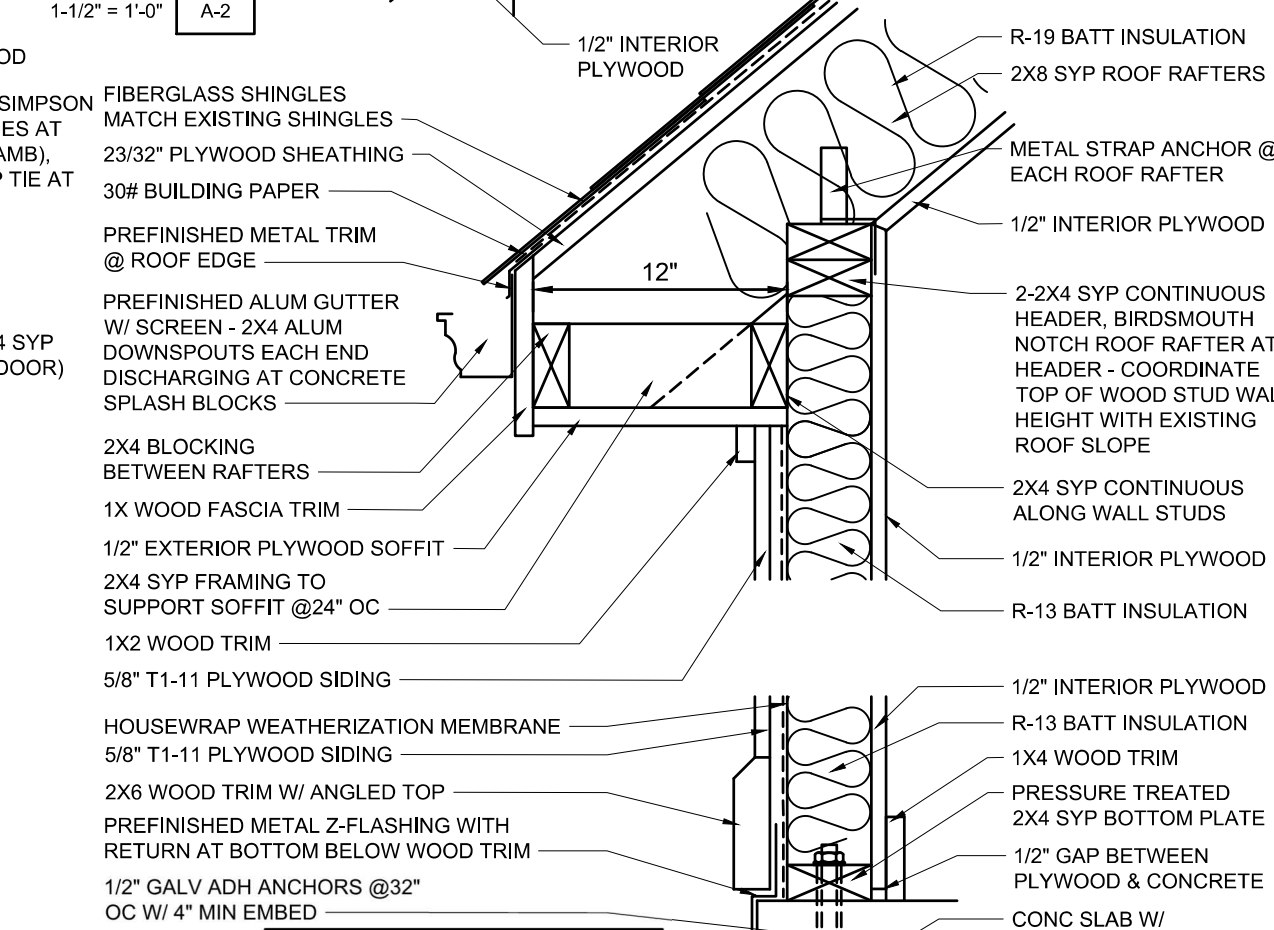
DETAIL 2
1-1/2" = 1'-0" A-2



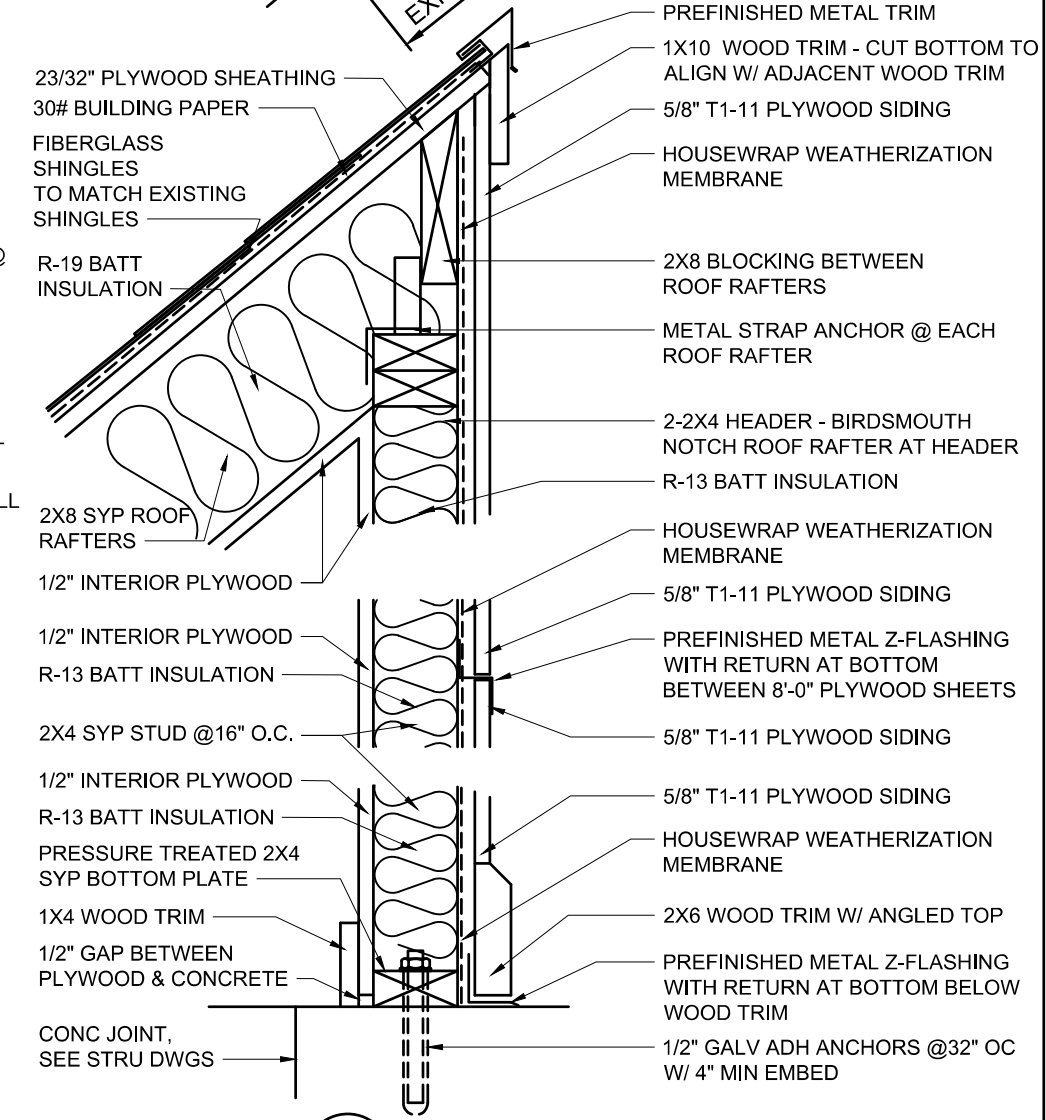
DETAIL 3
1-1/2" = 1'-0" A-2



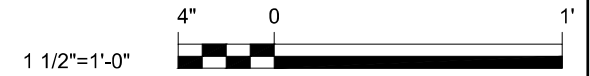
DETAIL 4
1-1/2" = 1'-0" A-2



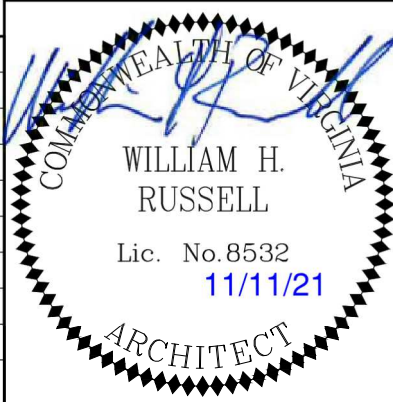
SECTION A
1-1/2" = 1'-0" A-2



SECTION B
1-1/2" = 1'-0" A-2



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 DRAWN BY M. TAWADROUS
 CHECKED BY W. RUSSELL
 APPROVED BY J. HISE



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CATTAIL BRANCH SPS
LEESBURG, VIRGINIA
ARCHITECTURAL
DETAILS

A-5
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GENERAL STRUCTURAL NOTES:

G-1 DESIGN IS IN ACCORDANCE WITH AND CONSTRUCTION SHALL COMPLY WITH THE PROVISIONS OF THE 2018 VIRGINIA UNIFORM STATEWIDE BUILDING CODE.

G-2 LIVE LOADS:

STRUCTURE \ LEVEL	ROOF	BOTTOM / GROUND FLOOR
CATTAIL BRANCH SPS	20 PSF	250 PSF

G-3 SNOW LOAD:

GROUND SNOW LOAD (Pg) = 25 PSF
 FLAT-ROOF SNOW LOAD (Pf) = 22 PSF
 SNOW EXPOSURE FACTOR (Ce) = 0.9
 SNOW LOAD IMPORTANCE FACTOR (Is) = 1.1
 THERMAL FACTOR (Ct) = 1.2

G-4 WIND DESIGN CRITERIA:

BASIC DESIGN WIND SPEED (V) = 120 MPH
 ALLOWABLE STRESS DESIGN WIND SPEED (Vasd) = 90 MPH
 RISK CATEGORY = III
 WIND EXPOSURE = C

STRUCTURE \ PARAMETER	PRESSURE COEFFICIENT GCpi	WIND DESIGN PRESSURE	COMPONENTS AND CLADDING	LATERAL LOAD RESISTING SYSTEM
CATTAIL BRANCH SPS	±0.18	26.6 PSF	39.5 PSF	Light Frame (Wood)

G-2 SEISMIC LOAD:

RISK CATEGORY = III
 SEISMIC IMPORTANCE FACTOR (Ie) = 1.25
 SITE CLASS = D
 MAPPED SPECTRAL RESPONSE ACCELERATIONS (Ss/S1) = 0.135/0.044
 SPECTRAL RESPONSE ACCELERATIONS (SMS/SM1) = 0.216/0.104
 SPECTRAL RESPONSE COEFFICIENTS (SDS/SD1) = 0.144/0.070
 SEISMIC DESIGN CATEGORY = B

CATTAIL SPS ODOR CONTROL ROOMS:
 BASIC STRUCTURAL SYSTEM = LIGHT-FRAME (WOOD), WOOD SHEATHED FOR SHEAR RESISTANCE
 DESIGN BASE SHEAR = 0.2 KIPS
 SEISMIC RESPONSE COEFFICIENT, Cs = 0.0257
 RESPONSE MODIFICATION COEFFICIENT, R = 7
 ANALYSIS PROCEDURE = EQUIVALENT LATERAL FORCE

G-3 PLATFORMS ARE DESIGNED FOR A LIVE LOAD = 100 PSF.

G-4 ALL DIMENSIONS INDICATED FOR EXISTING STRUCTURES SHALL BE VERIFIED BY FIELD MEASUREMENT. ALL DIMENSIONS THAT ARE CONTROLLED BY OR RELATED TO EQUIPMENT SHALL BE VERIFIED BY THE CONTRACTOR WITH THE MANUFACTURER SHOP DRAWINGS PRIOR TO CONSTRUCTION.

G-5 EQUIPMENT ANCHOR SIZES, TYPES, EMBEDMENTS AND PATTERNS SHALL BE VERIFIED WITH THE MANUFACTURER. ALL ANCHOR PATTERNS SHALL BE TEMPLATED TO INSURE ACCURACY OF PLACEMENT.

G-6 THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING ALL EXISTING INFORMATION IN THE FIELD.

STRUCTURAL METALS AND COMPONENT ANCHORAGE:

M-1 DETAIL, FABRICATE, AND ERECT STRUCTURAL STEEL IN ACCORDANCE WITH ANSI/AISC 360 SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, LATEST EDITION.

M-2 STEEL MATERIAL:
 A) PLATES, BARS, AND ANGLES: ASTM A36 (36 KSI)
 B) STRUCTURAL W, C, & MC SHAPES: ASTM A992 (50 KSI)
 C) ANCHOR RODS: ASTM F1554 GRADE 55 (55 KSI)

M-3 PROVIDE MINIMUM 3/4" DIAMETER F3125 A325 TYPE 1 OR GRADE F1852 TYPE 1 HIGH STRENGTH BOLTS WITH SNUG TIGHTENED TYPE N CONNECTIONS FOR STRUCTURAL STEEL.

M-4 ALL BOLTS CONNECTING ALUMINUM SHALL BE STAINLESS STEELS TYPE 316 FOR UNDERWATER APPLICATIONS AND TYPE 304 FOR ALL OTHER APPLICATIONS.

M-5 ALUMINUM SHALL BE ISOLATED FROM CONTACT WITH CONCRETE AND DISSIMILAR METALS.

M-6 ALL GROOVE AND BUTT WELDS SHALL BE FULL PENETRATION.

M-7 FILLET WELD SIZES SHALL NOT BE LESS THAN THE MINIMUM SIZE REQUIRED BY AISC CODE FOR PLATE SIZES TO BE CONNECTED AND SHALL BE APPLIED TO THE ENTIRE JOINT CONTACT LENGTH, AND NOT LESS THAN 3/16".

M-8 STRUCTURAL WELDED JOINTS SHALL CONFORM TO THE PROVISIONS OF AWS D1.1, STRUCTURAL WELDING CODE BY AMERICAN WELDING SOCIETY. PROOF OF WELDER CERTIFICATION SHALL BE AVAILABLE AT THE JOB SITE DURING TIMES OF INSPECTION.

M-9 GRATING PANELS SHALL BE CONFINED TO PREVENT MOVEMENT PER DETAIL 1/S-5. USE OF GRATING CLIP ATTACHMENT IS NOT ACCEPTABLE TO PREVENT GRATING MOVEMENT.

FOUNDATIONS:

F-1 CONCRETE (CAST-IN-PLACE) NOTES APPLY TO FOUNDATIONS.

F-2 ALLOWABLE SOIL BEARING PRESSURE

STRUCTURE \ PARAMETER	ALLOWABLE SOIL BEARING PRESSURE
CATTAIL BRANCH SPS	2000 PSF

F-3 MINIMUM DEPTH FROM ADJACENT FINISHED GRADE TO BOTTOM OF FOUNDATION = 18 INCHES.

DEMOLITION:

D-1 FOR DEMOLITION REQUIREMENTS, REFER TO SPECIFICATION 01 73 00 - EXECUTION OF WORK.

D-2 CONCRETE DEMOLITION WITHIN STRUCTURES BEING MODIFIED SHALL BE SELECTIVE DEMOLITION BY CORE DRILLING OR SAWCUTTING AND CAREFUL REMOVAL OF CONCRETE SHOWN TO BE REMOVED. NO OVERTIPPING OF AREAS TO BE DEMOLISHED SHALL BE PERMITTED. EXPLOSIVES AND VIBRATORY HAMMERS SHALL NOT BE USED FOR DEMOLITION WORK.

D-3 UNLESS ANCHORING DEVICES AND/OR REINFORCEMENT IS NOTED TO REMAIN FOLLOWING DEMOLITION, REMOVED AND/OR BURN BACK ANCHORS AND REINFORCEMENT STEEL 1/2" MINIMUM BELOW SURFACE. VOIDS CREATED SHALL BE FILLED WITH EPOXY RESIN BINDER.

D-4 EMBEDDED CONDUIT ENCOUNTERED DURING DEMOLITION WORK LIMITS SHALL BE PERMANENTLY REROUTED AS NECESSARY. CONTRACTOR SHALL SUBMIT PROPOSED MEANS OF REROUTING ANY INTERFERING CONDUIT.

D-5 WHERE DRAWINGS INDICATE A CONCRETE EQUIPMENT PAD TO BE DEMOLISHED, THE FLOOR SLAB SURFACE SHALL BE REPAIRED AS APPROVED BY THE ENGINEER. FOLLOWING SELECT DEMOLITION AND REMOVAL OF THE EQUIPMENT PAD, THE REPAIR SHALL BE:
 A) SAWCUT THE FLOOR AROUND THE EQUIPMENT PAD PERIMETER TO A DEPTH OF 1/4".
 B) SCARIFY AND REMOVE SLAB CONCRETE WITHIN THE PERIMETER TO A NOMINAL 1/4" DEPTH, CLEAN AND REMOVE ALL CONCRETE LAITANCE.
 C) RESURFACE THE AREA BY APPLYING A POLYMER MODIFIED OR SILICA FUME ENHANCED CEMENTITIOUS REPAIR MORTAR, APPROVED BY THE ENGINEER, FOLLOWING THE MANUFACTURER'S RECOMMENDATIONS. LEVEL AND FINISH THE SURFACE TO MATCH THE FLOOR SLAB SURROUNDING AREA.

D-6 CONCRETE SURFACES LEFT EXPOSED FOLLOWING DEMOLITION SHALL BE SEALED WITH EPOXY RESIN COATING SUCH AS DURALKOTE 240 BY EUCLID CHEMICAL, OR APPROVED EQUAL.

D-7 DETAILED CONSTRUCTION AND DEMOLITION PLAN SHALL BE SUBMITTED TO THE ENGINEER AND APPROVED BY THE ENGINEER AND OWNER PRIOR TO BEGINNING CONSTRUCTION. ANY SHUTDOWNS SHALL BE SUBMITTED TO, COORDINATED WITH, AND APPROVED BY THE OWNER. ONCE APPROVED, CONTRACTOR SHALL PROVIDE A MINIMUM OF THREE (3) WEEKS NOTICE TO OWNER PRIOR TO SHUTDOWN.

CONCRETE (CAST-IN-PLACE):

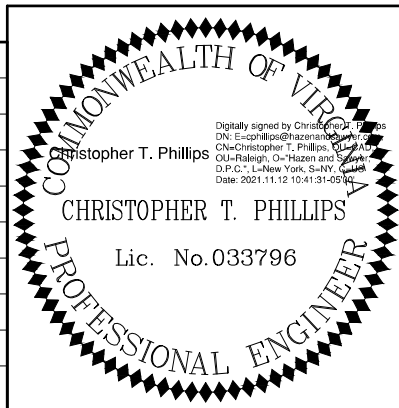
C-1 DESIGN OF CONCRETE ELEMENTS IS IN ACCORDANCE WITH ACI 318 (CODE REQUIREMENTS FOR STRUCTURAL CONCRETE) AND 350 (CODE REQUIREMENTS FOR ENVIRONMENTAL ENGINEERING CONCRETE STRUCTURES).

C-2 FOR CONCRETE MIX DESIGN SEE SPECIFICATION SECTION 03 30 00.

C-3 CONCRETE STRENGTH CLASSES (28-DAY COMPRESSIVE STRENGTH):
 A) CLASS A1 CONCRETE (4,500 PSI): NORMAL WEIGHT STRUCTURAL CONCRETE TO BE USED IN ALL STRUCTURES.

C-4 ALL BAR REINFORCING SHALL CONFORM TO ASTM A615, GRADE 60. WHERE REINFORCEMENT IS TO BE WELDED IN ACCORDANCE WITH AWS D1.4, ASTM A706 GRADE 60 SHALL BE USED. WELDED WIRE FABRIC SHALL CONFORM TO ASTM A185.

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NO	ISSUED FOR		DATE	JTH	BY



DESIGNED BY C. OHRNBERGER
 DRAWN BY C. OHRNBERGER
 CHECKED BY C. PHILLIPS
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PROJECT NO.
 31111-056

DATE:
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CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA

STRUCTURAL
 GENERAL NOTES

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CONCRETE (CAST-IN-PLACE) CONTINUED:

C-5 CONCRETE COVER FOR REINFORCING (UNLESS NOTED OTHERWISE ON THE DRAWINGS):

- A) CONCRETE DEPOSITED DIRECTLY AGAINST SOIL: 3"
- B) CONCRETE EXPOSED TO WEATHER (#5 OR SMALLER): 1 1/2"
- CONCRETE EXPOSED TO WEATHER (#6 OR LARGER): 2"
- C) SLABS: 1 1/2"
- AT SURFACES CONTACTING FLUID: 2"

C-6 SPLICES SHALL BE CLASS "B" CONFORMING TO THE PROVISIONS OF ACI 318 UNLESS NOTED OTHERWISE. SPLICE LENGTH FOR TWO DIFFERENT SIZED BARS TO BE LAP SPICED TOGETHER SHALL BE THE LENGTH OF THE LARGER BAR UNLESS NOTED OTHERWISE.

C-7 ALL EXPOSED CORNERS SHALL HAVE A 3/4" CHAMFER.

C-8 EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES AND REVEALS NOT SHOWN ON THE STRUCTURAL DRAWINGS BUT REQUIRED BY OTHER CONTRACT DOCUMENTS, SHALL BE PROVIDED FOR PRIOR TO PLACING CONCRETE.

C-9 REINFORCING BARS AND ACCESSORIES SHALL NOT BE IN CONTACT WITH ANY METAL PIPE, PIPE FLANGE, METAL CONDUIT, OR OTHER METAL PARTS EMBEDDED IN CONCRETE. A MINIMUM CLEARANCE OF 2" SHALL BE PROVIDED.

C-10 DOWELS, ANCHOR BOLTS, PIPES, WATERSTOPS AND OTHER EMBEDDED ITEMS SHALL BE HELD SECURELY IN POSITION WHILE CONCRETE IS BEING PLACED.

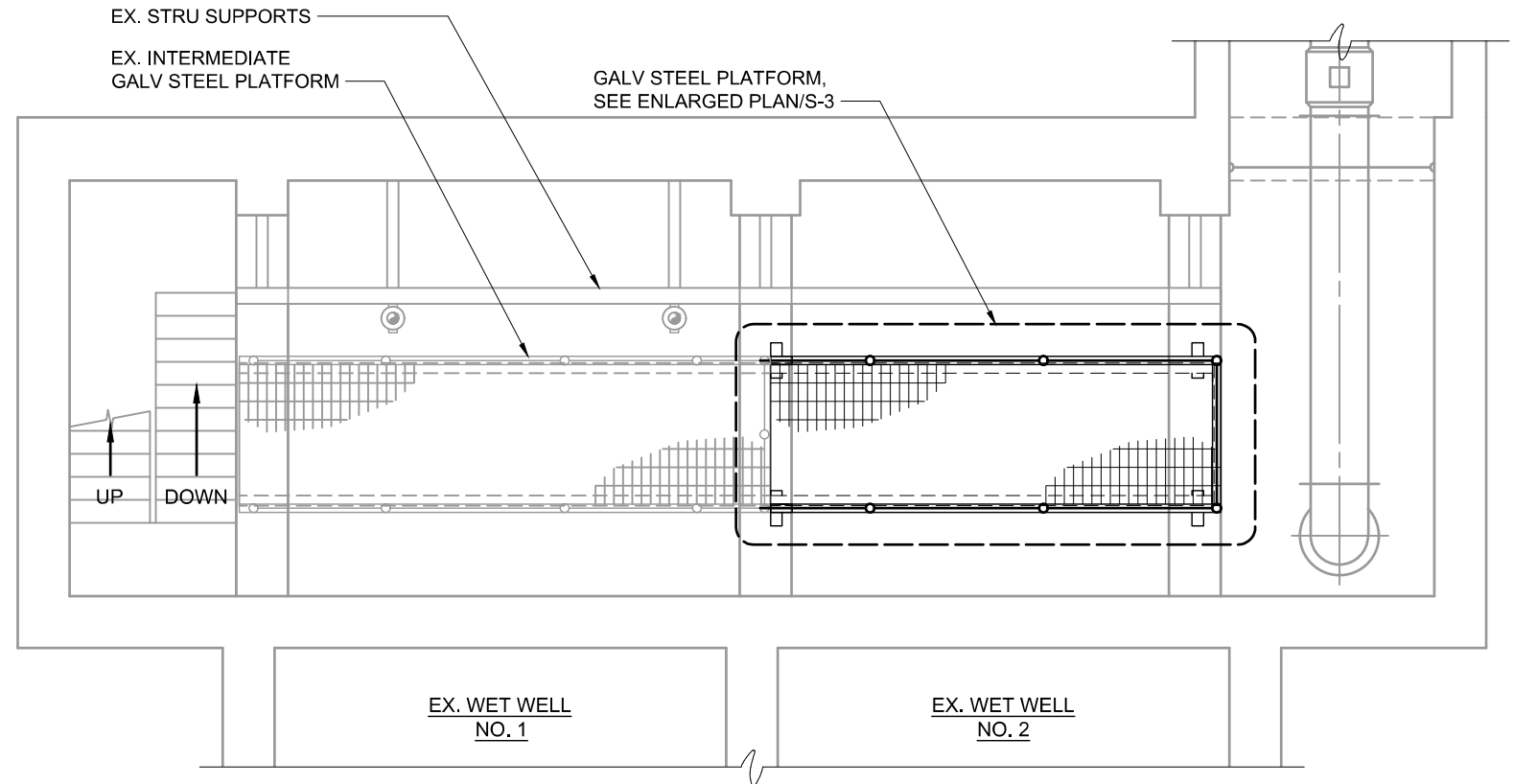
C-11 CONDUITS AND OTHER SIMILAR ITEMS EMBEDDED IN OR PENETRATING THROUGH CONCRETE SHALL BE SPACED ON CENTER NOT LESS THAN 3 TIMES THEIR OUTSIDE DIMENSION, BUT NOT LESS THAN 2 1/2" CLEAR. WHEN SUCH ITEMS ARE EMBEDDED IN WALLS OR SLABS, THEY SHALL NOT OCCUPY MORE THAN 1/3 OF THE MEMBER THICKNESS.

C-12 DRILLED ADHESIVE DOWELS AND CONCRETE ANCHORS (WHERE DOWELS OR ANCHORS ARE SHOWN TO BE PLACED INTO HARDENED CONCRETE):

- A) THE HOLE DIAMETER SHALL BE NO LARGER THAN 1/8" GREATER THAN THE DIAMETER OF THE REINFORCING BAR AT THE DEFORMATIONS FOR DOWELS. THE HOLE DIAMETER SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS FOR ANCHORS.
- B) THE DEPTH OF EMBEDMENT SHALL BE 12 BAR DIAMETERS, UNLESS NOTED OTHERWISE.
- C) ADJUST THE DOWEL OR ANCHOR LOCATIONS AS NEEDED TO AVOID DRILLING THROUGH ANY REINFORCING BARS. IF THE LOCATION NEEDS TO BE MODIFIED, CONTACT THE ENGINEER. CONTRACTOR SHALL USE NON-DESTRUCTIVE MEANS TO FIELD LOCATE REINFORCEMENT PRIOR TO DRILLING HOLES FOR DOWELS OR ANCHORS.

C-13 CLEAR DISTANCE FROM ANCHOR RODS TO ANY CONCRETE EDGE SHALL BE 4" MINIMUM UNLESS NOTED OTHERWISE.

C-14 CONCRETE COMPRESSIVE STRENGTH TESTS SHALL BE AVAILABLE ON THE JOB SITE FOR REVIEW BY THE ENGINEER.

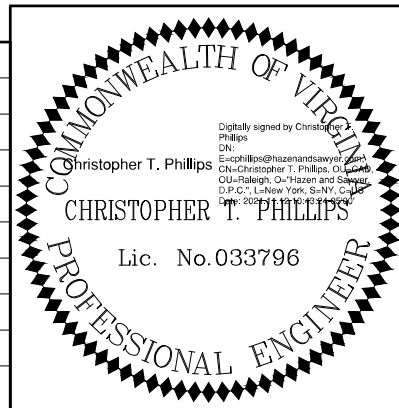


OVERALL PLAN - INTERMEDIATE LEVEL EL 195.50

3/16" = 1'-0"

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DESIGNED BY	C. OHRNBERGER
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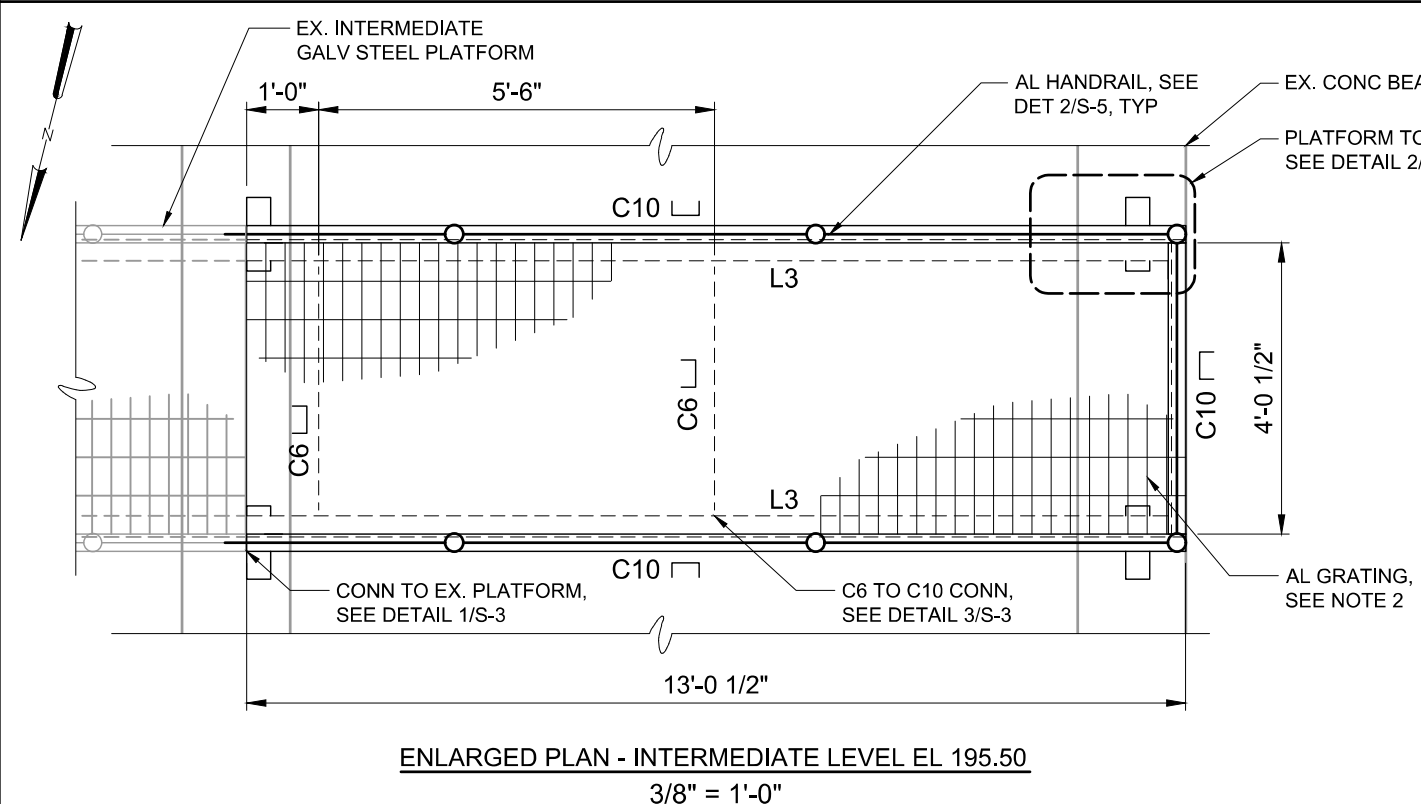
PROJECT NO.	31111-056
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CATTAIL BRANCH SPS LEESBURG, VIRGINIA	STRUCTURAL
GENERAL NOTES AND INTERMEDIATE LEVEL PLATFORM PLAN	

S-2
SHEET 12 OF 57

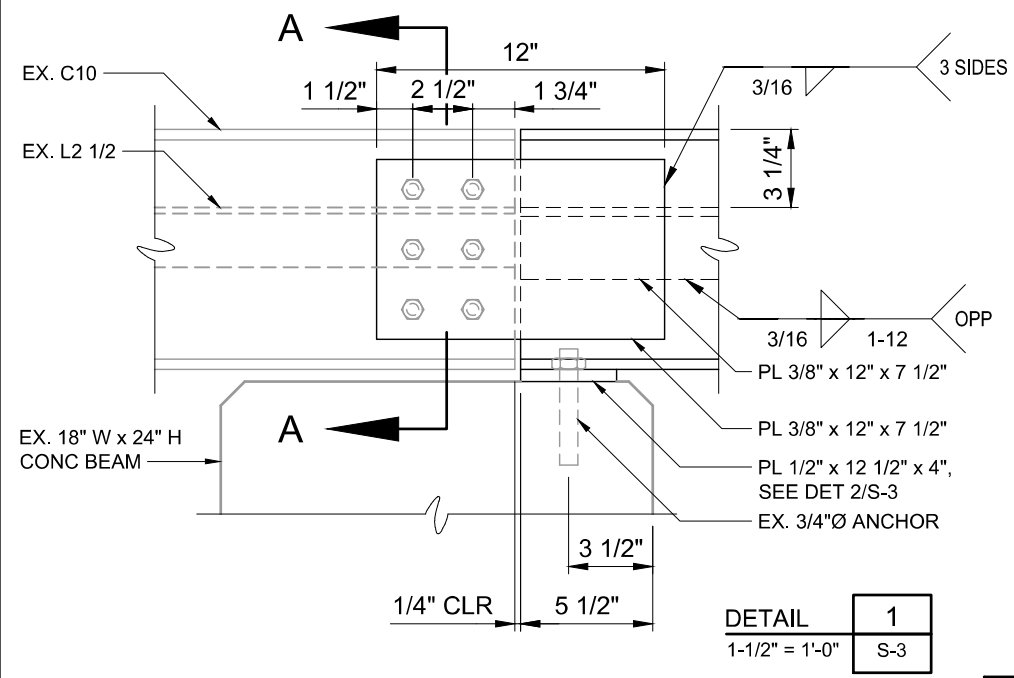


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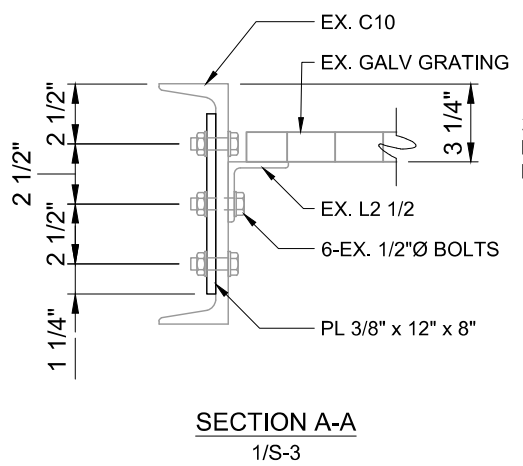


ENLARGED PLAN - INTERMEDIATE LEVEL EL 195.50

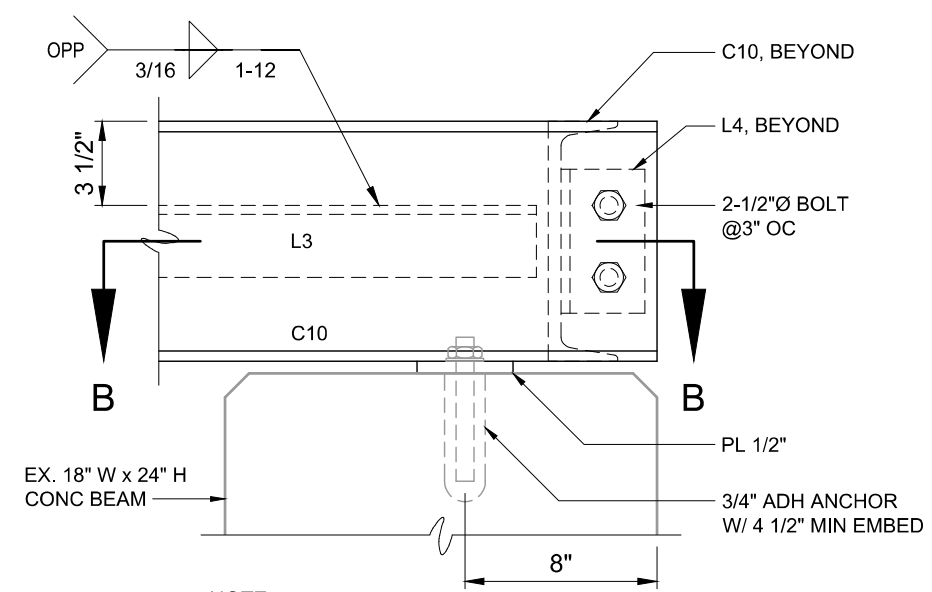
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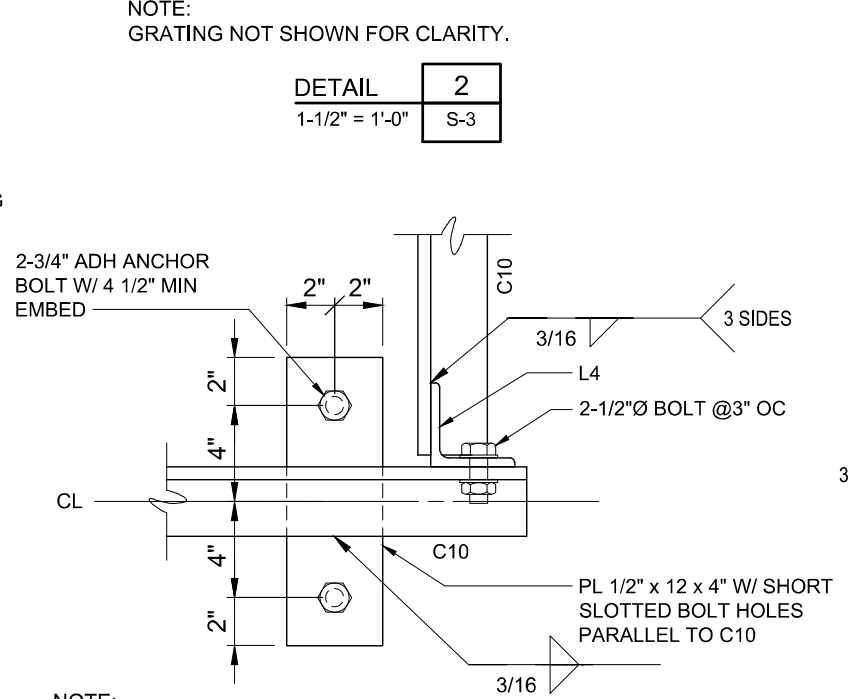
DETAIL 1
1-1/2" = 1'-0"



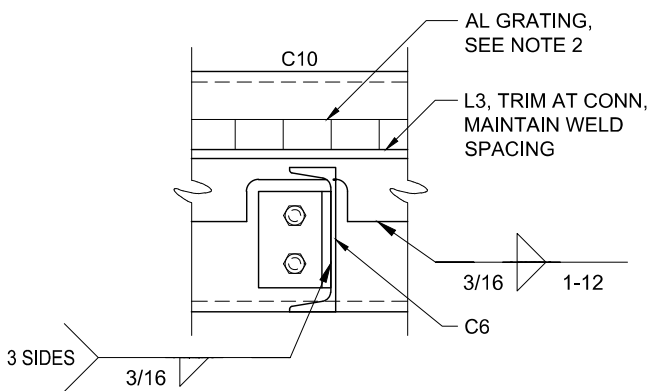
SECTION A-A
1/S-3



DETAIL 2
1-1/2" = 1'-0"



SECTION B-B
2/S-3



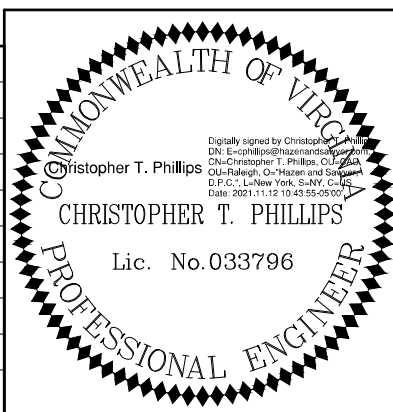
DETAIL 3
1-1/2" = 1'-0"



NOTES:

1. ALL INTERMEDIATE PLATFORM CHANNELS, ANGLES, PLATES, AND FASTENERS SHALL BE GALVANIZED STEEL IN ACCORDANCE WITH SECTION 05035. INTERMEDIATE PLATFORM HANDRAIL AND GRATING SHALL BE ALUMINUM.
2. ALUMINUM GRATING SHALL BE 1 1/2" DEEP, INCLUDE A MINIMUM OF 1/8" CLEARANCE ALL AROUND, AND SHALL BE IN ACCORDANCE WITH SECTION 05531. GRATING SHALL BE CONFINED USING GRATING CONFINEMENT STUDS PER DETAIL 1/S-5.
3. INTERMEDIATE PLATFORM AND GRATING SHALL BE REMOVABLE TO ALLOW PERIODIC ACCESS TO EQUIPMENT BELOW.
4. C10 DENOTES C10x25
C6 DENOTES C6x8.2
L4 DENOTES L4x4x3/8
L3 DENOTES L3x3x3/8

1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY C. OHRNBERGER
 DRAWN BY C. OHRNBERGER
 CHECKED BY C. PHILLIPS
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

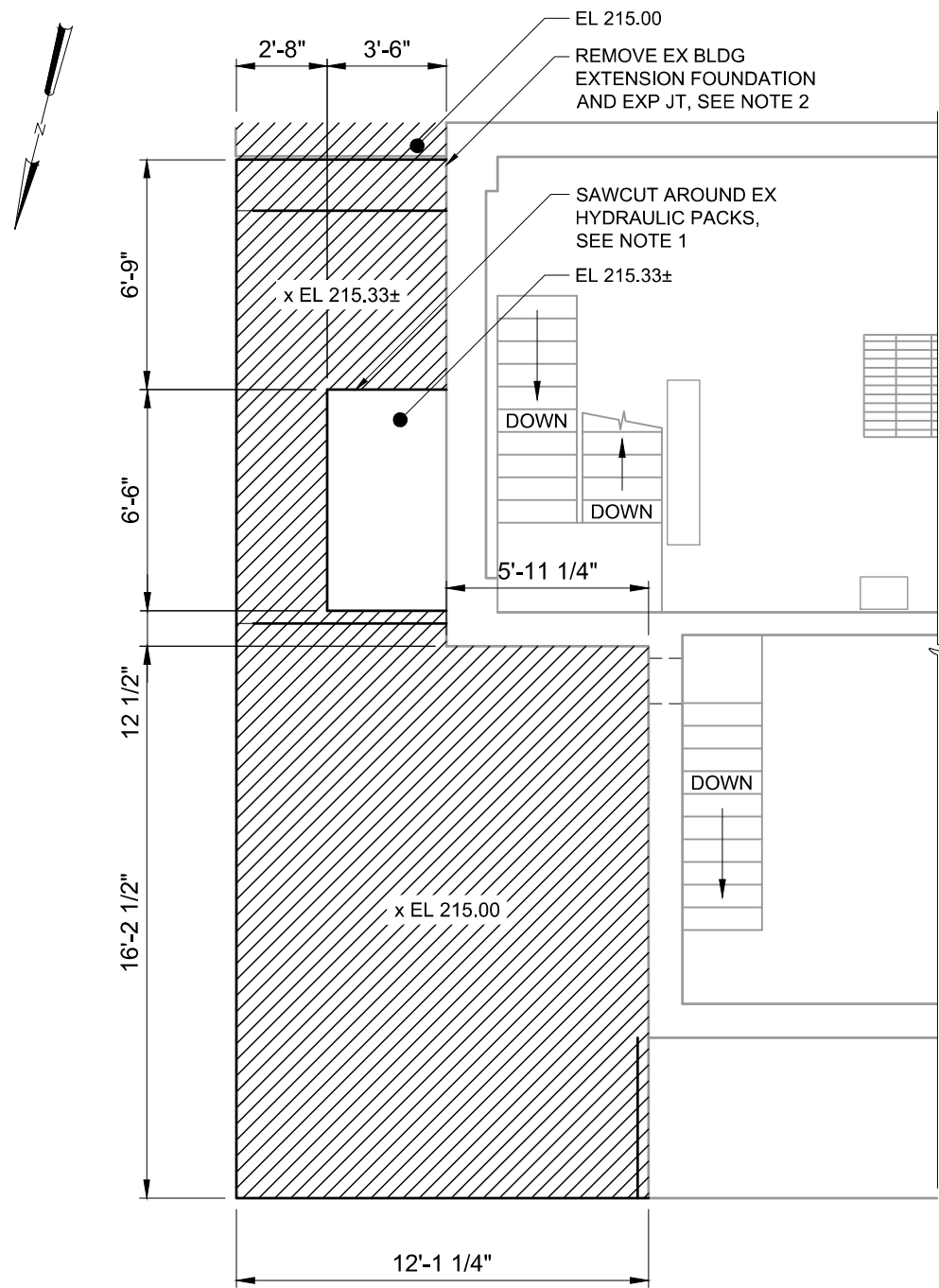
CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

STRUCTURAL
INTERMEDIATE LEVEL PLATFORM

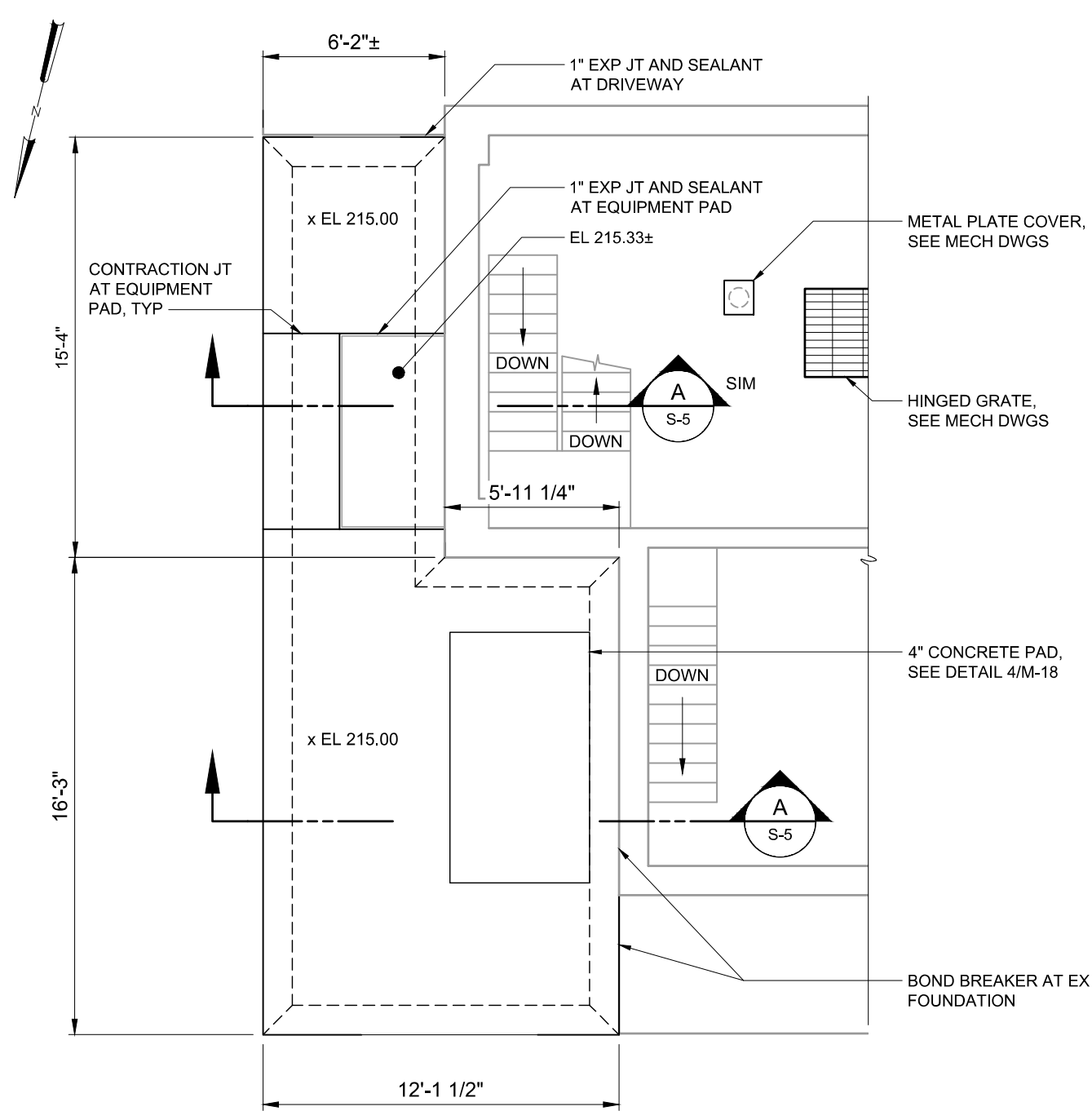
S-3

SHEET
13 OF 57

20211111 4:29P C:\31111-BAL\31111-056\GIS\CAD-BIM\STRU\S-4 UPPER LEVEL PLAN.dwg By: COHRNBERGER Last Saved By: COHRNBERGER



DEMOLITION - PLAN @ EL 215.00
3/16" = 1'-0"

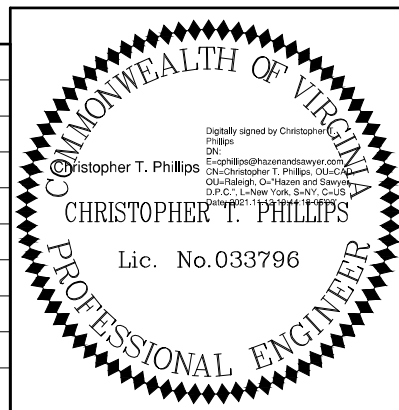


PLAN @ EL 215.00
3/16" = 1'-0"

NOTES:

1. REMOVE EXISTING FOUNDATION AROUND OPERATING HYDRAULIC PACKS. SAWCUT EXISTING FOUNDATION TO EXTENTS SHOWN AND GRIND EXPOSED CORNERS OF REMAINING EQUIPMENT PAD TO A 3/4" CHAMFER. REFER TO DEMOLITION NOTES ON DRAWING S-1.
2. EXISTING BUILDING EXTENSION FOUNDATION IS ISOLATED FROM THE ORIGINAL PUMP STATION CONCRETE STRUCTURE, SIDEWALK, AND DRIVEWAY VIA EXPANSION JOINTS. REMOVE THE EXISTING EXPANSION JOINT FILLER MATERIAL AND SEALANT PRIOR TO INSTALLATION OF FOUNDATION.

NO	BID SET	ISSUED FOR	DATE	BY
1	BID SET		11/21	JTH
	ISSUED FOR			



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 DRAWN BY C. OHRNBERGER
 CHECKED BY C. PHILLIPS
 APPROVED BY J. HISE



PROJECT NO.
31111-056

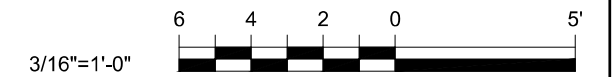
DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

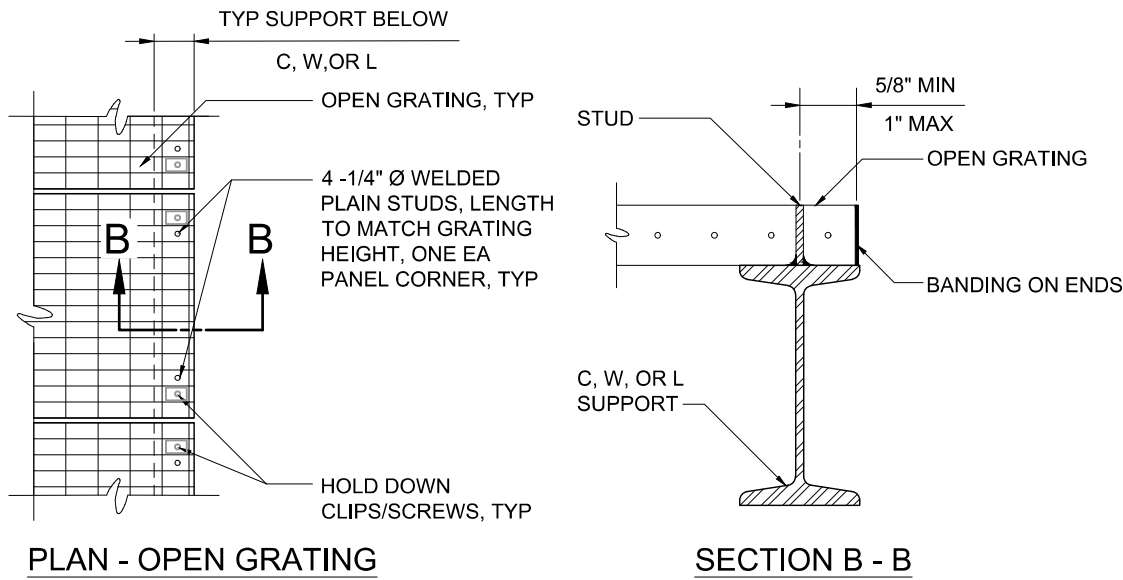
STRUCTURAL
UPPER LEVEL PLAN AND DETAILS

S-4

SHEET
14 OF 57



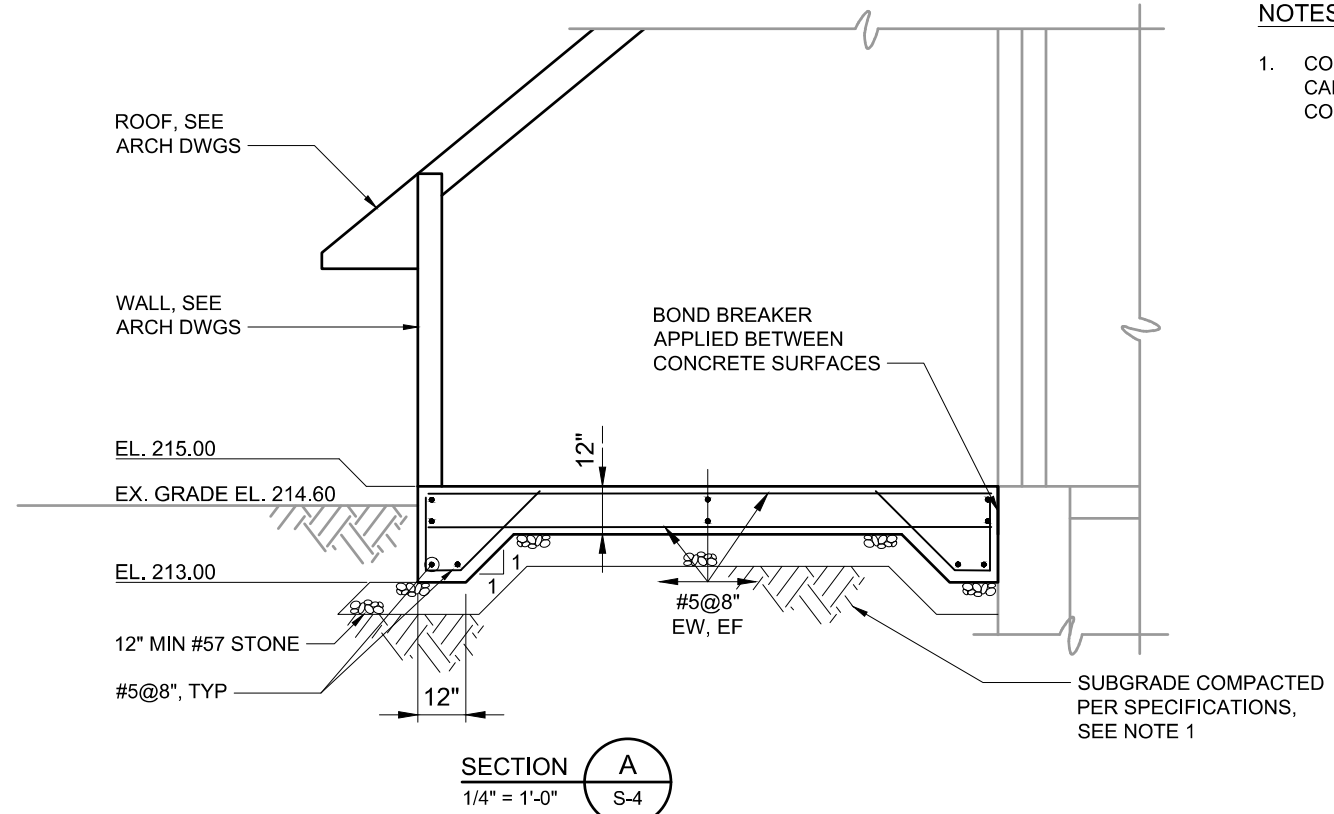
20211111 4:29P O:\31111-BAL\31111-056\GIS\CAD-BIM\STRU\S-5 SECTION AND DETAILS.dwg By: COHRNBERGER Last Saved By: COHRNBERGER



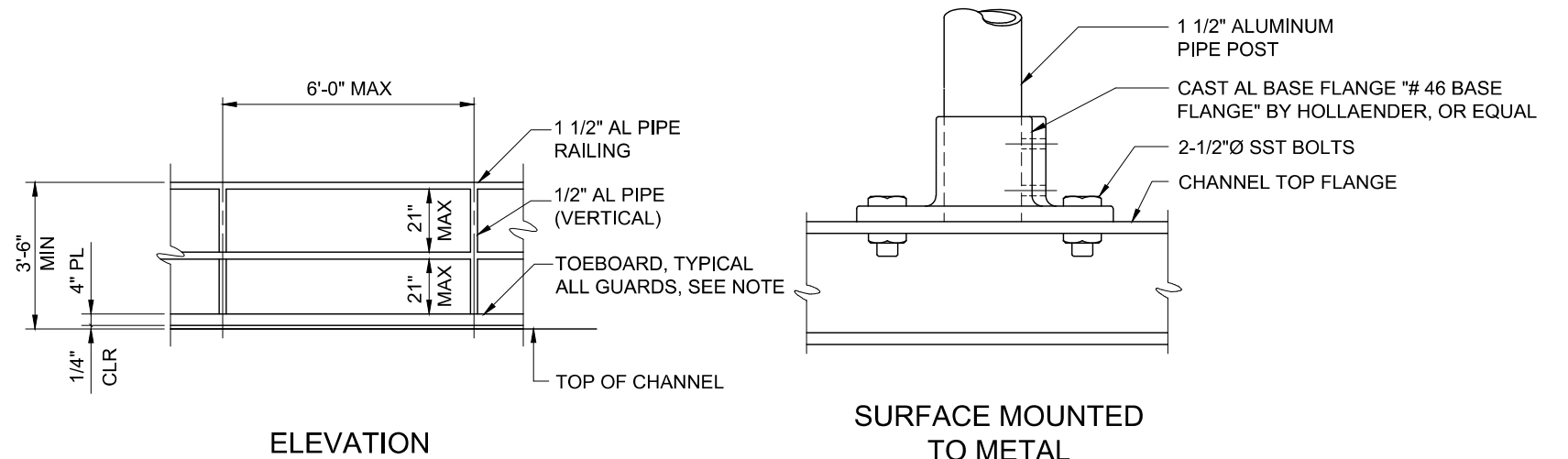
- NOTES:
- STUDS SHALL BE: METAL GRATING - 1/4" Ø WELDED PLAIN STUD OF SAME MATERIAL AS SUPPORT, WITH STUDS WELDED PER AWS REQUIREMENTS.
 - INSTALLED STUD SHALL MATCH GRATING HEIGHT.
 - STUD SHALL BE PLACED BETWEEN CROSS BAR(S) AND/OR BEARING BARS.

GRATING CONFINEMENT USING STUDS

DETAIL	1
NTS	S-1



- NOTES:
- CONTRACTOR SHALL VERIFY SOIL BEARING CAPACITY OF 2000 PSF PRIOR TO BEGINNING CONCRETE FOUNDATION CONSTRUCTION.



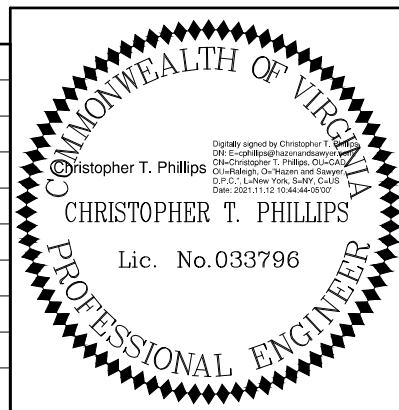
NOTE:
TOEBOARD SHALL BE INSTALLED AT BOTH THE NEW AND EXISTING INTERMEDIATE LEVEL PLATFORMS. ATTACH TOEBOARD TO EXISTING GALVANIZED STEEL HANDRAIL POSTS USING COMPONENT STYLE ATTACHMENTS.

ALUMINUM GUARD AND HANDRAIL

DETAIL	2
NTS	S-3



1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY C. OHRNBERGER
 DRAWN BY C. OHRNBERGER
 CHECKED BY C. PHILLIPS
 APPROVED BY J. HISE

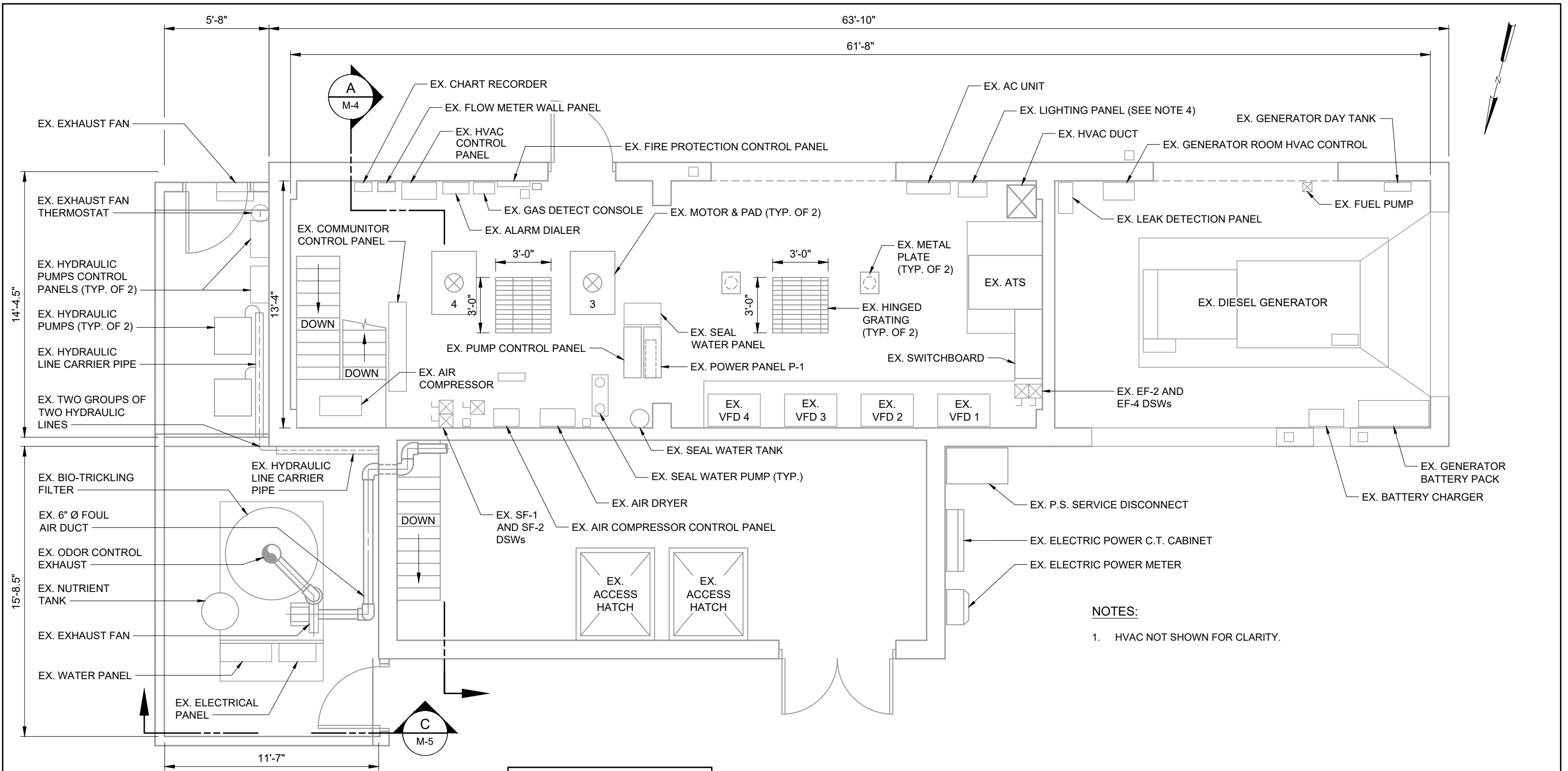
Hazen
 HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO.
31111-056
 DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA
 STRUCTURAL
 SECTION AND DETAILS

S-5
 SHEET
 15 OF 57

20211111 11:44A 0:\31111-bat\31111-056\GIS\CAD-BM\MECH\M-1 EXISTING PLAN - UPPER LEVEL EL 215.00.dwg By:MBROCATO Last Saved By: CNguyen

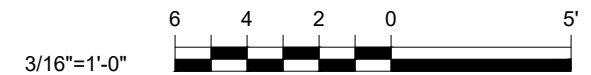


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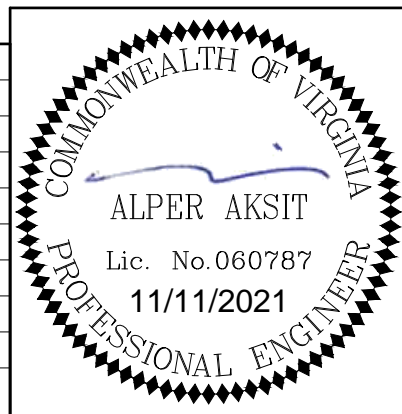
- 1. HVAC NOT SHOWN FOR CLARITY.

EXISTING PLAN - UPPER LEVEL EL 215.00

3/16" = 1'-0"



NO	BID SET ISSUED FOR	DATE	BY
1	BID SET	11/21	JTH
	ISSUED FOR	DATE	BY



DESIGNED BY	A. AKSIT
DRAWN BY	M. BROCATO
CHECKED BY	J. HISE
APPROVED BY	J. HISE

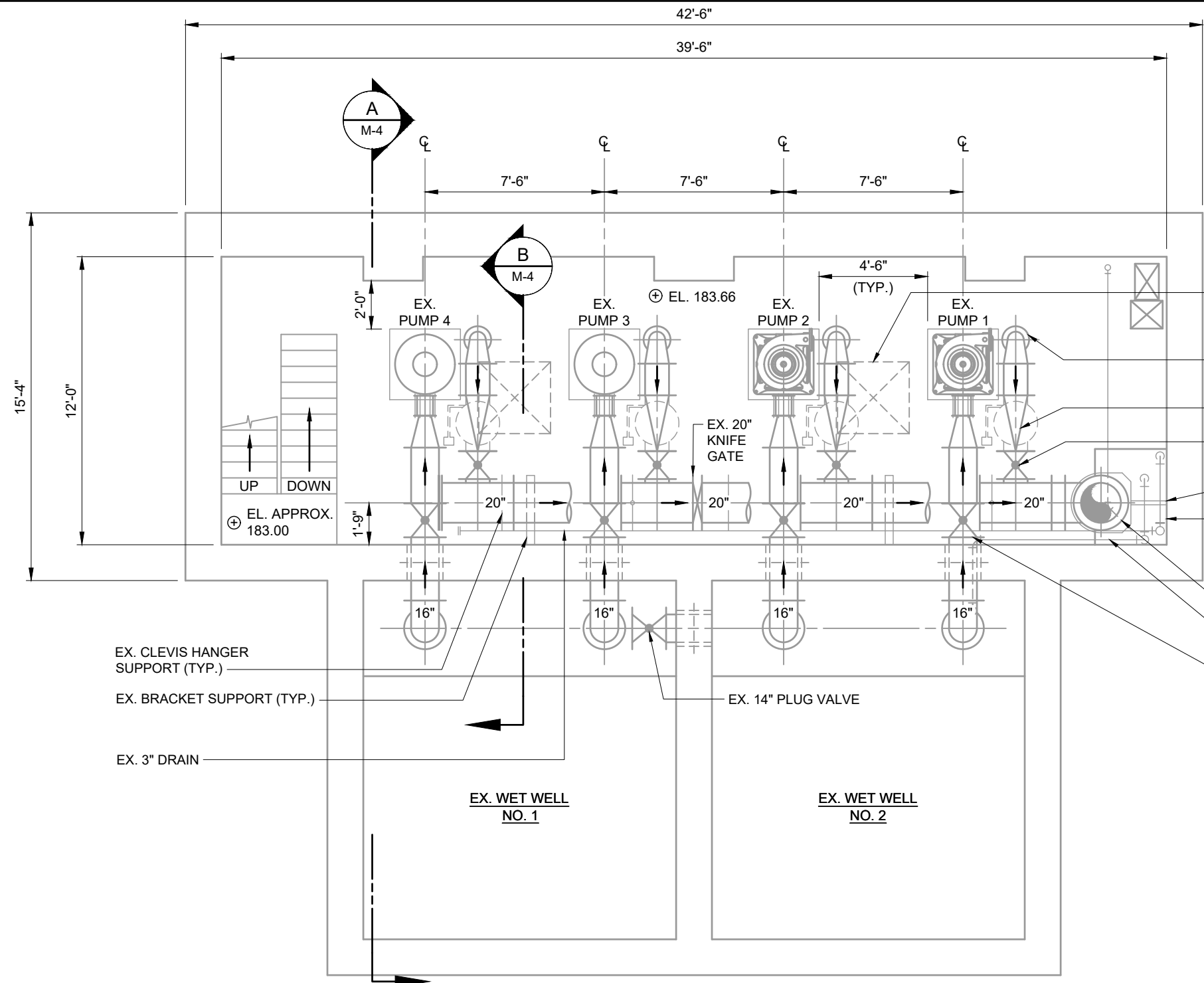
Hazen

HAZEN AND SAWYER
1 SOUTH STREET, SUITE 1150
BALTIMORE, MARYLAND 21202

PROJECT NO.	31111-056
DATE:	NOVEMBER 2021

CATTAIL BRANCH SPS LEESBURG, VIRGINIA	M-1
MECHANICAL	SHEET 16 OF 57
EXISTING PLAN - UPPER LEVEL EL 215.00	

20211111 11:45A 0:\31111-bal\31111-056\GIS\CAD-BIM\MECH\M-3 EXISTING PLAN - LOWER LEVEL EL 183.66.dwg By: MBROCATO Last Saved By: mbrocato



NOTES:

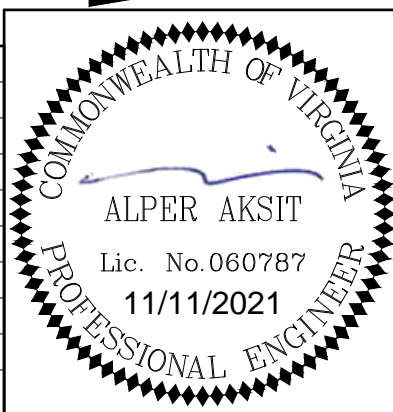
1. HVAC NOT SHOWN FOR CLARITY.

- EX. ACCESS HATCH ABOVE (TYP. OF 2)
- EX. 12"x8" REDUCING ELBOW (TYP.)
- EX. 12" CHECK VALVE (TYP.)
- EX. 12" DISCHARGE PLUG VALVE (TYP.)
- EX. PIPE SUPPORT
- EX. SUMP (PUMPS NOT SHOWN FOR CLARITY)
- EX. 20" DISCHARGE HEADER (ABOVE)
- EX. 3" SUMP PUMP PIPING
- EX. 16" SUCTION PLUG VALVE (TYP.)
- EX. 20" KNIFE GATE
- EX. 14" PLUG VALVE
- EX. 20" DISCHARGE HEADERS (TYP.)
- EX. 16" SUCTION PLUG VALVES (TYP.)
- EX. 3" DRAIN
- EX. BRACKET SUPPORT (TYP.)
- EX. CLEVIS HANGER SUPPORT (TYP.)

EXISTING PLAN - LOWER LEVEL EL 183.66
3/16" = 1'-0"



1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY A. AKSIT
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

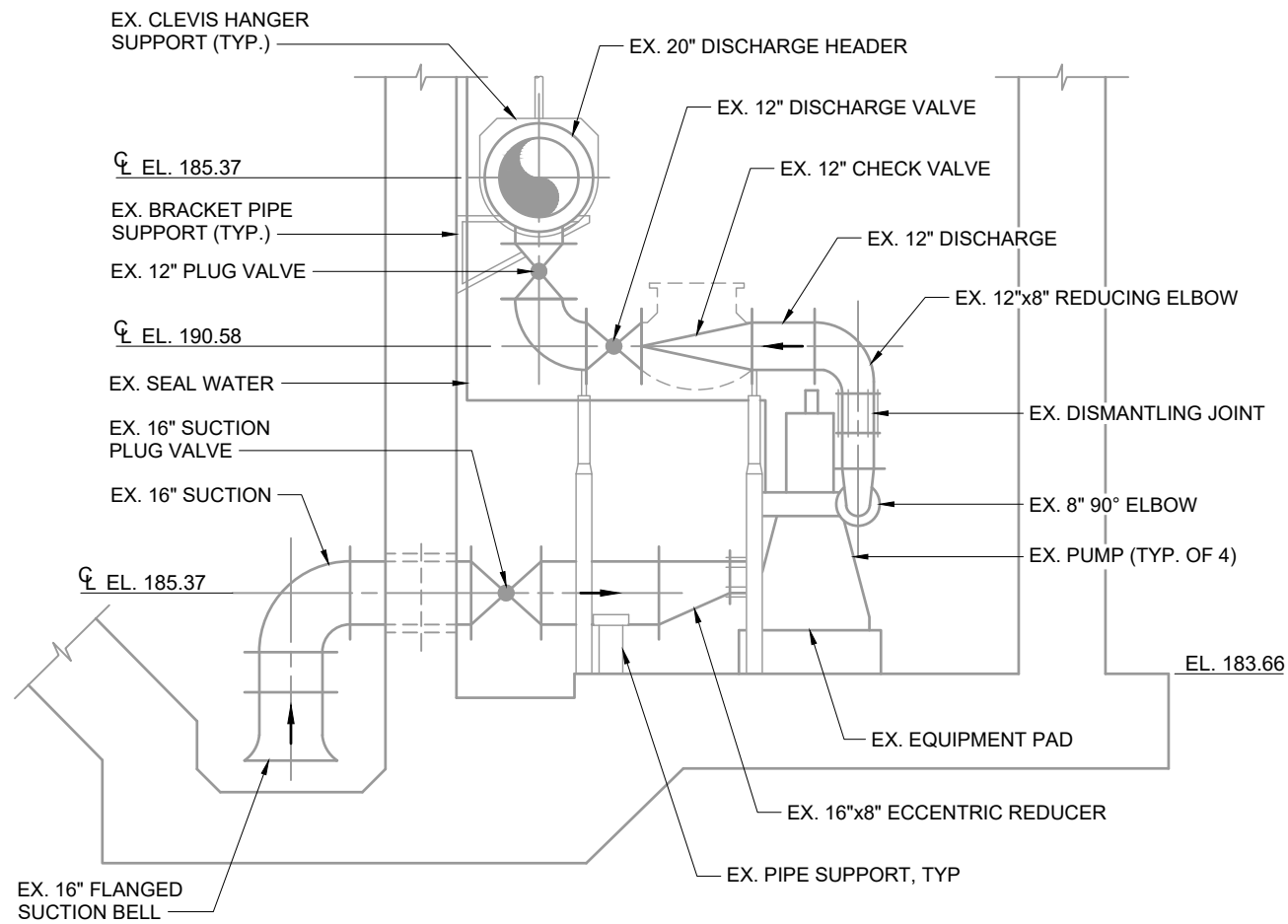
CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

MECHANICAL
EXISTING PLAN - LOWER LEVEL EL 183.66

M-3

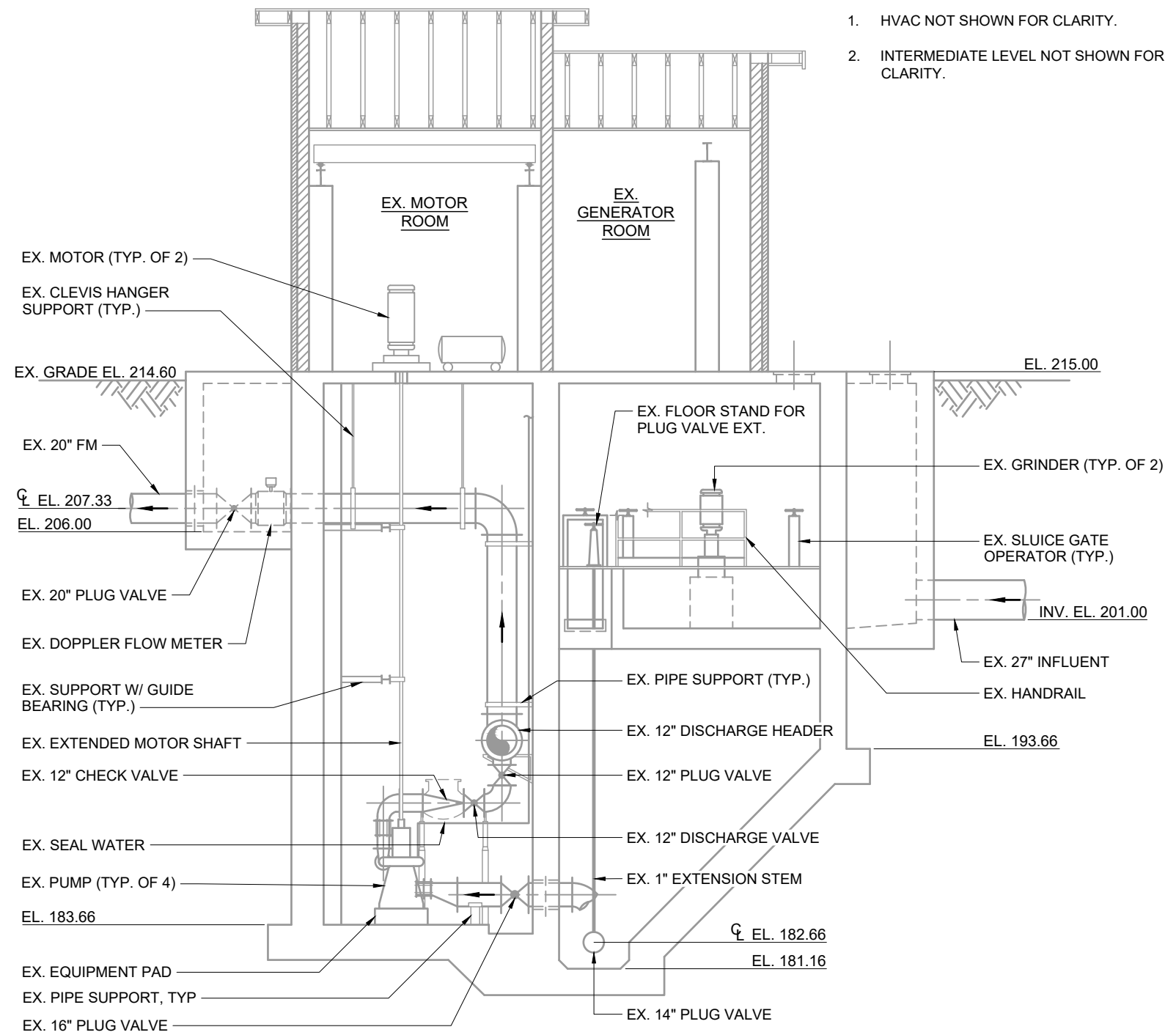
SHEET
18 OF 57

20211111 11:46A O:\31111-bat\31111-056\GIS\CAD-BIM\MECH\M-4 EXISTING SECTIONS.dwg By:MBROCATO Last Saved By: mbrocato



SECTION **B**
1/4" = 1'-0" M-3

(TYPICAL OF PUMPS 3 AND 4)

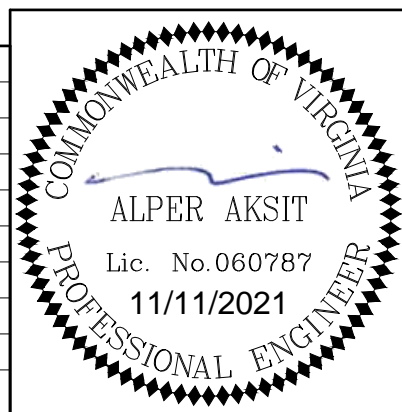


SECTION **A**
1/8" = 1'-0" M-1, M-3
(TYPICAL OF PUMPS 3 AND 4)

- NOTES:**
- HVAC NOT SHOWN FOR CLARITY.
 - INTERMEDIATE LEVEL NOT SHOWN FOR CLARITY.



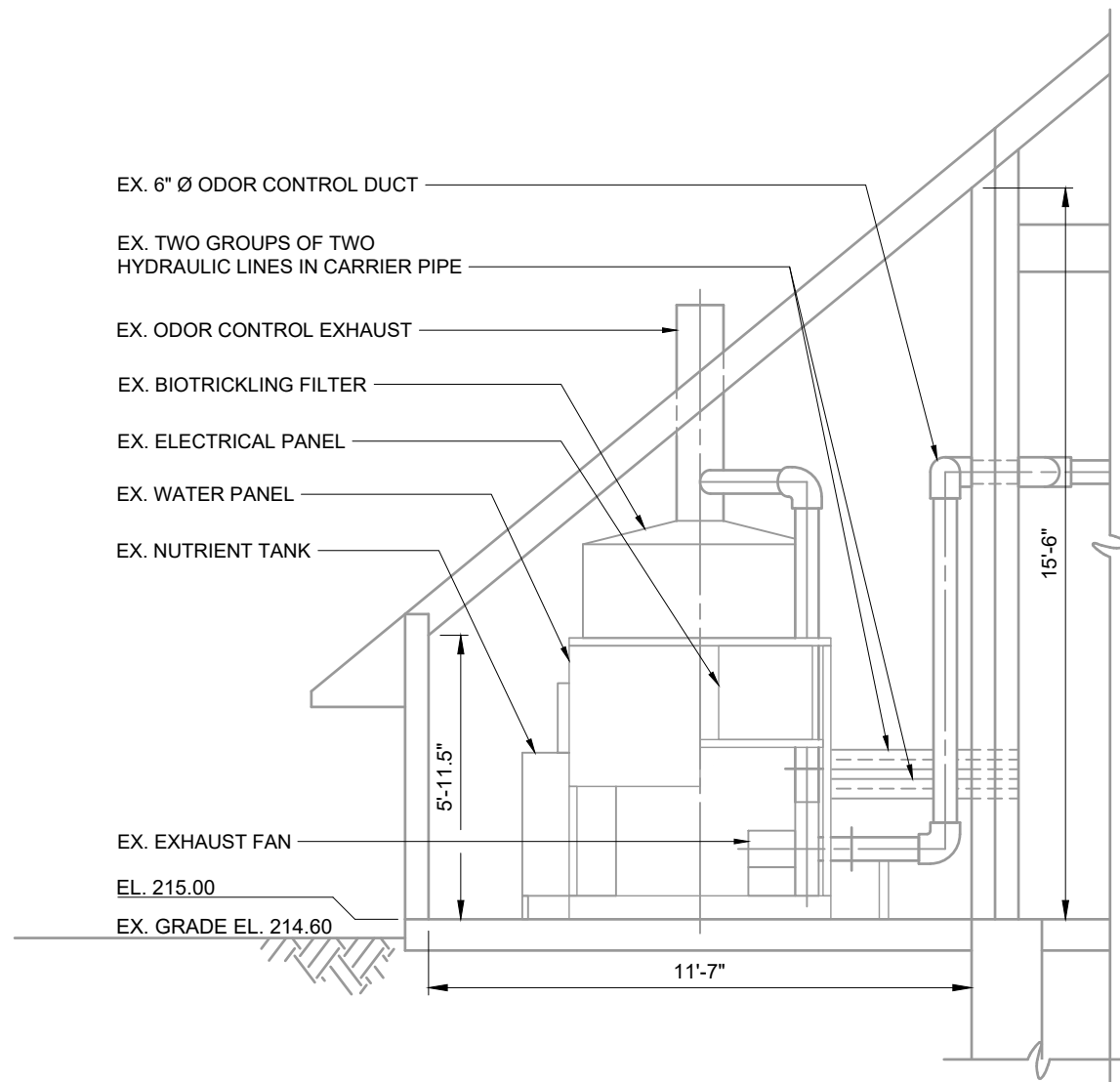
1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY <u> </u> A. AKSIT	Hazen	PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	M-4
DRAWN BY <u> </u> M. BROCATO		DATE: NOVEMBER 2021		
CHECKED BY <u> </u> J. HISE		HAZEN AND SAWYER 1 SOUTH STREET, SUITE 1150 BALTIMORE, MARYLAND 21202	MECHANICAL EXISTING SECTIONS	SHEET 19 OF 57
APPROVED BY <u> </u> J. HISE				

NOTES:

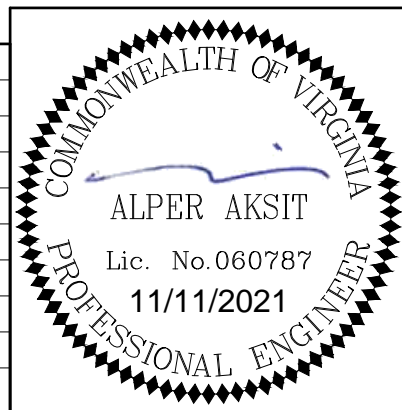
1. HVAC NOT SHOWN FOR CLARITY.



SECTION C
1/4" = 1'-0" M-1

20211111 11:46A O:\31111-bal\31111-056\GIS\CAD-BIM\MECH\5 EXISTING ODOR CONTROL_SECTION.dwg By:MBROCATO Last Saved By: mbrocato

1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY _____ A. AKSIT
 DRAWN BY _____ M. BROCATO
 CHECKED BY _____ J. HISE
 APPROVED BY _____ J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

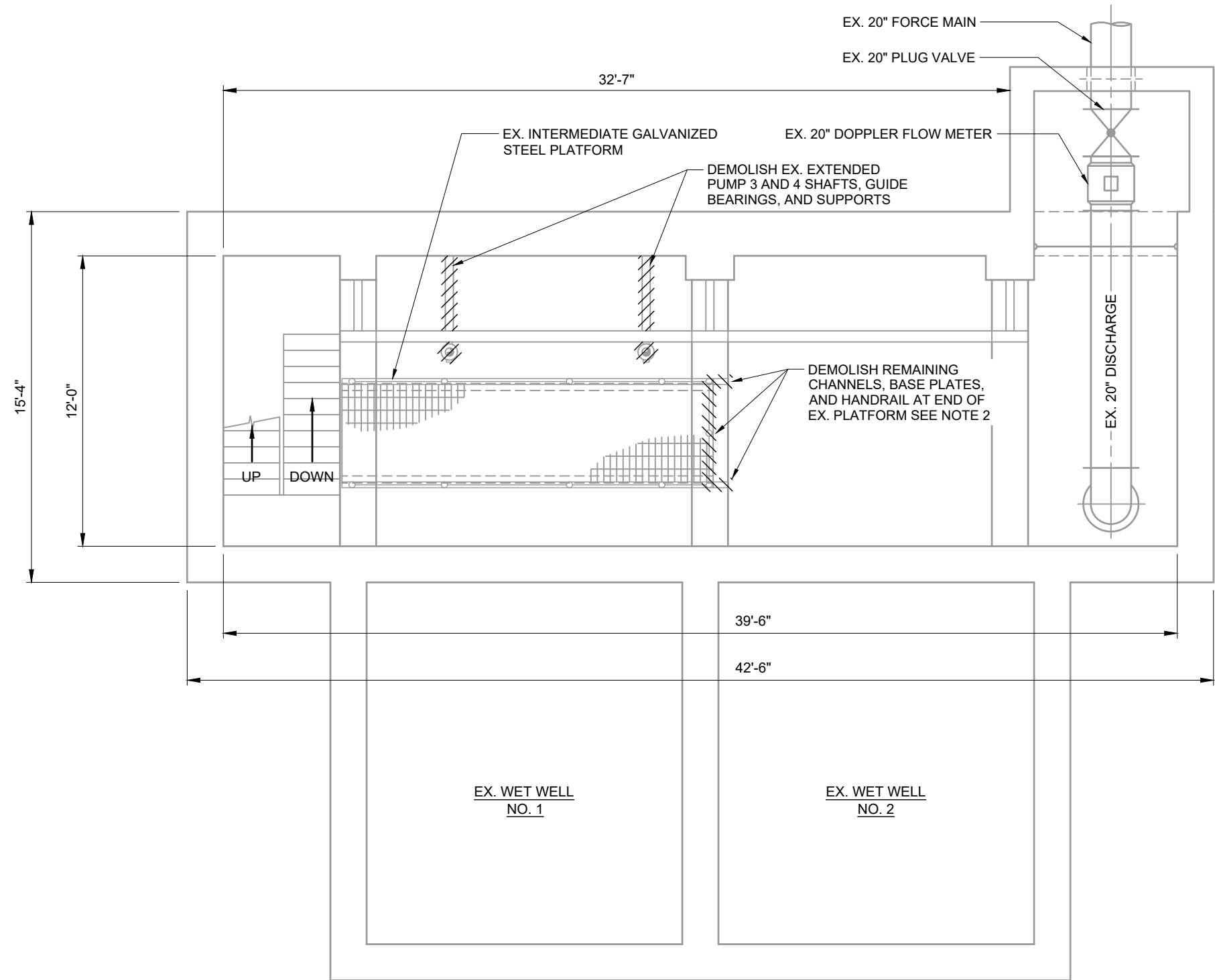
MECHANICAL
EXISTING ODOR CONTROL SECTION

M-5

SHEET
20 OF 57



20211111 11:48A O:\31111-056\GIS\CAD-BM\MECH\M-7 DEMOLITION PLAN - INTERMEDIATE LEVEL EL 195.50.dwg By:MBROCATO Last Saved By: mbrocato

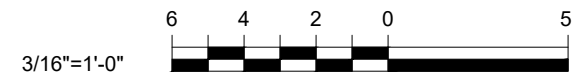


NOTES:

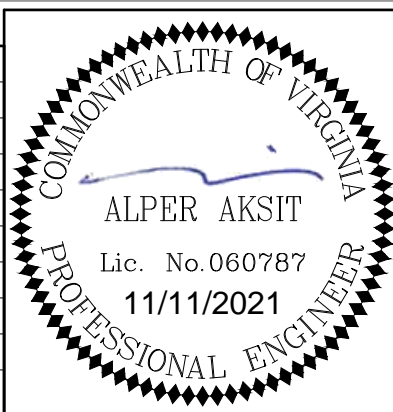
1. HVAC NOT SHOWN FOR CLARITY.
2. EXISTING INTERMEDIATE LEVEL PLATFORM CONSISTS OF PARTIALLY DEMOLISHED CHANNELS WITH ATTACHED BASE PLATES AT THE CENTER BEARING LOCATION. REMOVE REMAINING PARTIALLY DEMOLISHED CHANNELS AND BASE PLATES. TWO EXISTING CONCRETE ANCHORS AT EACH BEARING LOCATION SHALL BE RETAINED FOR USE WITH THE INTERMEDIATE LEVEL PLATFORM EXTENSION. DEMOLISH SECTION OF HANDRAIL AT END OF PLATFORM, SEE STRUCTURAL DRAWINGS FOR MORE INFORMATION.

DEMOLITION PLAN - INTERMEDIATE LEVEL EL 195.50

3/16" = 1'-0"



NO	BID SET ISSUED FOR	DATE	BY
1	BID SET	11/21	JTH
	ISSUED FOR	DATE	BY

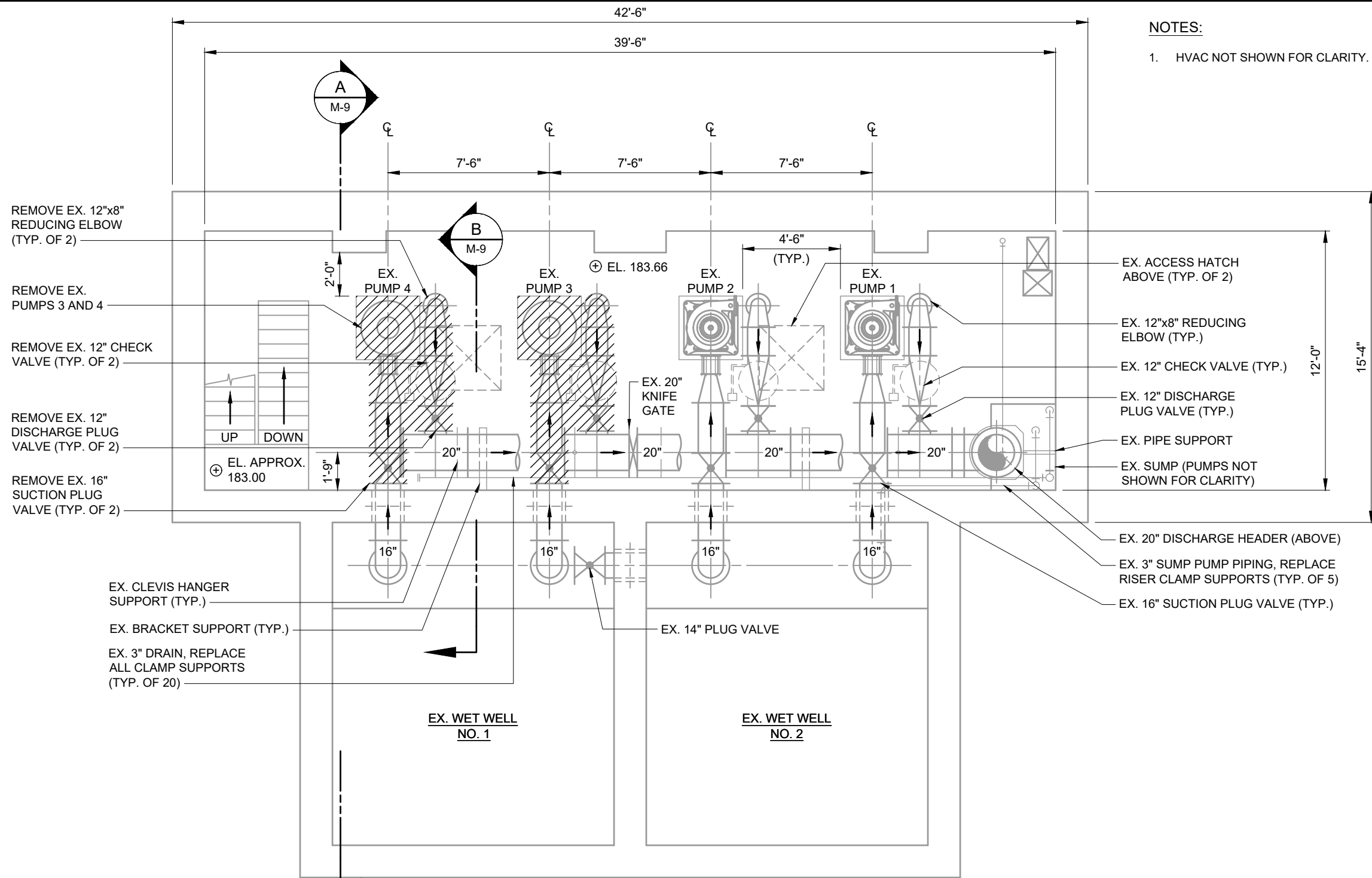


DESIGNED BY _____ A. AKSIT
 DRAWN BY _____ M. BROCATO
 CHECKED BY _____ J. HISE
 APPROVED BY _____ J. HISE



PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	M-7
DATE: NOVEMBER 2021	MECHANICAL	SHEET 22 OF 57
DEMOLITION PLAN - INTERMEDIATE LEVEL EL 195.50		

20211111 11:49A 0:\31111-ba\31111-056\GIS\CAD-BIM\MECH\M-8 DEMOLITION PLAN - LOWER LEVEL EL 183.66.dwg By:MBROCATO Last Saved By: mbrocato



NOTES:

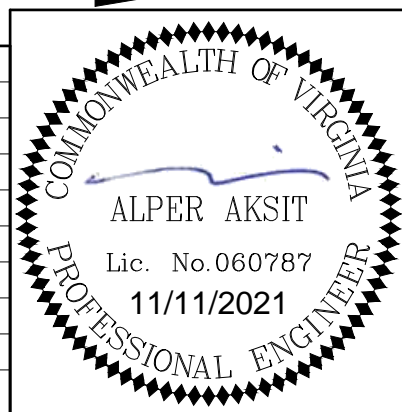
1. HVAC NOT SHOWN FOR CLARITY.

DEMOLITION PLAN - LOWER LEVEL EL 183.66

3/16" = 1'-0"



1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY A. AKSIT
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO.
 31111-056

DATE:
 NOVEMBER
 2021

CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA

MECHANICAL
 DEMOLITION PLAN - LOWER LEVEL EL 183.66

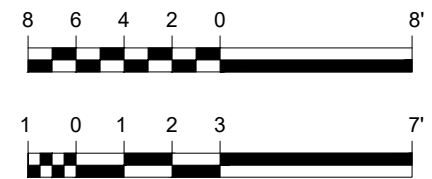
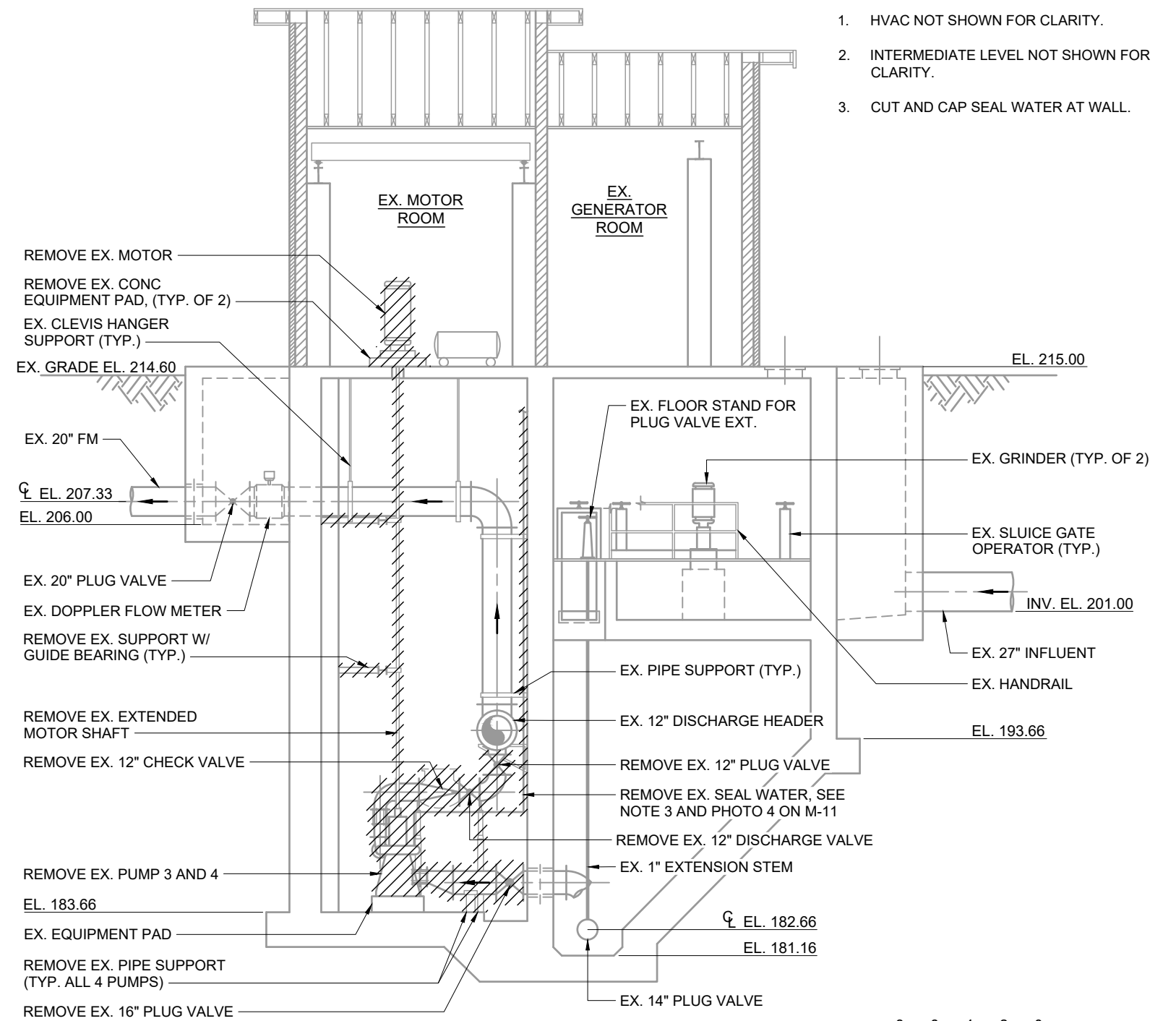
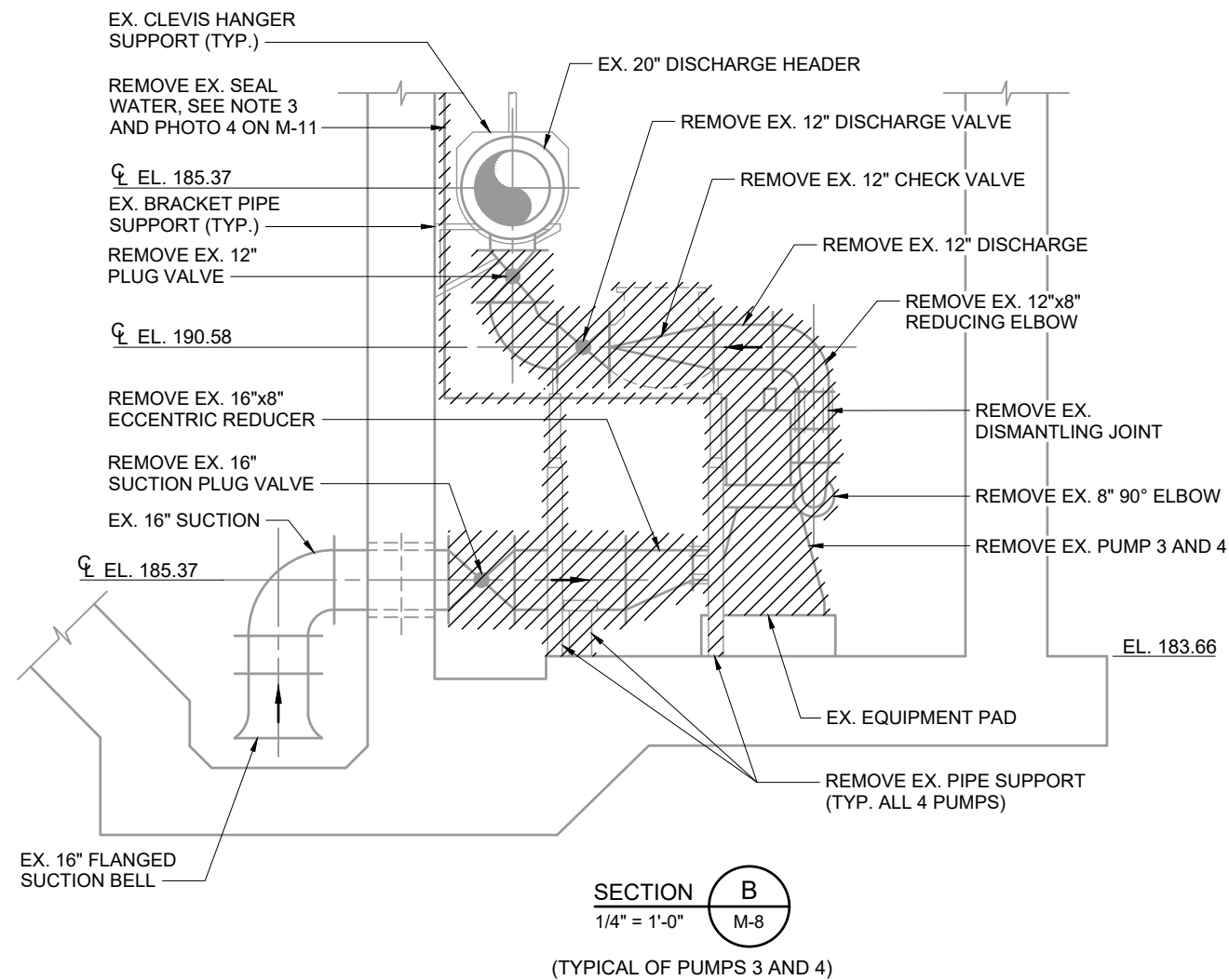
M-8

SHEET
 23 OF 57

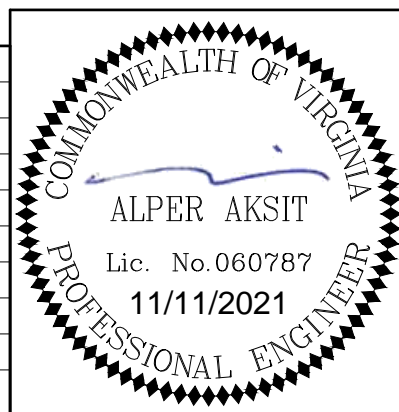
20211111 11:49A 0:\31111-bal\31111-056\GIS\CAD-BIM\MECH\M-9 DEMOLITION SECTIONS.dwg By:MBROCATO Last Saved By: mbrocato

NOTES:

1. HVAC NOT SHOWN FOR CLARITY.
2. INTERMEDIATE LEVEL NOT SHOWN FOR CLARITY.
3. CUT AND CAP SEAL WATER AT WALL.



1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY

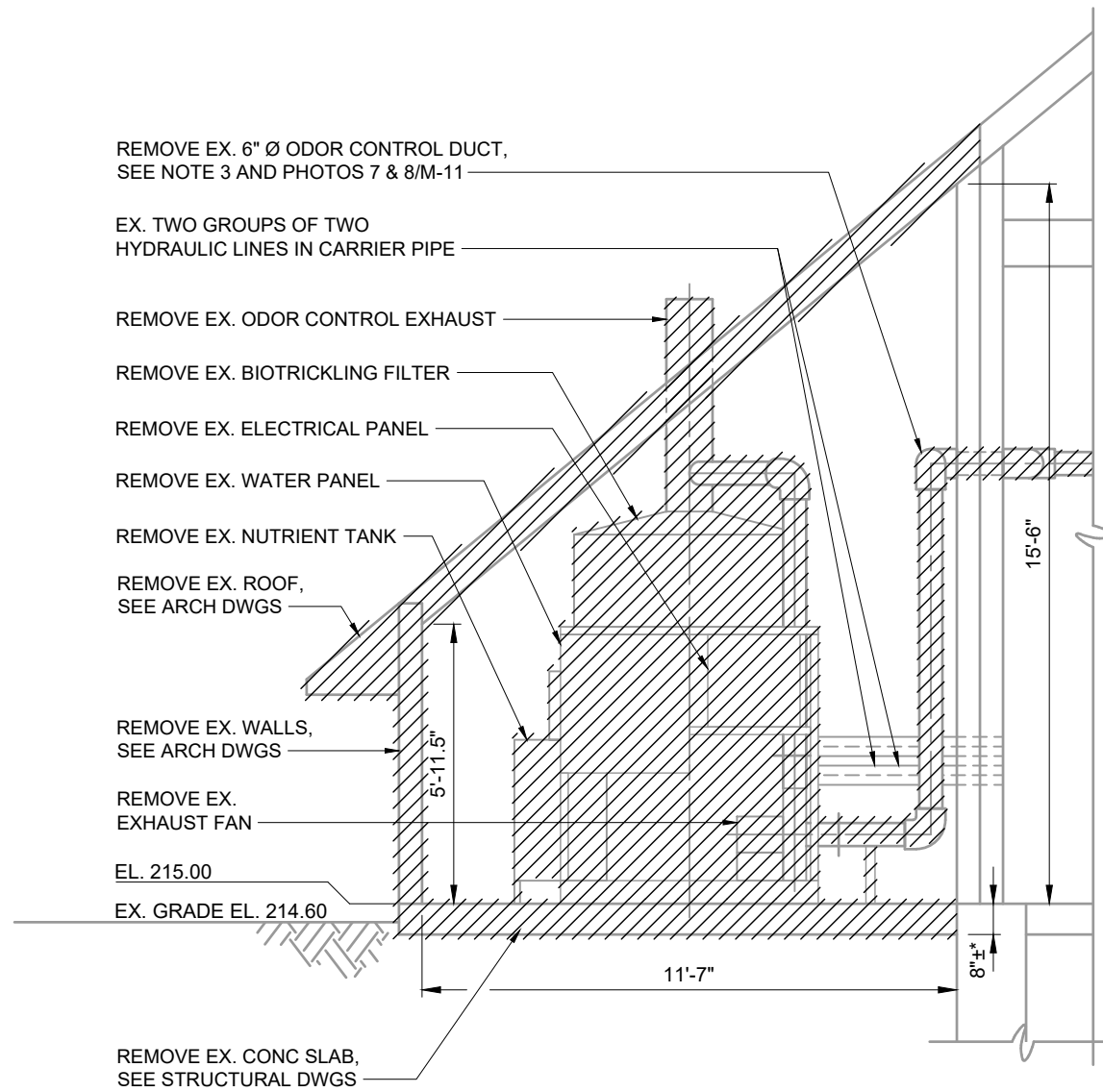


DESIGNED BY <u> </u> A. AKSIT	Hazen HAZEN AND SAWYER 1 SOUTH STREET, SUITE 1150 BALTIMORE, MARYLAND 21202	PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	M-9
DRAWN BY <u> </u> M. BROCATO		DATE: NOVEMBER 2021		
CHECKED BY <u> </u> J. HISE		MECHANICAL DEMOLITION SECTIONS	SHEET 24 OF 57	
APPROVED BY <u> </u> J. HISE				

20211111 11:50A 0:\311111-bat\311111-056\GIS\CAD-BIM\MECH\M-10 DEMOLITION ODOR CONTROL_SECTION.dwg By:MBROCATO Last Saved By: mbrocato

NOTES:

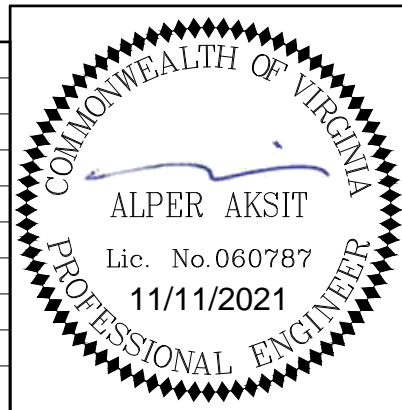
1. HVAC NOT SHOWN FOR CLARITY.
2. REMOVE IN SERVICEABLE CONDITION FOR REUSE
3. REMOVE EXISTING ODOR CONTROL DUCT SUPPORTS, CONDUIT, AND CONDUIT SUPPORTS. REPAIR WALL ANCHORS TO MATCH EXISTING.
4. * CONTRACTOR SHALL VERIFY EXISTING SLAB THICKNESS IN FIELD, SEE GENERAL STRUCTURAL NOTES ON DRAWING S-1.



SECTION **C**
1/4" = 1'-0" M-6



1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY A. AKSIT
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

MECHANICAL
DEMOLITION ODOR CONTROL SECTION

M-10

SHEET
25 OF 57

20211111 11:51A O:\31111-bal\31111-056\GIS\CAD-BIM\MECH\11 DEMOLITION PHOTOS.dwg By:MBROCATO Last Saved By: mbrocato



PHOTO 1 - PUMP
NTS

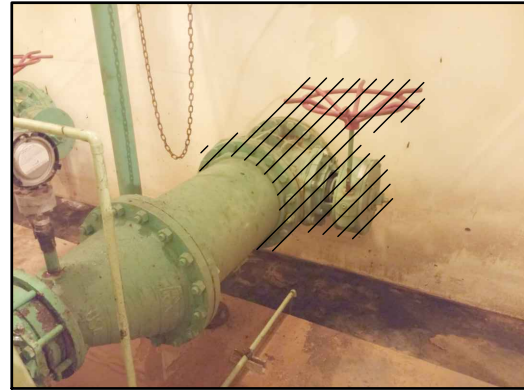


PHOTO 2 - SUCTION VALVE
NTS

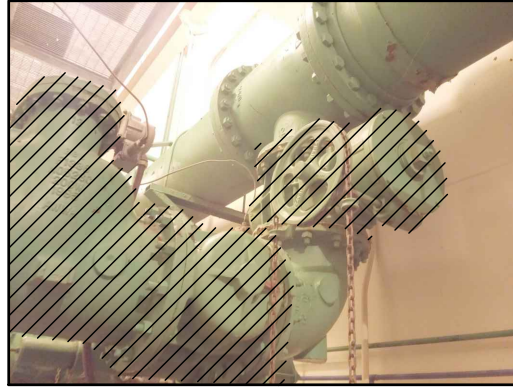


PHOTO 3 - DISCHARGE VALVES
NTS

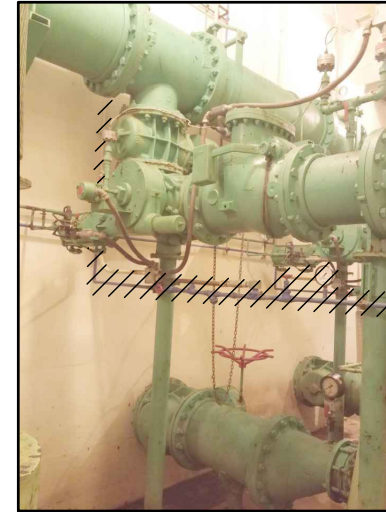


PHOTO 4 - SEAL WATER PIPE
NTS



PHOTO 5 - HYDRAULIC LINES
NTS



PHOTO 6 - HYDRAULIC LINES
NTS



PHOTO 7 - ODOR CONTROL DUCT
NTS

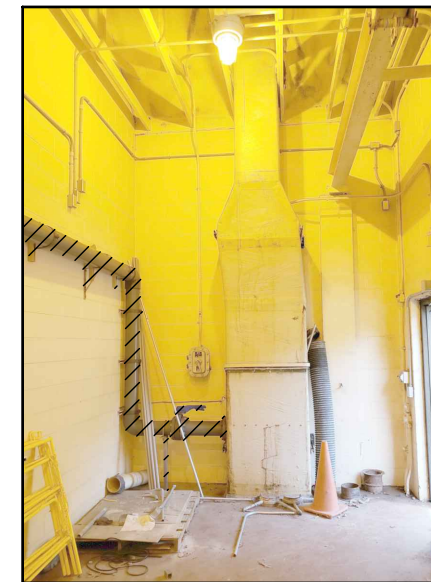
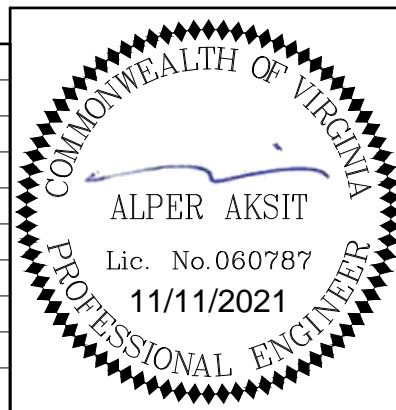


PHOTO 8 - ODOR CONTROL DUCT
NTS

NOTES:

1. PHOTOGRAPHS ARE FOR ILLUSTRATIVE PURPOSES ONLY. EXTENT OF DEMOLITION SHOWN IN PLAN.

1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY A. AKSIT
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

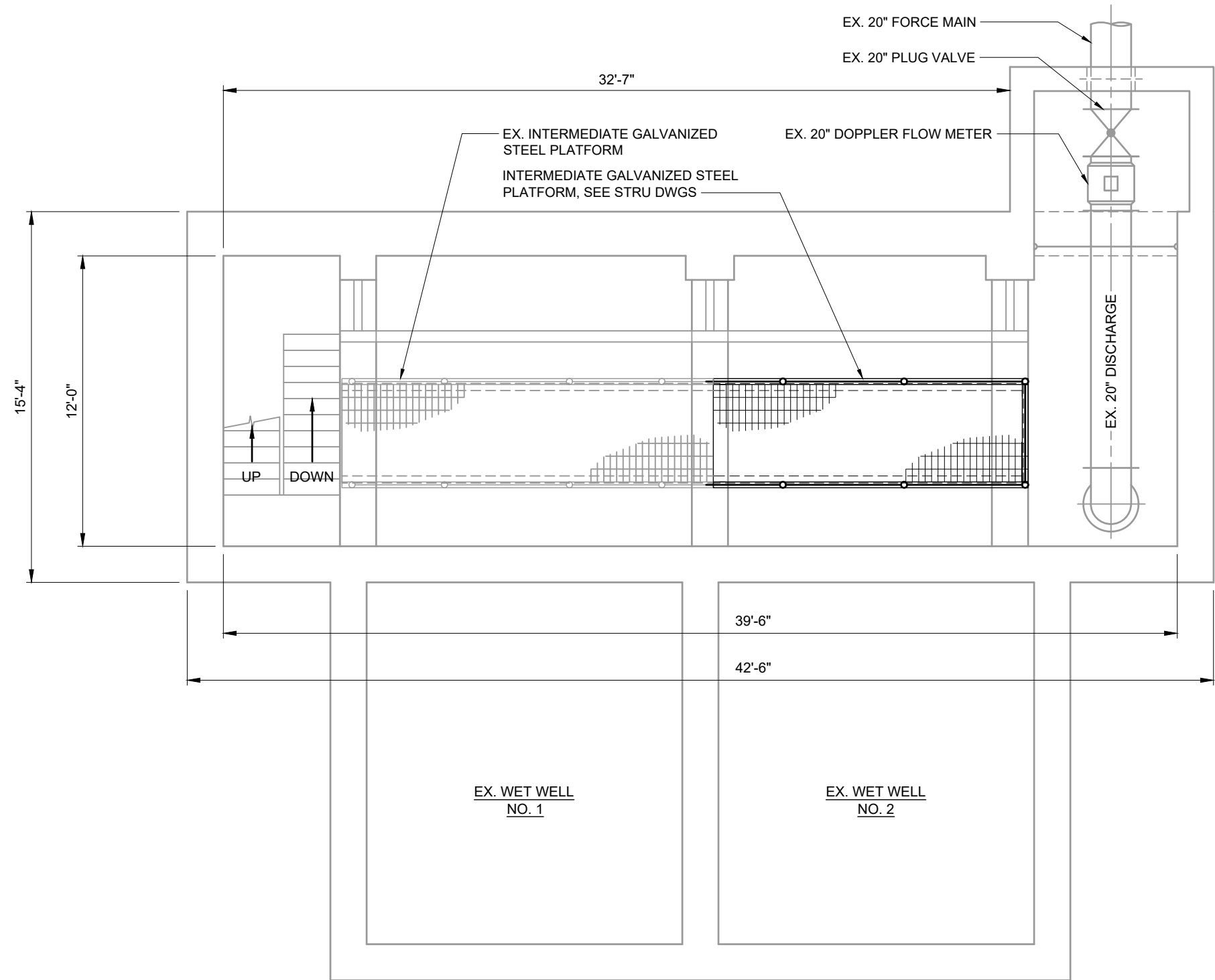
CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

MECHANICAL
DEMOLITION PHOTOS

M-11

SHEET
26 OF 57

20211111 11:52A 0:\31111-bat\31111-056\GIS\CAD-BIM\MECH\M-13 PROPOSED PLAN - INTERMEDIATE LEVEL EL 195.50.dwg By: MBROCATO Last Saved By: mbrocatto



NOTES:

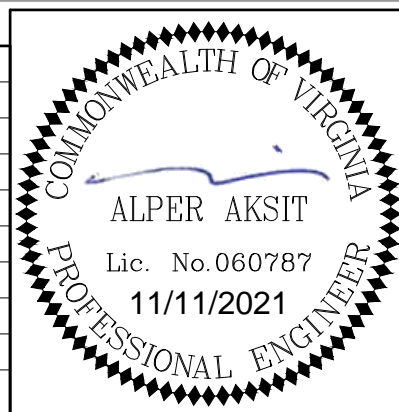
1. HVAC NOT SHOWN FOR CLARITY.

PROPOSED PLAN - INTERMEDIATE LEVEL EL 195.50

3/16" = 1'-0"



NO	BID SET ISSUED FOR	DATE	BY
1	BID SET	11/21	JTH
	ISSUED FOR	DATE	BY

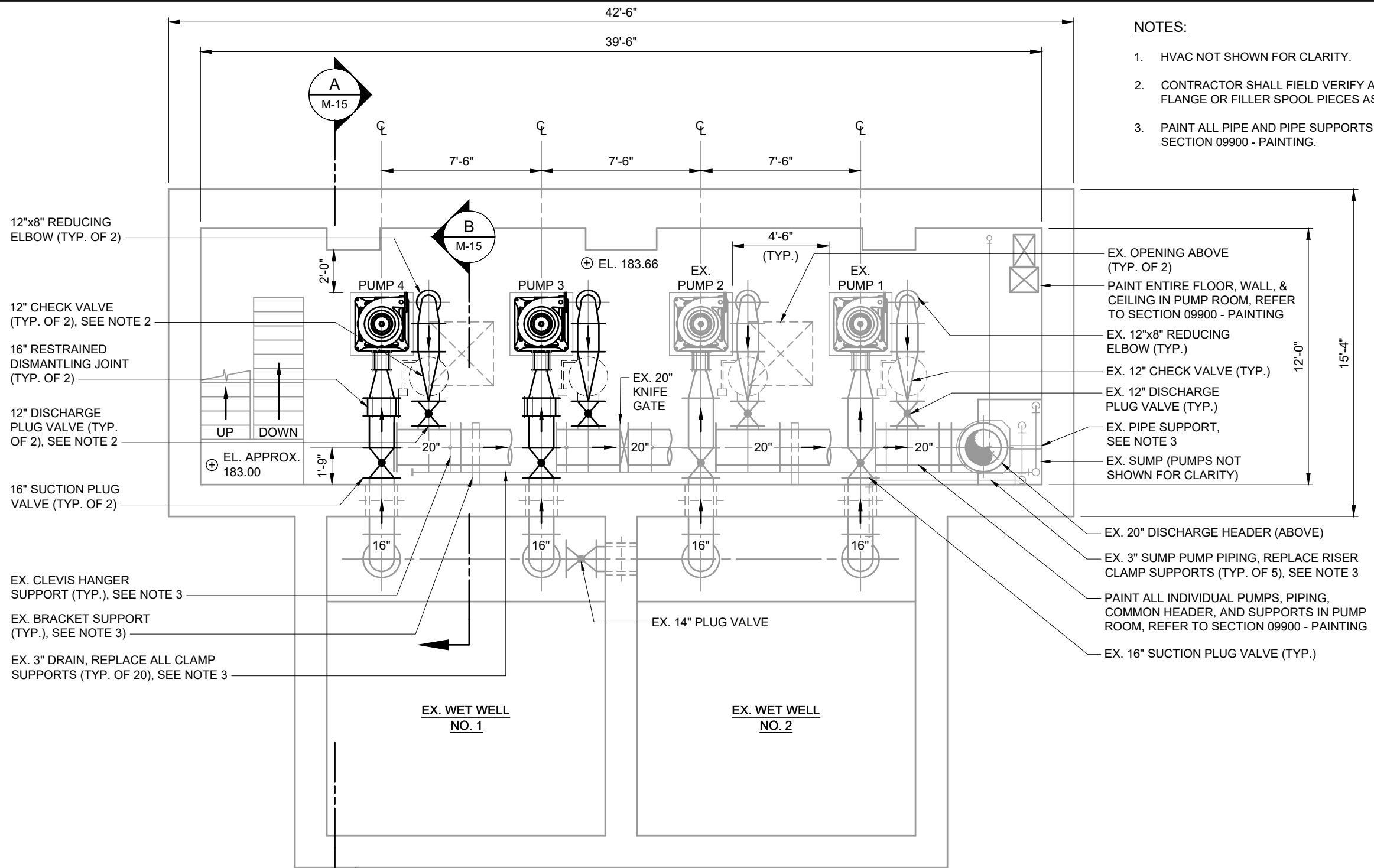


DESIGNED BY _____ A. AKSIT
 DRAWN BY _____ M. BROCATO
 CHECKED BY _____ J. HISE
 APPROVED BY _____ J. HISE



PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	M-13
DATE: NOVEMBER 2021		
MECHANICAL		SHEET 28 OF 57
PROPOSED PLAN - INTERMEDIATE LEVEL EL 195.50		

20211111 11:53A 0:\31111-bat\31111-056\GIS\CAD-BIM\MECH\M-14 PROPOSED PLAN - LOWER LEVEL EL. 183.66.dwg By: MBROCATO Last Saved By: mbrocat



NOTES:

1. HVAC NOT SHOWN FOR CLARITY.
2. CONTRACTOR SHALL FIELD VERIFY AND PROVIDE FILLER FLANGE OR FILLER SPOOL PIECES AS REQUIRED.
3. PAINT ALL PIPE AND PIPE SUPPORTS IN ACCORDANCE WITH SECTION 09900 - PAINTING.

12"x8" REDUCING ELBOW (TYP. OF 2)

12" CHECK VALVE (TYP. OF 2), SEE NOTE 2

16" RESTRAINED DISMANTLING JOINT (TYP. OF 2)

12" DISCHARGE PLUG VALVE (TYP. OF 2), SEE NOTE 2

16" SUCTION PLUG VALVE (TYP. OF 2)

EX. CLEVIS HANGER SUPPORT (TYP.), SEE NOTE 3

EX. BRACKET SUPPORT (TYP.), SEE NOTE 3

EX. 3" DRAIN, REPLACE ALL CLAMP SUPPORTS (TYP. OF 20), SEE NOTE 3

EX. OPENING ABOVE (TYP. OF 2)

PAINT ENTIRE FLOOR, WALL, & CEILING IN PUMP ROOM, REFER TO SECTION 09900 - PAINTING

EX. 12"x8" REDUCING ELBOW (TYP.)

EX. 12" CHECK VALVE (TYP.)

EX. 12" DISCHARGE PLUG VALVE (TYP.)

EX. PIPE SUPPORT, SEE NOTE 3

EX. SUMP (PUMPS NOT SHOWN FOR CLARITY)

EX. 20" DISCHARGE HEADER (ABOVE)

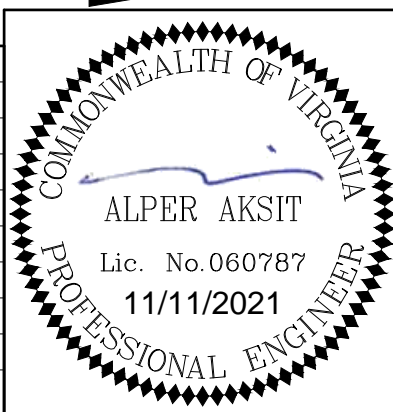
EX. 3" SUMP PUMP PIPING, REPLACE RISER CLAMP SUPPORTS (TYP. OF 5), SEE NOTE 3

PAINT ALL INDIVIDUAL PUMPS, PIPING, COMMON HEADER, AND SUPPORTS IN PUMP ROOM, REFER TO SECTION 09900 - PAINTING

EX. 16" SUCTION PLUG VALVE (TYP.)

PROPOSED PLAN - LOWER LEVEL EL 183.66

3/16" = 1'-0"



DESIGNED BY A. AKSIT
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

MECHANICAL
PROPOSED PLAN - LOWER LEVEL EL 183.66

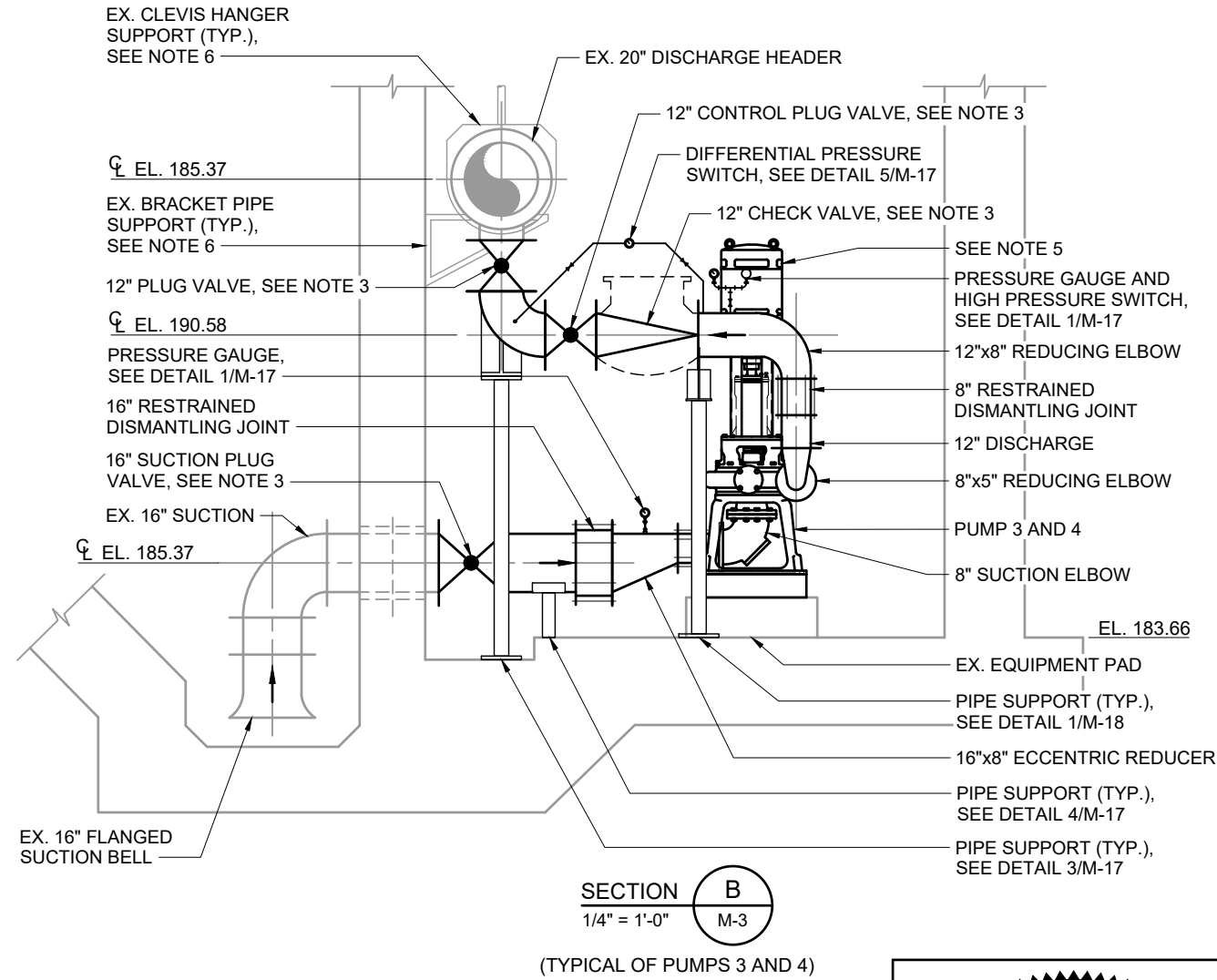
M-14

SHEET
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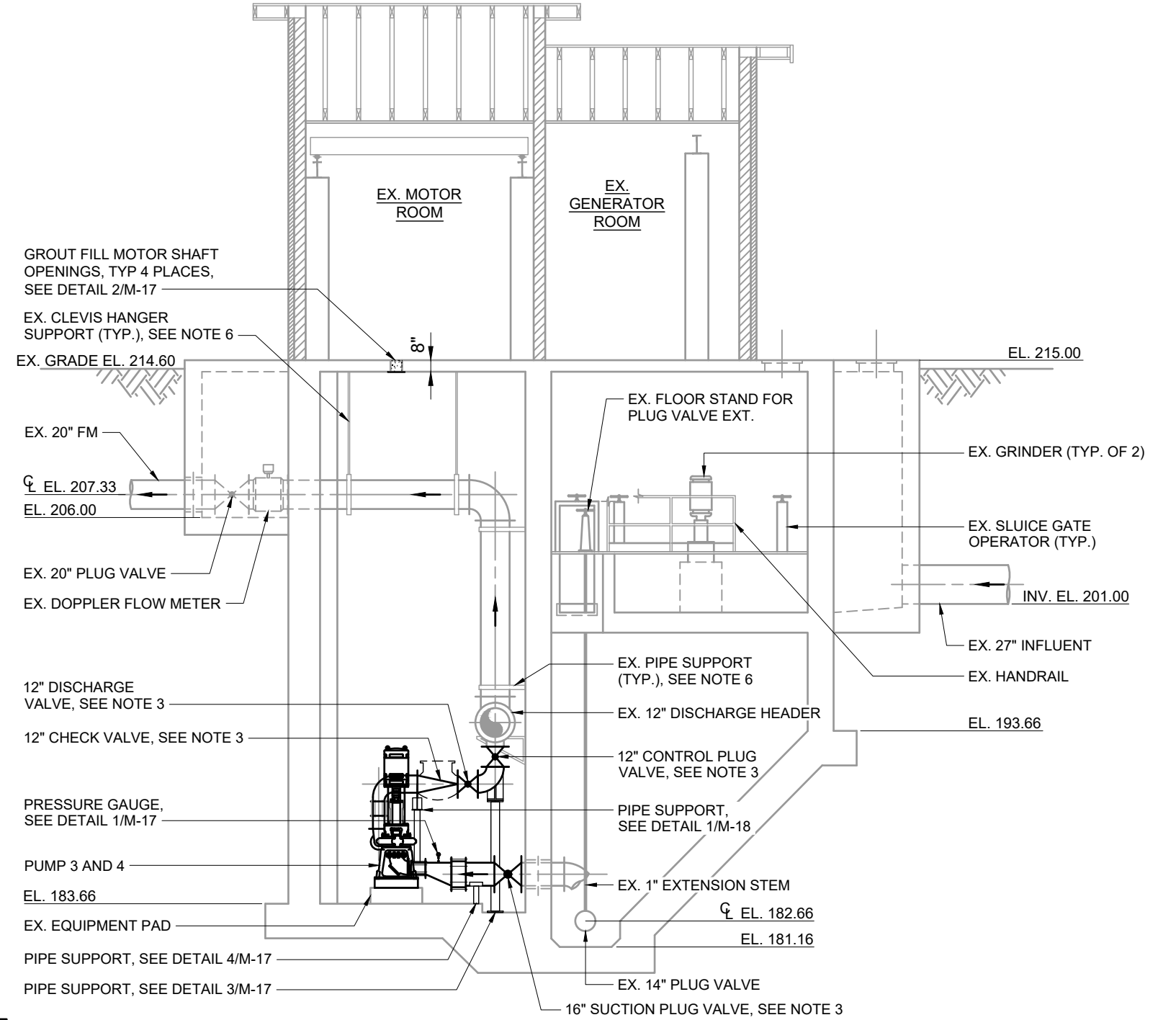
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NO	ISSUED FOR	DATE	BY

NOTES:

- HVAC NOT SHOWN FOR CLARITY.
- INTERMEDIATE LEVEL NOT SHOWN FOR CLARITY.
- CONTRACTOR SHALL FIELD VERIFY AND PROVIDE FILLER FLANGE OR SPOOL PIECES AS REQUIRED.
- NEW PLUG VALVES SHALL BE PROVIDED WITH NEW OPERATORS/HAND WHEELS AND CHAIN OPERATORS WITH CHAIN TO MATCH ORIGINAL. LOCATE SEAT END OF VALVE IN ACCORDANCE WITH VALVE MANUFACTURER RECOMMENDATIONS FOR SEWAGE SERVICE.
- COORDINATE LOCATION OF PUMP CONDUIT ENTRY BOX WITH ELECTRICAL, TYPICAL OF 2.
- PAINT ALL PIPE AND EXISTING PIPE SUPPORTS IN ACCORDANCE WITH SECTION 009900 - PAINTING.



SECTION B
1/4" = 1'-0" M-3
(TYPICAL OF PUMPS 3 AND 4)

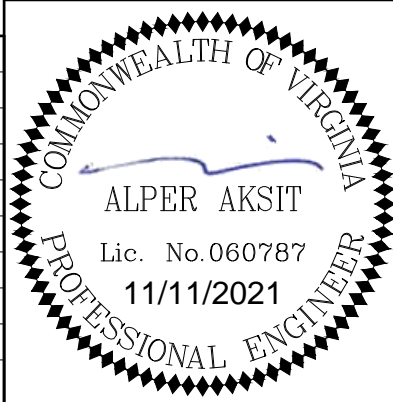


SECTION A
1/8" = 1'-0" M-1, M-3
(TYPICAL OF PUMPS 3 AND 4)



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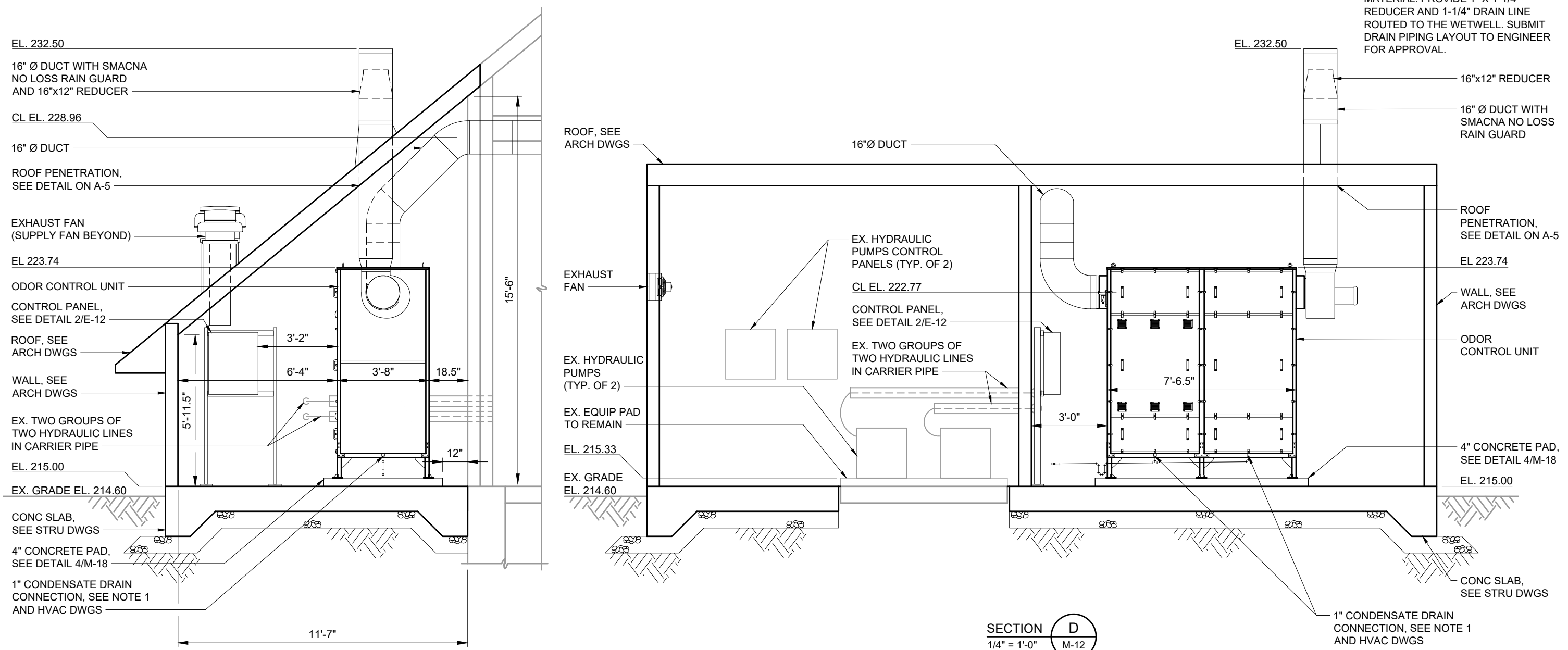


DESIGNED BY <u> </u> A. AKSIT	Hazen HAZEN AND SAWYER 1 SOUTH STREET, SUITE 1150 BALTIMORE, MARYLAND 21202	PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	M-15
DRAWN BY <u> </u> M. BROCATO		DATE: NOVEMBER 2021		
CHECKED BY <u> </u> J. HISE		MECHANICAL PROPOSED SECTIONS	SHEET 30 OF 57	
APPROVED BY <u> </u> J. HISE				

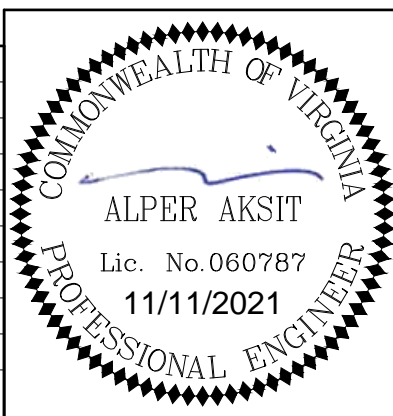
20211111 12:29P 0:\31111-056\GIS\CAD-BIM\MECH\M-16 PROPOSED ODOR CONTROL SECTIONS.dwg By:MBROCATO Last Saved By: mbrocato

NOTES:

- COORDINATE WITH MANUFACTURER FOR DRAIN CONNECTION TYPE AND MATERIAL. PROVIDE 1" X 1-1/4" REDUCER AND 1-1/4" DRAIN LINE ROUTED TO THE WETWELL. SUBMIT DRAIN PIPING LAYOUT TO ENGINEER FOR APPROVAL.



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 DRAWN BY M. BROCATO
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PROJECT NO.
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2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

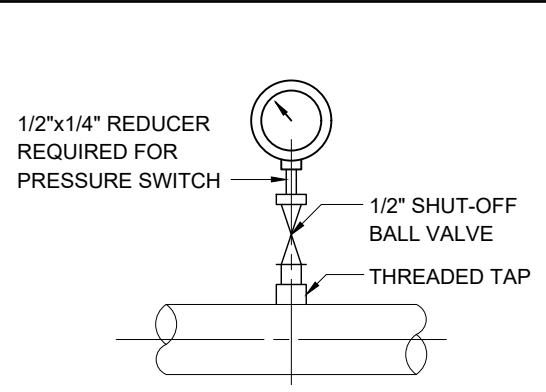
MECHANICAL

PROPOSED ODOR CONTROL SECTIONS

M-16

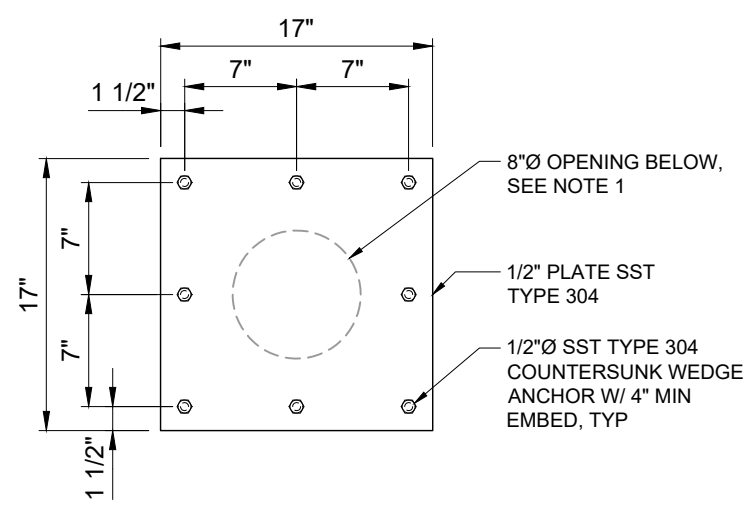
SHEET
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PRESSURE GAUGE

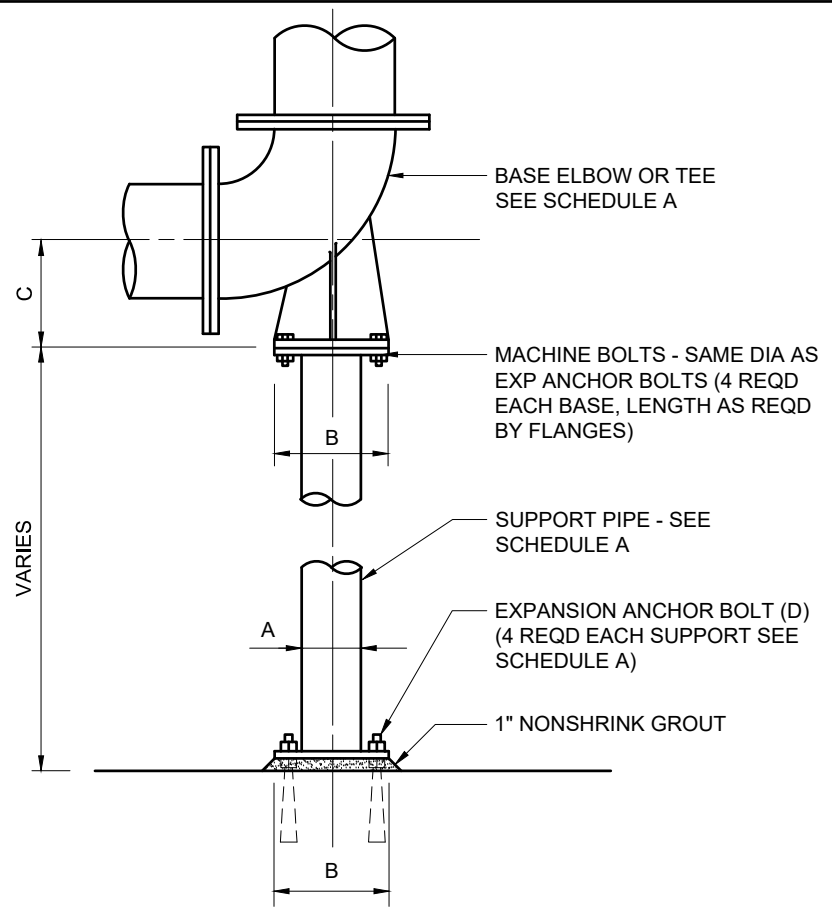
DETAIL	1
NTS	M-15



NOTES:
 1. FIELD VERIFY EXISTING FLOOR PENETRATION DIAMETER. SIZE OF PLATE SHOWN IS SUCH TO ACCOMMODATE A 8" OPENING WHILE MAINTAINING A 3" EDGE DISTANCE BETWEEN THE EDGE OF OPENING AND CENTER OF ANCHOR. IF SIZE OF OPENING DIFFERENT THAN THAT SHOWN, COORDINATE WITH ENGINEER PRIOR TO FABRICATION.

FLOOR OPENING PLATE DETAIL

DETAIL	2
NTS	M-12

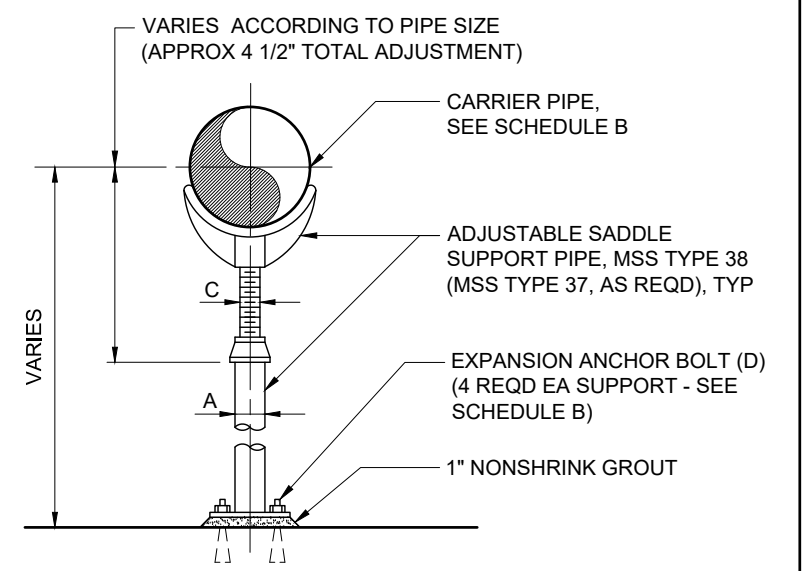


PIPE SUPPORT AT BASE ELBOW

DETAIL	3
NTS	M-15

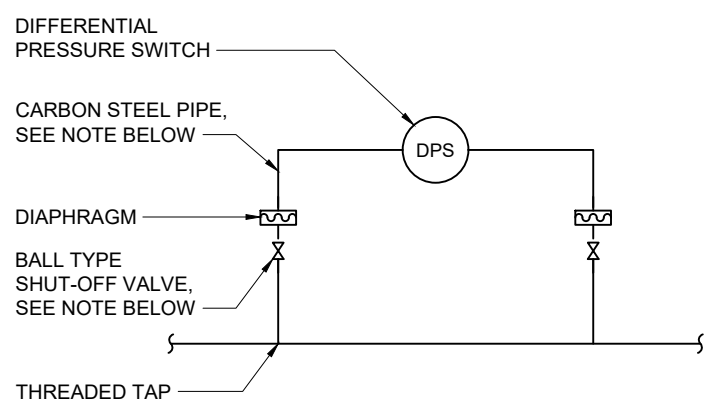
NOTES:

1. MSS REFERS TO THE MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, STANDARD PRACTICE SP-58 AND SP-69.



ADJUSTABLE SADDLE SUPPORT

DETAIL	4
NTS	M-15

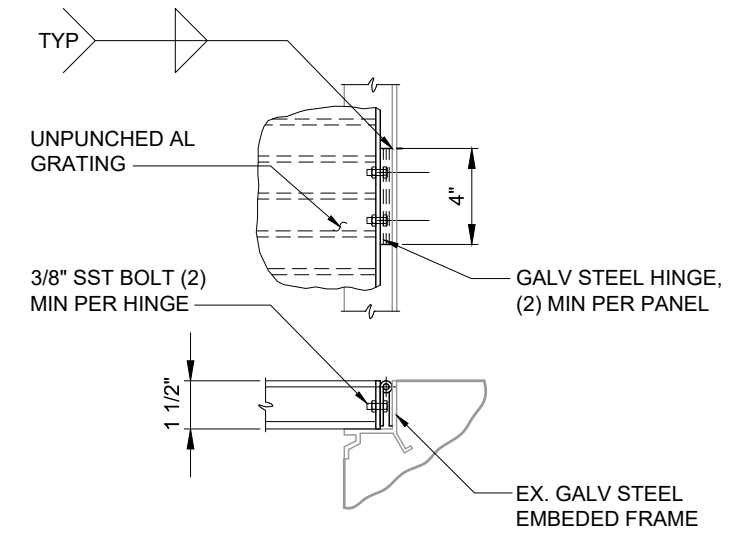


NOTE: COORDINATE LINE SIZE WITH DIFFERENTIAL PRESSURE SWITCH PRESSURE CONNECTION.

DIFFERENTIAL PRESSURE SWITCH

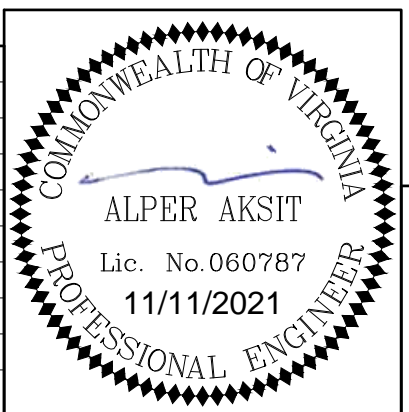
DETAIL	5
NTS	M-15

SCHEDULE A				
BASE ELBOW (TEE) (DIM IN INCHES)				
PIPE SIZE	A	B	C	D DIA x LG
16	6	11	VARIES	3/4 x 6
SCHEDULE B				
ADJUSTABLE SADDLE (DIM IN INCHES)				
PIPE SIZE	A	B	C	D DIA x LG
16	4	9	3	5/8 x 5



HINGED GRATING

DETAIL	6
NTS	M-12



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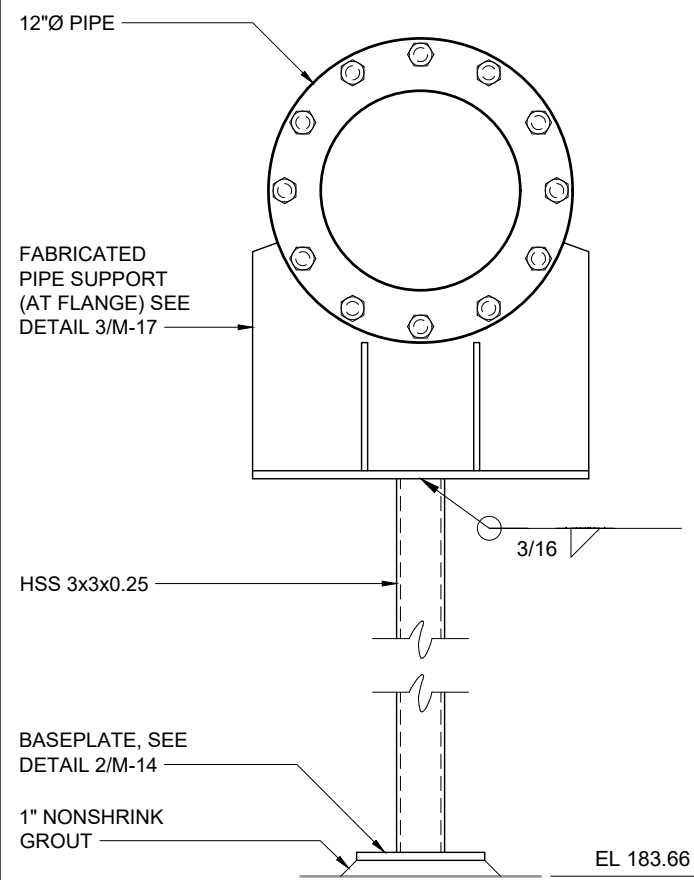
CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA
 MECHANICAL
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M-17
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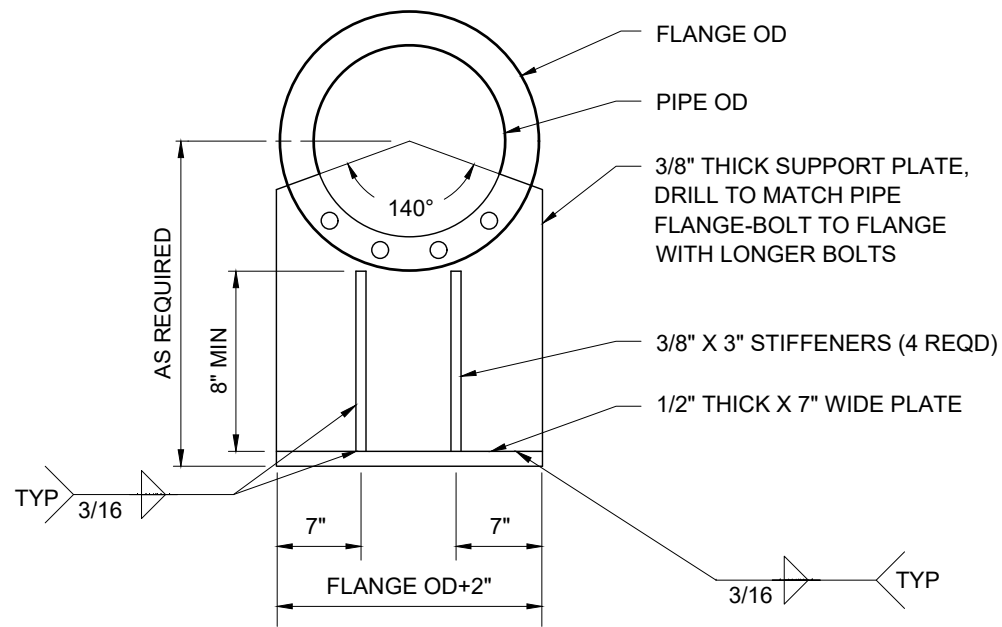
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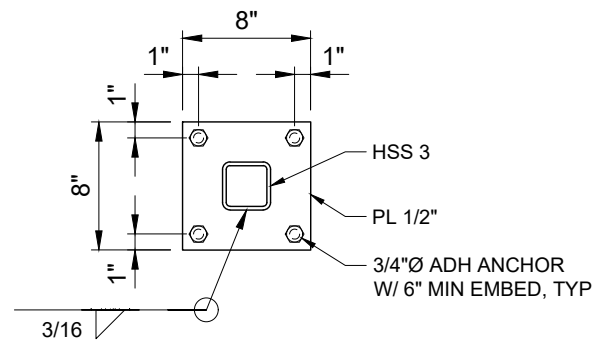
PIPE SUPPORT AT FLANGE

DETAIL	1
NTS	M-15



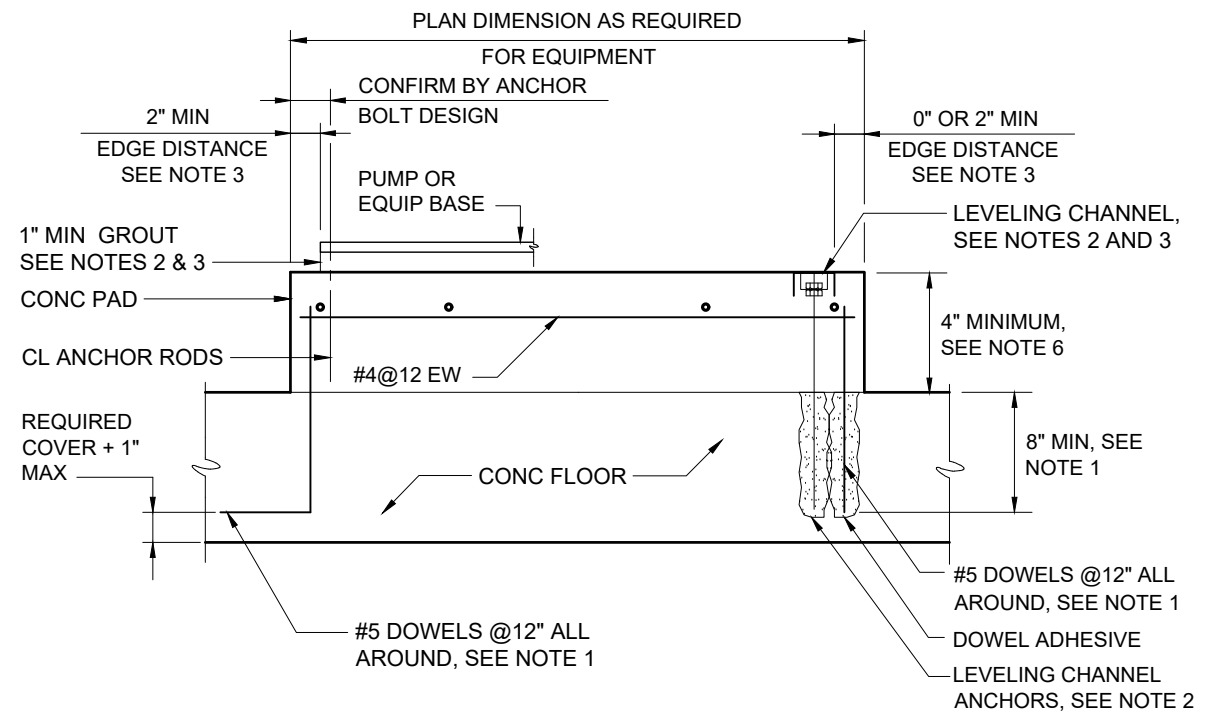
FABRICATED PIPE SUPPORT (AT FLANGE)

DETAIL	3
NTS	M-18



BASEPLATE DETAIL

DETAIL	2
NTS	M-18



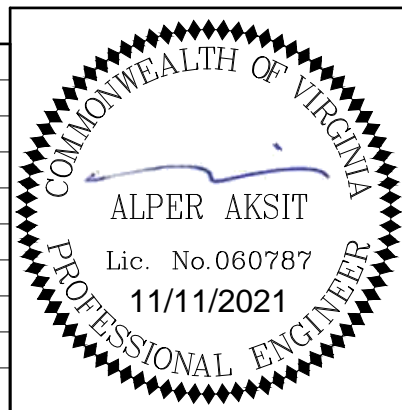
NOTES:

- DOWELS MAY BE CAST IN WITH 90° HOOK OR ANCHORED WITH DOWEL ADHESIVE AT CONTRACTORS OPTION. WHERE FLOOR IS 8" THICK OR LESS, USE #4 DOWELS EMBEDDED TO WITHIN 2" OF BOTTOM OF FLOOR SLAB.
- THE CONTRACTOR SHALL PROVIDE LEVELING CHANNELS AND LEVELING CHANNEL ANCHORS FOR SWITCHGEAR, SWITCHBOARDS, MOTOR CONTROL CENTERS, AND SIMILAR EQUIPMENT WHEN REQUIRED TO MEET EQUIPMENT MANUFACTURER'S LEVELING TOLERANCES. THE CONTRACTOR SHALL PROVIDE 1" MINIMUM GROUT FOR PUMPS AND SIMILAR EQUIPMENT WHEN REQUIRED TO MEET EQUIPMENT MANUFACTURER'S UNIFORM BEARING AND LEVELING REQUIREMENTS.
- PRIOR TO PLACING CONCRETE PAD, LEVELING CHANNEL SIZE AND MEANS OF INSTALLATION, ANCHORAGE, GROUT, CONCRETE EDGE DISTANCE, AND CONCRETE BLOCKOUTS REQUIREMENTS SHALL BE COORDINATED WITH EQUIPMENT MANUFACTURER.
- COAT DISSIMILAR MATERIALS PER THE CONTRACT DOCUMENTS.
- STAGGER CHANNEL ANCHORS AND PAD DOWELS.
- FOR PADS 24" OR GREATER IN DEPTH, PROVIDE #4@8" HORIZONTAL SKIN REINFORCING AROUND PERIMETER OF PAD.

EQUIPMENT PAD

DETAIL	4
NTS	M-18

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1	BID SET		11/21	JTH



DESIGNED BY	A. AKSIT
DRAWN BY	M. BROCATO
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APPROVED BY	J. HISE

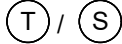






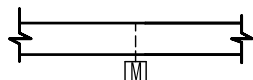
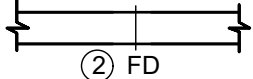

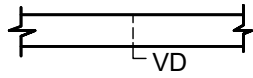
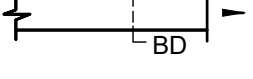

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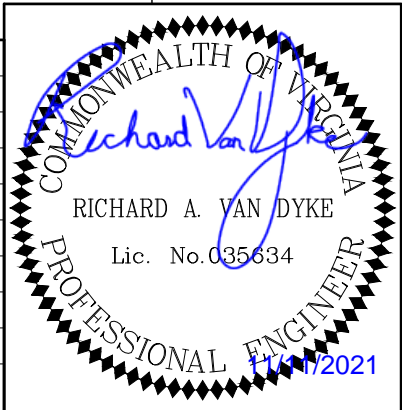
PROJECT NO.	31111-056
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CATTAIL BRANCH SPS LEESBURG, VIRGINIA	M-18
MECHANICAL DETAILS II	SHEET 33 OF 57

20211111 1:29P O:\31111-bal\31111-056\GIS\CAD-BIM\HVAC\H-1 LEGEND ABBREVIATIONS.dwg By:MBROCATO Last Saved By: mbrocato

SYMBOLS	ABBREVIATIONS				
 THERMOSTAT/SENSOR  SUPPLY AIR DUCT SECTION-UP  SUPPLY AIR DUCT SECTION-DOWN  RETURN AIR DUCT SECTION-UP  RETURN AIR DUCT SECTION-DOWN  EXHAUST AIR DUCT SECTION-UP  EXHAUST AIR DUCT SECTION-DOWN  MOTORIZED DAMPER  FIRE DAMPER WITH ACCESS DOOR <p># HOUR RATED WALL (2 HR. SHOWN)</p>  FIRE/SMOKE DAMPER WITH ACCESS DOOR <p># HOUR RATED WALL (2 HR. SHOWN)</p>  MANUAL VOLUME DAMPER  BACKDRAFT DAMPER  CHANGE OF ELEVATION: RISE (R) OR DROP (D)	<table style="width:100%; border: none;"> <tr> <td style="width:33%; border: none;"> AD AFF APD ATC BD BHP BOD BOT CFM CLG CONN DB DDC DIA, Ø DM DN EA EAT EDH EF EL/ELEV ESP FA FD FLA FPM GC GPM HP IN WG KW L1 LAT MAU </td> <td style="width:33%; border: none;"> ACCESS DOOR ABOVE FINISHED FLOOR AIR PRESSURE DROP AUTOMATIC TEMPERATURE CONTROL GRAVITY BACKDRAFT DAMPER BRAKE HORSEPOWER BOTTOM OF DUCT BOTTOM CUBIC FEET OF STANDARD AIR PER MINUTE CEILING CONNECTION DRY BULB DIRECT DIGITAL CONTROL DIAMETER DAMPER MOTOR DOWN EXHAUST AIR ENTERING AIR TEMPERATURE ELECTRIC DUCT HEATER EXHAUST FAN ELEVATION EXTERNAL STATIC PRESSURE FREE AREA FIRE DAMPER WITH ACCESS DOOR FULL LOAD AMPS FEET PER MINUTE GENERAL CONTRACTOR GALLONS PER MINUTE HORSEPOWER OR HEAT PUMP INCHES OF WATER GAGE KILOWATT (1,000 WATTS) LOUVER (TYPE 1) LEAVING AIR TEMPERATURE MAKEUP AIR UNIT </td> <td style="width:33%; border: none;"> MBH MC MCA MD MTD NTS OA OAI PD PF PH, Ø PROP RA RH RLA RPM SA SD SF SP SPEC SS SV TEMP TOD TOU TSP TS TYP UH V VD VEL W/ WB WC </td> <td style="width:33%; border: none;"> 1,000 BTU PER HOUR MECHANICAL CONTRACTOR MINIMUM CIRCUIT AMPACITY MOTORIZED DAMPER MOUNTED NOT TO SCALE OUTSIDE AIR OUTSIDE AIR INTAKE PRESSURE DROP PROPELLER FAN PHASE PROPELLER RETURN AIR RELATIVE HUMIDITY RATED LINE AMPS REVOLUTIONS PER MINUTE SUPPLY AIR SMOKE DETECTOR SUPPLY AIR FAN STATIC PRESSURE SPECIFICATION STAINLESS STEEL SOLENOID VALVE TEMPERATURE TOP OF DUCT TOP OF UNIT TOTAL STATIC PRESSURE TEMPERATURE SENSOR TYPICAL UNIT HEATER VOLTS VOLUME DAMPER VELOCITY WITH WET BULB WATER COLUMN </td> </tr> </table>	AD AFF APD ATC BD BHP BOD BOT CFM CLG CONN DB DDC DIA, Ø DM DN EA EAT EDH EF EL/ELEV ESP FA FD FLA FPM GC GPM HP IN WG KW L1 LAT MAU	ACCESS DOOR ABOVE FINISHED FLOOR AIR PRESSURE DROP AUTOMATIC TEMPERATURE CONTROL GRAVITY BACKDRAFT DAMPER BRAKE HORSEPOWER BOTTOM OF DUCT BOTTOM CUBIC FEET OF STANDARD AIR PER MINUTE CEILING CONNECTION DRY BULB DIRECT DIGITAL CONTROL DIAMETER DAMPER MOTOR DOWN EXHAUST AIR ENTERING AIR TEMPERATURE ELECTRIC DUCT HEATER EXHAUST FAN ELEVATION EXTERNAL STATIC PRESSURE FREE AREA FIRE DAMPER WITH ACCESS DOOR FULL LOAD AMPS FEET PER MINUTE GENERAL CONTRACTOR GALLONS PER MINUTE HORSEPOWER OR HEAT PUMP INCHES OF WATER GAGE KILOWATT (1,000 WATTS) LOUVER (TYPE 1) LEAVING AIR TEMPERATURE MAKEUP AIR UNIT	MBH MC MCA MD MTD NTS OA OAI PD PF PH, Ø PROP RA RH RLA RPM SA SD SF SP SPEC SS SV TEMP TOD TOU TSP TS TYP UH V VD VEL W/ WB WC	1,000 BTU PER HOUR MECHANICAL CONTRACTOR MINIMUM CIRCUIT AMPACITY MOTORIZED DAMPER MOUNTED NOT TO SCALE OUTSIDE AIR OUTSIDE AIR INTAKE PRESSURE DROP PROPELLER FAN PHASE PROPELLER RETURN AIR RELATIVE HUMIDITY RATED LINE AMPS REVOLUTIONS PER MINUTE SUPPLY AIR SMOKE DETECTOR SUPPLY AIR FAN STATIC PRESSURE SPECIFICATION STAINLESS STEEL SOLENOID VALVE TEMPERATURE TOP OF DUCT TOP OF UNIT TOTAL STATIC PRESSURE TEMPERATURE SENSOR TYPICAL UNIT HEATER VOLTS VOLUME DAMPER VELOCITY WITH WET BULB WATER COLUMN
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1	BID SET	11/21	JTH



DESIGNED BY	R. VAN DYKE
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APPROVED BY	J. HISE

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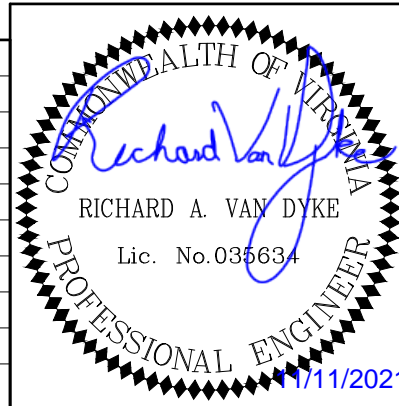
PROJECT NO.	31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	H-1
DATE:	NOVEMBER 2021	HVAC LEGEND & ABBREVIATIONS	SHEET 34 OF 57

GENERAL NOTES

1. THE SYMBOLS AND ABBREVIATIONS LIST ON THIS SHEET IS A COMPREHENSIVE STANDARD GUIDE INTENDED FOR GENERAL USE ON ALL PROJECTS. THEREFORE NOT ALL THE SYMBOLS AND ABBREVIATIONS CONTAINED IN THIS LIST ARE NECESSARILY USED ON THIS PARTICULAR PROJECT AND SHOULD BE USED FOR CLARIFICATION ONLY.
2. ALL DUCT DIMENSIONS ARE CLEAR DIMENSIONS TO INSIDE OF DUCT. DIMENSIONS TO DUCTS FROM FLOOR OR WALL SHALL BE TO THE OUTSIDE OF DUCT/INSULATION. WHERE INTERNAL INSULATION IS REQUIRED THE DUCT SIZE SHALL BE INCREASED TO GIVE CLEAR INSIDE DIMENSIONS AS NOTED ON THE DRAWINGS.
3. EQUIPMENT SIZES AND LOCATIONS ARE APPROXIMATE. ACTUAL DIMENSIONS TO BE DETERMINED BY EQUIPMENT FURNISHED. COORDINATE HVAC WORK WITH THE WORK OF ALL OTHER TRADES.
4. FINAL OPENING DIMENSIONS, CONCRETE PAD SIZES, AND LOCATIONS MUST BE COORDINATED DURING CONSTRUCTION WITH APPROVED EQUIPMENT.
5. FINAL SIZES OF FLOOR OPENINGS, DUCT PLENUMS, TRANSITIONS AND PIPING CONNECTIONS TO ALL EQUIPMENT SHALL BE DETERMINED BY EQUIPMENT FURNISHED.
6. THE DRAWINGS ARE SCHEMATIC IN NATURE AND SHOW INTENDED GENERAL LOCATION OF HVAC EQUIPMENT AND SYSTEMS. NOT ALL OFFSETS AND REQUIRED FITTINGS FOR ACTUAL FIELD INSTALLATION ARE INTENDED TO BE SHOWN FOR INSTALLATION OF SYSTEMS IN THE SPACE AVAILABLE IN CONSIDERATION OF WORK OF OTHER TRADES AND FIELD CONDITIONS. CONTRACTOR SHALL PROVIDE ADDITIONAL OFFSETS IN DUCTWORK AND PIPING AS REQUIRED TO AVOID SUCH INTERFERENCES OR FIELD CONDITIONS AT NO ADDITIONAL COST TO THE ORIGINAL CONTRACT AMOUNT.
7. FIRST FIGURE OF DUCT SIZE INDICATES DIMENSION OF FACE SHOWN OR INDICATED OR WIDTH OF DUCT IN PLAN VIEW.
8. COORDINATE THE REQUIREMENTS FOR HVAC OPENINGS AND SLEEVES IN BUILDING ELEMENTS WITH THE GC.
9. CONTRACTOR SHALL REFER TO SPECIFICATION SECTION 09900 FOR PAINTING REQUIREMENTS UNLESS OTHERWISE NOTED.
10. REFER TO ELECTRICAL DRAWINGS OR SPECIFICATIONS FOR INTERLOCKING WIRING REQUIREMENTS.
11. CONTRACTOR SHALL COORDINATE DUCTWORK INSTALLATION WITH OTHER TRADES SO THAT THE DUCTWORK IS INSTALLED BEFORE THE PIPING, LIGHTING AND ELECTRICAL CONDUIT.
12. PROVIDE ADEQUATE SUPPORT, PER THE MANUFACTURER'S RECOMMENDATIONS, FOR ALL HVAC EQUIPMENT.
13. CONTRACTOR SHALL BE RESPONSIBLE FOR CHECKING ELECTRICAL RATINGS FROM CERTIFIED DRAWINGS OF EQUIPMENT AND SHALL MAKE ANY BRANCH CIRCUIT DISTRIBUTION MODIFICATION REQUIREMENTS WITHOUT ANY ADDITIONAL COST TO OWNER. THE CONTRACTOR SHALL SUBMIT A SCHEDULE OF SUCH CHANGES FOR APPROVAL BY ENGINEER.
14. WHEREVER THE REQUIREMENTS AND REGULATIONS OF STATE, FEDERAL AND LOCAL AUTHORITIES HAVING JURISDICTION DIFFER FROM THE DRAWINGS OR SPECIFICATIONS, THEY SHALL TAKE PRECEDENCE AND SHALL BE MADE PART OF THE CONTRACT (EXCEPT WHERE THE DRAWINGS OR SPECIFICATIONS ARE MORE STRINGENT).
15. THE CONTRACTOR SHALL PROVIDE AND INSTALL FIRE AND SMOKE RATED DAMPERS IN HVAC DUCTS WHICH PENETRATE FIRE RATED BUILDING ASSEMBLIES AS SHOWN ON ARCHITECTURAL DRAWINGS.
16. DUCTWORK AND PLENUM TO LOUVERS SHALL BE CONNECTED TO FRAMED OPENINGS AND, SEALED AIRTIGHT AND WEATHER RESISTANT.
17. THERMOSTATS, SENSORS, AND/OR CONTROL PANEL LOCATIONS SHOWN ARE APPROXIMATE AND SHALL BE COORDINATED TO SUIT FIELD CONDITIONS.
18. INSTALL WALL MTD SENSORS, CONTROLS AND THERMOSTATS 5'-0" AFF UNLESS OTHERWISE NOTED. ALIGN WITH OTHER NEARBY ITEMS SUCH AS LIGHT SWITCHES. DO NOT INSTALL CLOSER THAN 6-INCHES FROM EDGE OF DOOR FRAME OR CORNER OF WALL AS SHOWN ON ARCH PLANS. WHERE CONFLICTS MAY OCCUR WITH ITEMS SUCH AS LIGHT SWITCHES, MOUNT THE SENSOR OR CONTROL DEVICE 4'-6" AFF CENTERED ABOVE THE LIGHT SWITCH.
19. PROVIDE ADEQUATE MEANS OF ACCESS CLEARANCE FOR ALL HVAC/MECHANICAL EQUIPMENT AND SYSTEMS THAT REQUIRE ACCESS FOR PROPER OPERATION, MAINTENANCE AND REPAIR PER RECOMMENDED MANUFACTURER CLEARANCES. PROVIDE ACCESS DOORS WHERE NECESSARY IN FINISHED WALLS OR DRYWALL CEILINGS FOR ACCESS TO VALVES, DAMPERS, OR CONTROL DEVICES.
20. COORDINATE THE REQUIREMENTS OF HVAC HANGERS AND SUPPORTS W/ OTHER PRIME CONTRACTORS PROVIDING STRUCTURAL AND/OR ARCHITECTURAL BUILDING ELEMENTS WHICH HVAC SUPPORTS SHALL INTERFACE.
21. HVAC CONTRACTOR SHALL PROVIDE ALL FIRESTOPPING AND PIPE SLEEVES FOR ALL PIPE AND DUCT PENETRATIONS THRU FIRE RATED BUILDING ASSEMBLIES.
22. CONTRACTOR SHALL OBTAIN AND PAY ALL FEES RELATED TO PERMITTING, AND INSPECTIONS.
23. FOR ADDITIONAL REQUIREMENTS REFER TO SPECIFICATIONS.
24. APPLICABLE CODES:
 2015 INTERNATIONAL BUILDING CODE
 2015 INTERNATIONAL MECHANICAL CODE
 2015 INTERNATIONAL ENERGY CONSERVATION CODE

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1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY R. VAN DYKE
 DRAWN BY R. VAN DYKE
 CHECKED BY N. BARTLEY
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

HVAC
GENERAL NOTES

H-2

SHEET
35 OF 57

NFPA CLASSIFICATIONS AND OUTSIDE AIR VENTILATION

ROOM, STRUCTURE OR AREA	NFPA 820 TABLE & ROW	FUNCTION	EXTENT OF CLASSIFIED AREA	INITIAL AREA CLASSIFICATION	VENTILATION RATE (ACH)	FINAL CLASSIFICATION	PRESSURIZATION	ROOM VOLUME (CU FT)	O. A. REQUIRED (CFM)	SUPPLY (CFM)	EXHAUST (CFM)
BELOW GRADE OR PARTIALLY BELOWGRADE WASTEWATER PUMPING STATION DRY WELL	TABLE 4.2.2 ROW 14b	LIQUID SIDE OF PUMPING STATION SERVING A SANITARY SEWER OR COMBINED SEWER SYSTEM	ENTIRE SPACE	CLASS 1; DIV. 1	6	CLASS 1; DIV. 1	NEGATIVE	10,869	1,087	2,385	2,650
BELOW GRADE OR PARTIALLY BELOWGRADE WASTEWATER PUMPING STATION DRY WELL	TABLE 4.2.2 ROW 15b	PUMP ROOM PHYSICALLY SEPARATED FROM WET WELL; PUMPING OF WASTEWATER FROM A SANITARY SEWER SYSTEM OR COMBINED SEWER SYSTEM THROUGH CLOSED PUMPS AND PIPES	ENTIRE SPACE	CLASS 1; DIV. 2	6	UNCLASSIFIED	NEGATIVE	14,385	2,200	2,200	2,500
ODOR CONTROL ROOM	TABLE 4.2.2 ROW 18b	AREAS BEYOND 3 FEET FROM SOURCES OF LEAKAGE OR VENTILATION EQUIPMENT	ENTIRE SPACE	CLASS 1; DIV 2	6	UNCLASSIFIED	NEGATIVE	1,963	196	175	200
ELECTRICAL ROOM	TABLE 4.2.2 ROW 14b	ELECTRICAL ROOM PHYSICALLY SEPARATED FROM CLASSIFIED SPACES	ENTIRE SPACE	UNCLASSIFIED	NA	UNCLASSIFIED	NEGATIVE	1,963.	196	175	200

FAN SCHEDULE

MARK	LOCATION	AREA SERVED	MANUFACTURER		AIRFLOW (CFM)	EXT. STATIC (IN. W.G.)	FAN		FAN WHEEL		FAN SPEED (RPM)	MOTOR			POWER			WEIGHT (LBS)	NOTES
			MAKE	MODEL			SERVICE	DRIVE	TYPE	MIN. DIA.		BHP	HP	VFD	VOLTS	PH	HZ		
SF-1	PUMP STATION	WET WELL	GREENHECK	RBS-2H24	2,385	0.63	SUPPLY	BELT	AXIAL	24	1,239	0.84	1.5	NO	480	3	60	290	1, 2, 3, 4
SF-2	PUMP STATION	DRY WELL	GREENHECK	RSF-100	2,200	0.5	SUPPLY	BELT	FORWARD	35.5	869	0.46	0.5	NO	480	3	60	110	1, 2, 3, 4
EF-2	PUMP STATION	DRY WELL	GREENHECK	CUBE-180	1,980	0.6	EXHAUST	BELT	BACKWARD	24	836	0.39	0.5	NO	480	3	60	110	1, 2, 3, 4
SF-3	PUMP STATION	ODOR CONTROL	GREENHECK	AS-10-420-A	175	0.38	SUPPLY	DIRECT	PROPELLER	16	1,559	0.04	0.12	NO	480	1	60	40	1, 2, 3, 4
EF-4	PUMP STATION	ODOR CONTROL	GREENHECK	G-080-D	200	0.38	EXHAUST	DIRECT	BACKWARD	10	1,434	0.04	0.05	NO	480	1	60	30	1, 2, 3, 4
EF-5	PUMP STATION	HYDRAULIC RM	GREENHECK	SE1-8-440-G	140	0.19	EXHAUST	DIRECT	PROPELLER	10	1,350	0.02	0.02	YES	120	1	60	20	1, 2, 3, 4, 5

NOTES:

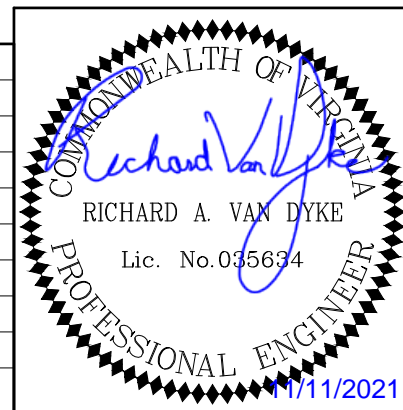
- SPECIFICATION 15590.
- ROOF CURB
- BACKDRAFT DAMPER
- HI-PRO POLYESTER COATING
- VARI-GREEN ELECTRONICALLY COMMUTATED MOTOR

DESIGN TEMPERATURE CONDITIONS

OUTSIDE	ELECTRICAL ROOMS
WINTER: 14.2° F DB	WINTER: 60° F
SUMMER: 95.0° F DB / 76.3° F WB	SUMMER: 78° F DB
OUTSIDE DESIGN TEMPERATURES BASED UPON ASHRAE 2017 FUNDAMENTALS CHAPTER 14 CLIMATIC DESIGN DATA FOR THE 99 PERCENTILE HEATING DRYBULB INCIDENCE AND 1 PERCENTILE COOLING DRYBULB AND WETBULB INCIDENCES: LEESBURG EXECUTIVE, LEESBURG, VA. (WMO: 724055).	PROCESS AREAS
	WINTER: 55° F
	SUMMER: 105° F DB

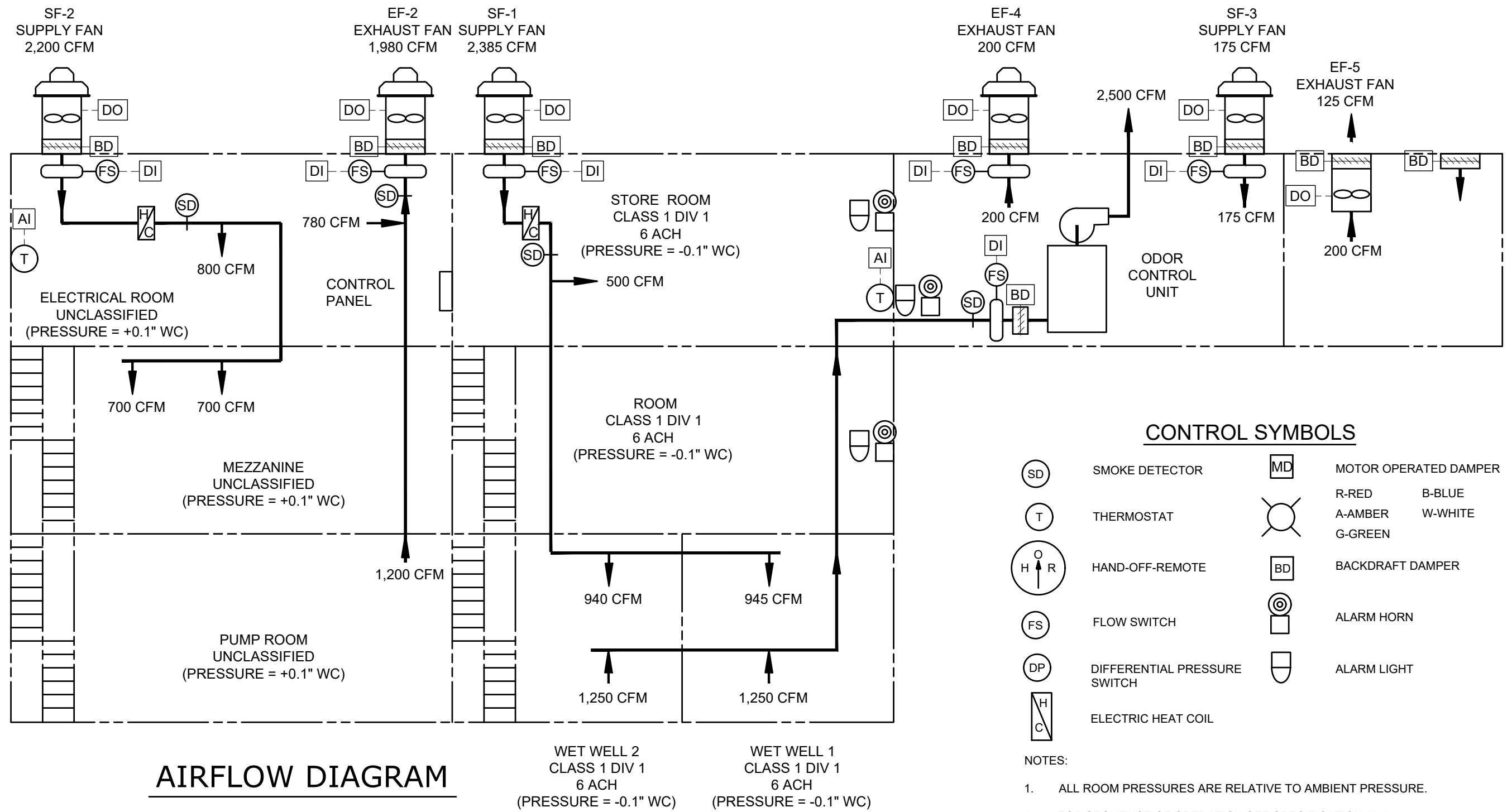
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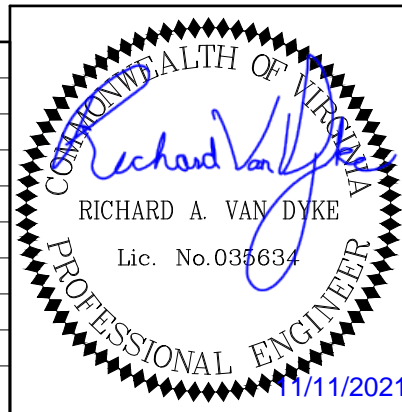


DESIGNED BY <u> </u> R. VAN DYKE	Hazen HAZEN AND SAWYER 1 SOUTH STREET, SUITE 1150 BALTIMORE, MARYLAND 21202	PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	H-3
DRAWN BY <u> </u> R. VAN DYKE		DATE: NOVEMBER 2021		
CHECKED BY <u> </u> N. BARTLEY				HVAC HVAC SCHEDULES
APPROVED BY <u> </u> J. HISE				

20211111 1:30P O:\31111-bal\31111-056\GIS\CAD-BIM\HVAC\H-4 HVAC AIRFLOW DIAGRAMS.dwg By:MBROCATO Last Saved By: mbrocato



1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



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 DRAWN BY R. VAN DYKE
 CHECKED BY N. BARTLEY
 APPROVED BY J. HISE

Hazen
 HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO.
31111-056
 DATE:
NOVEMBER
2021

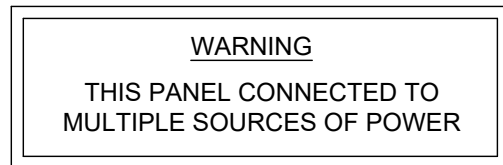
CATTAIL BRANCH SPS
LEESBURG, VIRGINIA
 HVAC
 HVAC AIRFLOW DIAGRAMS

H-4
 SHEET
37 OF 57

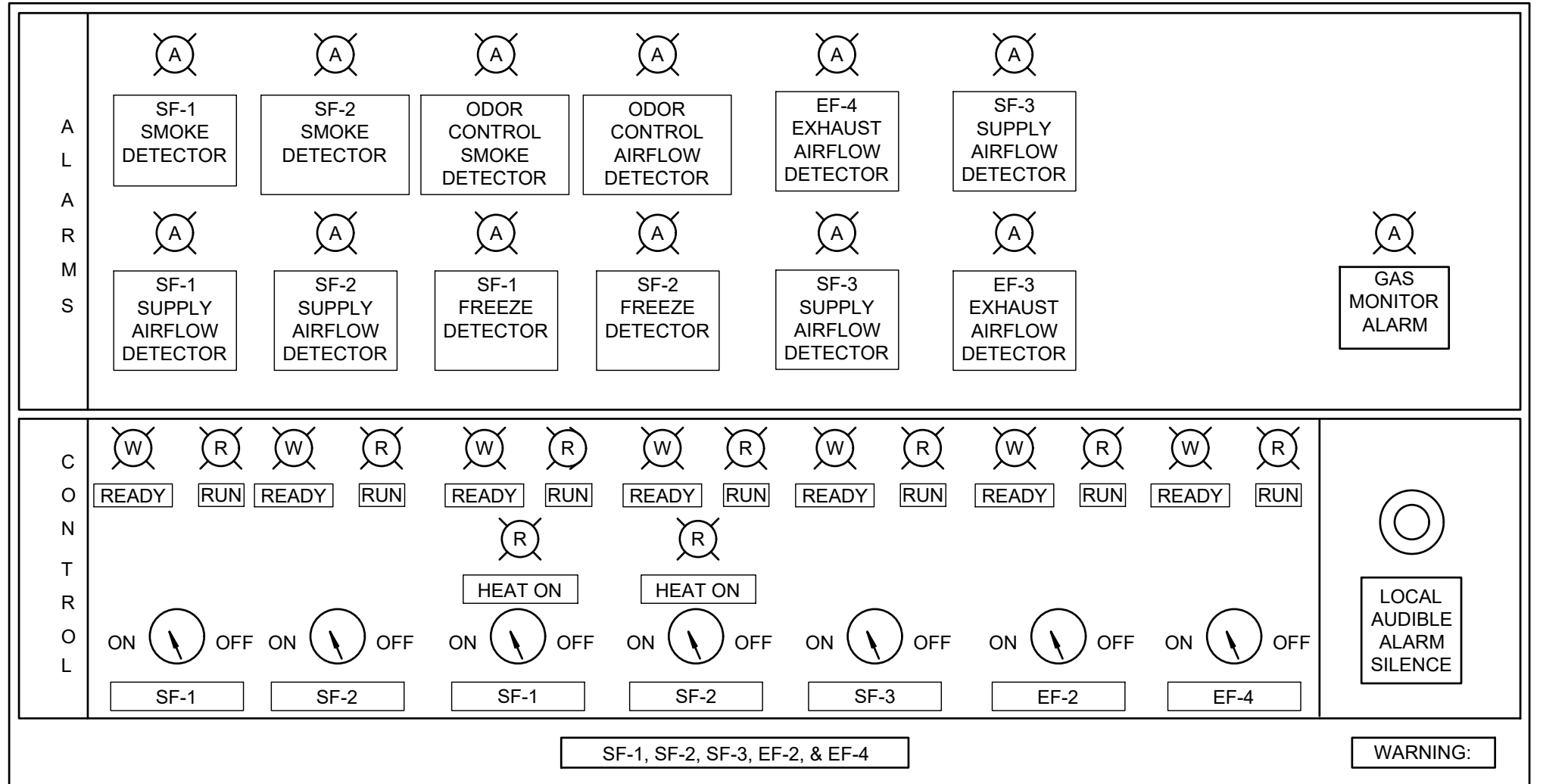
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NOTES:

1. PLACE A RED WARNING SIGN CONSPICUOUSLY ON THE FACE OF EACH HVAC CONTROL PANEL WHICH READS AS FOLLOWS:

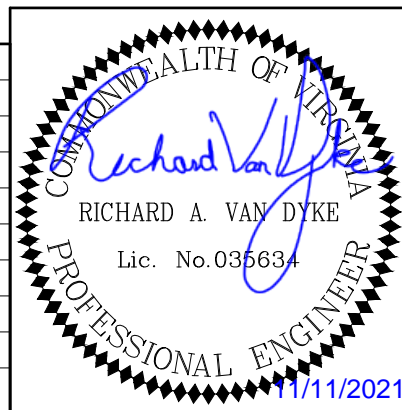


2. ALL ROOM PRESSURES ARE RELATIVE TO AMBIENT PRESSURE.
3. FOR SEQUENCE OF OPERATION SEE SPECIFICATION 23 09 01.
4. MECHANICAL CONTRACTOR SHALL COORDINATE SMOKE DETECTOR WIRING INTERFACE WITH ELECTRICAL CONTRACTOR'S INSTALLATION OF THE BUILDING FIRE ALARM SYSTEM.
5. NOTE: CUSTOM AIR HANDLING UNITS, SPECIFICATION 15584: CUSTOM AIR HANDLER MANUFACTURER SHALL FURNISH ROOM TEMPERATURE SENSORS AND AIRFLOW SWITCHES (SHIPPED LOOSE) FOR FIELD MOUNTING BY CONTRACTOR.



HRCP-1

1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



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 DRAWN BY R. VAN DYKE
 CHECKED BY N. BARTLEY
 APPROVED BY J. HISE



HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO.
 31111-056

DATE:
 NOVEMBER
 2021

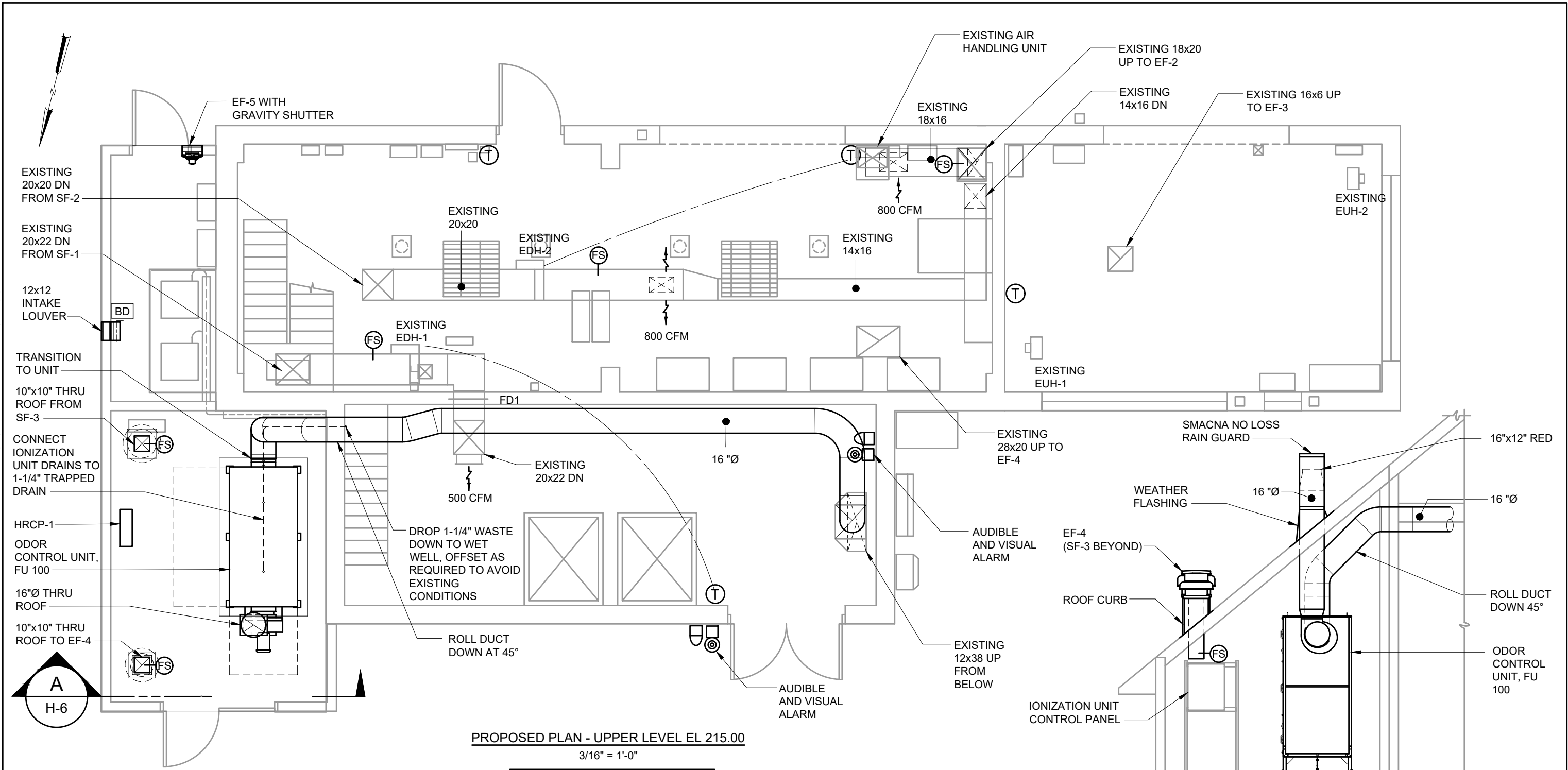
CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA

HVAC
 HVAC CONTROL PANEL

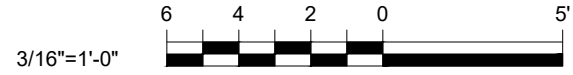
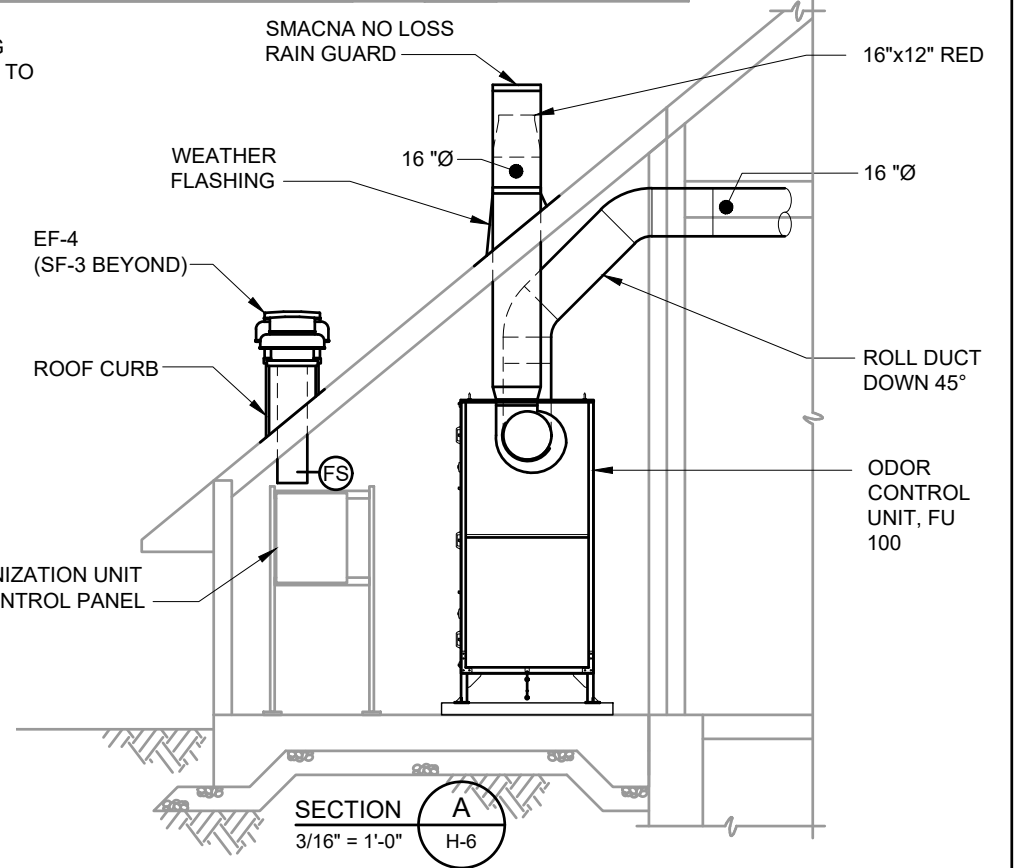
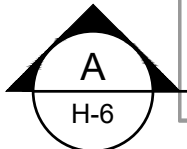
H-5

SHEET
 38 OF 57

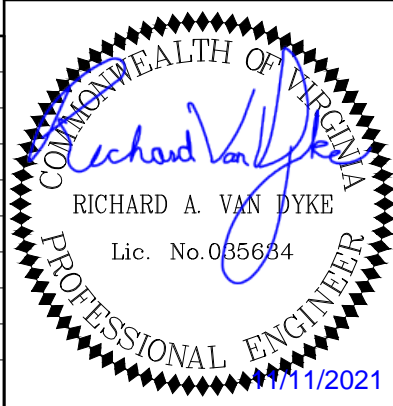
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PROPOSED PLAN - UPPER LEVEL EL 215.00
3/16" = 1'-0"



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	ISSUED FOR		DATE	BY

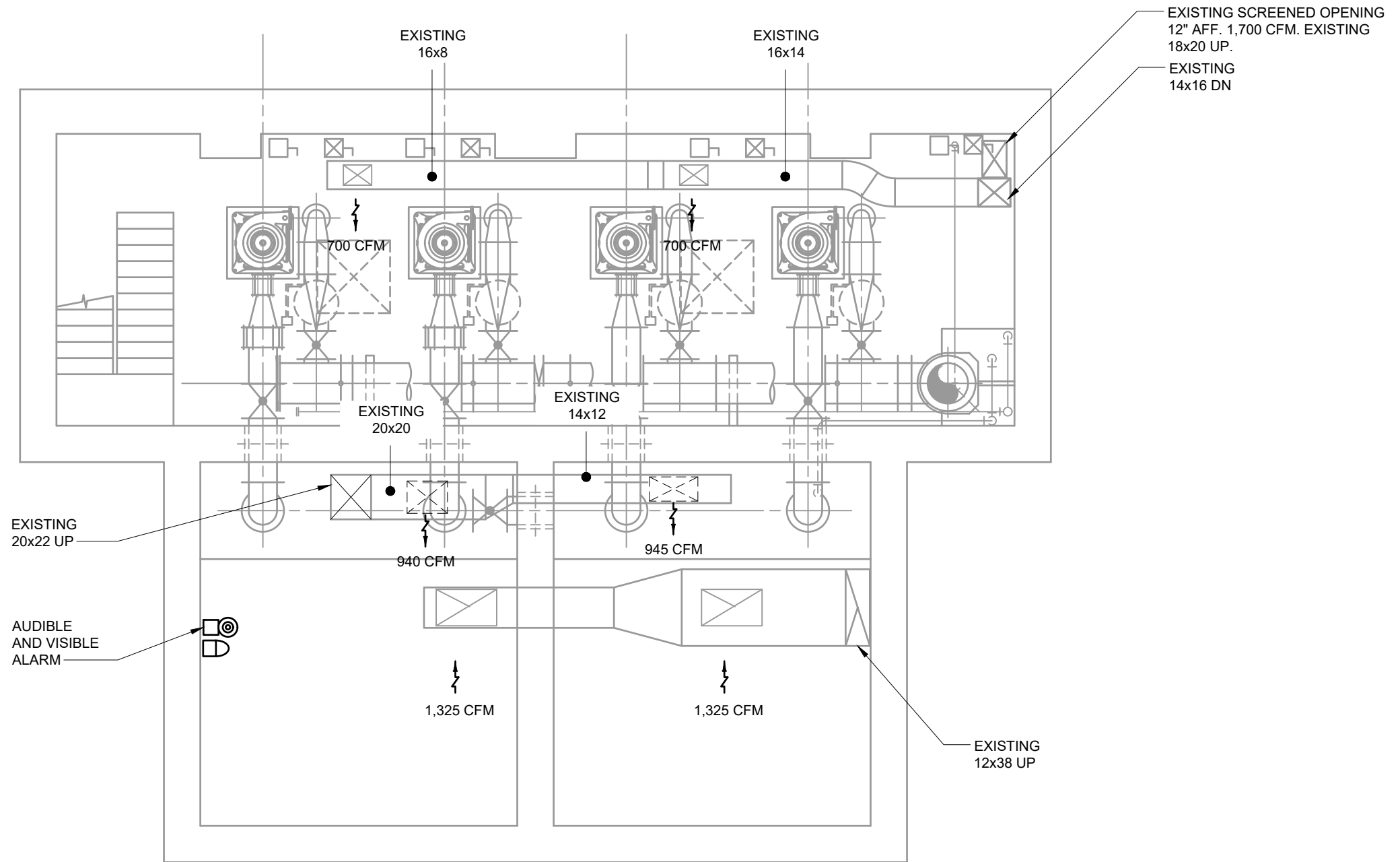


DESIGNED BY	R. VAN DYKE
DRAWN BY	R. VAN DYKE
CHECKED BY	N. BARTLEY
APPROVED BY	J. HISE

Hazen
HAZEN AND SAWYER
1 SOUTH STREET, SUITE 1150
BALTIMORE, MARYLAND 21202

PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	H-6
DATE: NOVEMBER 2021	HVAC	SHEET 39 OF 57
PROPOSED PLAN - UPPER LEVEL EL 215.00		

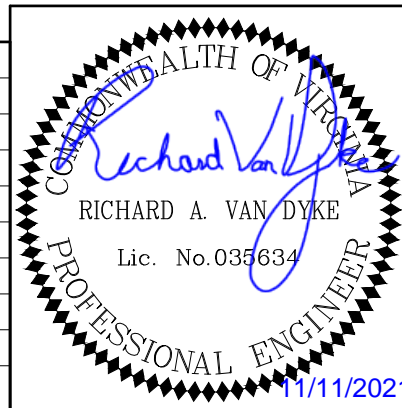
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PROPOSED PLAN - LOWER LEVEL EL 183.66
3/16" = 1'-0"



1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



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 DRAWN BY R. VAN DYKE
 CHECKED BY N. BARTLEY
 APPROVED BY J. HISE

Hazen

HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO.
 31111-056

DATE:
 NOVEMBER
 2021

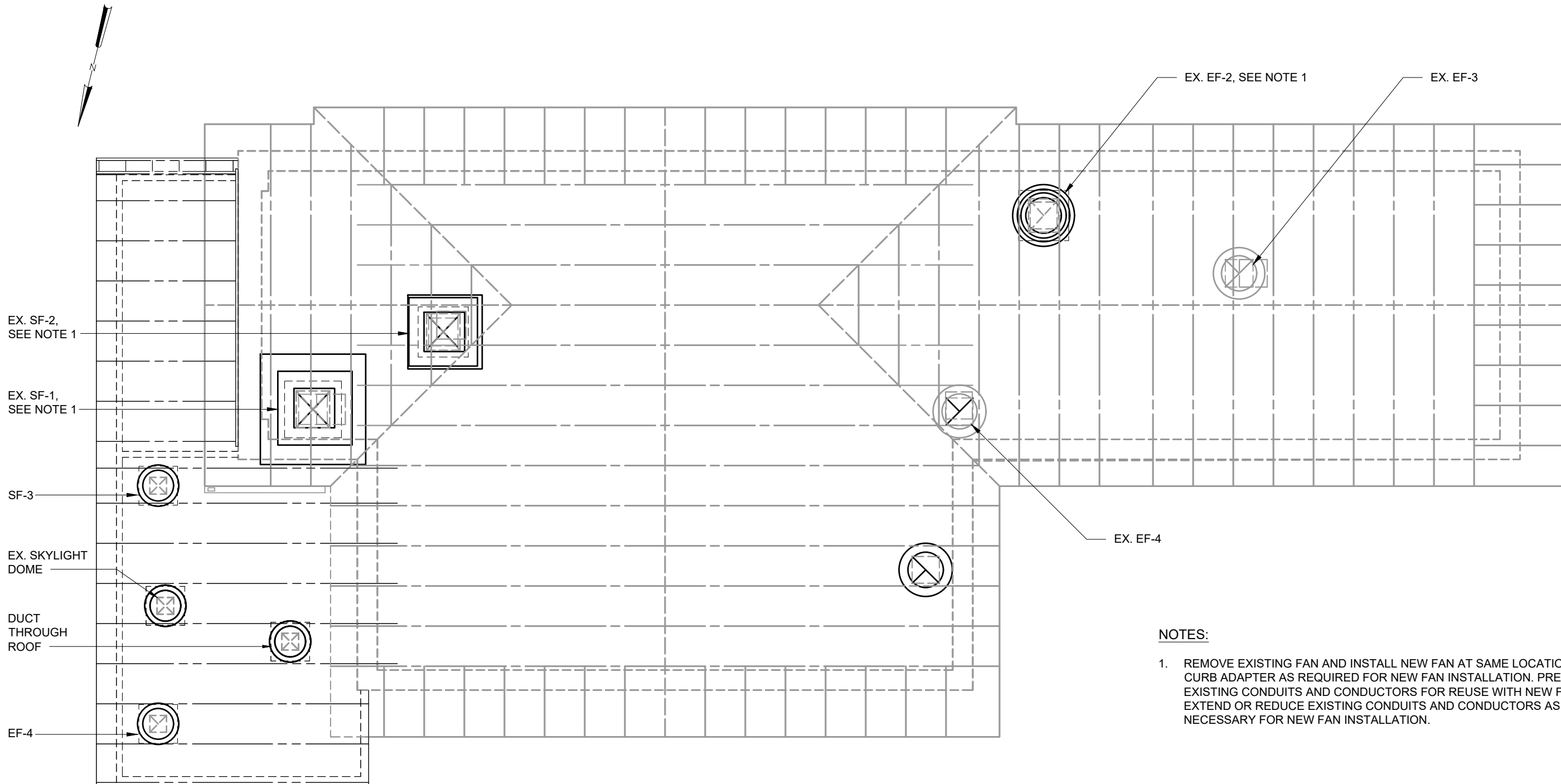
CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA

HVAC
 PROPOSED PLAN - LOWER LEVEL EL 183.66

H-7

SHEET
 40 OF 57

20211111 1:55P C:\Users\mbrocato\appdata\local\temp\AcPublish_29884\H-8 PROPOSED PLAN - ROOF.dwg By:MBROCATO Last Saved By: mbrocato



NOTES:

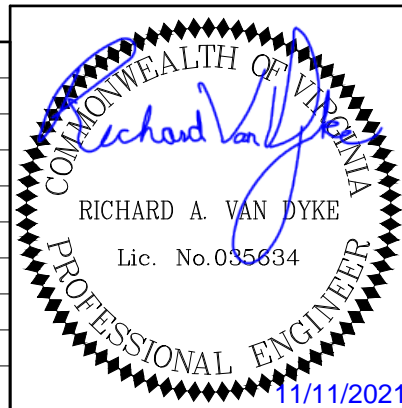
1. REMOVE EXISTING FAN AND INSTALL NEW FAN AT SAME LOCATION. PROVIDE CURB ADAPTER AS REQUIRED FOR NEW FAN INSTALLATION. PRESERVE EXISTING CONDUITS AND CONDUCTORS FOR REUSE WITH NEW FAN. EXTEND OR REDUCE EXISTING CONDUITS AND CONDUCTORS AS NECESSARY FOR NEW FAN INSTALLATION.

PROPOSED PLAN - ROOF

3/16" = 1'-0"



NO	BID SET ISSUED FOR	DATE	BY
1		11/21	JTH



DESIGNED BY R. VAN DYKE
 DRAWN BY R. VAN DYKE
 CHECKED BY N. BARTLEY
 APPROVED BY J. HISE

Hazen

HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO.
 31111-056

DATE:
 NOVEMBER
 2021

CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA

HVAC
 PROPOSED PLAN - ROOF

H-8

SHEET
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LIGHTING:

- X DENOTES FIXTURE TYPE (TYP.) SEE SPECIFICATION 16500 FOR FIXTURE SCHEDULE # DENOTES CIRCUIT NUMBER (TYP.)
RECTANGULAR FIXTURE
CEILING-MOUNTED FIXTURE
WALL-MOUNTED FIXTURE
EMERGENCY WALL-MOUNTED FIXTURE: LEFT: STANDARD/RIGHT: REMOTE-HEAD
CEILING-MOUNTED EXIT SIGN: SHADED PORTION DENOTES SIGN FACE
WALL-MOUNTED EXIT SIGN: SHADED PORTION DENOTES SIGN FACE
POLE-MOUNTED FIXTURE
PHOTOCELL
CEILING MOUNTED OCCUPANCY SENSOR: NUMBER DENOTES TYPE
WALL MOUNTED OCCUPANCY SENSOR: NUMBER DENOTES TYPE

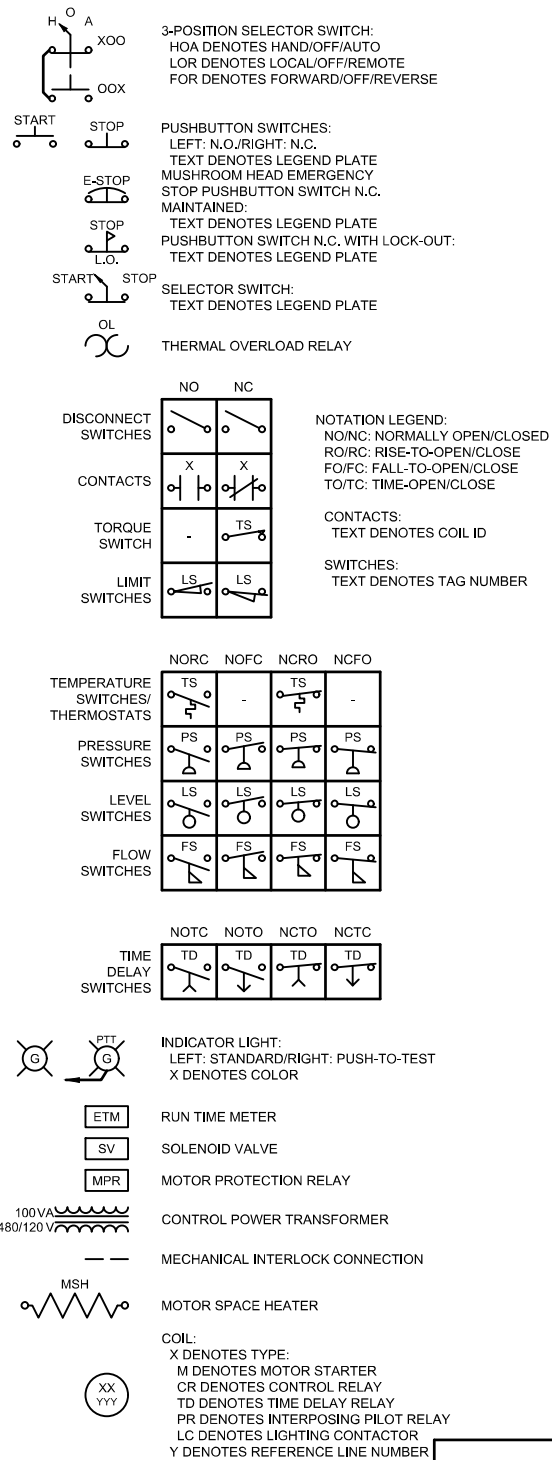
RECEPTACLES:

- X DENOTES RECEPTACLE TYPE (TYP.): GFCI DENOTES GROUND FAULT CIRCUIT INTERRUPT UPS DENOTES UNINTERRUPTIBLE POWER SUPPLY WPCR DENOTES WEATHERPROOF CORROSION RESISTANT # DENOTES CIRCUIT NUMBER (TYP.)
DUPLEX RECEPTACLE
SIMPLEX RECEPTACLE
QUADRUPLEX RECEPTACLE
MULTI-OUTLET RECEPTACLE SIMPLEX
MULTI-OUTLET RECEPTACLE DUPLEX
240 VOLT RECEPTACLE
SPECIAL PURPOSE OUTLET

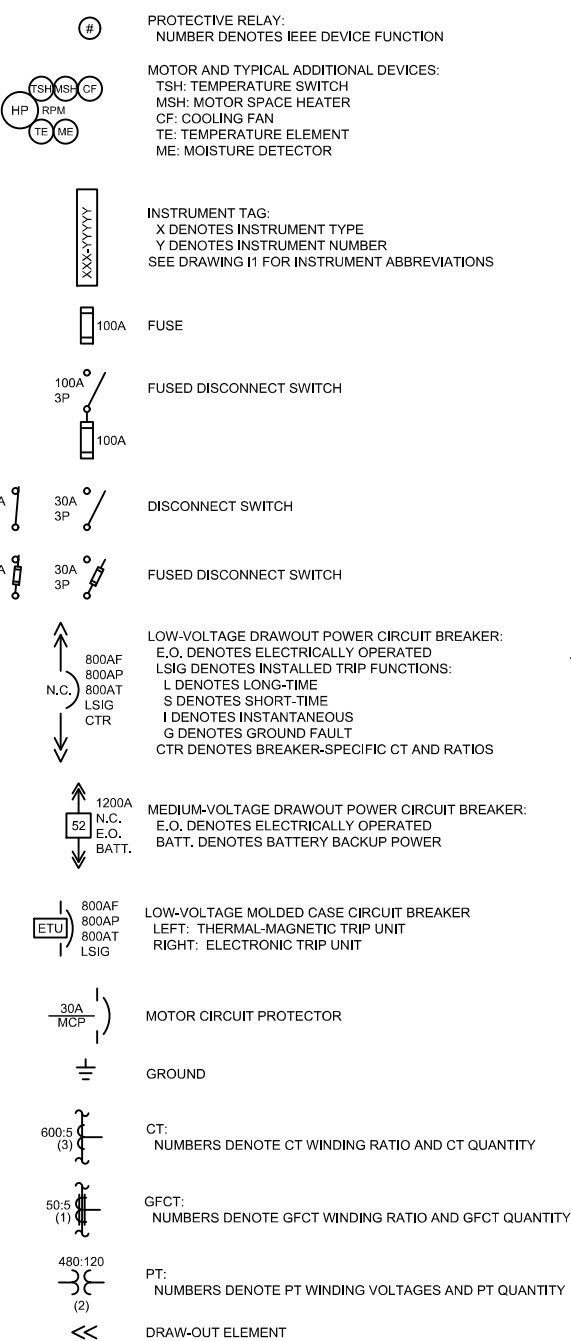
HVAC AND FIRE ALARM

- FIRE ALARM CONTROL PANEL
FIRE ALARM ANNUNCIATOR PANEL
FIRE ALARM PULL STATION
FIRE ALARM INDICATOR: X DENOTES ALERT TYPE (TYP.): A DENOTES AUDIBLE V DENOTES VISIBLE (# DENOTES STROBE INTENSITY)
FIRE ALARM INDICATOR MOUNTED ABOVE A FIRE ALARM PULL STATION
DUCT DETECTOR
SMOKE DETECTOR: X DENOTES TYPE: Z DENOTES IONIZATION P DENOTES PHOTOELECTRIC T DENOTES THERMAL
HEAT DETECTOR
THERMOSTAT
AMBIENT TEMPERATURE TRANSMITTER

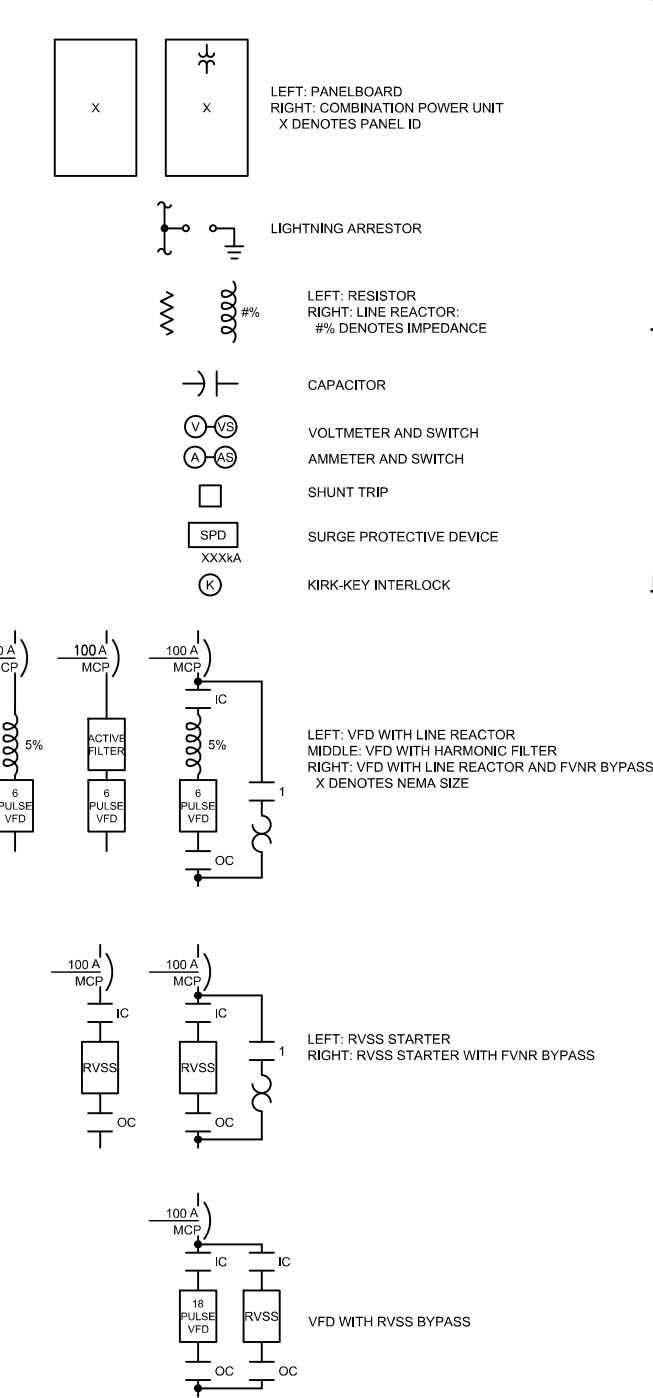
ELEMENTARY CONTROL SCHEMATICS



SINGLE-LINE DIAGRAMS



SINGLE-LINE DIAGRAMS, CONT'D.



SWITCHES

- WALL SWITCH: X DENOTES TYPE: NO SUBSCRIPT DENOTES SINGLE-POLE SWITCH 3 DENOTES 3-WAY SWITCH 4 DENOTES 4-WAY SWITCH M DENOTES MANUAL MOTOR STARTER # DENOTES CIRCUIT NUMBER WPCR DENOTES WEATHERPROOF AND CORROSION RESISTANT
COMBINATION MOTOR STARTER
DISCONNECT SWITCH
LOCAL CONTROL STATION

EQUIPMENT/DEVICE LOCATION SYMBOLS

- LOCATED IN MCC
LOCATED IN STAND-ALONE MOTOR STARTER/CONTROLLER
LOCATED IN FIELD
LOCATED AT PANEL: X DENOTES PANEL ID: L DENOTES LOCAL CONTROL STATION

MISC PLAN VIEW SYMBOLS

- EQUIPMENT CONNECTION
GROUND RODS: LEFT: BURIED RIGHT: IN TESTWELL
DUCTBANK SECTION CUT IDENTIFIER: DBXX DENOTES DUCTBANK ID EXX DENOTES DRAWING NUMBER WHERE SECTION CUT IS LOCATED
DUCTBANK TAG: X DENOTES DUCTBANK ID
CABLE TRAY TAG: X DENOTES CABLE TRAY ID Y DENOTES SCHEDULE REFERENCE
INSTRUMENT TAG: X DENOTES INSTRUMENT TYPE # DENOTES INSTRUMENT NUMBER SEE DRAWING 11 FOR INSTRUMENT ABBREVIATIONS
CONDUIT TAGS: P DENOTES POWER C DENOTES CONTROL I DENOTES INSTRUMENTATION XXXX DENOTES CONDUIT ID XXX-XXX DENOTES CONDUIT ID

COMMUNICATIONS

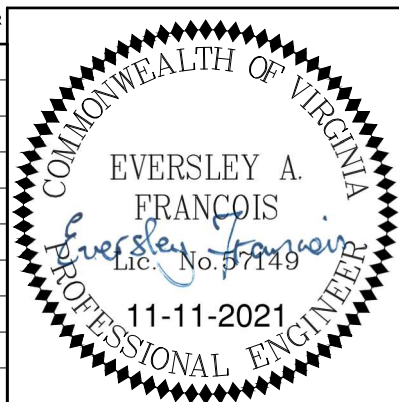
- TELEPHONE OR NETWORK DROP
PAGER RECEPTACLE
HORN/LIGHT DEVICE
PA UNIT

WIRING

- CONDUIT HOME RUN
CONDUIT EXPOSED
CONCRETE ENCASED CONDUIT
CONDUIT CONCEALED
FLEXIBLE CONDUIT
CONCRETE ENCASED DUCTBANK
LEFT: CONDUIT RISE (TURN UP) RIGHT: CONDUIT DROP (TURN DOWN)

PANELS AND BOXES

- JUNCTION BOX
PULL BOX
CONTROL PANEL



DESIGNED BY E. FRANCOIS
DRAWN BY M. BROCATO
CHECKED BY J. HISE
APPROVED BY J. HISE



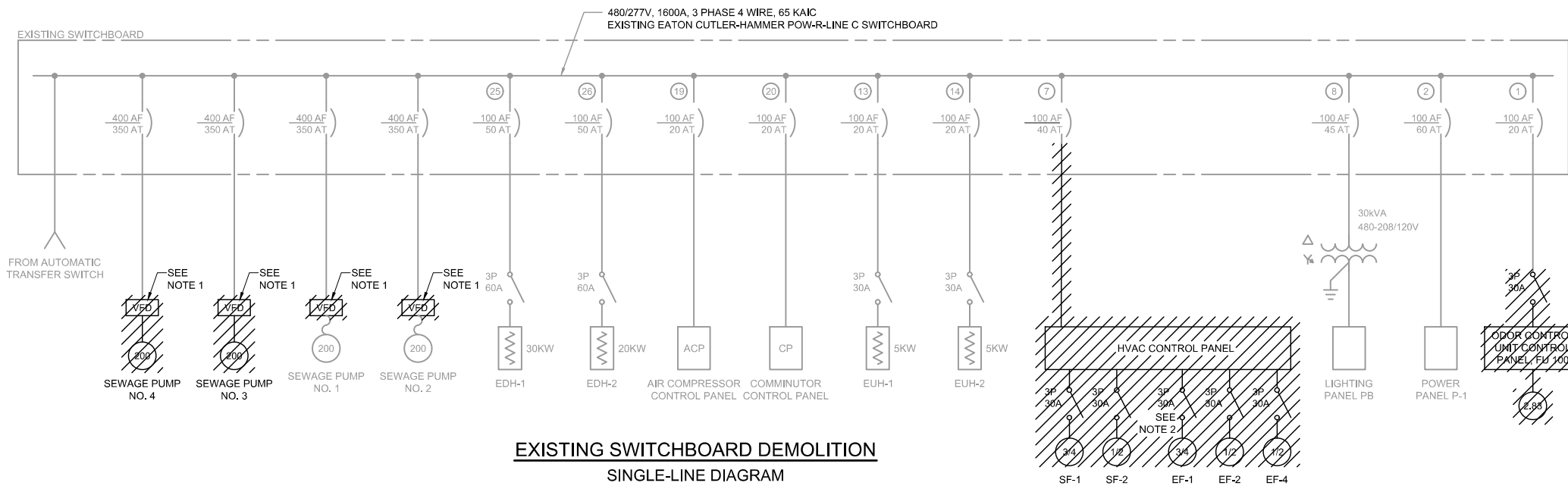
PROJECT NO. 31111-056
DATE: NOVEMBER 2021

CATTAIL BRANCH SPS LEESBURG, VIRGINIA
ELECTRICAL
LEGEND AND SYMBOLS

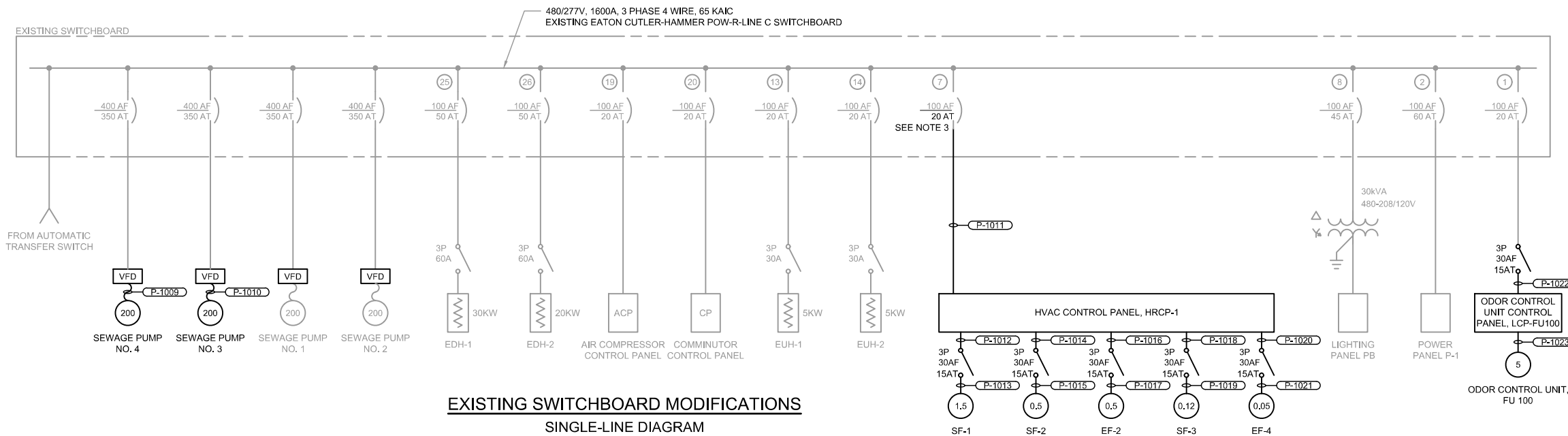
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SHEET 42 OF 57

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EXISTING SWITCHBOARD DEMOLITION
SINGLE-LINE DIAGRAM

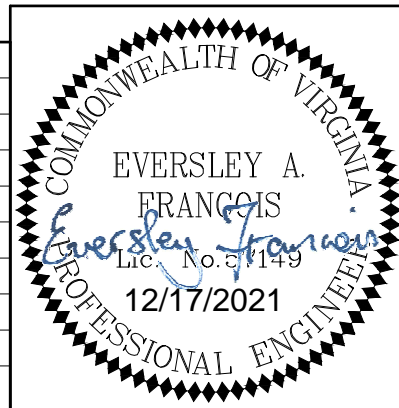


EXISTING SWITCHBOARD MODIFICATIONS
SINGLE-LINE DIAGRAM

NOTE:

1. DISCONNECT AND REMOVE EXISTING VFD ENCLOSURE AND VFD. PRESERVE EXISTING POWER AND CONTROL CONDUIT AND WIRE FOR RECONNECTION TO NEW EQUIPMENT.
2. FIELD LOCATE EXACT LOCATION OF DISCONNECT SWITCH.
3. SET CIRCUIT BREAKER TRIP SETTING TO 20A.

NO	ISSUED FOR	DATE	BY
2	BED SET - REVISED	12/21	JTH
1	BID SET	11/21	JTH



DESIGNED BY E. FRANCOIS
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
DECEMBER
2021

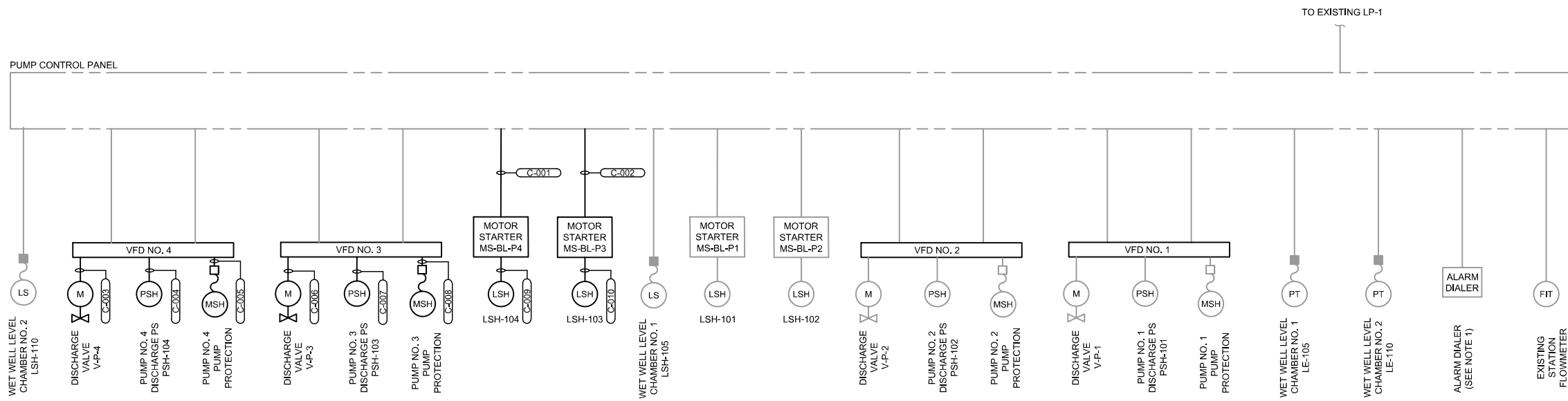
CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

ELECTRICAL
SINGLE-LINE DIAGRAMS

E-2

SHEET
43 OF 57

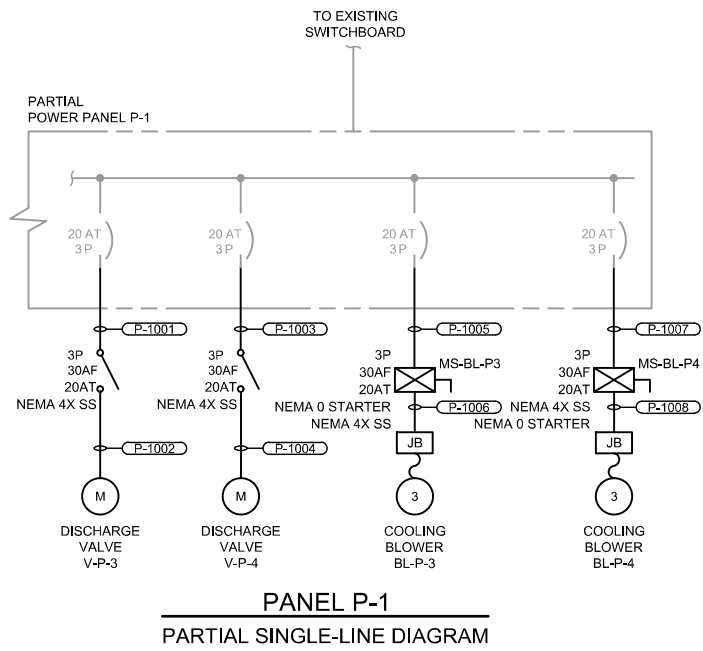
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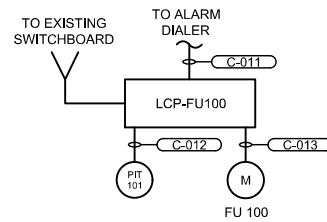
PUMP CONTROL PANEL
SINGLE-LINE DIAGRAM

NOTES:

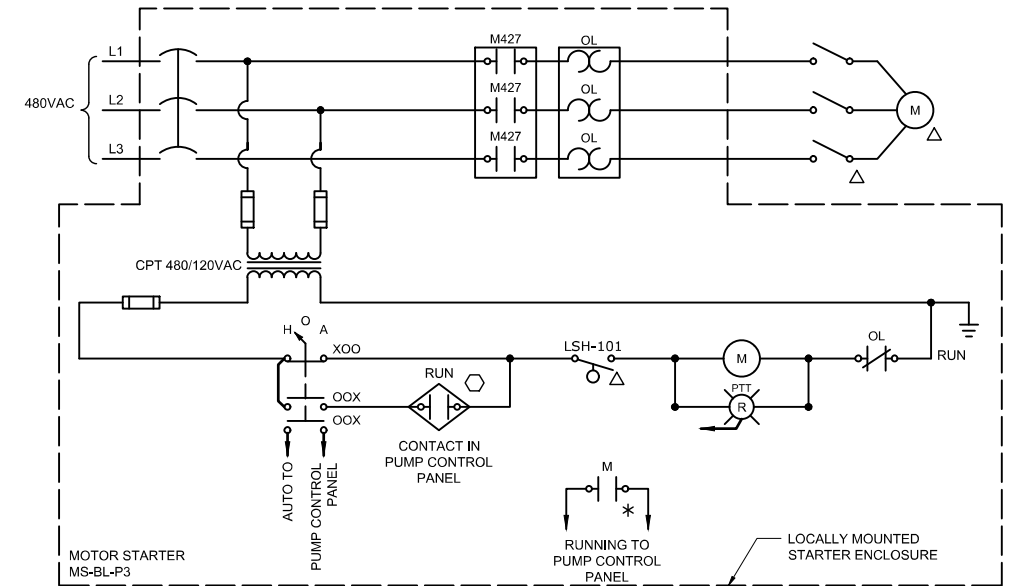
- VENDOR TO PROVIDE ELEMENTARY SCHEMATIC DIAGRAM FOR ODOR CONTROL UNIT FU 100. SEE SPECIFICATION SECTION 13255 - PHOTOIONIZATION ODOR CONTROL SYSTEM FOR MORE INFORMATION.



PANEL P-1
PARTIAL SINGLE-LINE DIAGRAM

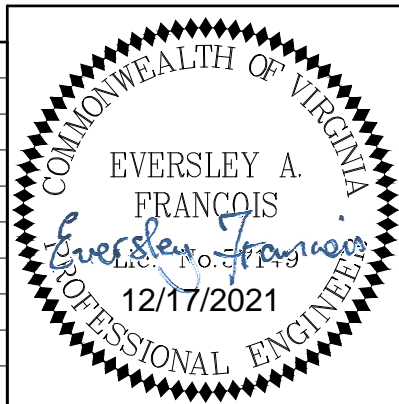


ODOR CONTROL UNIT CONTROL PANEL LCP-FU100
ONE-LINE DIAGRAM
SEE NOTE 1



MOTOR COOLING BLOWER BL-P3
ELEMENTARY SCHEMATIC
(TYPICAL FOR BL-P4)

NO	ISSUED FOR	DATE	BY
2	BED SET - REVISED	12/21	JTH
1	BID SET	11/21	JTH



DESIGNED BY E. FRANCOIS
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO.
 31111-056

DATE:
 DECEMBER
 2021

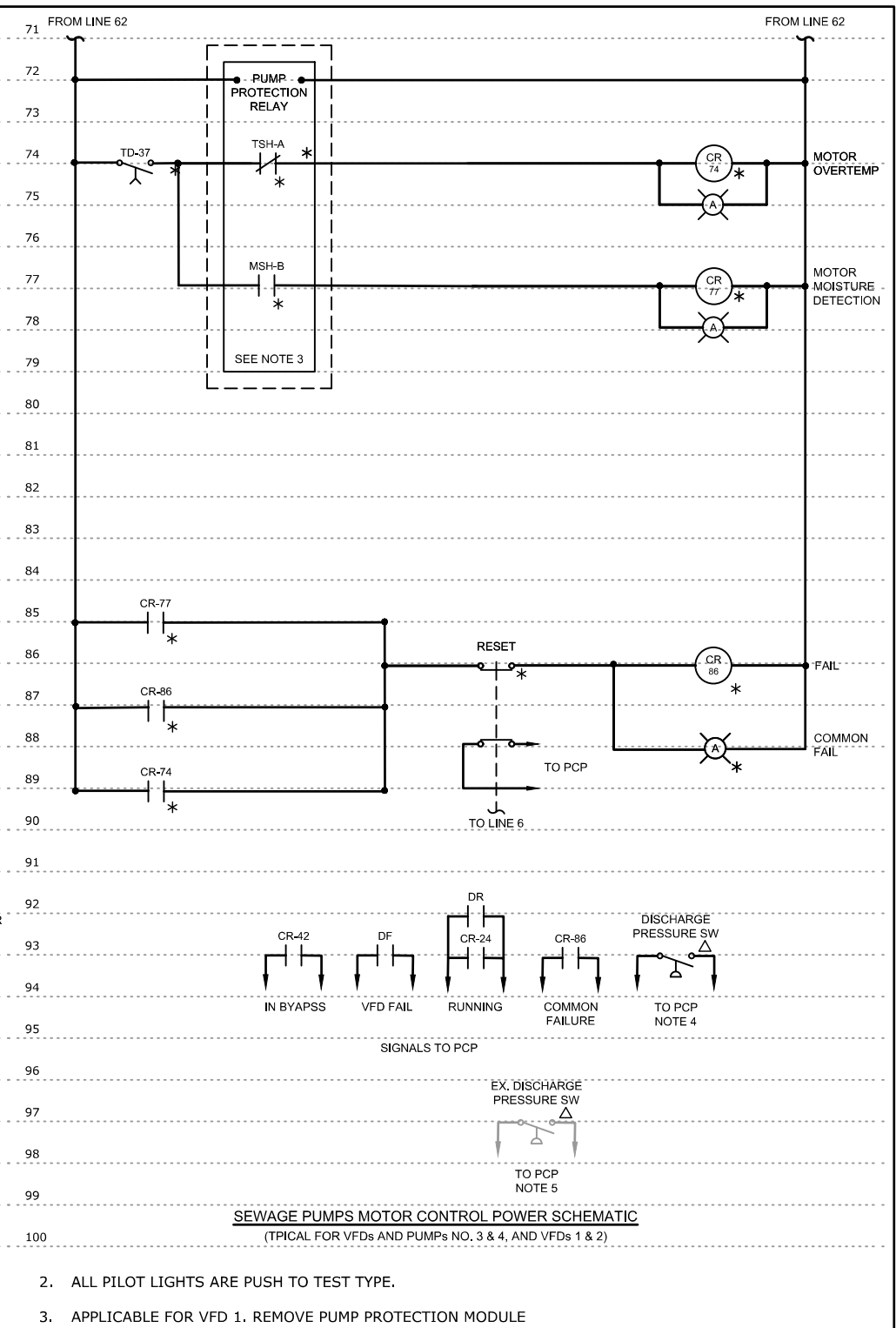
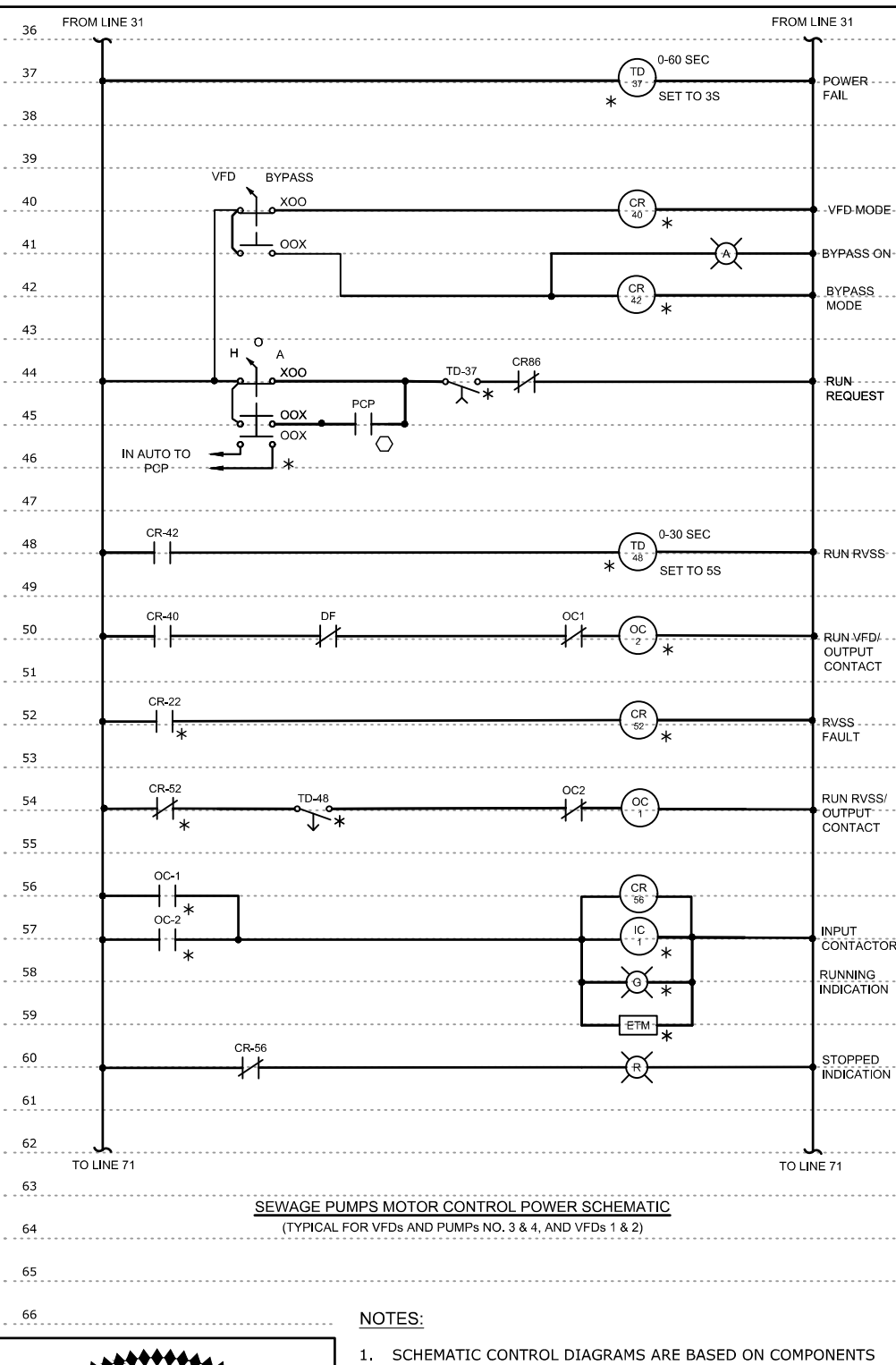
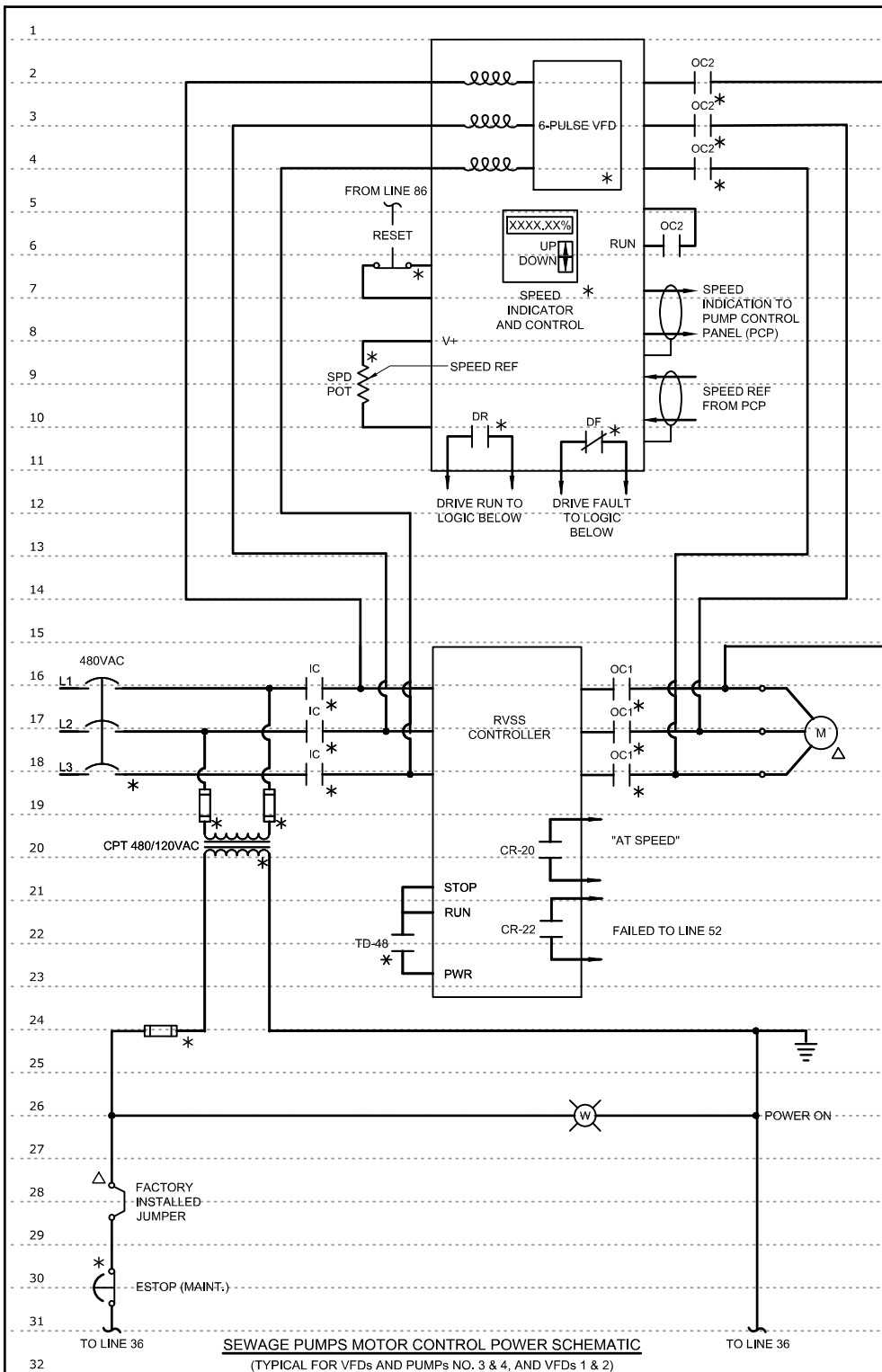
CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA

ELECTRICAL
 DIAGRAMS

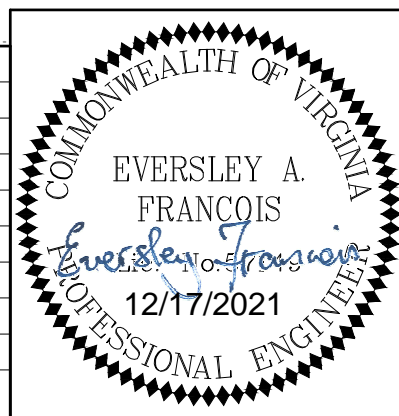
E-3

SHEET
 44 OF 57

20211217 10:53A C:\Users\mbrocato\AppData\Local\Temp\AcPublish_30732\E-4 ELEMENTARY SCHEMATIC DIAGRAMS.dwg By:MBROCATO Last Saved By: mbrocato



NO	ISSUED FOR	DATE	BY
2	BED SET - REVISED	12/21	JTH
1	BID SET	11/21	JTH



NOTES:

1. SCHEMATIC CONTROL DIAGRAMS ARE BASED ON COMPONENTS PROVIDED FROM SPECIFIC VENDORS. DETAILED SCHEMATICS AND WIRING DIAGRAMS SHALL BE DEVELOPED BY THE CONTROL SYSTEM VENDOR DURING CONSTRUCTION THAT REPRESENT THE ACTUAL COMPONENTS AND EQUIPMENT SELECTION.
2. ALL PILOT LIGHTS ARE PUSH TO TEST TYPE.
3. APPLICABLE FOR VFD 1. REMOVE PUMP PROTECTION MODULE FROM EXISTING VFD AND FIELD INSTALL IN NEW UNIT.
4. APPLICABLE FOR VFDs 3 AND 4. PROVIDE TERMINAL BLOCK FOR DEVICE ROUTED THROUGH VFD.
5. APPLICABLE FOR VFD 1. PROVIDE TERMINAL BLOCKS FOR EXISTING DEVICES ROUTED THROUGH VFD.

DESIGNED BY <u>E. FRANCOIS</u>	Hazen HAZEN AND SAWYER 1 SOUTH STREET, SUITE 1150 BALTIMORE, MARYLAND 21202	PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	E-4
DRAWN BY <u>M. BROCATO</u>		DATE: DECEMBER 2021		
CHECKED BY <u>J. HISE</u>			ELECTRICAL	SHEET 45 OF 57
APPROVED BY <u>J. HISE</u>			ELEMENTARY SCHEMATIC DIAGRAMS	

20211111 12:48P 0:\31111-056\GIS\CAD-BIM\ELEC\5-POWER PANEL_P-1 SCHEDULE.dwg By: MBROCATO Last Saved By: CNguyen

480/277 VOLTS 3 PHASE, 4 WIRE						P-1 MAIN BREAKER 60 A 3P						TYPE: NEMA 12 MOUNT: SURFACE					
MODS	DESCRIPTION	WIRE	TRIP	POLE	CKT No.	VOLT-AMPERES			VOLT-AMPERES			CKT No.	POLE	TRIP	WIRE	DESCRIPTION	MODS
						A	B	C	A	B	C						
-	SPARE		20	3	1	-			300			2					
					3		-			300		4	3	20	P-1001	PUMP NO. 3- DISCHARGE VALVE V-P-3	
					5			-			300	6					
-	PUMP NO. 4 - DISCHARGE VALVE V-P-4	P-1002	20	3	7	300			300			8					
					9		300			300		10	3	20	3#12, 1#12 GND (EXISTING)	PUMP NO. 1 - DISCHARGE VALVE V-P-1	
					11			300				12					
-	PUMP NO. 2 - DISCHARGE VALVE V-P-2	3#12, 1#12 GND (EXISTING)	20	3	13	300			150			14			P-1003	PUMP NO. 3 MOTOR COOLING BLOWER BL-P-3	
					15		300			150		16	3	20			
					17			300			150	18					
-	PUMP NO. 4 MOTOR COOLING BLOWER BL-P-4	P-1004	20	3	19	150			150			20			3#12, 1#12 GND (EXISTING)	PUMP NO. 1 MOTOR COOLING BLOWER BL-P-1	
					21		150			150		22	3	20			
					23			150			150	24					
-	PUMP NO. 2 MOTOR COOLING BLOWER BL-P-2	3#12, 1#12 GND (EXISTING)	20	3	25	150			-			26					
					27		150			-		28	3	20		SPARE	
					29			150			-	30					
-	SPARE		20	3	31	-			-			32					
					33		-			-		34	3	20		SPARE	
					35			-			-	36					
-	SPARE		20	3	37	-			-			38					
					39		-			-		40	3	20		SPARE	
					41			-			-	42					

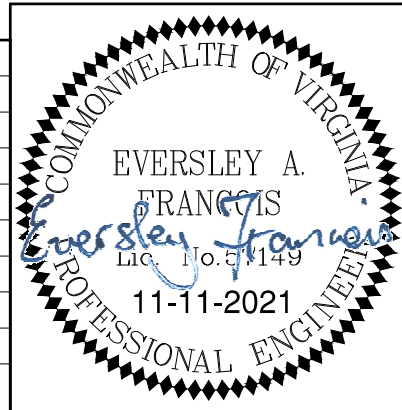
TOTAL	900	900	900	TOTAL
PHASE TOTAL				
	1,800	1,800	1,800	

900	900	900	TOTAL
TOTAL LOAD (VA)			
5,400			
TOTAL LOAD (A)			
6			

MODIFICATION (MODS) LEGEND:
 EPD - GROUND FAULT CIRCUIT INTERRUPTER (30mA)
 GFCI - GROUND FAULT CIRCUIT INTERRUPTER (5mA)
 LOD - LOCK-ON DEVICE
 LFD - LOCK-OFF DEVICE

NOTES:
 65K AIC
 100KA SPD

1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY E. FRANCOIS
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

ELECTRICAL
POWER PANEL P-1 SCHEDULE

E-5

SHEET
46 OF 57

20211111 12:48P 0:\31111-056\GIS\CAD-BIM\ELEC\E-6 LOAD VERIFICATION.dwg By:MBROCATO Last Saved By: mbrocato

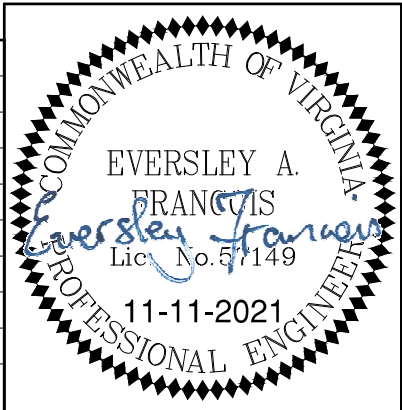
31111-056 (Cattail Branch SPS Phase III)													
Load Verification of Switchboard													
Phase: EXISTING/PROPOSED													
Facility / Load	Description	Voltage	Phase	Power Factor	Loads				All Phases Total				
					Connected Load				Demand Factor	Operating Load			
					HP	KW	KVA	FLA		FLA	FLA	KW	KVA
	LOADS ADDED				402.5	0.0	8.6	506.6	X	506.6	455.9	333.7	370.7
	LOADS REMOVED				401.6	0.0	10.8	503.7		503.7	456.3	334.5	371.7
					0.9	0.0	-2.2	2.9		2.9	-0.4	-0.9	-1.0
LOADS ADDED	Sewage Pump No. 3	480	3	0.90	200.0			240.0	0.90	240.0	216.0	161.6	179.6
	Sewage Pump No. 4	480	3	0.90	200.0			240.0	0.90	240.0	216.0	161.6	179.6
	SF-1	480	3	0.90	1.5			3.0	0.90	3.0	2.7	2.0	2.2
	SF-2	480	3	0.90	0.5			1.1	0.90	1.1	1.0	0.7	0.8
	SF-3	120	1	0.90			0.5	3.8	0.90	3.8	3.4	0.4	0.4
	EF-2	480	3	0.90	0.5			1.1	0.90	1.1	1.0	0.7	0.8
	EF-4	120	1	0.90			0.3	2.8	0.90	2.8	2.5	0.3	0.3
	EF-5	120	1	0.90			0.3	2.4	0.90	2.4	2.1	0.2	0.3
	Odor Control Unit	480	3	0.90			7.0	8.4	0.90	8.4	7.6	5.7	6.3
	Light Fixtures	120	1	0.90			0.1	1.1	0.90	1.1	1.0	0.1	0.1
Receptacles	120	1	0.90			0.4	3.0	0.90	3.0	2.7	0.3	0.3	
	Subtotal				402.50	0.0	8.6	506.6		506.6	455.9	333.7	370.7
LOADS REMOVED	Sewage Pump No. 3	480	3	0.90	200.0			240.0	0.90	240.0	216.0	161.6	179.6
	Sewage Pump No. 4	480	3	0.90	200.0			240.0	0.90	240.0	216.0	161.6	179.6
	SF-1	480	3	0.90	0.8			1.6	0.90	1.6	1.4	1.1	1.2
	SF-2	480	3	0.90			0.7	0.8	0.90	0.8	0.8	0.6	0.6
	EF-1	480	3	0.90	0.8			1.6	0.90	1.6	1.4	1.1	1.2
	EF-2	480	3	0.90			0.7	0.9	0.90	0.9	0.8	0.6	0.6
	Hydraulic Pumps Rm EF	120	1	0.90	0.1			4.4	0.90	4.4	4.0	0.4	0.5
	Odor Control Unit	480	3	0.90			8.9	10.7	0.90	10.7	9.7	7.2	8.0
Light Fixtures	120	1	0.90			0.4	3.6	0.90	3.6	3.3	0.4	0.4	
	Subtotal				401.6	0.0	10.8	503.7		503.7	456.3	334.5	371.7

Prepared by:
Chau Nguyen

Date Modified:
9/29/2021

Notes: There is a net loss in load on Switchboard. Addition of new loads will not overload Switchboard.

1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY E. FRANCOIS
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056

DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

ELECTRICAL
LOAD VERIFICATION

E-6

SHEET
47 OF 57

20211111 12:49p o:\31111-056\GIS\CAD-BIM\ELEC\E-7 SCHEDULES.dwg By:MBROCATO Last Saved By: CNguyen

NOTE:

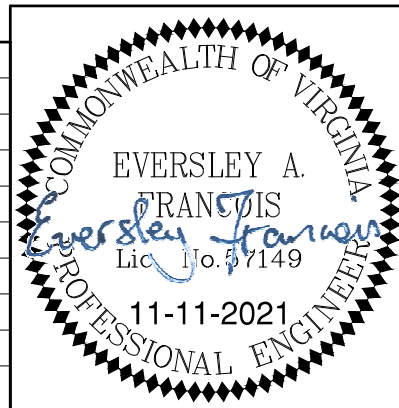
- CONTROL WIRING FOR HVAC IS PROVIDED UNDER DIVISION 15.

POWER CONDUIT SCHEDULE					
CONDUIT ID	SIZE	FROM	TO	CONDUCTORS	REMARKS
P-1001	3/4"	POWER PANEL P-1	DSW-V-P-3	3#12, 1#12 GND	
P-1002	3/4"	DSW-V-P-3	DISCHARGE VALVE V-P-3	3#12, 1#12 GND	
P-1003	3/4"	POWER PANEL P-1	DSW-V-P-4	3#12, 1#12 GND	
P-1004	3/4"	DSW-V-P-4	DISCHARGE VALVE V-P-4	3#12, 1#12 GND	
P-1005	3/4"	POWER PANEL P-1	MS-BL-P3	3#12, 1#12 GND	
P-1006	3/4"	MS-BL-P3	COOLING BLOWER BL-P-3 JUNCTION BOX	3#12, 1#12 GND	
P-1007	3/4"	POWER PANEL P-1	MS-BL-P4	3#12, 1#12 GND	
P-1008	3/4"	MS-BL-P4	COOLING BLOWER BL-P-4 JUNCTION BOX	3#12, 1#12 GND	
P-1009	4"	PUMP NO. 4 VFD	PUMP NO. 4	MFG PROVIDED CABLE	
P-1010	4"	PUMP NO. 3 VFD	PUMP NO. 3	MFG PROVIDED CABLE	
P-1011	3/4"	SWITCHBOARD	HVAC CONTROL PANEL, HRCP-1	3#12, 1#12 GND	
P-1012	3/4"	HVAC CONTROL PANEL, HRCP-1	SF-1 DSW	3#12, 1#12 GND	
P-1013	3/4"	SF-1 DSW	SF-1	3#12, 1#12 GND	
P-1014	3/4"	HVAC CONTROL PANEL, HRCP-1	SF-2 DSW	3#12, 1#12 GND	
P-1015	3/4"	SF-2 DSW	SF-2	3#12, 1#12 GND	
P-1016	3/4"	HVAC CONTROL PANEL, HRCP-1	EF-2 DSW	3#12, 1#12 GND	
P-1017	3/4"	EF-2 DSW	EF-2	3#12, 1#12 GND	
P-1018	3/4"	HVAC CONTROL PANEL, HRCP-1	SF-3 DSW	3#12, 1#12 GND	
P-1019	3/4"	SF-3 DSW	SF-3	3#12, 1#12 GND	
P-1020	3/4"	HVAC CONTROL PANEL, HRCP-1	EF-4 DSW	3#12, 1#12 GND	
P-1021	3/4"	EF-4 DSW	EF-4	3#12, 1#12 GND	
P-1022	3/4"	FU 100 DSW	LCP-FU100	3#12, 1#12 GND	
P-1023	3/4"	LCP-FU100	FU 100	3#12, 1#12 GND	

CONTROL CONDUIT SCHEDULE					
CONDUIT NO.	SIZE	FROM	TO	CONDUCTORS	REMARKS
C-001	3/4"	PUMP CONTROL PANEL	CONTROL PANEL MS-BL-P4	8#14, 1#14 GND	2 SPARE
C-002	3/4"	PUMP CONTROL PANEL	CONTROL PANEL MS-BL-P3	8#14, 1#14 GND	2 SPARE
C-003	3/4"	PUMP NO. 4 VFD CABINET	DISCHARGE VALVE V-P-4	12#14, 1#14 GND	
C-004	3/4"	PUMP NO. 4 VFD CABINET	DISCHARGE PRESSURE SWITCH PSH-104	3#14, 1#14 GND	
C-005	1"	PUMP NO. 4 VFD CABINET	PUMP NO. 4 (MSH)	VENDOR CABLE	PUMP (MSH/TSH) SENSORS
C-006	3/4"	PUMP NO. 3 VFD CABINET	DISCHARGE VALVE V-P-3	12#14, 1#14 GND	
C-007	3/4"	PUMP NO. 3 VFD CABINET	DISCHARGE PRESSURE SWITCH PSH-103	3#14, 1#14 GND	
C-008	1"	PUMP NO. 3 VFD CABINET	PUMP NO. 3 (MSH)	VENDOR CABLE	PUMP (MSH/TSH) SENSORS
C-009	3/4"	MS-BL-P4	FLOAT SWITCH LSH-104	2#14, 1#14 GND	
C-010	3/4"	MS-BL-P3	FLOAT SWITCH LSH-103	2#14, 1#14 GND	
C-011	3/4"	ALARM DIALER	LCP-FU100	8#14, 1#14 GND	
C-012	3/4"	LCP-FU100	PIT-101	1 TSP, 1#14 GND	
C-013	3/4"	LCP-FU100	FU 100	24#14, 1#14 GND	

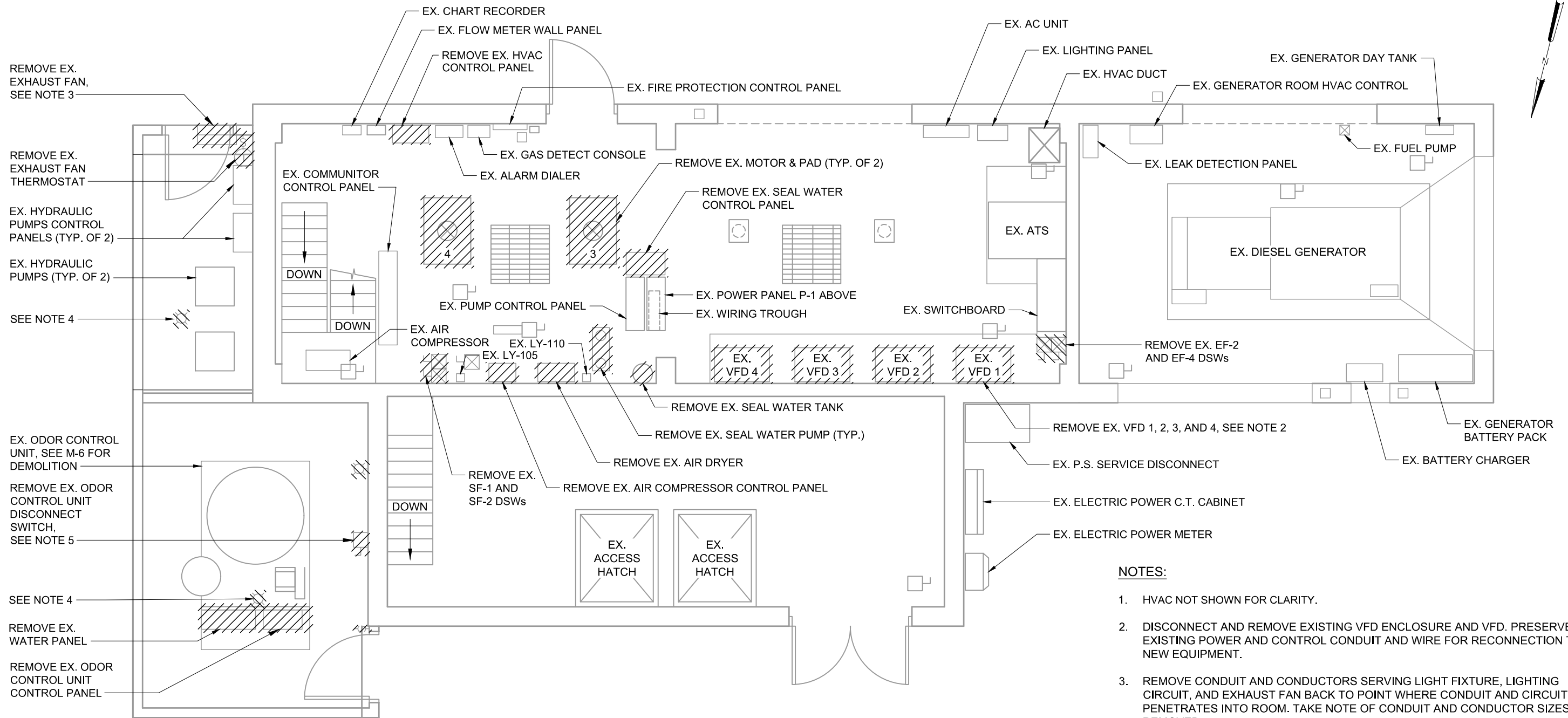
LUMINAIRE SCHEDULE			
FIXTURE TYPE	LAMP/ FIXTURE WATTAGE	DESCRIPTION	MFR AND MODEL
LC1	37.8W	CEILING-MOUNTED, 120VAC, LED LIGHT FIXTURE, COLOR TEMPERATURE OF 4000K, 90 CRI, LINEAL RIBBED FROSTED ACRYLIC LENS, MEDIUM DISTRIBUTION, GASKETED FIBERGLASS HOUSING, STAINLESS STEEL LATCHES, 4FT, 6000 LUMEN MINIMUM, AND WET LOCATION LISTED.	HOLOPHANE EMS LED SERIES, OR ENGINEER APPROVED EQUAL.
LC2	94W	CEILING-MOUNTED, 120VAC, LED LIGHT FIXTURE, COLOR TEMPERATURE OF 4000K, 80 CRI MINIMUM, LINEAL RIBBED FROSTED ACRYLIC LENS, GASKETED FIBERGLASS HOUSING, STAINLESS STEEL LATCHES, 8FT, 6000 LUMEN MINIMUM, AND RATED FOR CLASS 1, DIV 2 HAZARDOUS LOCATIONS.	COLUMBIA LIGHTING HEM LED SERIES, OR ENGINEER APPROVED EQUAL.

1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



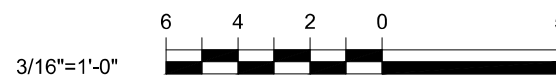
DESIGNED BY <u>E. FRANCOIS</u>	<p>HAZEN AND SAWYER 1 SOUTH STREET, SUITE 1150 BALTIMORE, MARYLAND 21202</p>	PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	E-7
DRAWN BY <u>M. BROCATO</u>		DATE: NOVEMBER 2021		
CHECKED BY <u>J. HISE</u>		HAZEN AND SAWYER 1 SOUTH STREET, SUITE 1150 BALTIMORE, MARYLAND 21202		ELECTRICAL SCHEDULES
APPROVED BY <u>J. HISE</u>				

20211217 10:50A C:\31111-ba\31111-056\GIS\CAD-BIM\ELEC\E-8 DEMOLITION PLAN - UPPER LEVEL EL 215.00.dwg By:MBROCATO Last Saved By: mbrocato



DEMOLITION PLAN - UPPER LEVEL EL 215.00

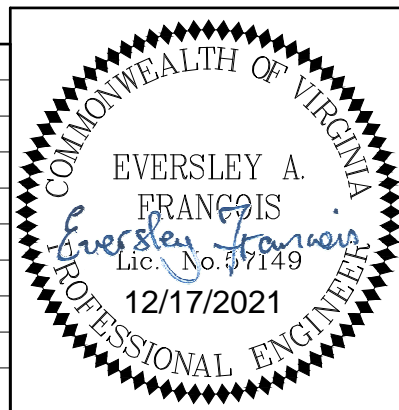
3/16" = 1'-0"



NOTES:

1. HVAC NOT SHOWN FOR CLARITY.
2. DISCONNECT AND REMOVE EXISTING VFD ENCLOSURE AND VFD. PRESERVE EXISTING POWER AND CONTROL CONDUIT AND WIRE FOR RECONNECTION TO NEW EQUIPMENT.
3. REMOVE CONDUIT AND CONDUCTORS SERVING LIGHT FIXTURE, LIGHTING CIRCUIT, AND EXHAUST FAN BACK TO POINT WHERE CONDUIT AND CIRCUIT PENETRATES INTO ROOM. TAKE NOTE OF CONDUIT AND CONDUCTOR SIZES REMOVED.
4. REMOVE CONDUIT AND CONDUCTORS SERVING LIGHT FIXTURE AND LIGHTING CIRCUIT BACK TO POINT WHERE CONDUIT AND CIRCUIT PENETRATES INTO ROOM. TAKE NOTE OF CONDUIT AND CONDUCTOR SIZES REMOVED AND WIRING SCHEME. SEE SHEET E-9 FOR MORE INFORMATION.
5. REMOVE CONDUIT AND CONDUCTORS SERVING ODOR CONTROL UNIT BACK TO POINT WHERE CONDUIT AND CIRCUIT PENETRATES INTO ROOM. TAKE NOTE OF CONDUIT AND CONDUCTOR SIZES REMOVED. SEE SHEET E-9 FOR MORE INFORMATION.

NO	ISSUED FOR	DATE	BY
2	BED SET - REVISED	12/21	JTH
1	BID SET	11/21	JTH



DESIGNED BY E. FRANCOIS
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO.
 31111-056

DATE:
 DECEMBER
 2021

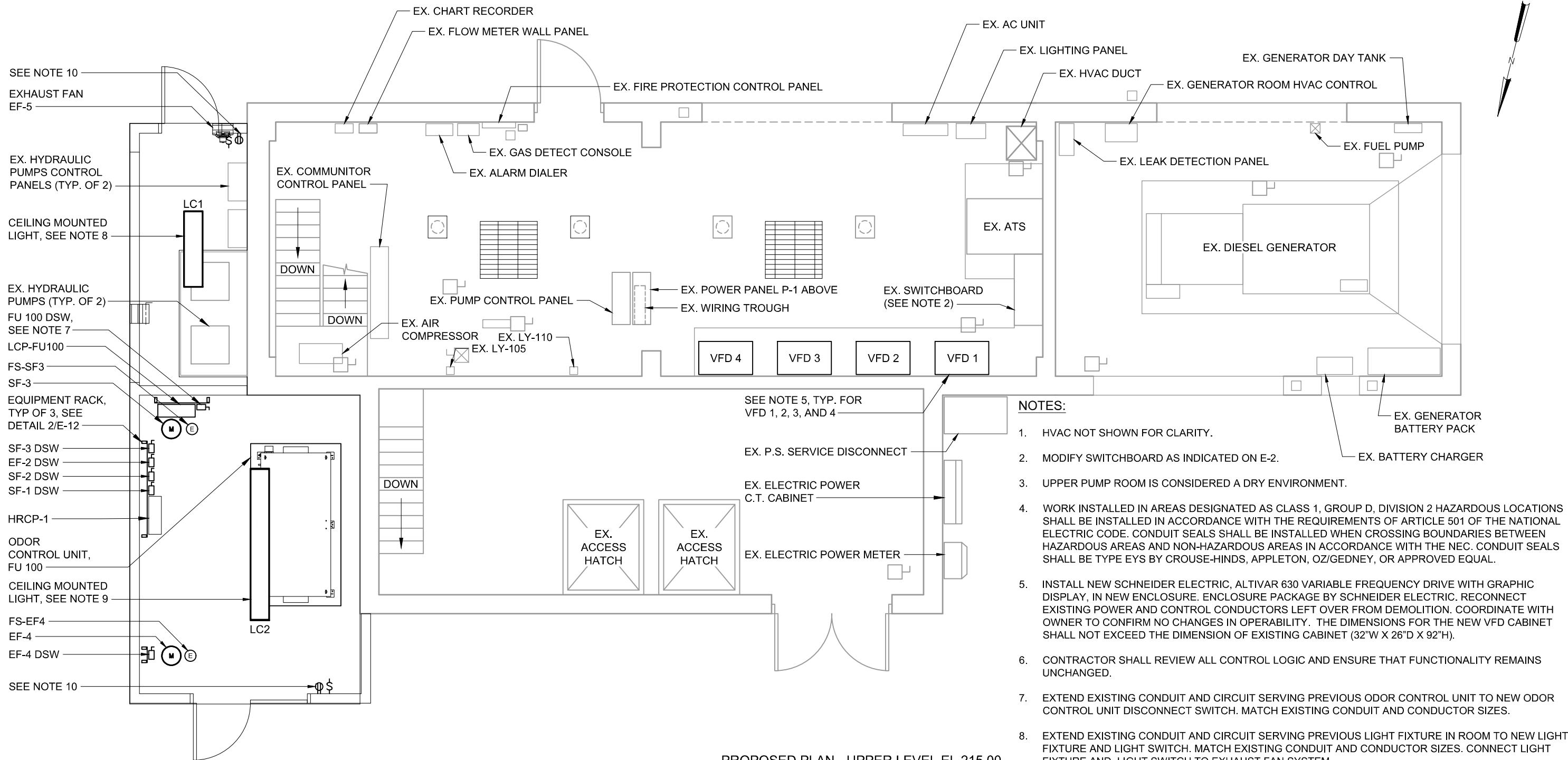
CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA

ELECTRICAL
 DEMOLITION PLAN - UPPER LEVEL EL 215.00

E-8

SHEET
 49 OF 57

20211217 10:50A C:\31111-BAL\31111-056\GIS\CAD-BIM\ELEC\E-9 PROPOSED PLAN - UPPER LEVEL EL 215.00.dwg By:MBROCATO Last Saved By: mbrocato



- NOTES:**
- HVAC NOT SHOWN FOR CLARITY.
 - MODIFY SWITCHBOARD AS INDICATED ON E-2.
 - UPPER PUMP ROOM IS CONSIDERED A DRY ENVIRONMENT.
 - WORK INSTALLED IN AREAS DESIGNATED AS CLASS 1, GROUP D, DIVISION 2 HAZARDOUS LOCATIONS SHALL BE INSTALLED IN ACCORDANCE WITH THE REQUIREMENTS OF ARTICLE 501 OF THE NATIONAL ELECTRIC CODE. CONDUIT SEALS SHALL BE INSTALLED WHEN CROSSING BOUNDARIES BETWEEN HAZARDOUS AREAS AND NON-HAZARDOUS AREAS IN ACCORDANCE WITH THE NEC. CONDUIT SEALS SHALL BE TYPE EYS BY CROUSE-HINDS, APPLETON, OZ/GEDNEY, OR APPROVED EQUAL.
 - INSTALL NEW SCHNEIDER ELECTRIC, ALTIVAR 630 VARIABLE FREQUENCY DRIVE WITH GRAPHIC DISPLAY, IN NEW ENCLOSURE. ENCLOSURE PACKAGE BY SCHNEIDER ELECTRIC. RECONNECT EXISTING POWER AND CONTROL CONDUCTORS LEFT OVER FROM DEMOLITION. COORDINATE WITH OWNER TO CONFIRM NO CHANGES IN OPERABILITY. THE DIMENSIONS FOR THE NEW VFD CABINET SHALL NOT EXCEED THE DIMENSION OF EXISTING CABINET (32"W X 26"D X 92"H).
 - CONTRACTOR SHALL REVIEW ALL CONTROL LOGIC AND ENSURE THAT FUNCTIONALITY REMAINS UNCHANGED.
 - EXTEND EXISTING CONDUIT AND CIRCUIT SERVING PREVIOUS ODOR CONTROL UNIT TO NEW ODOR CONTROL UNIT DISCONNECT SWITCH. MATCH EXISTING CONDUIT AND CONDUCTOR SIZES.
 - EXTEND EXISTING CONDUIT AND CIRCUIT SERVING PREVIOUS LIGHT FIXTURE IN ROOM TO NEW LIGHT FIXTURE AND LIGHT SWITCH. MATCH EXISTING CONDUIT AND CONDUCTOR SIZES. CONNECT LIGHT FIXTURE AND LIGHT SWITCH TO EXHAUST FAN SYSTEM.
 - EXTEND EXISTING CONDUIT AND CIRCUIT SERVING PREVIOUS LIGHT FIXTURES IN ROOM TO NEW LIGHT FIXTURE AND LIGHT SWITCH. MATCH EXISTING CONDUIT AND CONDUCTOR SIZES.
 - CONNECT RECEPTACLE TO ROOM LIGHTING CIRCUIT. WIRE TO LIGHT SWITCH UNSWITCHED HOT LEG.

PROPOSED PLAN - UPPER LEVEL EL 215.00

3/16" = 1'-0"



NO	ISSUED FOR	DATE	BY
2	BED SET - REVISED	12/21	JTH
1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY

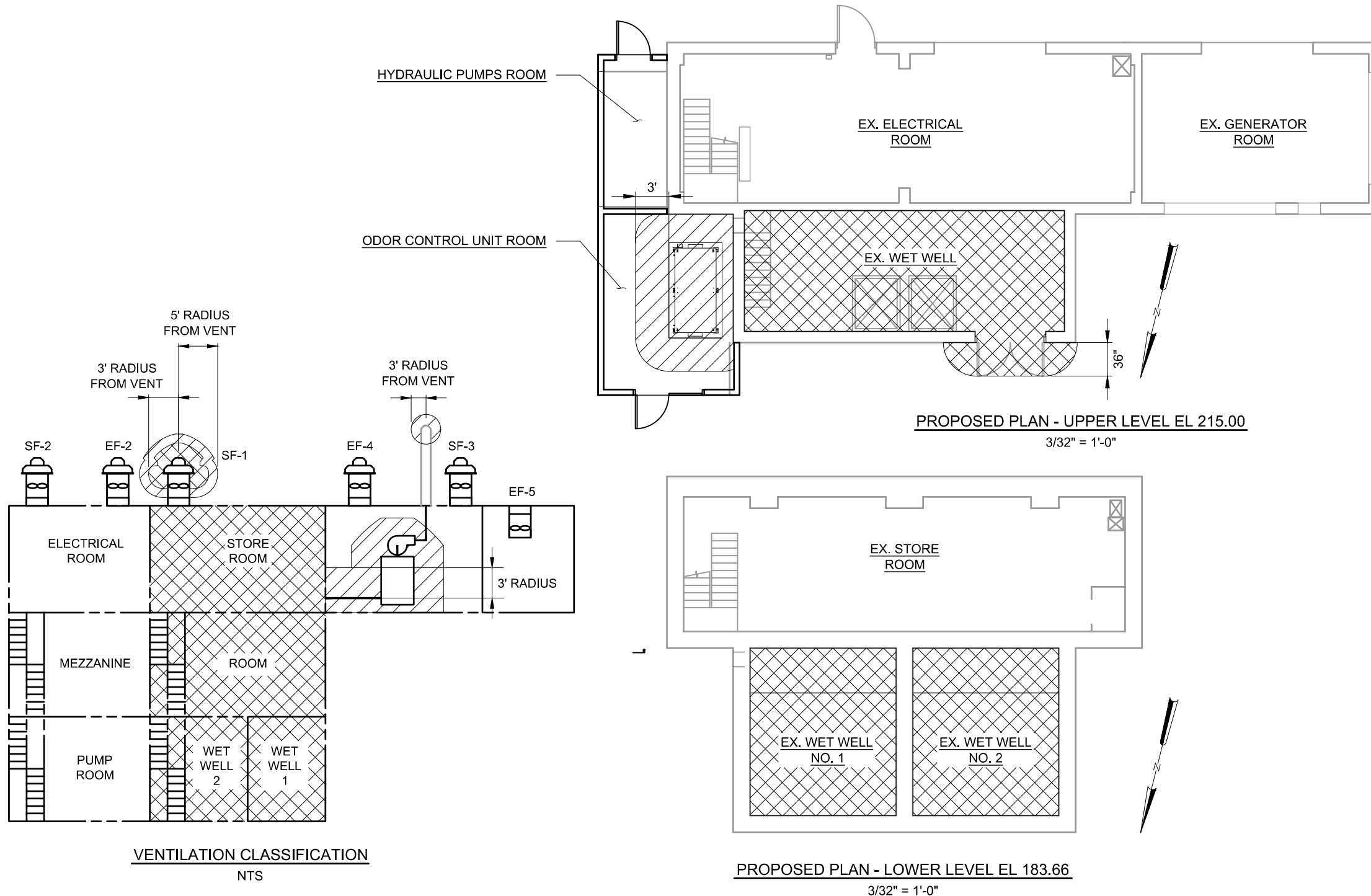


DESIGNED BY E. FRANCOIS
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE

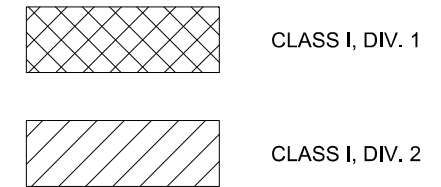


PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	E-9
DATE: DECEMBER 2021	ELECTRICAL PROPOSED PLAN - UPPER LEVEL EL 215.00	SHEET 50 OF 57

20211111 12:52P 0:\31111-056\GIS\CAD-BIM\ELEC\E-11 AREA DESIGNATION PLANS.dwg By:MBROCATO Last Saved By: CNguyen



LEGEND:



LIFT STATION:

SPACE CLASSIFIED PER NFPA 820-2016 EDITION, TABLE 4.2, ROW 16a AND ROW 17a.

CLASS I, DIVISION 1 AREAS:

- ENTIRE INTERIOR OF THE WETWELLS
- 36" SPHERE AROUND THE WETWELL VENTS

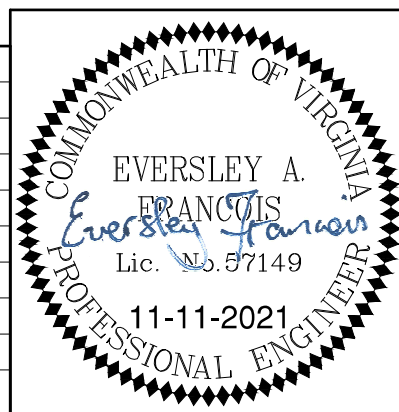
CLASS I, DIVISION 2 AREAS:

- SPHERE BETWEEN 36" AND 60" AROUND THE WETWELL VENT OPENING
- HORIZONTALLY WITHIN 36" OF EACH WETWELL HATCH EDGE AND WITHIN 18" VERTICALLY OF THE SAME AREA.

NOTES:

1. ALL EQUIPMENT, ELECTRICAL MATERIALS AND WIRING METHODS IN THE HAZARDOUS AREAS SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE NEC.
2. CONDUIT SEALS SHALL BE INSTALLED WHEN CROSSING BOUNDARIES BETWEEN HAZARDOUS AREAS AND NON-HAZARDOUS AREAS IN ACCORDANCE WITH THE NEC. CONDUIT SEALS SHALL BE TYPE EYS BY CROUSE-HINDS, APPLETON EQUIVALENT, OZ/GEDNEY EQUIVALENT, OR APPROVED EQUAL.
3. SEE HAZARDOUS AREA DETAIL ON DRAWING E7.
4. CONTROL ROOM SHALL BE CONSIDERED AN UNCLASSIFIED DRY LOCATION.
5. DRY WELL SHALL BE CONSIDERED AN UNCLASSIFIED WET LOCATION BASED ON NFPA 820, TABLE 4.2, ROW 17a.

NO	ISSUED FOR	DATE	BY
1	BID SET	11/21	JTH



DESIGNED BY E. FRANCOIS
 DRAWN BY M. BROCATO
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056

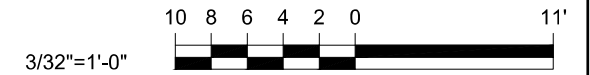
DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA

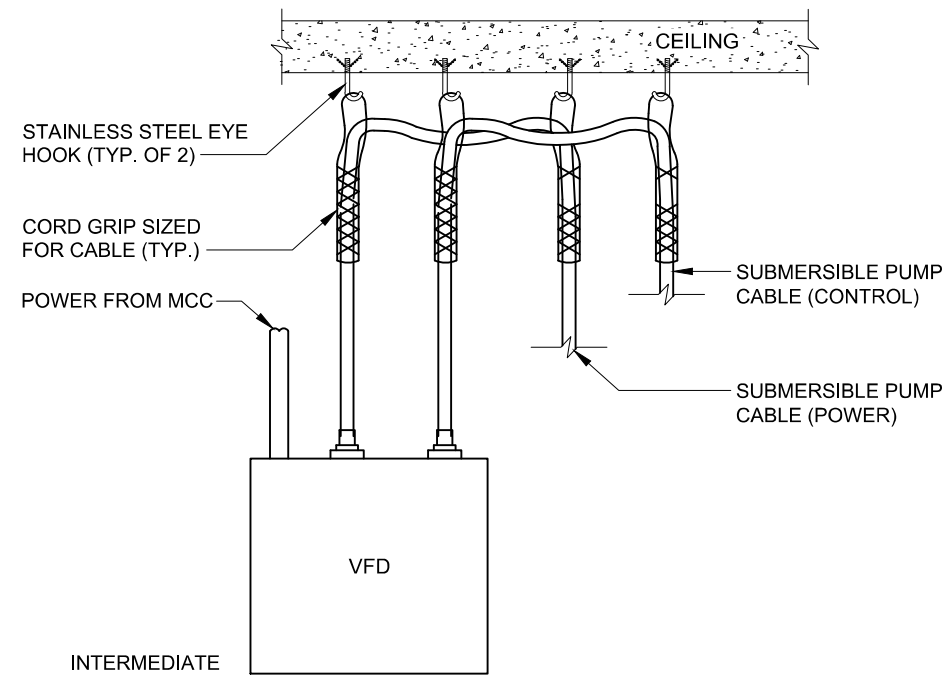
ELECTRICAL
AREA DESIGNATION PLANS

E-11

SHEET
52 OF 57

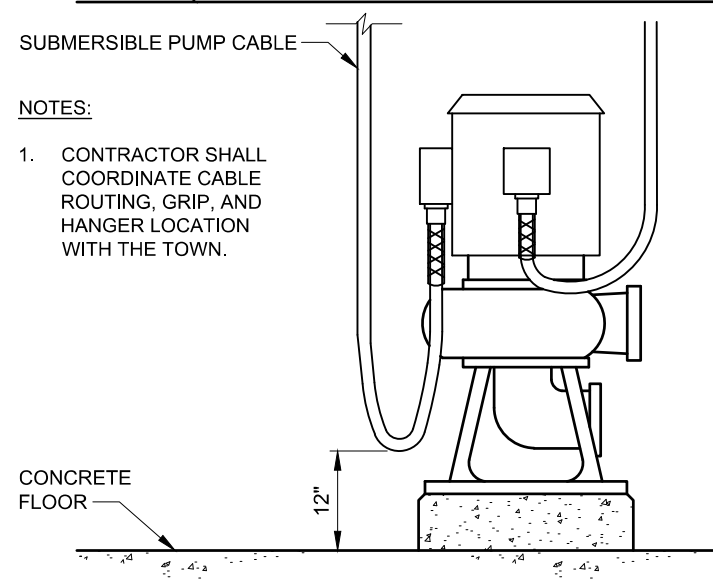


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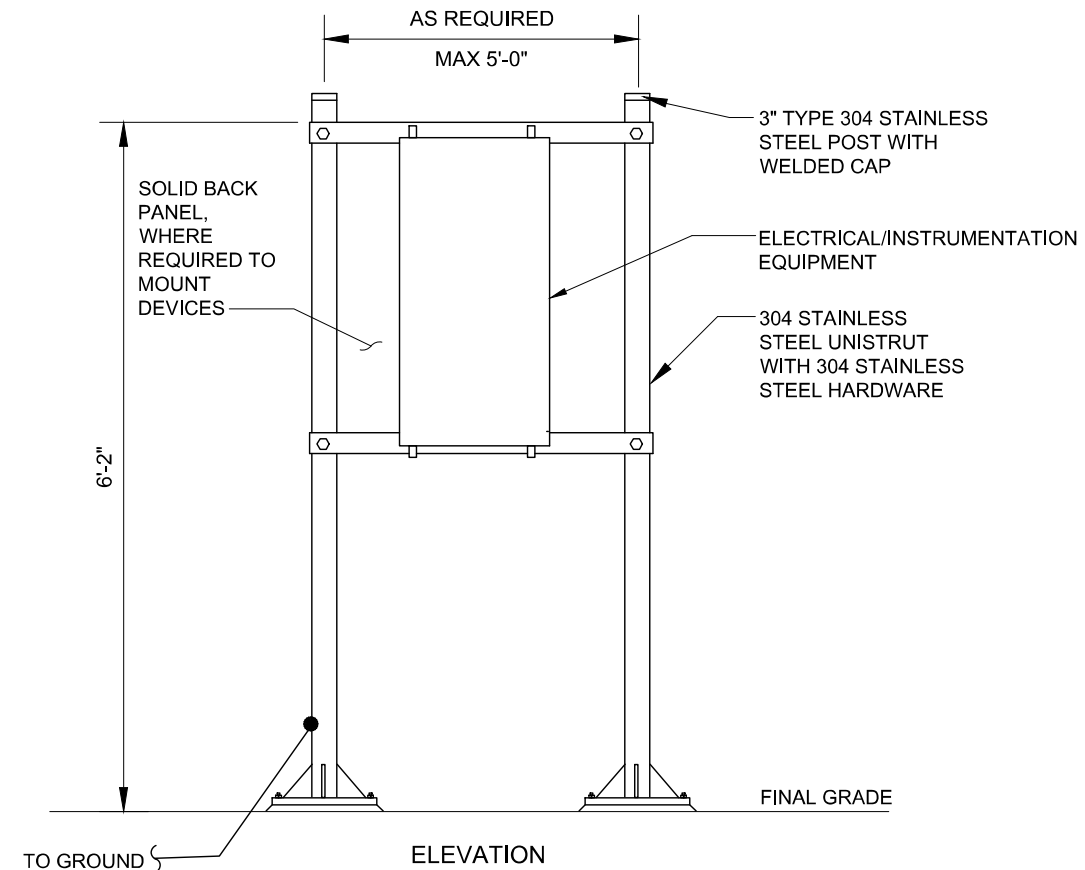
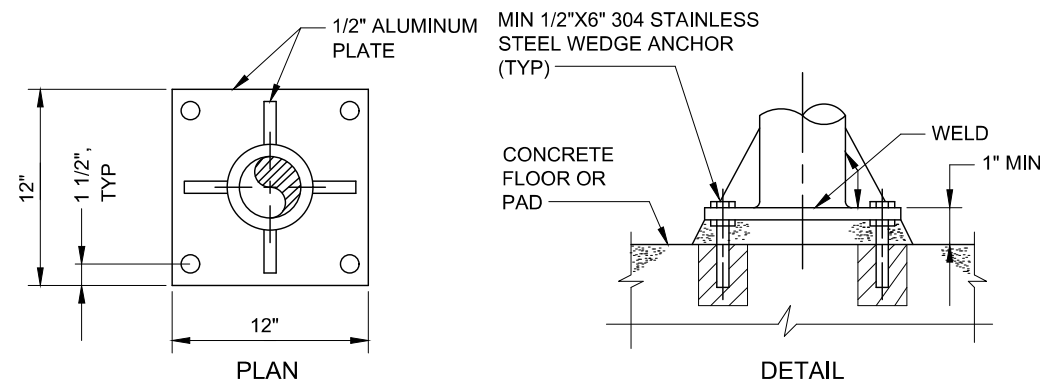
NOTES:

- CONTRACTOR SHALL COORDINATE CABLE ROUTING, GRIP, AND HANGER LOCATION WITH THE TOWN.



PUMP ELECTRIC FEED

DETAIL	1
NTS	E-12



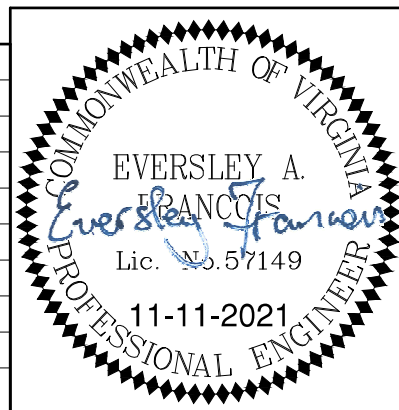
NOTE:

- ADJUST THE NUMBER OF SUPPORT POSTS TO ACCOMMODATE THE EQUIPMENT TO BE INSTALLED.

TYPICAL EQUIPMENT RACK ON GRADE

DETAIL	2
NTS	E-12

1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



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DRAWN BY	M. BROCATO
CHECKED BY	J. HISE
APPROVED BY	J. HISE


Hazen
 HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202


PROJECT NO.	31111-056
DATE:	NOVEMBER 2021


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ELECTRICAL DETAILS

E-12
SHEET 53 OF 57

INSTRUMENT AND FUNCTION SYMBOLS

 SINGLE INSTRUMENT OR OTHER DEVICE HAVING MULTIPLE FUNCTIONS OR SHARING A COMMON HOUSING


 YYY SOFTWARE LOGIC OR CONTROL MODULE XXXX AND SUB-MODULE YYY RESIDENT IN DISTRIBUTED CONTROL SYSTEM (DCS) OR PROGRAMMABLE LOGIC CONTROLLER (PLC) REFER TO CONTRACT DOCUMENTS FOR CONTROL AND MODULE DESCRIPTIONS.








 ZZZ DESIGNATIONS OF CONTROL FUNCTIONS (ZZZ) ASSOCIATED WITH INSTRUMENT OR OTHER DEVICES.

AHC - AUTO/HOLD/CLOSE
AM - AUTOMANUAL
DEV - DEVIATION
HOA - HAND/OFF/AUTO
MOA - MANUAL/OFF/AUTO
HOR - HAND/OFF/REMOTE
LOS - LOCKOUT STOP
LR - LOCAL/REMOTE
LOR - LOCAL/OFF/REMOTE
OO - ON/OFF

OC - OPEN/CLOSE
OSC - OPEN/STOP/CLOSED
POT - POTENTIOMETER
RL - RAISE/LOWER
RSL - RAISE/STOP/LOWER
SD - SHUTDOWN
SEL - SELECT
SP - SET POINT
SR - START/RESET
SS - START/STOP

INSTRUMENT PANEL MOUNTED WITH COMPUTING OR CONVERTING FUNCTION

CONVERT  E - VOLTAGE I - CURRENT P - PNEUMATIC A - ANALOG B - BINARY H - HYDRAULIC O - ELECTROMAGNETIC, SONIC R - RESISTANCE (ELECT.) D - DIGITAL


EXPONENTIAL  AVERAGING  RATIO  HIGH SELECTING  LOW SELECTING  INTEGRAL  PID 


xxx 000 PANEL MOUNTED PILOT LIGHT


AIT 000 ANALYZER, XXXX = TYPE


xxxx ALK - ALKALINITY O₃ - OZONE
Cl₂ - CHLORINE CONCENTRATION ORP - OXIDATION/REDUCTION POTENTIAL
COMB - COMBUSTIBLE GAS
COND - CONDUCTIVITY pH - HYDROGEN ION CONCENTRATION
DO - DISSOLVED OXYGEN
H₂S - HYDROGEN SULFIDE TH - TOTAL HARDNESS
LEL - LOWER EXPLOSIVE LIMIT UV - ULTRAVIOLET
O₂ - OXYGEN CONCENTRATION

(*) ASTERISK IDENTIFIES FIELD INSTRUMENTS FURNISHED BY EQUIPMENT SUPPLIER
⊙ ASTERISK IDENTIFIES LOCAL CONTROL PANELS FURNISHED BY EQUIPMENT SUPPLIER

 OPERATIONAL INTERLOCK

















 COMPLEX INTERLOCK

 AND LOGIC































 OR LOGIC

= 1, 2, 3, etc. INTERLOCK NUMBER DESCRIPTION ON SAME SHEET


































INSTRUMENT AND FUNCTION SYMBOLS, CONT'D

	PRIMARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	FIELD MOUNTED	AUXILIARY LOCATION NORMALLY ACCESSIBLE TO OPERATOR	NORMALLY INACCESSIBLE OR BEHIND THE PANEL DEVICES OR FUNCTIONS
FIELD/PANEL EQUIPMENT				
SHARED DISPLAY, SHARED CONTROL (OIT)				
PROGRAMMABLE LOGIC CONTROLLER				
SUPERVISORY COMPUTER FUNCTION (HMI/SERVER)				

INSTRUMENT SYMBOLS

 MAGNETIC FLOW METER	 VENTURI FLOW TUBE	 TURBINE FLOW METER	 ROTAMETER	 ULTRASONIC FLOW METER	 PADDLE WHEEL FLOW METER	 VORTEX FLOW METER	 POSITIVE DISPLACEMENT FLOW METER
 PITOT TUBE	 PARSHALL FLUME	 WEIR	 ORIFICE PLATE	 STRAIGHTENING VANES	 ULTRASONIC LEVEL SENSOR	 SUBMERSIBLE LEVEL SENSOR	 FLOAT TYPE LEVEL SWITCH
 TAPPED RING SEAL	 DIAPHRAGM SEAL	 FULL LINE RING SEAL	 VALVED TAP	 RTD AND THERMOWELL	 RADAR LEVEL SENSOR (UNGUIDED)	 RADAR LEVEL SENSOR (GUIDED)	 CAPACITANCE LEVEL SENSOR
 SIGNAL BOOSTER	 SEQUENTIAL EQUIPMENT	 ANALOG INPUT	 ANALOG OUTPUT	 DIGITAL INPUT	 DIGITAL OUTPUT		











VALVE AND ACTUATOR SYMBOLS

 GENERIC VALVE	 PLUG VALVE	 GLOBE VALVE	 BALL VALVE
 BALL VALVE (3-WAY)	 3-WAY VALVE (GENERAL)	 PINCH VALVE	 COMBINATION VACUUM & PRESSURE RELIEF VALVE
 BUTTERFLY VALVE	 SWING CHECK VALVE	 BALL CHECK VALVE	 DIAPHRAGM VALVE
 NEEDLE VALVE	 ANGLE VALVE	 ROTARY VALVE	 THROUGH PLUG VALVE
 PRESSURE RELIEF OR SAFETY VALVE	 VACUUM RELIEF VALVE	 PRESSURE-REDUCING REGULATOR	 BACKPRESSURE REGULATOR
 BACKFLOW PREVENTER	 SLUICE GATE	 STOP/SLIDE GATE	 STRAINER
 BACKFLOW PREVENTER	 ELECTRIC ACTUATOR	 SOLENOID ACTUATOR	 PNEUMATIC ACTUATOR
 ELECTROPNEUMATIC ACTUATOR	 ELECTROHYDRAULIC ACTUATOR	 HAND WHEEL	 HYDRANT
 CENTRIFUGAL PUMP			

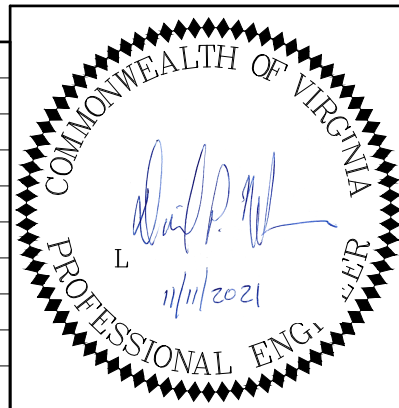
INSTRUMENT/DEVICE IDENTIFICATION LETTERS

	FIRST-LETTER		SUCCEEDING-LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION				
C				CONTROL	CLOSE, CLOSED
D		DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT SENSOR		
F	FLOW RATE	FRACTION RATIO			
G	GAUGE		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	ELECTRICAL CURRENT		INDICATE		
J	POWER	SCANE			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M		MOMENTARY			MIDDLE, INTERMEDIATE
N	TORQUE				
O			ORIFICE, RESTRICTION		OPEN, OPENED
P	PRESSURE, VACUUM		TEXT POINT CONNECTION		
Q	QUANTITY	INTEGRATE, TOTALIZE			
R	RUN		RECORD & STORE	REPORT	
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, VOLUME MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	FAILURE OR TROUBLE	X AXIS			
Y	EVENT,	Y AXIS		COMPUTE, REVERT, RELAY	
Z	STATE/PRESENCE	Z AXIS		DRIVER, ACTUATOR, FINAL CONTROL ELEMENT	

LINETYPE LEGEND

	MAJOR PROCESS PIPES OR CHANNELS
	SECONDARY PROCESS OR MECHANICAL CONNECTIONS
	CAPILLARY OR IMPULSE TUBING
	AIR SUPPLY OR SIGNAL
	HYDRAULIC SUPPLY OR SIGNAL
	ELECTRICAL SIGNAL
	DATA LINK OR INTERNAL SOFTWARE LINK
	PROCESS FLOW
	TYPICAL PUMP
	PUMPING STATION EQUIPMENT

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1			11/21	JTH

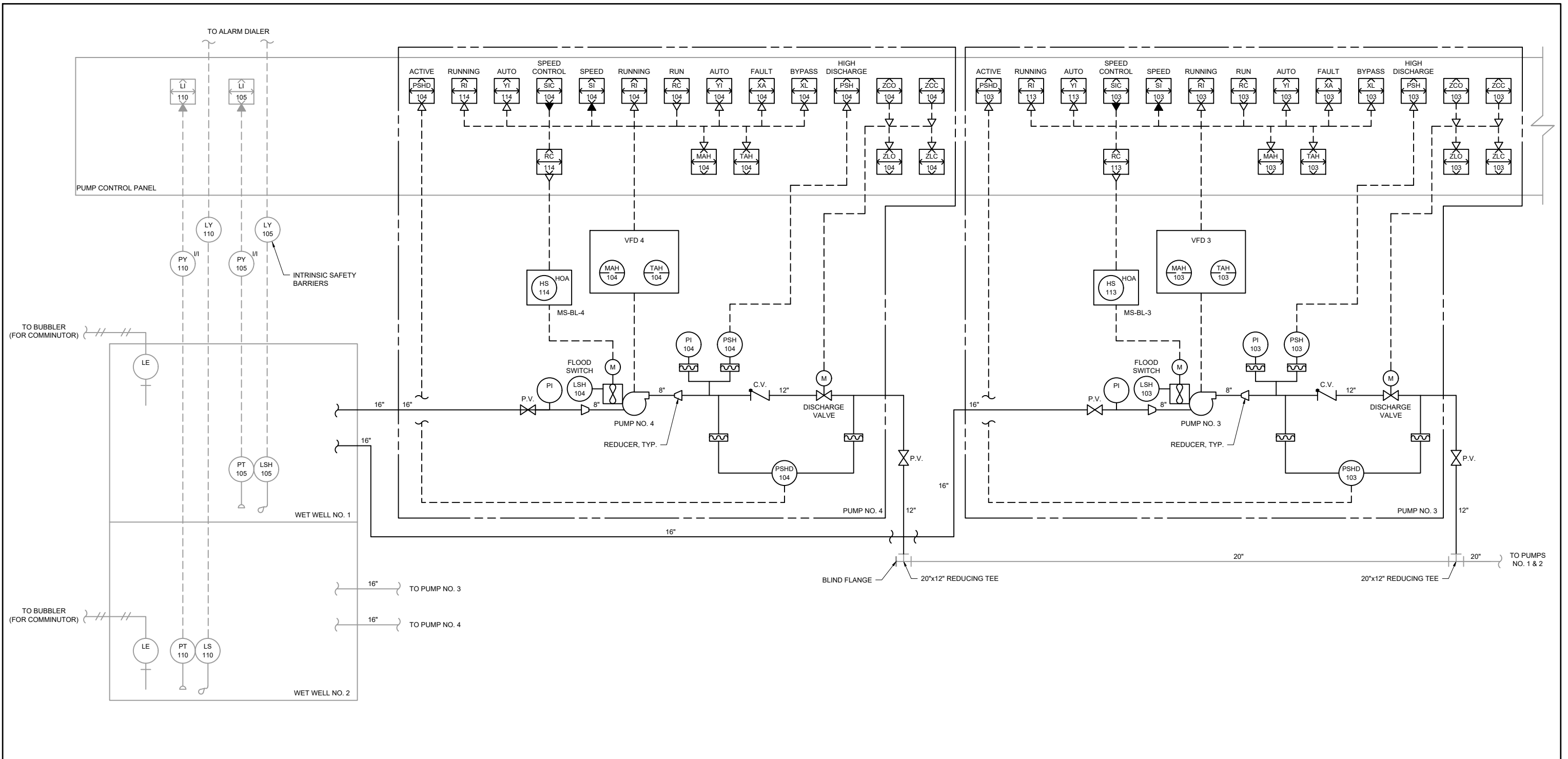


DESIGNED BY _____ D. WEBER
 DRAWN BY _____ M. BROCATO
 CHECKED BY _____ J. HISE
 APPROVED BY _____ J. HISE

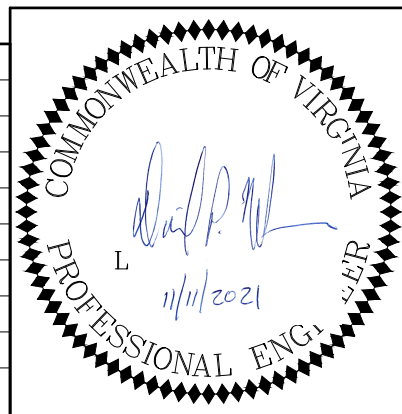
Hazen
 HAZEN AND SAWYER
 1 SOUTH STREET, SUITE 1150
 BALTIMORE, MARYLAND 21202

PROJECT NO. 31111-056	CATTAIL BRANCH SPS LEESBURG, VIRGINIA	I-1
DATE: NOVEMBER 2021	INSTRUMENTATION LEGEND, SYMBOLS, AND ABBREVIATIONS	

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1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



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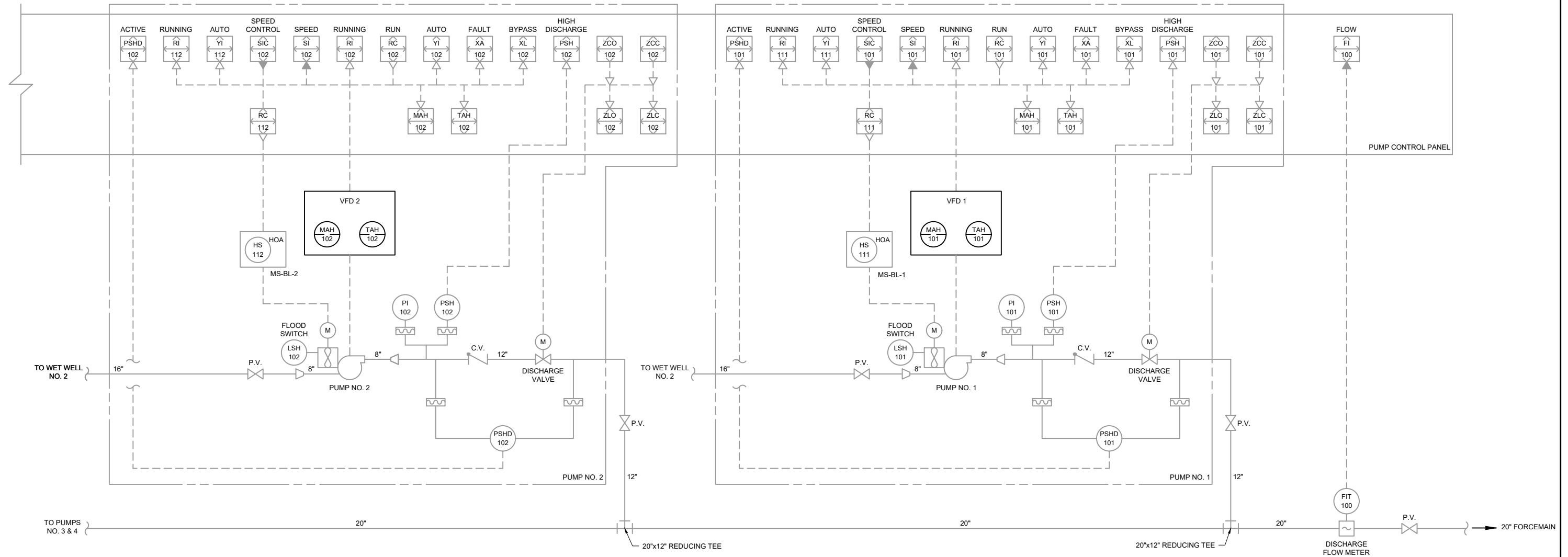


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NOVEMBER
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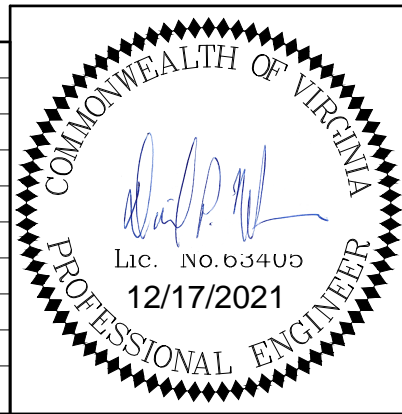
CATTAIL BRANCH SPS
LEESBURG, VIRGINIA
 INSTRUMENTATION
 PROCESS AND INSTRUMENTATION DIAGRAM I

I-2
 SHEET
55 OF 57

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NO	ISSUED FOR	DATE	BY
2	BED SET - REVISED	12/21	JTH
1	BID SET	11/21	JTH



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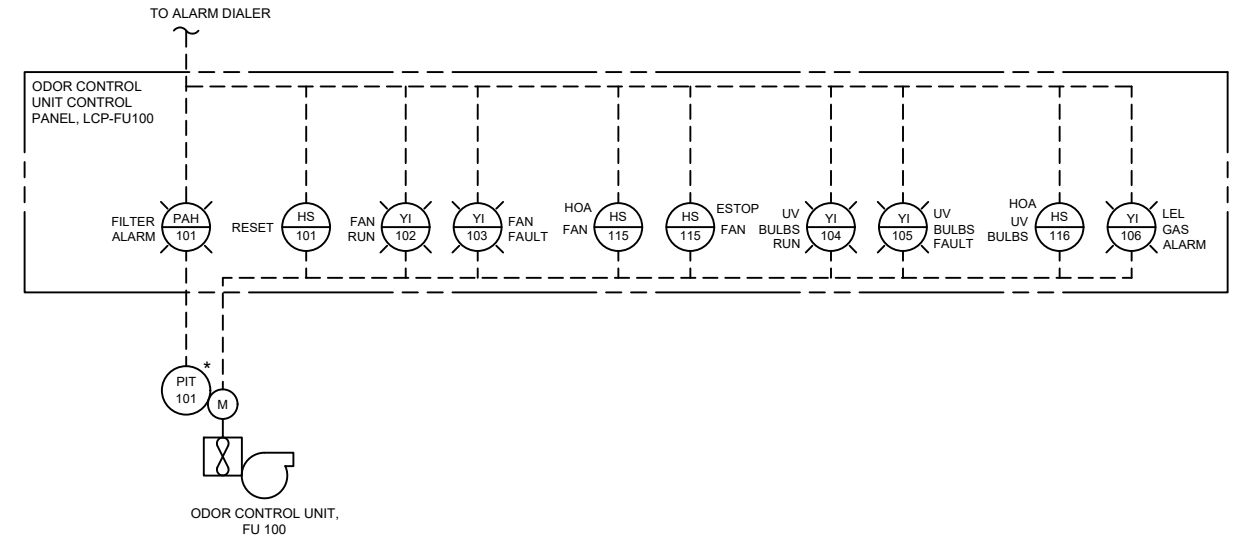
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 BALTIMORE, MARYLAND 21202

PROJECT NO.
 31111-056
 DATE:
 DECEMBER
 2021

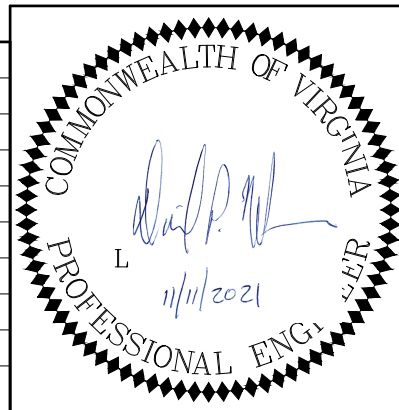
CATTAIL BRANCH SPS
 LEESBURG, VIRGINIA
 INSTRUMENTATION
 PROCESS AND INSTRUMENTATION DIAGRAM II

I-3
 SHEET
 56 OF 57

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1	BID SET	11/21	JTH
NO	ISSUED FOR	DATE	BY



DESIGNED BY D. WEBER
 DRAWN BY C. NGUYEN
 CHECKED BY J. HISE
 APPROVED BY J. HISE



PROJECT NO.
31111-056
DATE:
NOVEMBER
2021

CATTAIL BRANCH SPS
LEESBURG, VIRGINIA
INSTRUMENTATION
PROCESS AND INSTRUMENTATION DIAGRAM III

I-4
SHEET
57 OF 57

GENERAL CONDITIONS



THE TOWN OF LEESBURG

GENERAL CONDITIONS

GENERAL CONDITIONS

THE TOWN OF LEESBURG

GENERAL CONDITIONS

ARTICLE 1: CONTRACT DOCUMENTS

1.1. DEFINITIONS

1.1.1. The Contract Documents

The Contract Documents consist of the Advertisement or Invitation for Bids, Request for Proposals, Information for Bidders, Insurance Certificates, Official Bid Form, Offeror's Bid or Proposal, Bonds, the Notice of Award, the Project Manual, the Owner/Contractor Agreement, the General and Special Conditions, the Drawings, the Specifications, all Addenda issued prior to and all Modifications issued after execution of the Agreement. A Modification is either a written Change Order issued pursuant to the provisions of Article 12.5, or a Field Order issued pursuant to Article 12.2.

1.1.2. The Contract

The Contract is the sum of all the Contract Documents. This Contract represents the entire and integrated agreement between the Owner and the Contractor and supersedes all prior negotiations, representations, or agreements, either written or oral. The Contract may be changed only by a Modification as defined in Article 1.1.1.

1.1.3. The Work

The Work comprises the completed construction required by the Contract Documents and includes all labor, material, equipment, supplies and other facilities or things necessary to produce such construction, and all materials, equipment and supplies incorporated or to be incorporated in such construction.

1.1.4. The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part.

1.1.5. Furnish, Install, Provide

The terms "Furnish", "Install" or "Provide," unless specifically limited in context, mean: furnishing and incorporating a specified item, product or material in the Work, including all labor, materials, and equipment necessary to perform the Work required, ready for intended use.

1.1.6. Firm, Fixed Price or Lump Sum

The terms "Firm, Fixed Price" or "Lump Sum" mean that the Contract Work shall be performed for the price stated in the Contract without any adjustment based on the Contractor's actual costs unless such adjustment is made by a properly executed Contract Change or Modification.

GENERAL CONDITIONS

1.1.7. Schedule of Values

The term "Schedule of Values" means the unit prices for portions of the Work submitted by the Contractor and approved by the Owner's Project Manager for use in preparing Applications for Payment and pricing Contract Changes in accordance with Article 9.2. The Schedule of Values shall not alter the Firm, Fixed Price or Lump Sum value of the Contract.

1.1.8. Miscellaneous Words or Terms

Whenever they refer to the Work or its performance, "Directed," "Required," "Permitted," "Ordered," "Designated," "Prescribed," and words of like import shall imply the direction, requirements, permission, order, designation or prescription of the Owner and/or the Owner's Project Manager, and "Approved," "Acceptable," "Satisfactory," "in the judgment of," and words of like import shall mean approved by or acceptable to or satisfactory to or in the judgment of the Owner and/or the Owner's Project Manager. "Approved" means approved in writing, including subsequent written confirmation of prior oral approval and "Approval" means approval in writing, including all aforesaid.

1.2. EXECUTION, CORRELATION AND INTENT

1.2.1. The Contract Documents may be signed in duplicate originals by the Owner and the Contractor and each set shall be deemed an original, but all sets shall constitute one and the same instrument.

1.2.2. By executing the Contract, the Contractor represents that he has familiarized himself with, and assumes full responsibility for having familiarized himself with, the nature and extent of the Contract Documents, Work, locality, and with all local conditions and federal, state and local laws, ordinances, rules and regulations that may in any manner affect performance of the Work, and represents that his study and observations have been correlated with the requirements of the Contract Documents. The Contractor also represents that he has studied all surveys and investigation reports of subsurface and latent physical conditions referred to in the Contract Documents and made such additional surveys and investigations as he deems necessary for the performance of the Work at the Contract Price in accordance with the requirements of the Contract Documents and that he has correlated the results of all such data with the requirements of the Contract Documents. Failure to make an examination necessary for this determination shall not release the Contractor from the obligations of this Contract nor be grounds for any claim based upon unforeseen conditions.

GENERAL CONDITIONS

The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Owner. The Owner assumes no responsibility for any understanding reached or representation made concerning conditions that can affect the Work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.

- 1.2.3.** The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. Should any work or material be required which is not denoted in the drawings and specifications either directly or indirectly, but which is nevertheless necessary for the proper carrying out of the intent thereof, it is understood and agreed that the same is implied and required and that the Contractor shall perform such work and furnish such materials as fully as if they were completely delineated and prescribed.

Words and abbreviations which have well-known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings unless otherwise specifically defined herein. The Table of Articles, titles, headings, and running headlines are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light upon the interpretation of the provisions to which they refer.

- 1.2.4.** The organization of the specifications into divisions, sections and articles, and the arrangement of drawings are for clarity only, and shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. The Contractor may subcontract the Work in such divisions as he sees fit and he is ultimately responsible for furnishing all work shown on the drawings and/or in the specifications.

- 1.2.5.** Unless otherwise provided for or amended herein, work shall be performed in accordance with the VDOT Road and Bridge Specifications, current edition; the Town of Leesburg Design and Construction Standards Manual (DCSM), current edition; the Virginia Erosion and Sediment Control Handbook; and the Special Provisions, Special Conditions, and Special Designs as may be described on the plans for the project or in this solicitation. Where there is a conflict between the VDOT Road and Bridge Specifications and the DCSM, the most stringent shall take precedence. A copy of the DCSM may be purchased from the Department of Plan Review at the current standard rate.

Anything shown on the drawings and not mentioned in the specifications or mentioned in the specifications and not shown on the drawings shall have the same effect as if shown or mentioned respectively in both. Technical specifications take priority over general specifications and detail drawings take precedence over general drawings. Any work shown on one drawing shall be construed to be shown in all drawings and the Contractor will coordinate the Work and the drawings. If any portion of the Contract Documents shall be in conflict with any other portion, the various documents comprising the Contract

GENERAL CONDITIONS

Documents shall govern in the following order of precedence: The Owner/Contractor Agreement; Modifications; Changes; Addenda; the Supplementary Conditions; the General Conditions; the Specifications; the drawings; the Town DCSM; other published construction standards and specifications; the bonds; the advertisement for bids or invitation or request for proposal; information for bidders; bids; the notice of award. As between schedules and information given on drawings and the scaled measurements, the figures shall govern. As between large-scale drawings and small-scale drawings, the larger scale shall govern. Any such conflict or inconsistency between or in the drawings shall be submitted to the Project Manager whose decision thereon shall be final and conclusive.

1.2.6. This Contract is not intended to create, nor shall any provision be interpreted as creating, any contractual relationship between the Owner and any third parties including all Subcontractors.

1.2.7. The Provisions of this Contract cannot be changed, varied or waived in any respect except by a written Modification or Change Order. No person has authority to orally waive, or to release the Contractor from any of the Contractor's duties or obligations under or arising out of this Contract. Any waiver, approval or consent granted by Changes to the Contractor shall be limited to those matters specifically and expressly stated thereby to be waived, approved or consented to and shall not relieve the Contractor of the obligation to obtain any future waiver, approval or consent.

1.3. OWNERSHIP AND USE OF DOCUMENTS

1.3.1. All drawings, specifications, and copies thereof furnished by or to the Owner under this Contract are and shall remain the property of the Owner. They are to be used only with respect to this Project and are not to be used in whole or in part for any other purpose.

1.3.2. The Contractor shall be provided five sets of the Contract Documents by the Owner's Project Manager. Additional sets of Drawings and Specifications may be obtained from the Owner's Project Manager by paying the then current and regular printing, mailing and handling charges.

END OF ARTICLE 1

GENERAL CONDITIONS

ARTICLE 2: OWNER'S PROJECT MANAGER

2.1. DEFINITIONS

- 2.1.1.** The term "Project Manager" as used in the Contract Documents, shall mean the entity so identified in the Owner/Contractor Agreement or its duly authorized representatives.
- 2.1.2.** The Project Manager is referred to throughout the Contract Documents as if singular in number and masculine in gender.

2.2. SERVICES OF THE OWNER'S PROJECT MANAGER

- 2.2.1.** The Owner's Project Manager will serve during construction and until the end of the warranty period. The Owner's Project Manager will advise and consult with the Owner and will have the authority to act on behalf of the Owner only to the extent provided in the Contract Documents. The Owner may identify a substitute Owner's Project Manager at any time by providing written notice to the Contractor.
- 2.2.2.** The Owner's Project Manager will inform the Owner and the Contractor whenever in his reasonable opinion any of the Work is proceeding contrary to the requirements of the Contract Documents and will be unacceptable. Failure of the Contractor to take corrective action to make the Work conform to the Contract Documents will subject the Contractor to any and all remedies available to the Owner, including, without limitation, termination pursuant to Article 14. Such notification by the Owner's Project Manager will not be a cause for the Contractor to claim either delay of the Work or any increase in the Contract Price.
- 2.2.3.** The Owner, the Owner's Project Manager and other government representatives shall at all times have access to the Work wherever it is in preparation or progress, to include off-site facilities of Subcontractors and suppliers at any tier. The Contractor shall provide safe facilities for such access so the Owner's Project Manager may perform his functions under the Contract Documents.
- 2.2.4.** All communications, correspondence, submittals and documents exchanged between the Owner's Project Manager and the Contractor in connection with the Project shall be through or in the manner prescribed by the Owner and consistent with the Owner/Contractor Agreement.
- 2.2.5.** The Owner's Project Manager shall make decisions on all matters relating to aesthetic effect, which decision shall be final.

END OF ARTICLE 2

GENERAL CONDITIONS

ARTICLE 3: OWNER

3.1. DEFINITIONS

- 3.1.1.** "Owner" means the Town of Leesburg, Virginia, unless the Owner/Contractor Agreement provides otherwise. The Owner shall be referred to as the "Town," or as the "Owner."
- 3.1.2.** The term "Owner" or "Owner's Project Manager" specifically excludes any and all inspectors having building code or Town ordinance responsibilities or jurisdiction under the requirements of the Building Permit, unless the Owner designates such person to serve as the Owner's Representative.
- 3.1.3.** "Contractor" means the person or persons, firm or company whose bid or proposal has been accepted by the Owner and includes the Contractor's representatives, successors and assigns as permitted by the Owner.

3.2. INFORMATION, SERVICES AND RIGHTS OF THE OWNER

- 3.2.1.** The Project Manager will provide administration of the Contract as described below.
- 3.2.2.** The Owner or, at the Owner's sole discretion, the Owner's Project Manager or Project Manager, will review and process all Progress Payments, including the Final Payment.
- 3.2.3.** The Project/Manager shall have the authority to reject the Work when, in his opinion, the Work does not conform to the Contract Documents.
- 3.2.4.** Whenever in the Project Manager's reasonable opinion it is necessary or advisable for the implementation of the Contract Documents, the Project Manager will have authority to require special inspection or testing of the Work in accordance with the provisions of the Contract Documents, whether or not such Work is then fabricated, installed or completed.
- 3.2.5.** The Owner or the Owner's Project Manager shall at all times have access to the Work wherever it is in preparation or progress. The Contractor shall provide safe facilities for such access.
- 3.2.6.** The Owner, the Owner's Project Manager and the Engineer shall not be responsible for or have control or charge of the construction means, methods, techniques, sequences, or procedures, or for the safety precautions and programs in connection with the Work, and will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents.

GENERAL CONDITIONS

- 3.2.7.** The Owner or the Owner's Project Manager shall not be responsible or liable to the Contractor for the acts, errors or omissions of the Contractor, any separate Subcontractor, any separate Contractor or any Contractor's or Subcontractor's agents or employees, or any other persons performing any of the Work.
- 3.2.8.** The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Owner. The Owner assumes no responsibility for any understanding reached or representation made concerning conditions that can affect the Work by any of its officers or agents before the execution of this Contract, unless that understanding or representation is expressly set forth in this Contract.
- 3.2.9.** The Owner shall not be held responsible for failure to perform the duties and responsibilities imposed by the Contract if such failure is due to strikes, fires, riots, rebellions, or Force Majeure, beyond the control of the Owner, that make performance impossible or illegal, unless otherwise specified in the Contract.
- 3.2.10.** The Owner will, throughout the Contract Time and any extension thereof have the right of reasonable rejection and approval of staff assigned to the project by the Contractor. If the Owner reasonably rejects staff or Subcontractors, the Contractor must provide replacement staff or Subcontractors satisfactory to the Owner in a timely manner and at no additional cost to the Owner.
- 3.2.11.** The foregoing rights are in addition to other rights of the Owner enumerated herein and those provided by law.

3.3. OWNER'S RIGHT TO STOP OR TO SUSPEND WORK

- 3.3.1.** If the Contractor fails to correct defective Work as required by Article 13.2 "CORRECTION OF WORK," or fails to carry out the Work or supply labor and materials in accordance with the Contract Documents, the Owner by written order may order the Contractor to stop the Work, or any portion thereof, without monetary compensation to the Contractor until the cause for such order has been eliminated.
- 3.3.2.** The Owner may order the Contractor in writing to suspend, delay, or interrupt all or any part of the Work for such period of time as he may determine to be appropriate for the convenience of the Owner.
- 3.3.3.** If the performance of all or any part of the Work is suspended, delayed, or interrupted by the Owner or the Owner's Project Manager for an unreasonable period of time, or by failure of either of them to act within the time specified (or if no time is specified, within a reasonable time), an adjustment increasing the time of performance of the Work shall be made. Such adjustments will be made solely for unreasonable suspension, delay, or interruption. The Contract shall be modified in writing accordingly. However, no claim for an extension of time shall be made under this Article 3.3.3 for any suspension, delay, or interruption pursuant to Article 3.4.1, or for which claim is provided or excluded under any other provision of this Contract.

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No claim under this Article 3.3.3 shall be allowed for any claim for an extension of time required for performance, unless within twenty days after the act or failure to act involved, the Contractor submits to the Owner's Project Manager a written statement setting forth, as then practicable, the extent of such claimed time extension and unless the claim for an extension of time is submitted with supporting data within thirty days after the termination of such suspension, delay, or interruption.

3.3.4. In the event of a suspension of work or delay or interruption of work, the Contractor will and will cause his Subcontractors to protect carefully his, and their, materials and work against damage from the weather and maintain completed and uncompleted portions of the work as required by the Contract Documents. If, in the opinion of the Owner's Project Manager, any work or material shall have been damaged by reason of failure on the part of the Contractor or any of his Subcontractors to protect same, such work and materials shall be removed and replaced at the expense of the Contractor.

3.3.5. No claim by the Contractor under Article 3.3.3 shall be allowed if asserted after Final Payment under this Contract.

3.4. OWNER'S RIGHT TO CARRY OUT THE WORK

3.4.1. If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may after the seven day period give the Contractor a second written notice to correct the deficiencies within a three day period. If the Contractor fails to commence and continue to correct any deficiencies within the second notice's three day period, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such a case an appropriate Change Order shall be issued pursuant to Article 12 deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for services of the Owner's Project Manager, the Engineer and any other additional services made necessary by such default, neglect or failure. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay on demand the difference to the Owner.

3.4.2. The Owner will not be liable or accountable to the Contractor for the method by which the Work, or any portion thereof, performed by the Owner or by separate contractors pursuant to Article 3.4 is accomplished or for the price paid therefore. Notwithstanding the Owner's right to carry out a portion of the Work, maintenance and protection of the Work remains the Contractor's responsibility.

3.5. EXAMINATION OF RECORDS

3.5.1. The Owner, or any duly authorized representative, shall, until the expiration of five years after final payment hereunder, have access to and the right to examine, audit and copy any directly pertinent books, documents, as-builts, papers and

GENERAL CONDITIONS

records of the Contractor involving transactions related to this Contract. Any audit or examination shall occur during regular business hours and not exceed a reasonable period of time under the circumstances.

- 3.5.2.** The Contractor further agrees to include in any subcontract for more than \$10,000 entered into as a result of this Contract, a provision to the effect that the Subcontractor agrees that the Owner or any duly authorized representative shall, until the expiration of three years after final payment under the Contract, have access to and the right to examine, audit and copy, without charge, any directly pertinent books, documents, papers and records of such contractor involved in transactions related to such subcontract, or this Contract. The term subcontract shall exclude subcontracts or purchase orders for public utility services at rates established for uniform applicability to the general public.
- 3.5.3.** The period of access provided in Subparagraphs 3.5.1 and 3.5.2 above shall continue for all contracts and subcontracts until any appeals, litigation, or claims have been finally concluded.
- 3.5.4.** Nothing in these General Conditions shall be deemed to modify in any manner any applicable statute of limitations.

END OF ARTICLE 3

GENERAL CONDITIONS

ARTICLE 4: CONTRACTOR

4.1. DEFINITION

- 4.1.1.** The Contractor is the person or organization identified as such in the Owner/Contractor Agreement. The term Contractor means the Contractor or his authorized representative, who shall have authority to bind the Contractor in all matters pertinent to this Contract.
- 4.1.2.** The Contractor is not an agent for the Owner but is an independent contractor engaged in the business of providing the services and performing the Work described in the Contract Documents.

4.2. REVIEW OF CONTRACT DOCUMENTS

- 4.2.1.** Before submitting his bid or proposal to the Owner, and continuously after execution of the Contract, the Contractor shall carefully study and compare the Contract Documents and shall at once report to the Owner any error, inconsistency or omission he may discover, including any requirement that may be contrary to any law, ordinance, rule, regulation or order of any public authority bearing on the performance of the Work. By submitting his bid or proposal for the Contract and the Work under it, the Contractor agrees that the Contract Documents are accurate, consistent and complete. The Contractor shall perform no portion of the Work at any time without Contract Documents and, where required, approved Shop Drawings, product data, samples, mock ups or other submittals for such portion of the Work

4.3. SUPERVISION AND CONSTRUCTION PROCEDURES

- 4.3.1.** The Contractor shall supervise and direct the Work, using his best skill and attention. He shall be solely responsible for and have control over all construction means, uses, sequences, procedures, safety precautions and programs, and coordination of all portions of the Work under the Contract.
- 4.3.2.** The Contractor shall be responsible to the Owner for the acts and omissions of his employees, Subcontractors, Suppliers, their agents and employees, and other persons performing any of the Work and for their compliance with each and every requirement of the Contract Documents, in the same manner as if they were fully employed by the Contractor.
- 4.3.3.** The Contractor shall not be relieved from his obligations to perform the Work in accordance with the Contract Documents either by acts, failures to act or duties of the Owner or the Owner's Project Manager in their administration of the Contract, or by inspections, tests, or approvals (or the lack thereof) required or performed under Article 4.4 "INSPECTION OF CONSTRUCTION" or Article 7.5 "TESTS" by persons other than the Contractor.

- 4.3.4.** The Contractor shall employ no plant, equipment, materials, methods or persons

GENERAL CONDITIONS

to which the Owner or Owner's Project Manager reasonably objects.

- 4.3.5.** The Contractor shall not remove any portion of the Work or stored materials from the site of the Work, if payment for such was requested or received from the Owner.
- 4.3.6.** The Contractor shall at all times so conduct its work as to ensure the least possible obstruction to traffic and inconvenience to the general public and the residents in the vicinity of the Work. No road or street shall be closed to the public except with the permission of the Town Traffic Engineer and proper governmental authority. Fire hydrants on or adjacent to the Work shall be kept accessible to fire fighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the use of sidewalks and the proper functioning of all gutters, drainage inlets, drainage ditches, and irrigation ditches, which shall not be obstructed except as approved by the Owner's Project Manager.
- 4.3.7.** When construction crosses highways, railroads, streets, or utilities under the jurisdiction of State, County, Town, or other public agency, public utility, or private entity, the Contractor shall secure written permission where necessary from the proper authority before executing such new construction. A copy of such written permission must be filed with the Owner before any work is started. The Contractor shall be required to furnish a release from the proper authority before final acceptance of the Work.
- 4.3.8.** The Contractor shall provide and maintain such sanitary accommodations for the use of the Contractor's employees and those of its Subcontractors as may be necessary to comply with the requirements and regulations of the local and State departments of health and where additional accommodations are necessary for a reasonably sanitary activity, then such additional accommodations shall be made by the Contractor.

4.4. INSPECTION OF CONSTRUCTION

- 4.4.1.** The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the Work called for by this Contract conforms to Contract requirements. The Contractor shall maintain complete inspection records and make them available to the Owner and Owner's Project Manager. All work is subject to inspection and testing at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract.

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4.5. CONTRACTOR'S REPRESENTATIONS

4.5.1. By entering into this Contract with the Owner, the Contractor represents and warrants the following, together with all other representations and warranties in the Contract Documents:

1. That he is experienced in and competent to perform the type of work required and to furnish the plant, materials, supplies or equipment to be so performed or furnished by him;
2. That he is financially solvent, able to pay his debts as they mature, and possessed of sufficient working capital to initiate and complete the Work and Changes required under the Contract;
3. That he is familiar with all laws, ordinances, permits, regulations and resolutions that may in any way affect the Work or those employed therein, including but not limited to any special laws or regulations related to contractor licenses and/or registrations for the Work or any part thereof;
4. That such temporary and permanent work required by the Contract Documents that is to be done by him will be satisfactorily constructed and fit for use for its intended purpose and that such construction will not injure any person, or damage any property;
5. That he will fully comply with all requirements of the Contract Documents;
6. That he will perform the Work in a skillful manner consistent with good workmanship, sound business practice, and in the most expeditious and economical manner consistent with the best interests of the Owner;
7. That he will furnish efficient business administration and experienced superintendence and an adequate supply of workers, equipment, tools, and materials at all times;
8. That he has carefully reviewed the Work required and that the Work can be planned and executed in a normal and orderly sequence and be reasonably scheduled so as to insure completion of the Work in accordance with the Contract Documents, allowing for normal and reasonably foreseeable weather, labor and other delays, interruptions and disruptions of the Work at the site designated;

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9. That he will complete the Work within the Contract Time and all portions thereof within any required Contract milestones;
10. That his Contract Price is based upon the labor, materials, systems and equipment required by the Contract Documents, without exception;
11. That he does not and will not during the performance of the Contract violate the provisions of the Federal Immigration Reform and Control Act of 1986, as amended, which prohibits the employment of illegal aliens, and Federal and State employment and wage hour laws;
12. That he has taken steps reasonably necessary to ascertain the nature and locations of the Work of the Contract, has investigated and satisfied himself as to the general and local conditions which can affect the Work or its cost, including but not limited to: conditions bearing upon transportation, disposal, handling, and storage of materials; the availability of labor, water, electric power, and roads; uncertainties of weather, river stages, tides, or similar physical conditions at the site; the conformation and conditions of the ground; and the character of equipment and facilities needed before and during work performance;
13. That no employee of the Owner shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom which is not available to the general public; and
14. That Contractor's bid or offer was made without collusion or fraud and that it has not offered or received any kickbacks or inducements from any other offeror, supplier, manufacturer, or Subcontractor and that it has not conferred on any public employee having official responsibility for this purchase any payment, loan, subscription, advance, deposit of money, services, or anything of more than nominal value, present or promised unless consideration of substantially equal or greater value was exchanged. Contractor acknowledges that this Contract incorporates by reference the Virginia Public Procurement Act, VA Code Sect. 2.2-4300 et seq. (VPPA), as well as any state or federal law related to ethics, conflicts of interest, or bribery, including by way of illustration and not limitation, the Virginia State and Local Government Conflict of Interests Act, then Virginia Governmental Frauds Act, and Articles 2 and 3 of Chapter 10 of Title 18.2 of the Virginia Code, as amended.

GENERAL CONDITIONS

4.6. LABOR AND MATERIALS

- 4.6.1.** Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all labor, materials, equipment, supplies, tools, construction equipment and machinery, heat, utilities, transportation, and other facilities and services necessary or proper for or incidental to the execution and completion of the Work required by and in accordance with the Contract Documents and any applicable code or statute, whether specifically required by the Contract Documents, or whether their provision may reasonably be inferred as necessary to produce the intended results, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. Unless otherwise specified, all materials and equipment incorporated in the Work under the Contract shall be new. All work performed, shall be accomplished by persons qualified in the respective trades. Final Payment will not be made until the Work is so completed.
- 4.6.2.** Whenever materials or equipment are specified or described in the Drawings or Specifications by using the name of a proprietary item or the name of a particular manufacturer, fabricator, supplier, or distributor, the naming of the item is intended to establish the type, function, and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other manufacturers, fabricators, suppliers or distributors may be accepted by the Owner's Project Manager if sufficient information is submitted by the Contractor to allow the Owner's Project Manager to determine that the material or equipment proposed is equivalent to that name.
- 4.6.3.** Requests for review of substitute items of material and equipment will not be accepted by the Owner's Project Manager from anyone other than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor shall make written application to the Owner's Project Manager for acceptance thereof, certifying that the proposed substitute will perform adequately the functions called for by the general design, be similar and of equal or better substance to that specified, and be suited to the same use and capable of performing the same or better function as that specified. The application shall state whether or not acceptance of the substitute for use in the Work will require a change in the drawings or specifications to adapt the design to the substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of a license fee or royalty. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair, and replacement service shall be indicated.

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4.6.4. The Contractor shall submit complete data substantiating compliance of the proposed substitution with the Contract Documents, including:

1. Product identification including manufacturer's name, address and phone number;
2. Manufacturer's literature showing complete product description, performance and test data, and all reference standards;
3. Samples and colors in the case of articles or products;
4. Name and address of similar projects on which the product was used and date of installation;
5. For construction methods, include a detailed description for the proposed method and drawings illustrating same;
6. Itemized comparison of proposed substitution with product or method specified and any cost reduction which shall benefit the Owner;
7. Accurate cost data on proposed substitution with product or method specified and any cost reduction which shall benefit the Owner;
8. All directions, specifications and recommendations by manufacturers for installation, handling, storing, adjustment and operation; and
9. A mock up if determined necessary by the Project Manager.

4.6.5. The Contractor shall also submit with his request for approval a sworn and notarized statement that shall include the following representations:

1. That he has investigated the proposed product or method and determined that it is equal or better in all respects to that specified and that it fully complies with all requirements of the Contract Documents;
2. That he will meet all Contract obligations with regard to the substitution;
3. That he will coordinate installation of accepted substitutions into the Work, making all such changes and any required schedule

GENERAL CONDITIONS

adjustment, at no additional cost to the Owner, as may be required for the Work to be complete in all respects;

4. He waives all claims for additional costs and additional time related to substitutions which consequently become apparent. He also agrees to hold the Owner harmless from claims for extra costs and time incurred by other Subcontractors and suppliers, or additional services which may have to be performed by the Owner's Project Manager, for changes or extra work that may, at some later date, be determined to be necessary in order for Work to function in the manner intended in the Contract Documents;
5. He will provide the same warranty and guarantee, and perform any work required in accordance therewith, for the substitution that is applicable to the specified item for which the substitution is requested;
6. Material will be installed, handled, stored, adjusted, tested, and operated in accordance with the manufacturers' recommendations and as specified in the Contract Documents;
7. In all cases new materials will be used unless this provision is waived by notice from the Owner or the Owner's Project Manager or unless otherwise specified in the Contract Documents;
8. All material and workmanship will be in every respect in accordance with that which, in the opinion of the Owner or the Owner's Project Manager, is in conformity with approved current practice;
9. He has provided accurate cost data on the proposed substitution in comparison with the product or method specified; and
10. He has taken into consideration the necessary adjustment, relocation and/or installation of public utilities in areas within the limits of this Contract. No additional compensation will be paid to the Contractor for delays to the project schedule, work interruptions, changes in construction sequences, changes in handling excavation, drainage or paving, or for changes in types of equipment used, etc., caused by complying with the provisions of this statement. The Contractor shall include activities in its initial schedule indicating the utility relocation necessary to complete the Work. Delays to the project schedule caused by untimely relocations of utilities will not be considered a compensable delay, but if supported in accordance with the

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provisions of Article 8.3, may entitle the Contractor to a non-compensable time extension. The Contractor shall assume all responsibility for coordinating with the various utility companies to verify their relocation schedules, determine the anticipated duration to complete the respective utility relocations, and to facilitate utility relocations to minimize the impact to the project schedule upon notification of being named the apparent low bidder.

4.6.6. The application shall also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change. All of the foregoing shall be considered by the Owner's Project Manager in evaluating the proposed substitute. The Owner's Project Manager may require the Contractor to furnish at the Contractor's expense additional data about the proposed substitute. The Owner shall be the sole judge of acceptability, and no substitute shall be ordered or installed without the Owner's prior written acceptance. The Owner may require the Contractor to furnish at the Contractor's expense a special performance guarantee or other surety with respect to any substitute.

4.6.7. If a substitution is approved, no additional change in brand or make will be permitted unless satisfactory written evidence is presented to and approved by the Owner showing that the manufacturer cannot make scheduled delivery of the approved substituted item. Substitutions will not be considered by the Owner if:

1. The proposed substitution is indicated or implied on the Contractor's shop drawing or product data submittals and has not been formally submitted for approval by the Contractor in accordance with the above-stated requirement; or
2. Acceptance of the proposed substitution will require substantial revisions to the Contract Document or is otherwise not acceptable to the Owner or his authorized representative.

4.6.8. The Contractor shall not have any right of appeal from the decision of the Project Manager rejecting any materials submittal.

4.6.9. Manufactured articles, material and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer unless herein specified to the contrary.

4.6.10. Any material specified by reference to the number, symbol or title of a specific standard, such as a Commercial Standard, a Federal Specification, a Trade Association Standard, or other similar standard, shall comply with the requirements in the latest revision of the standards or specification and any amendment or supplement, except as limited to type, class or grade, or as modified in such reference. The standard referred to, except as modified in the Specifications, shall have full force and effect as though printed in the Specifications.

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1. Reference in the Specifications or on the Drawings to any article, device, product, material, fixture, form or type of construction by name, make or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as eliminating from competition other products of equal or better quality by other manufacturers where fully suitable, as approved by the Owner's Project Manager. Applications for approval of substitutions for the specified items will be considered only upon request of the Contractor, not of individuals, trades or suppliers, and only for a specific purpose; no blanket approvals will be granted. No approval of a substitution shall be valid unless it is in written form and signed by the Owner's Project Manager.
2. If any proposed substitution will affect a correlated function, adjacent construction or the work of other contractors, then the necessary changes and modifications to the affected work shall be considered as an essential part of the proposed substitution, to be accomplished by the Contractor without additional expense to the Owner, if and when approved. Detail drawings and other information necessary to show and explain the proposed modifications shall be submitted with the request for approval of the substitution.

4.6.11. All equipment, apparatus, or devices of any kind to be incorporated into the Work that are shown or indicated on the drawings or called for in the specifications or required for the completion of the Work shall be entirely satisfactory to the Owner's Project Manager as regards operations, capacity, or performance. No approval, either written or oral, of any drawings, descriptive data, or samples of such equipment, apparatus, or device shall relieve the Contractor of his responsibility to turn over the same in good working order for its intended purpose at the completion of the Work in complete accordance with the Contract Documents. Any equipment, apparatus and/or device not fulfilling these requirements shall be removed and replaced by proper and acceptable equipment, or put in good working order satisfactory to the Owner's Project Manager without additional cost to the Owner.

4.6.12. The Contractor shall at all times enforce strict discipline and good order among his employees and shall not employ on the Work any unfit person or anyone not skilled in the task assigned to him. The Owner may, by written notice, require the Contractor to remove from the Work any employee the Owner deems incompetent, careless or otherwise objectionable.

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4.7. WARRANTY

4.7.1. The Contractor guarantees and warrants to the Owner all work as follows:

1. That all materials and equipment furnished under this Contract will be new and the best of its respective kind unless otherwise specified;
2. That all Work will comply with or exceed industry standards and be free of omissions and faulty, poor quality, imperfect or defective materials or workmanship;
3. That where no standard is specified for such workmanship or materials, they shall be the best of their respective kinds;
4. That all applicable Work shall be entirely watertight and leakproof in accordance with all applicable industry customs and practices, and shall be free of shrinkage and settlement;
5. That the Work, including but not limited to, mechanical and electrical machines, devices and equipment shall be fit and fully usable for its intended and specified purpose and shall operate satisfactorily with ordinary care;
6. That consistent with requirements of the Contract Documents, the Work shall be installed and oriented in such a manner as to facilitate unrestricted access for the operation and maintenance of fixed equipment; and
7. That the Work will be free of abnormal or unusual deterioration that occurs because of poor quality materials, workmanship or unsuitable storage.

4.7.2. All work not conforming to guarantees and warranties specified in the Contract Documents, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner's Project Manager, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty is not limited by the provisions of Article 13 "UNCOVERING AND CORRECTION OF WORK."

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- 4.7.3.** The warranties set forth in this Article 4.7 and elsewhere in the Contract Documents shall survive Final Completion of the Work under Article 9.8 "FINAL COMPLETION AND FINAL PAYMENT."
- 4.7.4.** If, within one year after the Date of Final Acceptance of the Work or designated portion thereof or within one year after acceptance by the Owner of designated equipment or within such longer period as may be prescribed by law or by the terms of the applicable special warranty required by the Contract Documents, any of the Work is found to be defective, not in accordance with the Contract Documents, or not in accordance with the guarantees and warranties specified in the Contract Documents, the Contractor shall correct it within five working days, or such other period as agreed, after receipt of written notice from the Owner or Owner's Project Manager to do so.
- 4.7.5.** If at any time deficiencies in the Work are discovered that are found to have resulted from latent defects, gross mistakes, fraud or misrepresentation by the Contractor, any Subcontractor or Supplier, the Contractor will be liable for replacement or correction of such Work or any damage that the Owner has incurred, or will incur, related thereto, regardless of the time limit of any guarantees or warranty.
- 4.7.6.** Any materials or other portions of the Work, installed, furnished, or stored on site that are not of the character or quality required by the specifications, or are otherwise not acceptable to the Owner's Project Manager shall be immediately removed and replaced by the Contractor to the satisfaction of the Owner's Project Manager when notified to do so by the Owner's Project Manager.
- 4.7.7.** If the Contractor fails to correct defective or nonconforming Work as required by Article 4.7.4 or Article 4.7.5 or, if the Contractor fails to remove defective or nonconforming Work from the site, as required by Article 4.7.6, the Owner may elect to either correct such Work in accordance with Article 3.4 "OWNER'S RIGHT TO CARRY OUT THE WORK" or remove and store materials and equipment at the expense of the Contractor.
- 4.7.8.** The Contractor shall bear the cost of making good all work of the Owner, separate contractors or others, destroyed or damaged by such correction or removal required under this Article, Article 13 "UNCOVERING AND CORRECTION OF WORK" or elsewhere in the Contract Documents.

4.8. TAXES

- 4.8.1.** The Contractor shall pay all applicable Federal, State, and local taxes and duties for the Work or portions thereof provided by the Contractor that are legally enacted at the time the Contract is awarded, whether or not yet effective.
Increases in the rates of such taxes and duties during performance of the Contract shall be the responsibility of the Contractor.

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4.9. PERMITS, FEES AND NOTICES

- 4.9.1.** The Contractor shall secure and pay for all permits, fees, licenses and inspections necessary for the proper execution and completion of the Work that are legally required at the time the proposals are received.
- 4.9.2.** The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the performance of the Work.
- 4.9.3.** The Contractor shall have personnel on site that are qualified and have the proper certifications for Erosion and Sedimentation Control, Best Management Practice (BMP), and Storm Water Management (SWM), or any other Department of Environmental Quality (DEQ) certifications as required for any and all permits issued and/or required by the Work.

4.10. SUPERINTENDENT

- 4.10.1.** The Contractor shall employ a competent Superintendent and necessary assistants who shall be in attendance at the Project site during the progress of the Work. The Superintendent shall be an authorized representative of the Contractor and all communications given to the Superintendent shall be as binding as if given to the Contractor.
- 4.10.2.** The Superintendent shall be in attendance at the Project site not less than eight hours per day, five days per week, unless the job is closed down due to a general strike or conditions beyond the control of the Contractor or until termination of the Contract in accordance with the Contract Documents. It is understood that such Superintendent shall be approved in writing by the Owner and shall be the one who will continue in that capacity for the duration of the Project, unless the Superintendent ceases to be on the Contractor's payroll or his withdrawal is required or approved by the Owner. The Superintendent shall not be employed on any other project for or by the Contractor or any other entity during the course of the Work.
- 4.10.3.** Such Superintendent shall be fluent in English and in such other languages as may be necessary to communicate effectively with all owner's representatives, employees and Subcontractors of the Contractor. This requirement may be satisfied by the on-site presence of a competent foreign language interpreter to English interpreter. Any costs associated with foreign language interpretation shall be borne by the Contractor.

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4.10.4. Any and all project documents, including but not limited to daily reports and logs, maintained by the Superintendent or the Contractor's employees or Subcontractors shall be in English. Any costs of foreign language translation shall be borne solely by the Contractor and shall not be a basis for any additional compensation or time extension from the Owner.

4.11. PROJECT SCHEDULES

4.11.1. The Schedule of Completion shall consist of the Contractor planning, scheduling, and constructing this project by using a Critical Path Method Project Schedule (CPM). The CPM shall be used for coordinating and monitoring all the Work specified in the Contract Documents including all activities of subcontractors, vendors, suppliers, utilities, and all other parties associated with the construction of the project. The CPM shall be based upon the entirety of the Contract Documents. All physical work and major procurement activities shall be included. The CPM shall be the Activity-On-Arrow type. The Contractor shall use either Primavera or SureTrak scheduling software.

The CPM utilized float: Float is defined as the amount of time between when an activity "can start" (the early start) and when an activity "must start" (the late start). Float is a shared commodity for the Owner and the Contractor and is not for the exclusive use or financial benefit of either party. Either party has the full use of the float until it is depleted.

4.11.2. Initial Critical Path Method Project Schedule (ICPM) shall consist of the following:

1. Activity-On-Arrow Time Scale Diagram
2. Total Float Computer sort
3. Written Narrative (WN)
4. Printed calendars. The painted calendars shall include a listing, description, and calendar form tabulation of all calendars used in the ICPM. The calendars shall contain the total number of anticipated work days required to complete all the Work required in the Contract. The calendars shall delineate the holidays, anticipated nonwork days, and bad weather days. An explanation of the Contractor's basis for determining nonwork and bad weather days shall be included with the calendars.
5. Data disc containing all of the information for (a) thru (d). The format shall be compatible with the Owner's computer software.

The ICPM diagram shall be drafted to a scale that allows the I node and J node numbers of each activity to be printed adjacent to that activity. The activities shall be clearly defined. All restraints between activities shall be shown.

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The Contractor shall expend the entire Contract time specified in this Invitation for Bids. On Contracts with calendar date completions or calendar day durations, all planned activities shall have durations not exceeding 14 calendar days, except the activities required for the Owner's review and approval of the working drawings and material sources which shall be given a duration of not less than 30 calendar days. On Contracts with working day durations, these time periods shall be 10 working days and 25 working days.

All activities in the Contract Documents along with a written narrative explanation shall be identified in the ICPM. The Project Manager reserves the right to specify the number of activities, and to require at any time additional breakdown of the activities.

The Contractor shall provide a written narrative as part of the ICPM describing the original critical path, the sequence of work, number of shifts per day, number of hours per shift, composition and number of crews, and the equipment to be utilized on each activity. Subcontracting activities shall be listed and identified by activity number. Each activity shall be identified by physical location and phase of work. Abbreviations used in preparing the ICPM shall be explained in the written narrative.

The Contractor shall complete the proposed ICPM within 14 calendar days after receiving the Notice of Award and submit 5 sets to the Project Manager for review and approval. The Project Manager will review the Contractor's ICPM within 5 calendar days after the submittal. If required, the Project Manager will convene a Joint Review Conference at which time the Project Manager and Contractor may make corrections and adjustments to the proposed ICPM. If a revision is necessary due to the Project Manager's review or the Joint Review Conference, the proposed revisions shall be submitted, by the Contractor, within 7 calendar days after the initial review date to the Project Manager for another review. Revisions shall conform to the format used in the ICPM. The Project Manager will respond to the revised ICPM within seven calendar days after its receipt.

No construction work shall begin until the Project Manager has accepted the ICPM. Time charges shall begin no later than the on or before date of the Notice to Proceed. Any delay in starting work caused by the acceptance of the ICPM by the Project Manager will not be a basis for any monetary claim.

- 4.11.3.** When the Project Manager notifies the Contractor that the ICPM has been accepted, that document will become the CPM of Record (CPMR). The Contractor shall be responsible for implementing and executing the Work specified in the Contract in strict conformance with the CPMR. The CPMR shall be the Contractor's work plan for completing the entire Contract as specified in the Contract Documents.

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Failure of the Contractor to adhere to the latest approved CPMR will be cause for the Owner to deny any and all requests for additional compensation or extensions of the Contract duration.

4.11.4. Revisions to the CPMR shall consist of one or more of the following:

1. A change in duration of an activity.
2. A change in the logic of the schedule.
3. A change in the calendars.
4. The deletion or addition of one or more activities.

The Contractor may submit a proposed revision to the CPMR at any time during the life of the Contract.

The Contractor shall submit a proposed revision to the CPMR whenever the activities differ from the accepted CPMR. Proposed revisions shall be submitted by the Contractor within 30-calendar days from the date on which the Contractor's activities deviated from the accepted CPMR. The revisions shall be submitted to the Project Manager in the same format used for the ICPM. The revisions shall include data from all CPMR Updates, which have been accepted by the Administration. The Written Narrative accompanying the revision shall describe the reason for the revisions, the critical path, and all logic and duration modifications to the CPMR. These shall include, but not be limited to, changes in the method or manner of the Work, changes in Specifications, extra work, addition or deletion of work, increased or decreased quantities, defective work and acceleration of the Work.

The Project Manager will review the CPMR and respond to the Contractor's proposed revision within 5 calendar days after its receipt. The Project Manager reserves the right to deny any proposed revision which adversely impacts the Owner, utilities, or other interested parties.

4.11.5. Any written request for an extension of time or change in incentive/disincentive date (if applicable) shall be accompanied by a revised CPMR, which documents the actual delay to the Contract completion date or incentive/disincentive date. The request shall include a written narrative of the events which would require an extension of the Contract time or incentive/disincentive date.

Only delays to activities, which affect the Contract completion date or incentive/disincentive date will be considered for a time extension. The extension of the specified Contract completion date or incentive/disincentive date will be based upon the actual number of calendar days the Contract completion date or incentive/disincentive date is adjusted. No extensions of the specified Contract completion date will be issued for work performed on activities with float.

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4.11.6. Monthly updates of the CPMR are required. CPMR update submissions shall contain the activity data as specified in (a) thru (e) of the ICPM. The update shall describe the progress of the project to date. It shall include a description of the current critical path, the amount of float on the critical path, any delays or disruptions experienced by the Contractor during the period of the update, any change in manpower or equipment, the inclusion of any schedule revisions, and any potential delays or disruptions.

4.11.7. When a delay or a disruption to the Work is identified in the Written Narrative, which the Contractor believes to be the responsibility of the Owner, the Contractor shall submit a revision to the CPMR within 30 calendar days after the submittal of the updates.

4.11.8. The Owner and the Contractor will hold monthly job site progress meetings to discuss the progress of the project and update the CPMR. The Contractor shall arrange to have a representative of each subcontractor currently working on the project in attendance. The Contractor shall submit to the Project Manager the CPMR updates within 14 calendar days from the date of the monthly meeting. The Project Manager will review the update and advise the Contractor of its acceptability prior to the next monthly meeting.

4.12. RESPONSIBILITY FOR COMPLETION

4.12.1. The Contractor shall furnish such labor, materials, tools, equipment, and professional services and shall work such hours, including night shifts, overtime operations and Sundays and holidays, as may be necessary to ensure the performance of the Work within Milestone and Completion dates specified in the Owner/Contractor Agreement. If it becomes apparent to the Owner's Project Manager that the Work will not be completed within required Milestone or Completion dates, the Contractor agrees to undertake some or all of the following actions, at no additional cost to the Owner, in order to ensure, in the opinion of the Owner's Project Manager, that the Contractor will comply with all Milestone and Completion date requirements:

1. Increase labor, materials, tools, equipment and professional services;
2. Increase the number of working hours per shift, shifts per working day, working days per week, or any combination of the foregoing; and
3. Reschedule activities to achieve maximum practical concurrency of accomplishment of activities.

4.12.2. If the actions taken by the Contractor are not satisfactory, the Owner or the Owner's Project Manager may direct the Contractor to take any and all actions

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necessary to ensure completion within the required completion dates, without additional cost to the Owner. In such event, the Contractor shall continue to assume responsibility for his performance and for completion within the required dates.

4.12.3. If, in the opinion of the Project Manager, the actions taken by the Contractor pursuant to this Agreement or the progress or sequence of work are not accurately reflected on the Construction schedule, the Contractor shall revise such schedule to accurately reflect the actual progress and sequence of work.

4.12.4. This provision does not eliminate the Contractor's responsibility to comply with the Town noise ordinances, all Town permit requirements and all other applicable laws, regulations, rules, ordinances, resolutions, and permit requirements.

4.13. DOCUMENTS, OTHER SUBMITTALS AT THE SITE; AS-BUILT DRAWINGS

4.13.1. The Contractor and his Subcontractors shall maintain at the site, and at all times make available to the Owner and the Owner's Project Manager one record copy of all Drawings, Specifications, Addenda, Change Orders, and other Modifications, in good order and marked currently to record all changes made during construction, and approved Shop Drawings, Product Data, Samples, Mock Ups and other Submittals ("as-built drawings").

4.13.2. The Contractor shall prepare the as-built drawings by marking up two sets of prints and one electronic copy of the applicable Contract Drawings to portray as-built construction, in conformance with the DCSM. The prints shall be neatly and clearly marked to show all variations between the Work actually provided and that indicated on the Contract Drawings, and all utilities encountered in the Work. All drafting shall conform to good drafting practice and shall include such supplementary notes, legends and details as may be necessary for legibility and clear portrayal of the as-built construction. These drawings shall be marked promptly at the completion of the project and shall be turned over the Owner prior to Final Payment.

4.14. SHOP DRAWINGS, PRODUCT DATA, SAMPLES AND OTHER SUBMITTALS

4.14.1. The term "Shop Drawings" shall mean all drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by Contractor, a Subcontractor, manufacturer, supplier or distributor and which illustrate the equipment, material or some portion of the Work.

4.14.2. The Contractor shall submit with reasonable promptness and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate

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Contractor, all Shop Drawings, Product Data, Manuals, Samples, and Submittals required by the Contract Documents. All such submissions shall be made so as to cause no delay in the project, allowing the Owner or his designated representative fourteen (14) working days for review and checking.

- 4.14.3.** By approving and submitting Shop Drawings, Product Data, Manuals, Samples and Submittals, the Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. The Contractor shall adhere to any supplementary processing and scheduling instructions pertaining to any submittals that may be issued by the Owner's Project Manager.
- 4.14.4.** Parts and details not fully indicated on the Contract Drawings shall be detailed by the Contractor in accordance with standard engineering practice. Dimensions on the Contract Drawings, as well as detailed drawings themselves, are subject in every case to measurements of existing, adjacent, incorporated and completed work that shall be taken by the Contractor before undertaking any work dependent on such data.
- 4.14.5.** Where the Contract Documents call for the submittal of manufacturer's data to the Owner or the Owner's Project Manager for information only, such submittals shall be made before the commencement of any portion of the Work requiring such submission.
- 4.14.6.** The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by virtue of the review by the Owner or the Owner's Project Manager of Shop Drawings, Product Data, Samples or Manuals unless the Contractor has specifically informed the Owner's Project Manager in writing of such deviation at the time of submission and the Owner's Project Manager has given written approval to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data, Samples or Manuals by the Owner or Owner's Project Manager's review thereof.
- 4.14.7.** Shop drawings shall be submitted in such number of copies that three copies may be retained by the Project Manager or his designee after approval. Each submission shall be accompanied by a letter of transmittal in duplicate, listing the contents of the submission and identifying each item by reference to specification section or drawing. All Shop Drawings shall be clearly labeled with the name of the project and such information as may be necessary to enable their complete review by the Project Manager or his designee. Catalog plates and other similar material that cannot be so labeled conveniently shall be bound in suitable covers bearing the identifying data.

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- 4.14.8.** Shop drawings shall be accompanied by all required certifications and other such supporting material, and shall be submitted in such sequence or in such groups that all related items may be checked together. When Shop Drawings cannot be checked because a submission is not complete, or because Shop Drawings on related items have not been received by the Project Manager or his designee, such Shop Drawings will be returned without action, and marked 'rejected' with the reason for rejection clearly stated. Incomplete or defective submittals shall also be returned without action, and marked 'rejected' with the reason for rejection clearly stated.
- 4.14.9.** Shop Drawings shall have been reviewed by the Contractor and coordinated with all other related or affected work before they are submitted for approval and shall bear the Contractor's certification that the Contractor has checked and approved them as complying with all relevant information in the Contract Documents. Shop Drawings submitted without such certification and coordination will be returned to the Contractor without action and will be considered not a formal submission.
- 4.14.10.** SAMPLES required by the specifications or requested by the Project Manager or his designee shall be submitted for approval. Samples shall be submitted in single units only, unless the Contractor desires additional units for the Contractor's own use. Each sample shall bear a label indicating the material represented, the name of the producer and the title of the Project. Approval of a sample shall be only for conformance with the design concept of the Project and compliance with the information given in the Contract Documents, and only for the characteristics or use named in such approval. Such approval shall not be construed to change or modify any Contract requirements or the Contract Price. Materials and equipment incorporated in the Work shall match the approved samples.
- 4.14.11.** All TESTS of materials and finished articles shall be made by bureaus, laboratories or agencies approved by the Project Manager or his designee, and the certified reports of such tests shall be submitted to the Project Manager. All costs in connection with the testing shall be borne by the Contractor. Failure of any material to pass the specified tests or any test performed by the Project Manager or his designee will be sufficient cause for refusal to consider, under this Contract, any further materials of the same brand or make of that material. Samples of various materials delivered on the site or in place may be taken by the Project Manager or his designee for testing. Samples failing to meet the requirements of the Contract Documents will automatically void previous approvals of the items tested. See Article 7.5 for additional test requirements.

Unless otherwise specified, testing for soil compaction, soil suitability, concrete testing, etc. will be performed by or on behalf of the Contractor at the

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Contractor's expense. The Contractor shall furnish copies of all test results or related reports or documents to the Project Manager.

4.15. CUTTING AND PATCHING OF WORK

4.15.1. The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work and to make its several parts fit properly and in accordance with the Contract Documents.

4.15.2. The Contractor shall not damage or endanger any portion of the Work or the work of the Owner or any separate Contractors by cutting, patching or otherwise altering any work, or by excavation. The Contractor shall not cut or otherwise alter the work of the Owner or any separate Contractor except with the written consent of the Owner and of such separate Contractor. The Contractor shall not unreasonably withhold from the Owner or any separate Contractor his consent to cutting or otherwise altering the Work. The Owner shall not be required to accept work with a cut, a splice, or patch when such cut, splice or patch is not generally accepted practice for the particular work involved or is otherwise unworkmanlike in the opinion of the Owner or the Owner's Project Manager.

4.16. DRUG-FREE WORKPLACE

4.16.1. During the performance of this contract, the Contractor agrees as follows:

1. The Contractor will provide a drug-free workplace for the Contractor's employees. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition.
2. The Contractor shall state in all solicitations or advertisements for employees placed by or on behalf of the Contractor that the Contractor maintains a drug-free workplace.
3. The Contractor will include the provisions of the foregoing clauses in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each Subcontractor or vendor.

For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a Contractor in accordance with the VPPA Section 2.2-4312, the employees of

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whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

4.17. NON-DISCRIMINATION IN EMPLOYMENT

4.17.1. During the performance of this Contract, the Contractor agrees to comply fully with VPPA § 2.2-4201 and § 2.2-4343.1 as follows:

1. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, disability, color, sex or national origin, except where religion, sex or national origin is a bona fide occupational qualification reasonably necessary to the normal operation of the Contractor and the Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause;
2. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer;
3. Notices, advertisements and solicitations placed in accordance with Federal law, rule or regulation, shall be deemed sufficient for the purpose of meeting the requirements of this provision; and
4. The Contractor will include the provisions of paragraphs .1, .2, .3 above in every subcontract or purchase order of over \$10,000 so that the provisions will be binding upon every Subcontractor or vendor.
5. The Contractor will comply with the requirements VPPA Section 2.2-4343.1, Permitted Contracts with Certain Religious Organizations, as applicable.

4.18. SIGNS

4.18.1. The Contractor may at his option and without cost to the Owner, erect signs acceptable to the Owner on the site of the Contract for the purpose of identifying and giving directions to the job. No signs shall be erected without prior approval of the Owner as to design and location.

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4.19. CLEANING UP

- 4.19.1.** The Contractor at all times shall keep the project site and all surrounding public streets and neighboring property free from accumulation of waste materials or rubbish caused by his operations. At the completion of the Work and before Final Payment is made, he shall remove all his waste materials and rubbish from and about the Project as well as all his tools, equipment and surplus materials. The Contractor shall also thoroughly clean and leave reasonably dust free all interior of all buildings included in the Contract, and thoroughly clean all glass installed under the Contract including the removal of all paint and mortar splatters and other defacements.
- 4.19.2.** If the Contractor fails to clean up during or at the completion of the Work, the Owner may do so as provided in Article 6.3 "OWNER'S RIGHT TO PERFORM DISPUTED WORK" and the cost thereof shall be charged to the Contractor.
- 4.19.3.** The Contractor shall take all reasonable steps, including but not limited to providing a wash down area, to prevent mud, dirt, and other material from accumulating upon the public streets.
- 4.19.4.** During and at the completion of the Work, the Contractor shall prevent site soil erosion, the runoff of silt or debris carrying water from the site, and the blowing of debris off the site in accordance with the applicable requirements and standards of the Virginia Erosion and Sediment Control Handbook, latest edition, and the Contract Documents.

4.20. ROYALTIES AND PATENTS

- 4.20.1.** Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of the Owner or Owner's Project Manager its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents. Contractor shall indemnify, defend and hold harmless Owner and Owner's Project Manager and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses (including attorneys' fees) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

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4.21. ANTITRUST

4.21.1. By entering into a contract Contractor conveys sells assigns and transfers to the Owner all rights, title and interest in and to all causes of the action it now may have or hereafter acquire under the antitrust laws of the United States and the Commonwealth of Virginia, relating to the particular good(s) or service(s) purchased or acquired by the Owner under this contract.

4.22. INDEMNIFICATION

4.22.1. To the fullest extent permitted by law, the Contractor shall, at his sole cost and expense, indemnify, defend, and hold harmless the Owner, the Owner's Project Manager, their agents, representatives, employees, successors and assigns from and against all claims, actions, judgments, costs, liabilities, penalties, damages, losses and expenses, including but not limited to, attorneys' fees, arising out of or resulting from the performance of the Work, provided that any such claim, action, judgment, cost, liability, penalty, damage, loss or expense:

1. Is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom; and
2. Is caused in whole or in part by any negligent act or omission of the Contractor, any Subcontractor or supplier, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder;
3. The Contractor shall not be obligated to indemnify the Owner or the Owner's Project Manager hereunder for any damages or injuries, including death, the proximate cause of which is the sole negligence of the Owner or the Owner's Project Manager, consistent with Va. Code § 11-4.1.
4. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity that would otherwise exist as to any party or person described in this Article 4.22

4.22.2. In any and all claims against the Owner and the Owner's Project Manager or any of their agents, representatives, or employees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation under this Article 4.22 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

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4.22.3. No provision of Article 4.22 shall give rise to any duties on the part of the Owner or the Owner's Project Manager, or any of their agents, representatives or employees.

4.22.4. The obligations of the Contractor under Article 4.22 shall not extend to the liability of the Owner's Project Manager, or the Owner's design architect or engineers, their agents or employees arising out of (a) the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications, or (b) the giving of or the failure to give directions or instructions by Owner's Project Manager, his agents or employees provided such giving or failure to give is the primary cause of injury or damage.

4.23. PERSONS AUTHORIZED TO SIGN DOCUMENTS

The Contractor, within five days after the earlier of the date of a Notice to Proceed or the date of the Owner/Contractor Agreement shall file with the Owner's Project Manager a list of all persons who are authorized to sign documents such as contracts, certificates and affidavits on behalf of the Contractor and to fully bind the Contractor to all the conditions and provisions of such documents.

4.24. ASBESTOS AND OTHER HAZARDOUS SUBSTANCES

4.24.1. Whenever and wherever during the course of performing any work under this contract, the Contractor discovers the presence of asbestos or other hazardous substances or suspects the presence of any hazardous substances, he shall stop the work immediately, secure the area, notify the Owner and await positive identification of the suspect material. During the downtime in such a case, the Contractor shall not disturb any surrounding surfaces but shall protect the area with suitable dust covers. In the event the Contractor is delayed due to the discovery of asbestos, suspected asbestos or any other hazardous or suspected hazardous substances, then a mutually agreed extension of time to perform the Work shall be allowed the Contractor.

4.24.2. Any claims for extension of time shall be subject to the provisions of Article 8.

4.24.3. If the items/products to be purchased are "Hazardous Substances" as defined by 15 U.S.C. § 1261, then the Contractor certifies and warrants that the items or products to be delivered under the Contract shall be properly labeled as required by the foregoing sections and that by delivering the items/products, the Bidder does not violate any of the prohibitions of 15 U.S.C. §1263.

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4.24.4. Material Safety Data Sheets (MSDS) and descriptive literature shall be provided with the submittal or delivery of each chemical and/or compound subject to Article 4.24.3. Failure on the part of the Contractor to submit such data may be cause for termination in accordance with Article 14.3.

4.25. RIGHT TO PUBLISH

The Contractor otherwise agrees that he will not publish, cause to be published, or otherwise disseminate any information of any nature relating to the Work performed under this Contract, except as may be approved by the Owner in writing.

4.26. MATERIALS AND EQUIPMENT LIST

4.26.1. At least ten (10) working days before the start of construction the Contractor shall submit to the Project Manager for approval a complete list of materials and equipment proposed for use in connection with the project. Partial lists submitted from time to time will not be considered.

4.26.2. After any material or piece of equipment has been approved, no change in brand or make will be permitted unless satisfactory written evidence is presented to prove that the manufacturer cannot make scheduled delivery of the approved material, or that material delivered has been rejected and the substitution of a suitable material is an urgent necessity, or that other conditions have become apparent which indicate that approval of such other material is in the best interest of the Owner.

END OF ARTICLE 4

GENERAL CONDITIONS

ARTICLE 5: SUBCONTRACTORS

5.1. DEFINITIONS

- 5.1.1.** A Subcontractor is any firm, supplier, distributor or vendor that performs work for or furnishes services, equipment or supplies to or for the Contractor or another Subcontractor in conjunction with the Contract. The term Subcontractor is referred to throughout the Contract Documents as if singular in number and masculine in gender and means a Subcontractor or his authorized representative. Although the term Sub-subcontractor may appear within the Contract Documents, the term Subcontractor includes any person or entity that has a direct or indirect contract with the Contractor to perform any of the Work.
- 5.1.2.** The Contractor shall be fully responsible to the Owner for all acts and omissions of his Subcontractors, and of persons and organizations directly or indirectly employed by them, and of persons and organizations for whose acts any of them may be liable, to the same extent that he is responsible for the acts and omissions of persons directly employed by him.
- 5.1.3.** Nothing contained in the Contract Documents is intended to, nor shall it create, any contractual relationship between the Owner, the Owner's Project Manager, or any of their agents, consultants, employees, independent contractors, or representatives and any Subcontractor, but the Owner shall be entitled to performance of all obligations intended for its benefit, and to enforcement thereof.
- 5.1.4.** The Owner's Project Manager will not deal directly with any Subcontractor. Communication will be made only through the Contractor. Subcontractors shall route requests for information or clarification through the Contractor to the Owner's Project Manager.

5.2. AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

- 5.2.1.** The Contractor shall within fourteen days after award of the Contract furnish to the Owner's Project Manager in writing the names of the persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each of the principal portions of the Work. The Owner's Project Manager will promptly reply to the Contractor in writing stating whether the Owner has objection to any such proposed person or entity.
- 5.2.2.** The Contractor shall not contract with any such proposed Subcontractor to whom the Owner has made objection under the provisions of Article 5.2.1. The Contractor shall not be required to contract with anyone to whom he has an objection.

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5.2.3. If the Owner objects to any proposed Subcontractor under Article 5.2.1, the Contractor shall name a substitute to whom the Owner has no objection within fifteen days.

5.2.4. The Contractor shall make no substitution for any Subcontractor previously proposed by the Contractor and not objected to by the Owner's Project Manager if the Owner makes objection to such substitution.

5.3. SUBCONTRACTUAL RELATIONS

5.3.1. By an appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities that the Contractor, by these Documents, assumes toward the Owner.

1. This agreement shall preserve and protect the rights of the Owner under the Contract Documents with respect to the Work to be performed by the Subcontractor. The subcontracting will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the Contractor- Subcontractor Agreements, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with his Subcontractors.

2. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the Subcontract, copies of the Contract Documents to which the Subcontractor will be bound by this Article 5.3, and identify to the Subcontractor any terms and conditions of the proposed Subcontract that may be at variance with the Contract Documents. Each Subcontractor shall similarly make copies of such Contract Documents available to his Sub-subcontractors or Suppliers.

5.3.2. The Contractor shall be liable to and indemnify, defend and hold the Owner harmless from all costs, expenses, fees, attorney's fees, accountant's fees, damages and claims arising because of the Contractor's failure to comply with the provisions of this Article 5.3.

5.4. QUALIFICATION SUBMITTALS

5.4.1. Specific qualification submittals may be required of Subcontractors for certain critical items of the Work. Required qualification submittals are set forth in detail

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in the Contract Documents and shall be collected and submitted by the Contractor to the Owner's Project Manager for review and approval by the Owner and Owner's Project Manager. All information required of a single Subcontractor shall be contained in a single, complete submittal. The Contractor shall submit the required qualification information within ten days after receipt of the Owner's Project Manager's request.

5.4.2. The Owner may reject any proposed Subcontractor, or any qualification submittals related thereto, for the following reasons:

1. The Contractor's failure to submit requested information within the specified time; or
2. The Contractor's failure to provide all of the requested information; or
3. The Contractor's submission of a Subcontractor, or its qualifications, that are unacceptable to the Owner.

5.4.3. Should the Owner have objection to any proposed Subcontractor, the Contractor shall submit another firm for approval within fifteen days.

END OF ARTICLE 5

GENERAL CONDITIONS

ARTICLE 6: WORK BY OWNER OR BY SEPARATE CONTRACTORS

6.1. OWNER'S RIGHT TO PERFORM WORK AND TO AWARD SEPARATE CONTRACTS

- 6.1.1.** The Owner reserves the right to perform work related to the Project with its own forces, and to award separate contracts in connection with other portions of the Project or other work on the site.
- 6.1.2.** When separate contracts are awarded for different portions of the Project or other work on the site, the term Contractor in the Contract Documents in each case shall mean the Contractor who executes each separate Owner/Contractor Agreement.

6.2. MUTUAL RESPONSIBILITY

- 6.2.1.** The Contractor shall afford other Contractors and the Owner reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate the Work with that of the Owner and other Contractors, to store his tools, materials and equipment in such orderly fashion at the site of the Work as will not unduly or unreasonably interfere with the progress of the Work or the work of any other Contractors.
- 6.2.2.** If the execution or result of any part of the Work depends upon any work of the Owner or of any separate Contractor, the Contractor shall, prior to proceeding with the Work, inspect and promptly report in writing to the Owner's Project Manager any apparent discrepancies or defects in such work of the Owner or of any separate Contractor that render it unsuitable for such proper execution or result of any part of the Work under this Contract.
- 6.2.3.** Failure of the Contractor to so inspect and report shall constitute an acceptance of the Owner or separate Contractor's work as fit and proper to receive the Work, except as to defects that may develop in the Owner's or separate Contractor's work after completion of the Work, and that the Contractor could not have discovered by its inspection prior to completion of the Work under this Contract.
- 6.2.4.** Should the Contractor cause damage to the Work or property of the Owner or of any separate Contractor on the Project, or to other work on the site, or delay or interfere with the Owner's work on ongoing operations or facilities or adjacent facilities of the Contractor's work, the Contractor shall be liable for the same and, in the case of another Contractor, the Contractor shall attempt to settle such claim with such Contractor prior to such other Contractor's institution of litigation.

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6.3. OWNER'S RIGHT TO PERFORM DISPUTED WORK

6.3.1. If a dispute arises between the Contractor and separate Contractors as to their responsibility for cleaning up as required by Article 4.19 "CLEANING UP" or for accomplishing coordination as required by Article 6.4 "COORDINATION OF THE WORK," the Owner may carry out such Work and charge the cost thereof to the Contractors responsible therefor as the Owner's Project Manager shall determine.

6.4. COORDINATION OF THE WORK

6.4.1. By entering into this Contract, Contractor acknowledges that there may be separate Contractors on the Site whose work will be coordinated with that of his own. Contractor warrants and guarantees that he will cooperate with separate Contractors, and will do nothing to delay, hinder or interfere with the Work of other separate Contractors, the Owner or the Owner's Project Manager.

END OF ARTICLE 6

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ARTICLE 7: MISCELLANEOUS PROVISIONS

7.1. GOVERNING LAW

7.1.1. The Contract shall be governed by the law of the Commonwealth of Virginia, and shall be performed in accordance with the laws, ordinances, regulations, permits and resolutions of the Town of Leesburg. The sole venue for any litigation under this Contract shall be the Circuit Court of Loudoun County, Virginia. The conflicts of law provisions shall not be employed to apply the laws of any state other than those of the Commonwealth of Virginia to this Contract.

7.1.2. Each provision of law required to be inserted in this Contract shall be deemed inserted. If through mistake or otherwise, any provision is not properly inserted, the Contract shall be modified to include such provision upon the application of either party.

7.1.3. Where applicable, the Contractor shall meet or exceed all requirements of the Town of Leesburg Design and Construction Standards Manual and all other local, state and federal building codes.

7.2. SUCCESSORS AND ASSIGNS

7.2.1. The Contractor binds himself, his partners, successors, assigns and legal representatives to the Owner, its partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract or sublet it as a whole without the written consent of the Owner, nor shall the Contractor assign any monies due or to become due to him under the Contract, without the previous written consent of the Owner and the Contractor's Surety. Nor shall any contract be entered into or assigned to any party that is debarred from doing business with or in the Commonwealth of Virginia.

7.2.2. In the event the Contractor desires to make an assignment of all or part of the contract or any monies due or to become due under this Contract, the Contractor shall file a written consent of Surety, together with a copy of the proposed Assignment with the Owner or the Owner's Project Manager. In the event the Contractor assigns all or any part of the monies due or to become due under this Contract, the instrument or assignment shall state that the right of assignees in and to any monies due to or to become due to the Contractor shall be subject to prior liens and claims of all persons, firms and corporations that provided labor, services, or furnished material and equipment during the performance of the Work. The rights of assignees shall further be subject to the payment of any liens, claims or amounts due to Federal or State governments, and to all rights of retention and set-off granted to the Owner by the Contract Documents.

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7.3. CLAIMS FOR DAMAGES

7.3.1. Should the Contractor suffer injury or damage to person or property because of any act or omission of the Owner or of any of its employees, agents or others for whose acts either is legally liable, claim shall be made in writing to the Owner within thirty days after the first observance of such injury or damage; otherwise, the Contractor shall have waived any and all rights he may have against the Owner, or its employees, representatives and agents.

7.4. DISPUTES

7.4.1. A claim, if any, shall be made in writing and submitted by the Contractor to the Owner, the Project Manager and the Leesburg Town Attorney within ten calendar days after the occurrence of events giving rise to the claim. A claim is limited to events arising out of or relating to the Contract. Failure to file a written claim as required herein shall constitute an absolute waiver of any claim of any sort.

7.4.2. The parties shall first endeavor to resolve any disputes, claims or other matters in question between them through direct negotiations, and if such direct negotiations fail, by non-binding mediation, with the site of the mediation being the Town of Leesburg, Virginia.

7.4.3. If the procedures of subparagraph 7.4.2 have been followed, but more than 90 days have passed since a party has requested mediation, and the dispute, claim or matter in question remains unresolved, then either party may institute a lawsuit in the Circuit Court of Loudoun County, Virginia, which is agreed to be the sole and exclusive venue, and may pursue all available appeals in Virginia state courts, to the extent they have jurisdiction.

7.4.4. Nothing in paragraphs 7.4.1 or 7.4.2 shall prevent a party from seeking temporary injunctive or other temporary equitable relief in the Loudoun County Circuit Court if circumstances so warrant.

7.4.5. In the event of any dispute, claim, or other matter in question arising, Contractor shall continue its performance diligently during its pendency as if no dispute, claim or other matter in question had arisen. During the pendency of any dispute in connection with the payment of moneys, Contractor shall be entitled to receive payments for non-disputed items.

7.4.6. Notwithstanding any other provision hereof, the Contractor expressly waives all claims against the Owner for consequential damages arising out of or relating to this Contract. This waiver includes losses of financing, business and reputation, bonding capacity, and loss of profit other than profit arising directly from the Work where otherwise permitted in the Contract.

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7.5. TESTS

7.5.1. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested, or approved, the Contractor shall give the Owner's Project Manager five days notice of its readiness so the Owner's Project Manager may observe such inspection, testing, or approval. The Contractor shall bear all costs of such inspections, tests or approvals conducted by public authorities.

7.5.2. If the Owner's Project Manager determines that any Work requires special inspection, testing, or approval that Article 7.5.1 does not include, the Owner's Project Manager will order the Contractor to make arrangements for such special inspection, testing or approval, and the Contractor shall give the Owner's Project Manager five days notice of such inspection. If such special inspection or testing reveals a failure of the Work to comply with:

1. The requirements of the Contract Documents, or
2. The conformance of the Work with laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction.

The Contractor shall bear all costs of the Work, including compensation for the Owner's Project Manager and any additional services made necessary by such failure.

7.5.3. Inspections and tests required under Article 7.5.2 to establish compliance with the Contract Documents will be made by a testing agency employed by the Owner. If the initial tests indicate non-compliance with the Contract Documents, the Contractor shall bear the costs thereof and any subsequent testing occasioned by non-compliance shall be performed by the same agency and the cost thereof shall be borne by the Contractor. Representatives of the testing agency shall have access to the Work at all times. The Contractor shall provide facilities for such access in order that the agency may properly perform its functions.

7.5.4. Certificates of inspection, testing or approval required by public authorities shall be secured by the Contractor and promptly delivered by him to the Owner's Project Manager, in adequate time to avoid delays in the Work or Final Payment.

7.5.5. The Contractor shall pay for and have sole responsibility for inspection or testing performed exclusively for his own convenience and for tests necessary because of Contractor's or Subcontractor's errors, omission, or noncompliance with Contract Documents.

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7.5.6. All materials and workmanship (if not otherwise designated by the specifications) shall be subject to inspection, examination and test by the Owner or the Owner's Project Manager, at any time during the manufacture or construction and at any place where such manufacture or construction are carried on. Special, full-sized and performance tests shall be described in the specifications. Without additional charge, the Contractor shall furnish promptly all reasonable facilities, labor and materials necessary to make tests safe and convenient.

7.5.7. It is specifically understood and agreed that an inspection and approval of the materials or work by the Owner or the Owner's Project Manager shall not in any way subject the Owner to pay for the said materials or work or any portion thereof, even though incorporated in the Work, if said materials or work shall in fact turn out to be not in compliance with the Contract Documents or otherwise defective.

7.6. UNENFORCEABILITY OF ANY PROVISION

7.6.1. If any provision of this Contract is held as a matter of law to be unenforceable or unconscionable, the remainder of the Contract shall be enforceable without such provision.

7.7. AVAILABILITY OF LANDS

7.7.1. Owner shall furnish, as indicated in the Contract Documents, the lands upon which the Work is to be done, rights-of-way or easements for access thereto. The Owner reserves the right to delay the notice to proceed with the Contract Work in order to secure rights of way, easements or to relocate utilities, such as sewer, water, gas, electricity, cable television and other services.

7.7.2. If the Contractor requires additional land for temporary construction facilities and for storage of materials and equipment other than the areas available on the site or right-of-way, or as otherwise furnished by the Owner, the Contractor shall provide such other lands and access thereto entirely at the Contractor's own expense and without liability to the Owner. The Contractor shall not enter upon private property for any purpose without written permission. The contractor shall provide to the Owner evidence of written permission for entry onto private property for the purpose of temporary construction facilities and/or storage of materials and equipment.

7.8. NONEXCLUSIVITY OF REMEDIES

All remedies available to the Owner under the Contract are cumulative and no such remedy shall be exclusive of any other remedy available to the Owner.

END OF ARTICLE 7

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ARTICLE 8: TIME

8.1. DEFINITIONS

8.1.1. The Contract Time is the period set forth in the Owner/Contractor Agreement for Final Completion of the Work as defined in Article 8.1.4, including authorized extensions thereto.

8.1.2. The date of commencement of the Work is the date established in the Notice to Proceed issued by the Owner.

Submission by the Contractor of all Certificates of Insurance, Performance and Payment Bonds and their approval by the Owner are conditions precedent to the issuance of the Notice to Proceed. Availability of lands under Article 7.7 is also a condition precedent to the issuance of the Notice to Proceed. The Contractor shall not commence the Work or store materials or equipment on site until written Notice to Proceed is issued or until the Contractor otherwise receives the written consent of the Owner.

8.1.3. The date of Substantial Completion of the Work or designated portion thereof is the date certified by the Owner's Project Manager that the Work or a designated portion thereof is sufficiently complete, in accordance with the Contract Documents, so the Owner can fully occupy or utilize the Work or designated portion thereof for the use for which it is intended, with all of the Project's parts and systems operable as required by the Contract Documents. Only punch list work and any final cleaning beyond that needed for the Owner's full use may remain for Final Completion.

8.1.4. The date of Final Completion of the Work is the date certified by the Owner's Project Manager when the Work is complete, to include punch list work and final clean up, in accordance with the Contract Documents and the Owner may fully occupy or fully utilize the Work for the use for which it is intended.

8.1.5. If the date or time of completion is included in the Contract, it shall be the Date of Final Completion as defined in Article 8.1.4, including authorized extensions thereto, unless otherwise provided.

8.1.6. The term Day as used in the Contract Documents shall mean calendar day unless otherwise specifically designated. All dates shall mean midnight of the indicated day unless otherwise stipulated.

GENERAL CONDITIONS

8.2. PROGRESS AND COMPLETION

8.2.1. All time limits stated in the Contract Documents are of the essence of this Contract.

8.2.2. The Contractor shall prosecute the Work diligently to Final Completion.

8.3. DELAYS AND EXTENSIONS OF TIME

8.3.1. The time during which the Contractor is delayed in the performance of the Work, by the acts or omissions of the Owner, the Owner's Project Manager or their employees or agents, acts of God, unusually severe and abnormal climatic conditions, fires, floods, epidemics, quarantine restrictions, strikes (not to exceed the actual duration of the strike), riots, terrorism, civil commotions, war or freight embargoes, or other conditions beyond the Contractor's control and that the Contractor could not reasonably have foreseen and provided against, shall be added to the Contract Time; provided, however, that no claim by the Contractor for an extension of time for delays will be considered unless made in compliance with the requirements of this Article and other provisions of the Contract Documents.

8.3.2. The Contract Time shall be adjusted only for Change Orders pursuant to Article 12, "CHANGES IN THE WORK," Article 3.3, "OWNER'S RIGHT TO STOP OR SUSPEND THE WORK," and Article 8.3, "DELAYS AND EXTENSIONS OF TIME." If the Contractor requests an extension of the Contract Time, he shall furnish such justification and supporting evidence as the Owner's Project Manager may deem necessary for a determination of whether the Contractor is entitled to an extension of time under the provisions of the Contract.

8.3.3. The burden of proof to substantiate a claim for an extension of the Contract Time shall rest with the Contractor, including evidence that the cause was beyond his control. The Owner's Project Manager shall base his findings of fact and decision on such justification and supporting evidence and shall advise the Contractor in writing thereof.

8.3.4. The Contractor shall not be entitled to and hereby expressly waives any extension of time resulting from any condition or cause unless the request for an extension of time is made in writing to the Owner's Project Manager within seven days of the first instance of delay.

8.3.5. Any claim for an extension of time for a delay for any cause shall be made by filing a written notice of claim with the Owner and the Owner's Project Manager at the beginning of the occurrence or within seven days thereafter if the resulting delay was not reasonably foreseeable. If the asserted cause of delay is weather,

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such notice shall be given within seven days after asserted commencement of the claim delayed. The notice of claim shall state the circumstances of the occurrence, the justification for the delay and for the extension of time, and the estimated duration of the delay and of the extension requested. The claim for an extension of time for weather delays shall be further substantiated by weather data collected during the period of delay at the construction site. Said data must demonstrate that an actual departure from normal weather occurred at the work site during the dates in question. Within seven days after the cause of delay has been remedied, the Contractor shall give written notice to the Owner and the Owner's Project Manager of the actual time extension requested as a result of the claimed delay. Failure to file either of the notices as required herein shall constitute an absolute waiver of any claims resulting from a delay or any sort.

The anticipated adverse weather days per month are shown in the chart below.

<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>	<u>July</u>	<u>Aug</u>	<u>Sept</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>
8	7	7	8	8	7	5	6	4	6	5	5

The above chart will constitute the base line for monthly weather time evaluations. Actual adverse weather days will be recorded on a calendar day basis (including holidays and weekends), and compared to the anticipated monthly adverse monthly days based on the above chart. The number of actual adverse weather days shall be calculated chronologically from the first day to the last day in each month.

- 8.3.6.** Any extension of time beyond the date of completion fixed by the Contract shall not be effective unless granted in writing, signed by the Owner.
- 8.3.7.** The Contractor shall be entitled to an extension of time for delay which in the opinion of the Owner is entirely beyond the expectation and control of the Contractor by suspension of work pursuant to Article 3, or by strikes, lockouts, fire, insurrection, war, lightning, hurricane, and tornado. The Contractor shall be entitled to an extension of time for such causes only for the number of days of delay that the Owner may determine to be due solely to such causes and only to the extent that such occurrences actually delay the completion of the Project. Any request for extension of time shall be accompanied by detailed documentation of which specific schedule activities were affected, when they were affected and for what duration.
- 8.3.8.** No extension of time will be granted to the Contractor for delays occurring to parts of the Work that have no measurable impact on the competition of the total Work under this Contract; nor will extension of time be granted for delays to

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parts of the Work that are not located on the Critical Path as reflected on the approved construction schedule at the time of such delay.

- 8.3.9.** Delays in the delivery of equipment or material purchased by the Contractor or his Subcontractors (including Owner-selected equipment), or in the submission of required drawings or specifications by the Contractor's or its Subcontractor's materialmen, manufacturers or dealers, or in the performance of any of the Contractor's Subcontractors or caused by the performance of any of the Contractor's Subcontractors, shall not be considered as a just cause for delay. The Contractor shall be fully responsible for the timely submission, ordering, scheduling, expediting, delivery and installation of all equipment, materials and drawings.
- 8.3.10.** Within sixty days after the Contractor files the notice of the actual duration of the extension of time as required herein, the Owner's Project Manager shall present his written opinion to the Owner as to whether an extension of time is justified, and, if so, his recommendation as to the number of days for time extension. The Owner will make the final decision on all requests for extension of time. The Owner's written decision shall be presented to the Contractor within thirty days from receipt of the Owner's Project Manager's recommendation. All such decisions made by the Owner shall be binding and conclusive upon the Contractor.
- 8.3.11.** With respect to suspensions of work under Article 3, the Contractor may be entitled to an extension of time if the claim for such extension is submitted in accordance with the requirements of this Article, and if the suspension is not due to any act or omission of the Contractor, any Subcontractor or Sub-subcontractor or any other person or organization for whose acts or omission the Contractor may be liable.
- 8.3.12.** An extension of time shall be the sole remedy under this Contract for any reasonable delay caused by any reason or occurrence. The Contractor acknowledges such extension of time to be its sole remedy hereunder, and agrees to make no claim for monetary damages of any sort for delay in the performance of this Contract occasioned by or in any way related to or arising from any act or omission to act of the Owner or the Owner's Project Manager or any representatives of the Owner or any representatives of the Owner's Project Manager, or because of any injunction which may be brought against the Owner or the Owner's Project Manager.
- 8.3.13.** As a condition precedent to such additional compensation for unreasonable delay, the Contractor shall satisfy all notice and submission requirements set forth in the Contract Documents for approval of any extension of Contract Time or any change in the Contract Price.

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8.3.14. If the Contractor asserts an unwarranted claim for additional compensation for unreasonable delay, the Contractor shall be liable to the Owner and shall pay the Owner all costs incurred by the Owner in investigating, analyzing, negotiating, and litigating the claim.

8.3.15. This Article shall be construed to be included where applicable in every portion of the Contract Documents regardless of whether or not it is specifically referenced therein.

END OF ARTICLE 8

GENERAL CONDITIONS

ARTICLE 9: PAYMENTS AND COMPLETION

9.1. CONTRACT PRICE

9.1.1. Unless all or a part of the Contract is based on unit prices, the Contract Price is stated in the Contract and, including authorized adjustments thereto, is the firm, fixed price amount payable by the Owner to the Contractor for the performance of the Work under the Contract Documents. The Contract Price includes, but is not limited to, the Contractor's profits and general overhead and all costs and expenses of any nature whatsoever (including without limitation taxes, labor and materials), foreseen or unforeseen, and any increases in said costs and expenses, foreseen and unforeseen, incurred by the Contractor on this project. The Contractor agrees to assume all increases in costs of any nature whatsoever that may develop during the performance of the Work. The Contract Price includes all applicable Federal, State and local taxes and duties.

9.2. SCHEDULE OF VALUES

9.2.1. Within ten days after the Notice to Proceed is issued, the Contractor shall submit to the Owner's Project Manager a Schedule of Values, allocated to the various portions of the Work including mobilization and demobilization. This schedule, supported by data from the approved Progress Schedule, shall be used as a basis for the Contractor's Applications for Payment upon approval by the Owner's Project Manager. The Schedule of Values shall not alter in any way the firm, fixed price or lump sum contract price. The Contractor shall not front-end load or otherwise assign disproportionate amounts to the Schedule of Values.

9.2.2. If at any time the Contractor expects to receive an amount for a monthly progress payment larger than that indicated by the Schedule of Values and the approved Construction Schedule, the Contractor shall notify the Owner at least thirty days in advance of that payment so that the necessary allocation of funds can be processed. If the Contractor fails to give such notice, the Owner may defer such excess payment to the following progress payment.

9.2.3. With respect to any portion of the Contract subject to unit prices, the schedule of unit prices in the accepted bid shall be used as the basis for preparing Applications for Payment, and each partial payment shall represent the total value of all units of work completed, computed at the unit prices stated in the Contract, less the aggregate of previous payments and retainage. Final payment will be based on the actual quantities performed and justified on as-built drawings.

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9.3. APPLICATIONS FOR PAYMENT

- 9.3.1.** The Owner shall make progress payments monthly as the Work proceeds on Applications for Payment approved by the Owner's Project Manager.
- 9.3.2.** Prior to the date for each progress payment established in the Contract, the Contractor, in accordance with any Supplementary Conditions concerning schedules or payments, shall submit to the Owner's Project Manager an itemized Application for Payment, supported by such data substantiating the Contractor's right to payment as the Owner's Project Manager may require, including but not limited to the Contractor's certification that all work for which payment is requested has been completed in full accordance with the Contract Documents, copies of requisitions from Subcontractors and reflecting retainage, if any, as provided elsewhere in the Contract Documents. The Contractor shall certify that he has paid all due and payable amounts for which previous Certificates for Payment were issued and payments received from the Owner.
- 9.3.3.** The Owner will retain five percent of the amount of all progress payments until the Work is substantially completed and accepted, whether or not the Owner has occupied any or all of the Project before such time.
- 9.3.4.** The contractor warrants that title to all Work, materials and equipment covered by an Application for Payment will pass to the Owner either by incorporation in the construction or upon the receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests or encumbrances, hereinafter referred to in this Article 9 as "LIENS". The Contractor further warrants that no Work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor, or by any other person performing Work at the site or furnishing materials and equipment for the Project, subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person.
- 9.3.5.** Unless otherwise provided in the specifications the Owner will make partial payments to the Contractor on the basis of a duly certified and approved estimate of the Work performed during the preceding calendar month as certified by the Owner's Project Manager.
- 9.3.6.** The Contractor may, in preparing estimates, take into consideration the material delivered on site and preparatory work done, if properly documented as required by this Contract, or as may be required by the Owner or the Owner's Project Manager so that the quantities may be verified.
- 9.3.7.** The Contractor may, in preparing estimates, take into consideration material such as large pieces of equipment and items purchased specifically for the project, but

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stored off the site within the Commonwealth of Virginia, and these items may be considered for payment at the sole discretion of the Owner, provided that all of the following are accomplished prior to the submission of the monthly payment request in which payment for such materials is requested:

1. The Contractor must notify the Owner in writing at least ten days prior to the submission of the payment request, through the Owner's Project Manager, that specific items will be stored off site in a designated secure place within the Commonwealth of Virginia. The Schedule of Values must be detailed to separately indicate both the value of the material and of the labor/installation for trades requesting payment for stored materials. The Contractor warrants by giving such notification and by requesting payment for material stored off-site that the storage location is safe and suitable for the type of material stored and agrees that loss of such material shall not relieve him of the obligation to furnish these types and quantities of materials for the project and on a schedule to meet the time completion requirements of the Contract, subject to Article 8.
2. Such notification, as well as the payment request, shall:
 1. itemize the quantity of such materials, and document with invoices the cost of said materials;
 2. indicate the identification markings used on the materials. Such markings shall clearly reference the materials to the Project;
 3. State the specific location of the materials. The location must be within reasonable proximity to the job site within the Commonwealth of Virginia;
 4. State that the Surety on the Performance Bond and the Labor and Material Payment Bond has been notified of the request for payment of materials stored off the site and is agreeable to such payment;
 5. Certify that adequate all-risk insurance has been obtained by the Contractor on the materials. Such insurance shall be in the name of the Owner and the Contractor.
3. The Owner's Project Manager shall indicate, in writing, to the Owner that submittals for such materials have been reviewed and meet the requirements of the drawings and specifications of the

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Contract documents, that the stored materials meet the requirement of the drawings and specifications, and that such material conforms to the approved submittals.

4. The Owner, through the Owner's Project Manager, shall notify the Contractor in writing of his agreement to prepayment for materials.
5. The Contractor shall notify the Owner in writing, through the Owner's Project Manager, when the materials are to be transferred to the site and when the materials are received at the site.
6. No partial payment shall be made until the appropriate Certificates of Insurance have been provided.
7. All material and Work for which partial payments are made shall thereupon become the sole property of the Owner, but this provision shall not relieve the Contractor from the sole responsibility for all materials and Work, including those for which payment has been made, or the restoration of any damaged Work or as a waiver of the right of the Owner to require the fulfillment of all the terms of the Contract.

9.4. CERTIFICATES FOR PAYMENT

9.4.1. The Owner's Project Manager will within ten days after receipt of the Contractor's Application for Payment, either approve the Application for Payment for such amount as he determines is properly due, or notify the Contractor in writing of his reasons for not approving the Application for Payment as provided in Article 9.6 "PAYMENTS WITHHELD."

9.4.2. The submission and approval of the Progress Schedule and monthly updates thereof, as required by any Supplementary Conditions concerning Schedules, shall be part of the application upon which progress payment shall be made. The Contractor shall be entitled to progress payments only as determined from the currently Approved and Updated Progress Schedule.

9.5. PROGRESS PAYMENTS

9.5.1. After an Application for Payment has been approved by the Owner's Project Manager, the Owner shall make payment in the manner and within the time provided in the Contract Documents.

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9.5.2. In accordance with Title 2.2-4354, Va. Code. Ann., Contractor is obligated to take one of the two following actions within seven (7) days after receipt of amounts paid to the Contractor by the Owner for work performed by any Subcontractor under this Contract:

1. Pay the subcontractor for the proportionate share of the total payment received from the Owner attributable to the Work performed by the Subcontractor under this Contract; or
2. Notify the Owner and the Subcontractor, in writing, of the Contractor's intention to withhold all or a part of the Subcontractor's payment with the reason for nonpayment.

The Contractor is obligated to provide its social security numbers and if a proprietorship, partnership, or corporation, they must provide its federal employer identification number.

The Contractor is obligated to pay interest to Subcontractors on all amounts owed by the Contractor that remain unpaid after seven (7) days following receipt by the Contractor of payment from the Owner for Work performed by the Subcontractor under this Contract, except for amounts withheld as allowed in Article 9.5.2.2, above. It is herewith provided that interest shall accrue at the base rate on corporate loans (prime rate) at large United States money center commercial banks as reported daily in the publication entitled The Wall Street Journal.

The Contractor shall include in each of its subcontracts a provision requiring each Subcontractor to include or otherwise be subject to the same payment and interest requirements with respect to each lower-tier Subcontractor.

The Contractor's obligation to pay an interest charge to a Subcontractor pursuant to the above provisions shall not be construed to be an obligation of the Owner. A Contract modification may not be made for the purpose of providing reimbursement for such interest charge. A cost reimbursement claim may not include any amount for reimbursement for such interest charge.

9.5.3. The Owner's Project Manager may, on request and at his discretion, furnish to any Subcontractor, if practicable, information regarding the percentages of completion or the amounts applied for by the Contractor, and the action taken thereon by the Owner's Project Manager on account of Work done by such Subcontractor.

9.5.4. The Owner has no obligation to pay or to see to the payment of any monies to any Subcontractor except as may otherwise be required by law.

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9.5.5. No Application for Payment, nor any progress payment, nor any partial or entire use or occupancy of the Project by the Owner, shall constitute an acceptance of any Work that is not in accordance with the Contract Documents.

9.5.6. In the event of disputes, payment shall be mailed on or before the Payment date for amounts and Work not in dispute, subject to any set-offs claimed by the Owner; except in instances where further appropriations are required by the Owner or where the issuance of further bonds is required, in which case, payment shall be made within thirty days after the effective date of such appropriation or within thirty days after receipt of bond proceeds by the Owner.

9.6. PAYMENTS WITHHELD

9.6.1. The Owner's Project Manager may decline to approve the Application for Payment or reduce payment or because of subsequently discovered evidence or subsequent observations, he may nullify the whole or any part of any Application for Payment previously approved to such extent as may be necessary in his opinion to protect the Owner from loss, because of:

1. Defective Work not remedied;
2. Third party claims filed, whether in court, in arbitration or otherwise, or reasonable evidence indicating probable filing of such claims;
3. Failure of the Contractor to make payments properly to Subcontractors;
4. Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Price;
5. Damage to the Owner or to a separate contractor;
6. Reasonable evidence that the Work will not be completed within the Contract Time, or within any Contract Milestones as established in the Contract Documents;
7. Failure or refusal of the Contractor to carry out the Work in accordance with or to otherwise substantially or materially comply with the Contract Documents;
8. Failure or refusal of the Contractor to properly schedule and coordinate the Work, or to provide Progress Schedules, reports and updates; and

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9. Failure or refusal of the Contractor to fully comply with the provisions of Article 4.13 "DOCUMENTS, OTHER SUBMITTALS AT THE SITE; AS-BUILT DRAWINGS."

9.6.2. When the above grounds in Article 9.6.1 are removed, payment shall be made for amounts withheld because of them.

9.7. SUBSTANTIAL COMPLETION

9.7.1. When the Contractor considers that the Work, or a designated portion thereof which is acceptable to the Owner's Project Manager, is substantially complete as defined in Article 8.1.3, the Contractor shall prepare for submission to the Owner's Project Manager a list of items that in his opinion are to be completed or corrected and shall request in writing that the Owner's Project Manager perform a Substantial Completion inspection. The Owner's Project Manager shall review the Contractor's list and will compile a punch list of items to be corrected and completed. 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. When the Owner's Project Manager on the basis of an inspection determines that the Work or designated portion thereof is substantially complete, he will then prepare a Certificate of Substantial Completion that will establish the Date of Substantial Completion, state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work, and insurance, and shall fix the time within which the Contractor shall complete the items listed.

1. The Certificate of Substantial Completion shall be issued to the Contractor for his written acceptance of the responsibilities assigned to him in such Certificate and returned to the Owner's Project Manager within five days after issuance

9.7.2. The Contractor shall have thirty days from the Date of Substantial Completion to complete all items on the punch list to the satisfaction of the Owner's Project Manager. The Owner's Project Manager shall have the option to correct any and all punch list items not completed by the Contractor within thirty days from the Date of Substantial Completion by utilizing his own forces, those of the Owner, or by a separate Contractor. The cost of such correction of remaining punch list items by the Owner or others shall be deducted from the Final Payment to the Contractor.

9.7.3. The issuance of the Certificate of Substantial Completion does not indicate final acceptance of the Project by the Owner, and the Contractor is not relieved of any responsibility for the Project except as specifically stated in the Certificate of Substantial Completion.

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9.7.4. Should the Owner's Project Manager determine that the Work or a designated portion thereof is not substantially complete, he shall provide the Contractor a written notice stating why the project or designated portion is not substantially complete. The Contractor shall expeditiously complete the Work and shall request in writing that the Owner's Project Manager perform a Substantial Completion reinspection and the costs, if any, associated with such reinspection shall be assessed to the Contractor.

9.8. FINAL COMPLETION AND FINAL PAYMENT

9.8.1. Upon receipt of the documentation required by Article 9.8.3, and of written notice that the Work is ready for final inspection and acceptance, the Owner's Project Manager will promptly make such inspection and, when he finds the Work acceptable under the Contract Documents and the Contract fully performed, he will issue a Certificate of Final Completion to the Contractor. Upon his receipt of the Final Completion Certificate, the Contractor may submit his Application for Final Payment to the Owner's Project Manager for his approval. Final Payment shall be made in full to the Contractor within thirty calendar days after the approval by the Owner's Project Manager of the Application for Final Payment provided that the requirements of Article 9 have been fulfilled, except for an amount agreed upon for any Work remaining uncompleted for which the Owner is entitled a credit under the Contract Documents.

9.8.2. Should the Owner's Project Manager determine that the Work or a designated portion thereof is not complete, he shall provide the Contractor a written notice stating why the Project or designated portion is not complete. The Contractor shall expeditiously complete the Work and shall request in writing that the Owner's Project Manager perform a Final Completion reinspection and the costs, if any, associated with such reinspection shall be assessed to the Contractor.

9.8.3. Neither the Final Payment nor the remaining retained percentage shall become due until the Work is free and clear of any and all Liens and the Contractor submits to the Owner's Project Manager:

1. An affidavit that all payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or its property might in any way be responsible, have been paid or otherwise satisfied;
2. Consent of surety to Final Payment, if necessary;
3. As-built drawings, operation and maintenance manuals and other project closeout submittals, as required by the Contract Documents;

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4. A fully executed and notarized Release of claims in such form as may be designated by the Owner; and
5. A written certification that:
 - A. the Contractor has reviewed the requirements of the Contract Documents;
 - B. the Work has been inspected by the Contractor for compliance with all requirements of the Contract Documents;
 - C. pursuant to this inspection, the Contractor certifies and represents that the Work complies in all respects with the requirements of the Contract Documents;
 - D. the Contractor further certifies and represents that all equipment and systems have been installed and tested in accordance with the Contract Documents and the Owner personnel training in the proper operation and maintenance of equipment is complete; and
 - E. the Contractor provides construction releases as required by the Contract Documents from each property owner on whose property an easement for construction of this project has been obtained by the Owner, such release to be in the forms to be provided by the Owner. This release is for the purpose of releasing the Owner and the Contractor from liability, claims, and damages arising from construction operations on or adjacent to the easement and includes proper restoration of the property after construction. It shall be the Contractor's sole responsibility to obtain all such releases and furnish them to the Owner.

9.8.4. The making of Final Payment shall constitute a waiver of all claims by the Owner against the Contractor except those arising from:

1. Unsettled liens and claims against the Owner;
2. Faulty, defective or non-conforming Work discovered or appearing after Substantial or Final Completion;
3. Failure of Work to comply with the requirements of the Contract Documents; and

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4. Terms of any warranties contained in or required by the Contract Documents.

9.8.5. The acceptance of Final Payment shall constitute a waiver of all claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of the Application for Final Payment.

9.8.6. Warranties required by the Contract Documents shall commence on the Date of Final Acceptance of the Work or designated portion thereof unless otherwise provided in writing.

9.9. PARTIAL OCCUPANCY OR USE

9.9.1. The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Article 11.2.8 and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and the Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Owner's Project Manager as provided under Article 9.7. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner's Project Manager and the Contractor or, if no agreement is reached, by decision of the Owner's Project Manager.

9.9.2. Immediately prior to such partial occupancy or use, the Owner or the Owner's Project Manager, and the Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

9.9.3. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

END OF ARTICLE 9

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ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1. SAFETY PRECAUTIONS AND PROGRAMS

10.1.1. The Owner and the Owner's Project Manager are not responsible for the means, methods, techniques, sequences or procedures utilized by the Contractor, or for safety precautions and programs in connection with the Work. The Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. This requirement applies continuously throughout the Contract performance, until Final Payment is made, and is not limited to regular working hours.

10.2. SAFETY OF PERSONS AND PROPERTY

10.2.1. The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss, to:

1. All employees on the Work and other persons who may be affected thereby;
2. All the Work and materials and equipment to be incorporated therein whether in storage off the site, under the care, custody or control of the Contractor or any of his Subcontractors, machinery and equipment. The Contractor shall comply with, and ensure that the Contractor's personnel and subcontracted personnel comply with all current applicable local, state and federal policies, regulations and standards relating to safety and health, including, by way of illustration and not limitation, the standards of the Virginia Occupational Safety and Health Administration for the General Industry and for the Construction Industry, the Federal Environmental Protection Agency Standards, the Manual of Accident Prevention in Construction published by the Associated General Contractors of America and the applicable standards of the Virginia Department of Environmental Quality.
3. Other property at or adjacent to the Work, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

10.2.2. The Contractor shall give all notices and comply with applicable laws, ordinances, permits, rules, regulations and orders of any public authority bearing on the safety of persons or property or their protection from damage, injury or loss.

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- 10.2.3.** The Contractor shall at all times safely guard the Owner's property from injury or losses in connection with this Contract. He shall at all times safely guard and protect his own work and adjacent property as provided by law and the Contract Documents from damage. All security personnel, passageways, guard fences, lights, and other facilities required for protection of the property and the Work described herein shall be provided and maintained at the Contractor's expense.
- 10.2.4.** The Contractor shall erect and maintain, as required by existing conditions and progress of the Work, all reasonable safeguards for safety and protection, including danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.
- 10.2.5.** When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.
- 10.2.6.** The Contractor shall promptly remedy at his own cost and expense all damage or loss to any property referred to in Articles 10.2.1.2 and 10.2.1.3. The Contractor shall perform such restoration by underpinning, repainting, rebuilding, replanting, or otherwise restoring as may be required or directed by the Owner's Project Manager or shall make good such damage in a satisfactory and acceptable manner. In case of failure on the part of the Contractor to promptly restore such property or make good such damage, the Owner may, upon two days written notice, proceed to repair, rebuild or otherwise restore such property as may be necessary, and the cost thereof will be deducted from any monies due or to become due to the Contractor under the Contract.
- 10.2.7.** The Contractor shall give notice in writing at least 48 hours before breaking ground, to the Owner, all persons, Public Utility Companies, superintendents, inspectors or those otherwise in charge of property, streets, water pipes, gas pipes, sewer pipes, telephone cables, electric cables, railroads or otherwise, who may be affected by the Contractor's operation, in order that they may remove any obstruction for which they are responsible and have a representative on site to see that their property is properly protected. The Contractor is responsible for any damages or claims resulting from any excavation and shall defend, fully indemnify, and hold harmless the Owner from all actions resulting from such work regardless of whether the Contractor gave proper notice under this clause.
- 10.2.8.** The Contractor shall protect all utilities encountered while performing its work, whether indicated on the Contract Documents or not. The Contractor shall maintain utilities in service until moved or abandoned. The Contractor shall exercise due care when excavating around utilities and shall restore any damaged utilities to the same condition or better as existed prior to starting the Work, at no cost to the Owner. The Contractor shall maintain operating utilities or other services, even if they are shown to be abandoned on the Contract Drawings, in service until new facilities are provided, tested and ready for use.

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- 10.2.9.** The Contractor shall return all improvements on or about the site and adjacent property that are not shown to be altered, removed or otherwise changed to conditions that existed prior to starting work.
- 10.2.10.** The Contractor shall protect the Work, including but not limited to, the site, stored materials and equipment, excavations, and excavated or stockpiled soil or other material, intended for use in the Work, and shall take all necessary precautions to prevent or minimize damage to same or detrimental effect upon his performance or that of his Subcontractors, caused by or due to rain, run-off, floods, temperature, wind, dust, sand, and flying debris. For example, but not by way of limitation, Contractor shall, when necessary, utilize temporary dikes, channels or pumping to carry-off, divert or drain water, and as necessary tie-down or otherwise secure the Work and employ appropriate covers and screens.
- 10.2.11.** The Contractor shall be responsible for the prevention of accidents and the protection of material, equipment and property.
- 10.2.12.** The Contractor shall not load or permit any part of the Work to be loaded so as to endanger the safety of the Work, persons or adjacent property.
- 10.2.13.** The Contractor has sole and complete responsibility for the correction of any safety violation and sole liability for the consequences of the violation. The Contractor shall give prompt written notice of any safety violation to the Owner's Project Manager.
- 10.2.14.** The Contractor shall provide, or cause to be provided, all technical expertise, qualified personnel, equipment, tools and material to safely accomplish the Work, specified to be performed by the Contractor and Subcontractor(s).
- 10.2.15.** The Contractor shall be responsible for the preservation of all public and private property, trees, monuments, etc., along and adjacent to the street and/or right-of-way, and shall use every precaution to prevent damage to pipes, conduits and other underground structures, curbs, pavements, etc., except those to be removed or abandoned in place and shall protect carefully from disturbance or damage all monuments and property marks until an authorized agent has witnessed or otherwise referenced their location and shall not remove them until directed. Any damage which occurs by reason of the operations under this Contract shall be completely repaired by the Contractor at the Contractor's expense.
- 10.2.16.** The Contractor shall shore, brace, underpin, secure, and protect, as may be necessary, all foundations and other parts of existing structures adjacent to, adjoining, and in the vicinity of the site that may be affected in any way by excavations or other operations connected with the Work contained in this Contract. The Contractor shall be responsible for the giving of any and all required notices to any adjoining or adjacent property owned or other party before commencement of any Work. The Contractor shall indemnify and save the Owner harmless from any damages on account of settlements or loss of all damages for which the Owner may become liable in consequence of such injury or damage to adjoining and adjacent structures and their premises.

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10.2.17. The Contractor shall identify to the Owner's Project Manager at least one on-site person who is the Contractor's competent, qualified, and authorized person on the worksite and who is, by training or experience, familiar with policies, regulations and standards applicable to the Work being performed. The competent, qualified and authorized person must be capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees, shall be capable of ensuring that applicable safety regulations are complied with, and shall have the authority and responsibility to take prompt corrective measures, which may include removal of the Contractor's personnel from the work site.

10.2.18. The Contractor shall provide to the Owner's Project Manager, a copy of the Contractor's written safety policies and safety procedures applicable to the Work within seven (7) days of the issuance of the Notice to Proceed.

10.3. EMERGENCIES

10.3.1. In any emergency affecting the safety of persons or property, the Contractor shall act to prevent threatened damage, injury, or loss to the Owner. The Contractor shall notify the Owner's Project Manager of the situation and all actions taken immediately thereafter. If, in the opinion of the Contractor, immediate action is not required, the Contractor shall notify the Owner's Project Manager of the emergency situation and take necessary steps. If any loss, damage, injury or death occurs that could have been prevented by the Contractor's prompt and immediate action or the emergency resulted from acts or omissions of the Contractor or his Subcontractors, or anyone directly or indirectly employed by any of them, or by anyone whose acts any of them may be liable, the Contractor shall defend, fully indemnify and hold harmless the Owner (including attorneys' fees) from all actions resulting from the emergency. Any additional compensation or extension of time claimed by the Contractor on account of emergency work shall be determined as provided in Article 12 "CHANGES IN THE WORK."

10.3.2. Prior to commencing his work and at all times during the performance of the Work, the Contractor shall provide the Owner with two, 24-hour emergency phone numbers where his representatives can be contacted.

END OF ARTICLE 10

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ARTICLE 11: BONDS AND INSURANCE

11.1. BONDS

- 11.1.1.** The Contractor shall furnish to the Owner a performance bond in the sum of the contract price executed by a surety authorized to do business in Virginia, payable to the Town of Leesburg, Virginia, or such other entity as may be identified in the Contract, and conditioned upon the faithful performance of the contract in strict conformity with the plans, specifications, and conditions of the Contract Documents.
- 11.1.2.** The Contractor shall furnish to the Owner a payment bond in the amount of the contract price payable to the Town of Leesburg or such other entity as may be identified in the Contract, and executed by a surety authorized to do business in Virginia. Such bond shall be conditioned on the prompt payment to all claimants who have and fulfill contracts to supply labor or materials to the Contractor for all material furnished or labor supplied or performed in the prosecution of the Work. "Labor and materials" shall include public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the project site.
- 11.1.3.** If the amount of all Work subcontracted to any one Subcontractor is in excess of \$10,000, the Contractor may at his option require the Subcontractor to furnish a Labor and Material Payment Bond with surety thereon, in the amount of fifty percent of the amount of the Subcontract.
- 11.1.4.** The Contractor shall ensure that all sureties providing bonds for the Project will give written notice to the Owner, at least thirty days prior to expiration or termination of the bond(s).
- 11.1.5.** If the surety on any Bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located, the Contractor shall within five days thereafter substitute another Bond and surety, both of which shall be acceptable to the Owner.
- 11.1.6.** If at any time, the Owner shall be or become dissatisfied with any surety or sureties then upon the Performance and Labor and Materials Payment Bonds, or if for any other reason, such bond shall cease to be adequate security to the Owner, the Contractor shall within five days after notice from the Owner to do so, substitute an acceptable bond(s) in such form and sum and signed by such other sureties as may be satisfactory to the Owner. The premium on such bond(s) shall be paid by the Contractor. No further payment shall be deemed due nor shall be made until the new sureties have been qualified and accepted by the Owner.
- 11.1.7.** If more than one surety executes a bond, each shall be jointly and severally liable to the Owner for the entire amount of the bond.

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11.2. CONTRACTOR'S LIABILITY INSURANCE

11.2.1. The Contractor shall provide to the Owner, a Certificate of Insurance indicating that the Contractor has in force the coverage below prior to the start of any Work under this Contract. The Contractor agrees to maintain such insurance until the completion of this Contract. All required insurance coverages must be acquired from insurers authorized to do business in the Commonwealth of Virginia and acceptable to the Owner. The minimum insurance coverage shall be:

1. Workers Compensation Insurance – as required by federal, state, and municipal laws for the protection of all Contractors' employees working on or in connection with the project, shall be in accordance with Title, 2.2-4332, Va. Code Ann.
2. Comprehensive General Liability Bodily Injury and Property Damage: \$3,000,000 combined single limit/each occurrence in the primary policy or through the use of Umbrella or Excess Limits.

The General Liability Insurance shall include the following coverages; comprehensive form, premises-operations, explosion and collapse hazard, underground hazard, products/completed operations hazard, contractual liability insurance, broad form property damage including completed operations, contractors protective liability, personal injury (all insuring agreements) deleting the employee exclusion, and owners protective liability.

1. Contractor's Automobile Liability (Bodily Injury and Property Damage):

\$3,000,000 combined single limit per occurrence in the primary policy or through the use of Umbrella or Excess Limit

The Automobile Liability Insurance shall include the following coverages; comprehensive form, owned, hired, and non-owned.

2. Property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Article 9.8 or until no person or entity other than the Owner has an insurable interest in the property required by this Article 11.5 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project. The property

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insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements.

If the liability insurance purchased by the Corporation has been issued on a "claims made" basis, the Corporation must comply with the following additional conditions. The limits of liability and the extensions to be included as described previously in these provisions, remain the same.

The Corporation must either:

1. Agree to provide certificates of insurance evidencing the above coverage for a period of two (2) years after final payment for the Agreement for General Liability policies. This certificate shall evidence a "retroactive date" no later than the beginning of the Corporation's work under this Agreement, or
2. Purchase the extended reporting period endorsement for the policy or policies in force during the term of this Agreement and evidence the purchase of this extended reporting period endorsement by means of a certificate of insurance or a copy of the endorsement itself.

11.2.2. Additional Insured – The Owner, its officers, elected and appointed officials, and employees shall be named as an additional insured in the Contractor's Commercial General Liability policy; evidence of the Additional Insured endorsement shall be typed on the certificate and a copy of the additional insured endorsement shall be forwarded to the Owner along with the copy of the insurance certificate.

11.2.3. Contract Identification – The insurance certificate shall state this Contract's number and title.

11.2.4. The Contractor shall secure and maintain until all work required under the Contract is accepted, such insurance as will protect the Contractor and the Owner from claims directly or indirectly arising or alleged to arise out of the performance of, or failure to perform the Work, or the condition of the Work or the jobsite, from claims by workers, suppliers, Subcontractors, and the general public; from claims made under safe place laws, or any law with respect to protection of adjacent landowners; and from any other claims for damages to property from operations by the Contractor or any Subcontractor, or anyone directly or indirectly employed by either of them.

The Contractor assumes all risks for direct and indirect damage or injury to the property or persons used or employed on or in connection with the Work contracted for, and of all damage or injury to any person or property wherever located, resulting from any action, omission, commission or operation under the Contract, or in connection in any way whatsoever with the contracted Work.

GENERAL CONDITIONS

No acceptance or approval of any insurance by the Owner shall be construed as relieving or excusing the Contractor from any liability or obligation imposed upon the Contractor by the provisions of the Contract Documents.

- 11.2.5.** These certificates and the insurance policies required by Article 11.2 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least thirty days prior written notice has been given to the Owner. If any of the foregoing insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment as required by Article 9.8. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.
- 11.2.6.** Neither the Owner nor the Owner's Project Manager shall have any obligation to review any Certificates of Insurance provided by the Contractor or to check or verify the Contractor's compliance with any and all requirements regarding insurance imposed by the Contract. The Contractor is fully liable for the amounts and types of insurance required herein and is not excused should any policy or Certificate of Insurance provided by the Contractor not comply with the Contract's insurance requirements.
- 11.2.7.** If the Contractor fails to comply with the Contract's insurance requirements, the Owner shall be entitled to recover all amounts payable as a matter of law to the Owner or any other parties, including but not limited to the Owner's Project Manager, had the insurance coverage been in effect. Any recovery shall include but is not limited to interest for the loss of the use of such amounts of money, attorneys' fees, costs and expenses incurred in securing such determination and any other consequential damages.
- 11.2.8.** Partial occupancy or use in accordance with Article 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

GENERAL CONDITIONS

11.3. WAIVERS OF SUBROGATION

11.3.1. The Owner and Contractor waive all rights against (1) each other and any of the Subcontractors, Sub-subcontractors, agents and employees, each of the other, and (2) the Owner's Project Manager and Engineer or Architect or their consultants, separate contractors, if any, and any of their Subcontractors, Sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Article 11.5 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of his consultants, separate contractors, if any, and the Subcontractors, Sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

11.4. ADDITIONAL INSURANCE PROVISIONS

11.4.1. A loss insured under Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Article 11.5.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

11.4.2. If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 12.

11.4.3. The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved as provided in Article 7.4. The Owner as fiduciary shall, in the case of disputes, make settlement with insurers in accordance with orders of the Court.

END OF ARTICLE 11

GENERAL CONDITIONS

ARTICLE 12: CHANGES IN THE WORK

12.1. CHANGES IN THE WORK

12.1.1. The Owner, without invalidating the Contract and without notice to the surety, may order a Change in the Work consisting of additions, deletions, modifications or other revisions to the general scope of the Contract, or changes in the sequence of the performance of the Work. The Contract Price and the Contract Time shall be adjusted accordingly. All such Changes in the Work shall be authorized by written Change Order, and all Work involved in a Change shall be performed in accordance with the terms and conditions of this Contract. If the Contractor should proceed with a Change in the Work upon an oral order, by whomever given, it shall constitute a waiver by the Contractor of any claim for an increase in the Contract Price or Contract Time, on account thereof.

12.1.2. When the Owner and the Contractor have agreed upon a Change in the Work, but a written Change Order Document has not yet been executed, the Owner may, at its sole discretion and option, direct in writing the Contractor to proceed with the Change in the Work pending the execution of the formal Change Order. Contractor shall proceed in accordance with such direction.

12.1.3. The Contractor shall not begin work on any alteration requiring a modification until such modification has been executed by the Owner and the Contractor. If a satisfactory agreement cannot be agreed to for any item requiring a modification, the Owner reserves the right to terminate the contract as it applies to the items in question and make such arrangements as may be deemed necessary to complete the Work.

12.2. FIELD ORDER

12.2.1. A Field Order is a written order to the Contractor signed by the Owner or the Owner's Project Manager interpreting or clarifying the Contract Documents or directing the Contractor to perform minor changes in the Work. Any work relating to the issuance of a Field Order shall be performed promptly and expeditiously and without additional cost to the Owner and within the Contract Time, unless the Contractor submits a Proposed Change Order, defined below, which is approved by the Owner. Field Orders shall be numbered consecutively by date of issuance by the Owner or the Owner's Project Manager.

12.3. REQUEST FOR PROPOSAL

12.3.1. A Request For Proposal ("RFP") describes a proposed Change in the Work. In response to a Request for Proposal issued by the Owner or the Owner's Project Manager, the Contractor is required to submit a complete Proposal for the total cost and additional time, if any, necessary to perform the proposed Change in the

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Work. Requests For Proposals shall be numbered consecutively by date of issuance by the Owner or the Owner's Project Manager.

12.3.2. The Contractor's Proposal in response to an RFP shall be in the form prescribed by the Owner's Project Manager, including all appropriate back-up material.

12.4. PROPOSED CHANGE ORDER

12.4.1. A Proposed Change Order is a written request from the Contractor to the Owner requesting a change in the Contract Price and/or Contract Time. A Proposed Change Order may be submitted as a proposal in response to a Request For Proposal issued by the Owner or as a claim for an increase in the Contract Price and/or Contract Time pursuant to the issuance of a Field Order. A Proposed Change Order must be submitted within twenty days of the issuance of a Request For Proposal or a Field Order. Proposed Change Orders shall be numbered consecutively by date of issuance by the Contractor. The Contractor shall also indicate on the Proposed Change Order the number of the Request For Proposal or the Field Order to which it responds.

12.4.2. If a Request for Proposal provides for an adjustment to the Contract Price, the adjustment shall be based on one of the following methods:

1. Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
2. Unit prices stated in the Contract Documents or subsequently agreed upon;
3. Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
4. As provided in Articles 12.5.3 and 12.5.4.

12.4.3. If it is necessary in this subparagraph to increase the Contract Time to perform the Change in the Work, the Contractor shall provide an estimate of the increase in the Contract Time which shall be negotiated by the parties to the Contract. The Contractor's request for a time extension shall be evaluated in accordance with the criteria described in Article 8.

12.4.4. If the Contractor's Proposed Change Order is rejected by the Owner as being within the scope of the Work required by the Contract Documents the Owner may, at its sole option and discretion, direct the Contractor to perform the Work which is the subject of the Proposed Change Order; the Contractor shall then promptly proceed with the Work. Nothing shall excuse the timely performance by the Contractor of the Work because any Proposed Change Order is pending.

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12.5. CHANGE ORDER

12.5.1. A Change Order is a written order to the Contractor signed by the Contractor and the Owner's Project Manager, issued after execution of the Contract, authorizing a Change in the Work or an adjustment in the Contract Price and/or the Contract Time. The Contract Price and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates his agreement therein, including the adjustment in the Contract Price and/or the Contract Time. Change Orders shall be numbered consecutively by date of issuance by the Owner or the Owner's Project Manager and shall, if applicable, indicate the number of the Field Order(s), Request For Proposal(s) and/or Proposed Change Order(s) to which it relates.

12.5.2. If the Owner and the Owner's Project Manager determine that the Contractor's Proposed Change Order, submitted pursuant to Article 12.4 for a change in the Contract Price or Contract Time, is acceptable, the Owner's Project Manager shall prepare and issue, or cause to be prepared and issued, a Change Order which will authorize the Contractor to proceed with the Change in the Work for the cost and time stated in the Proposed Change Order, or as otherwise may be agreed upon by the parties. The amounts stated in the Change Order for the cost and time to perform the Change in the Work shall be binding on the parties.

1. The contractors markup for allowable profit and overhead shall be limited to 10%.

12.5.3. After issuance of the Change Order, the Contractor shall ensure that the amount of the Performance and Payment Bond coverage has been revised to reflect the increase in the Contract Price due to the Change Order.

12.5.4. If the Contractor's Proposed Change Order is not acceptable to the Owner and the Owner's Project Manager or if the parties are unable to otherwise agree as to the cost and time necessary to perform the Change in the Work, the Owner may, at its sole option and discretion, direct the Contractor to perform the Work on a time and material basis. The Contractor shall then promptly proceed with the Work.

12.5.5. If the Owner and the Owner's Project Manager elect to have the Change in the Work performed on a time and material basis, the same shall be performed, whether by the Contractor's forces or the forces of any of his Subcontractors or Sub-subcontractor's, at actual cost to the entity performing the Change in accordance with the time and material provisions included in the Road and Bridge Specifications of the Virginia Department of Transportation, current edition.

12.5.6. Prior to starting the work on a time and material basis, the Contractor shall notify the Owner's Project Manager in writing as to what labor, materials, equipment or rentals are to be used for the Change in the Work. During the performance of the Change, the Contractor shall submit to the Owner daily time and material tickets,

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which shall list the categories and amounts of labor and equipment for which Change Order compensation is to be charged for the previous work day. Such tickets shall be submitted in strict accordance with the time and material provisions included in the Road and Bridge Specifications of the Virginia Department of Transportation.

12.5.7. The Contractor shall commence submission of daily time and material tickets immediately upon commencement of the Change Order Work and continue to submit them until completion of the Change Order Work. The Owner may require authentication of all time and material tickets and invoices by persons designated by the Owner for such purpose.

12.5.8. The failure of the Contractor to provide any required authentication shall, if the Owner elects to treat it as such, constitute a waiver by the Contractor of any claim for the cost of that portion of the Change in the Work covered by a non-authenticated ticket or invoice; provided, however, that the authentication of any such ticket or invoice by the Owner shall not constitute an acknowledgment by the Owner that the items thereon were reasonably required for the Change in the Work.

12.5.9. The Contractor shall submit his complete submission of the reasonable actual cost and time to perform the Change in the Work within twenty days of the request of the Owner's Project Manager to do so. The Owner and the Owner's Project Manager shall review the costs and time submitted by the Contractor on the basis of reasonable expenditures and savings of those performing the Change in the Work. If such costs and time are acceptable to the Owner and the Owner's Project Manager, or if the parties otherwise agree to the actual reasonable cost to perform the Change in the Work, the Owner's Project Manager shall issue a Change Order for the cost and time agreed upon. The amounts stated in the Change Order for the cost and time to perform the Change in the Work shall be binding upon the parties.

12.5.10. The Contractor shall be entitled to costs as provided for in Article 12.4 which the Contractor, or his Subcontractors, may incur as a result of delays, interferences, suspensions, changes in sequence or the like, which are unreasonable, arising from the performance of any and all changes in the Work, caused by acts or omissions of the Owner, performed pursuant to this Article 12.

12.5.11. If any dispute should arise between the parties with respect to an increase or decrease in the Contract Price or an extension or reduction in the Contract Time or as a result of a Change in the Work, the Contractor shall not suspend performance of a Change in the Work or the Work itself unless otherwise so ordered by the Owner's Project Manager in writing. Disputes must be resolved pursuant to Article 7.4 of the Contract. The Owner will, however, pay the Contractor up to the Owner's Project Manager's estimated value of the Change in the Work, regardless of the dispute, if the Change in the Work results in an increase in the Contract Price; and the Owner will have the right to decrease the

GENERAL CONDITIONS

Contract Price up to the Owner's Project Manager's estimated value of the Change in the Work, regardless of the dispute, if the Change in the Work results in a decrease in the Contract Price.

12.6. UNILATERAL CHANGE ORDER

12.6.1. In the event that the parties are unable to agree as to the reasonable cost and time to perform the Change in the Work and the Owner does not elect to have the Change in the Work performed on a time and material basis, the Owner and the Owner's Project Manager shall make a unilateral determination of the reasonable cost and time to perform the Change in the Work, based upon their own estimates, the Contractor's submission or a combination thereof. A Change Order shall be issued for the amounts of cost and time determined by the Owner and the Owner's Project Manager and shall become binding upon the Contractor unless the Contractor submits his protest in writing to the Owner within ten days of the issuance of the Change Order. The procedure for the resolution of the Contractor's protest shall be as described in Article 12.10. The Owner has the right to direct in writing the Contractor to perform the Change in the Work, which is the subject of such Unilateral Change Order. Failure of the parties to reach an agreement regarding the cost and time of performing the Change in the Work, or any pending protest, shall not relieve the Contractor from performing the Change in the Work promptly and expeditiously.

12.7. DECREASES AND WORK NOT PERFORMED

12.7.1. Should it be deemed expedient by the Owner or the Owner's Project Manager at any time that the Contract Work is in progress to decrease the dimensions, quantity of material or work, or vary in any other way the Work herein contracted for, the Owner or the Owner's Project Manager shall have the full power to do so, and shall order, in writing, such decreases to be made or performed without affecting the enforcement of the Contract. The Contractor shall, in pursuance of such written orders and directions from the Owner or the Owner's Project Manager, execute the work ordered, and the difference in expense occasioned by such decrease so ordered shall be deducted from the amount payable under this Contract.

12.7.2. If Work is not performed, and such deletion of Work is not approved by the Owner, the Owner's Project Manager shall ascertain the amount of the credit due the Owner, based on the reasonable value of the labor and materials so deleted, for the lesser amount of materials and labor required.

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12.7.3. If Work is deleted from the Contract by Change Order, the amounts to be credited to the Owner shall reflect the same current pricing as if the Work were being added to the Contract at the time the deletion is ordered, and documentation will be required for a credit as specified in Article 12.4. If such deleted materials and equipment shall have already been purchased and stored on site and cannot be used in other projects or returned for credit or cannot be returned for credit at the price paid by the Contractor at the time of purchase, the Contractor shall be entitled, upon proper documentation and certification, to an adjustment in the pricing of the credit to avoid hardship to the Contractor. If necessary, in order to establish such reasonable value, the Contractor may be required to submit a detailed breakdown of his original bid for the items or Work involved.

12.8. CHANGES IN LINE AND GRADE

12.8.1. The Owner reserves the right through the Owner's Project Manager to make such alterations in the line and grade of various structures or pipelines shown on the drawings, as may be necessitated by conditions found during construction or that in the judgment of the Owner's Project Manager appears advisable. The Contractor shall not claim forfeiture of Contract by reason of such changes by the Owner's Project Manager.

12.8.2. In case of a fixed price contract, the price of the Work shall be negotiated as herein provided. If such alterations or changes diminish the quantity of Work to be done, they shall not constitute a claim for damages or for loss of anticipated profits in the Work which may be dispensed with, and the Work as constructed shall be paid for in accordance with the Contract prices as established for such Work under this Contract. In the case of a unit price, or partial unit price, contract, the altered Work shall be performed at the appropriate unit price.

12.8.3. The Contractor shall employ a certified Land Surveyor to establish a base line and set bench marks for the Contractor's use as necessary to stake the basic layout of the Work. Where new construction connects to existing facilities, it shall be the responsibility of the Contractor to check and establish the location of all existing facilities prior to construction of the new facilities.

12.8.4. All stakes, bench marks, and other base line information provided by the Owner or the Owner's Project Manager shall be carefully preserved by the Contractor, and in case of their removal by any cause without prior written consent from the Owner, such stakes, bench marks, and other base line information will be replaced by the Contractor at the Contractor's sole expense.

12.8.5. The dimensions for lines and elevations for grades of the structures, appurtenances, and utilities are indicated on the Drawings, together with pertinent information required for laying out the Work. Utility locations are approximate and it shall be the Contractor's responsibility to determine the exact location of the utilities prior to commencing Work in all areas where conflicts with utility installations are possible. If site conditions vary from those

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indicated, the Contractor shall notify the Owner immediately, who will promptly direct any adjustment as required. The locations of existing utilities, including underground utilities, which may affect the Work, are indicated on the drawings or in the specifications insofar as their existence and location were known at the time of preparation of the drawings. However, nothing in these drawings or specifications shall be construed as a guarantee that such utilities are in the location indicated or that they actually exist, or that other utilities are not within the area of the operations. The Contractor shall make all necessary investigations to determine the existence and locations of such utilities. The Contractor will be held responsible for any damage to and maintenance and protection of existing utilities and structures, of both public and private ownership. Acceptability of restored utility installation shall be determined by the respective utility Owner. All utilities shall remain in service during the construction of this project unless written authorization of interruption of service is received from the respective utility Owner and the interruption is approved by the Project Manager.

12.8.6. Contractor shall notify the Owner immediately upon discovery of any apparent errors in the lines or grades. If Contractor proceeds with knowledge of such apparent error without first receiving written clarification from the Owner's Project Manager, the Contractor does so at his own risk.

12.9. DIFFERING SITE CONDITIONS

12.9.1. The Contractor shall promptly, and before the conditions are disturbed, give written notice to the Owner's Project Manager of (a) subsurface or latent physical conditions at the site which differ materially from those indicated in the Contract Documents, or (b) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the Contract and which were not reasonably anticipated as a result of the investigation required by Article 1.2.2.

12.9.2. The Owner's Project Manager shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the cost or time of performance, the provisions of Article 12 "Changes in the Work" shall apply.

12.9.3. No request by the Contractor for a Change Order under this Article shall be allowed, unless the Contractor has given the required written notice.

12.9.4. No request by the Contractor for a Change Order under this Article shall be allowed if made after final payment under the Contract.

GENERAL CONDITIONS

12.10. CLAIMS FOR ADDITIONAL COST AND/OR TIME

12.10.1. If the Contractor wishes to make a claim for an increase in the Contract Price and/or Contract Time, he shall give the Owner written notice thereof within seven calendar days after the occurrence of the event giving rise to such claim. This notice shall be given by the Contractor before proceeding to execute the Work, except in an emergency endangering life or property in which case the Contractor shall proceed as provided in Article 10. No claim shall be allowed and no amounts shall be paid for any costs incurred more than ten calendar days prior to the time notice is given to the Owner. Any change in the Contract Price or Contract Time resulting from such claim must be authorized by Change Order. The Contractor's complete claim submittal for an increase in the Contract Price shall be submitted no later than twenty calendar days after the Work for which the claim is made has been completed or after the request of the Owner or the Owner's Project Manager, whichever is earlier.

12.10.2. If the Contractor claims that additional cost or time is involved because of, but not limited to, any of the following circumstances, the Contractor shall make such claim as provided in Subparagraph 12.10.1: (1) any written interpretation pursuant to Article 2, (2) any order by the Owner to stop the Work pursuant to Article 3.3 where the Contractor was not at fault, (3) failure of payment by the Owner pursuant to Article 9, or (4) any written order for a minor change in the Work issued pursuant to Article 12.8.1.

12.11. ATTORNEYS' FEES AND OTHER EXPENSES

12.11.1. In recognition of the public monies being administered by the Owner to fund this Contract, the Contractor agrees that he will not submit, assert, litigate or otherwise pursue any frivolous or unsubstantiated delay claims. If the Contractor's delay claim, or any separate item of a delay claim, is determined through litigation or other dispute resolution process to be false or to have no basis in law or fact, the Contractor shall be liable to the Owner and shall pay it for all Investigation Costs incurred by the Owner. These costs include investigating, analyzing, negotiating, appealing, defending, and litigating the false or baseless delay claims, attorneys' fees, audit costs, accountants' fees, expert witness' fees, additional architect/engineer expenses and any other consultant costs. The amount to be paid hereunder to the Owner shall be the percentage of the Owner's total Investigation Costs in an amount equal to the percentage of the Contractor's total delay claim which is determined to be false or to have no basis in fact.

12.11.2. If the Contractor breaches any obligation under the Contract Documents, the Contractor shall reimburse the Owner for all costs and expenses incurred by the Owner relating to such breach, including but not limited to, attorneys' fees, audit

GENERAL CONDITIONS

12.11.3. costs, accountants' fees, expert witness' fees, additional architectural or engineering expenses, and any other consultant costs.

12.11.4. If the Owner prevails in a claim brought against the Contractor, including but not limited to, claims for fraud or misrepresentation, overpayment, defective work, delay damages, and recovery of termination expenses, the Contractor shall reimburse the Owner for all costs and expenses incurred by the Owner relating to such claim, including but not limited to, attorneys' fees, audit costs, accountants' fees, expert witness' fees, additional architect or engineering expenses, and any other consultant costs.

END OF ARTICLE 12

GENERAL CONDITIONS

ARTICLE 13: UNCOVERING AND CORRECTION OF WORK

13.1. UNCOVERING OF WORK

13.1.1. If any portion of the Work should be covered contrary to the request of the Owner's Project Manager or to requirements specifically expressed in the Contract Documents or to requirements of applicable Construction Permits, it must, if required in writing by the Owner's Project Manager, be uncovered for its observation and shall be replaced at the Contractor's expense.

13.1.2. If any portion of the Work has been covered that the Owner's Project Manager has not specifically requested to observe prior to being covered, the Owner's Project Manager may request to see such Work and it shall be uncovered by the Contractor. If such Work complies with the Contract Documents, the cost of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work does not comply with the Contract Documents, the Contractor shall pay such costs unless the Owner caused this condition, in which event the Owner shall pay such costs.

13.2. CORRECTION OF WORK

13.2.1. The Contractor shall promptly reconstruct, replace or correct all Work rejected by the Owner's Project Manager as defective or as failing to conform to the Contract Documents or as not in accordance with the guarantees and warranties specified in the Contract Documents whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such rejected Work, including compensation for the Owner's Project Manager and any other additional services made necessary thereby.

13.2.2. The Contractor, unless removal is waived by the Owner, shall remove from the site all portions of the Work that are defective or non-conforming, or if permitted or required, he shall correct such Work in place at his own expense promptly after receipt of notice, and such rejected Work shall not thereafter be tendered for acceptance unless the former rejection or requirement for correction is disclosed.

13.2.3. If the Contractor does not proceed with the correction of such defective or non-conforming Work within a reasonable time fixed by written notice from the Owner's Project Manager, the Owner may either:

1. By separate contract or otherwise replace or correct such Work and charge the Contractor the cost occasioned the Owner thereby and remove and store the materials or equipment at the expense of the Contractor; or

GENERAL CONDITIONS

2. Terminate this Contract as provided in Article 14.3 "DEFAULT TERMINATION."

13.2.4. The Contractor shall bear the cost of making good all work of the Owner or separate Contractors destroyed or damaged by such correction or removal.

13.2.5. Nothing contained in this Article 13.2 shall be construed to establish a period of limitation with respect to any other obligation that the Contractor might have under the Contract Documents, including Article 4.7 "WARRANTY" hereof. The establishment of the period of one year after the Date of Final Completion or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, or to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the Work.

13.3. ACCEPTANCE OF DEFECTIVE OR NON-CONFORMING WORK

13.3.1. If the Owner or its Project Manager prefers to accept defective or non-conforming Work, it may do so instead of requiring its removal and correction. In this case, a Change Order will be issued to reflect a reduction in the Contract Price where appropriate and equitable, or the Owner may elect to accept payment in materials or services, in lieu of a reduction in the Contract Price. If the amount of a reduction is determined after Final Payment, it shall be paid on demand to the Owner by the Contractor.

END OF ARTICLE 13

GENERAL CONDITIONS

ARTICLE 14: TERMINATION OF THE CONTRACT

14.1. TERMINATION FOR THE CONVENIENCE OF THE OWNER

14.1.1. The Owner may, at any time upon ten days written notice to the Contractor, terminate, without prejudice to any right or remedy of the Owner, the whole or any portion of the Work for the convenience of the Owner. This Notice of Termination shall specify that portion of the Work to be terminated and the effective date of termination. The Contractor's sole remedy, in the event of such termination, will be the allowable termination costs permitted by Article 14.2 "ALLOWABLE CONVENIENCE TERMINATION COSTS."

14.1.2. The Contractor shall include termination clauses identical to Article 14 in all subcontracts and purchase orders related to the Work. Failure to include these termination clauses in any subcontracts or purchase orders shall preclude recovery of any termination costs related to that subcontract or purchase order.

14.1.3. Non-appropriation Clause

Notwithstanding anything contained herein to the contrary, this contract shall be terminated if all of the following events shall have occurred:

1. Funds are not appropriated for a subsequent fiscal period during the term of this contract for the acquisition of substantially the same functions as provided for herein, and written notice thereof is given to CONTRACTOR at least thirty (30) days prior to the first day of such subsequent fiscal periods or within five (5) days of the approval of the final budget for such fiscal year, whichever occurs later.
2. Town has exhausted all funds legally available for payment under this contract.

Upon such termination, Contractor's only remedy shall be to terminate the contract at the end of the fiscal period during which notice is given. Payment in compliance with the contract for materials, goods, and services rendered hereunder during the fiscal year at the end of which termination occurs, without penalty, termination, profit or overhead expenses of any kind shall constitute full performance on the part of the Town.

14.2. ALLOWABLE CONVENIENCE TERMINATION COSTS

14.2.1. After complying with the provisions of Article 14.4, the Contractor may submit a termination claim, not later than six months after the effective date of its

GENERAL CONDITIONS

termination, unless one or more extensions of three months each are granted by the Owner in response to the Contractor's written request.

14.2.2. The Owner shall pay the Contractor's reasonable costs of termination, plus a mark-up of ten percent for profit and overhead. This amount will not exceed the original contract price, reduced by any payments made prior to Notice of Termination, and further reduced by the price of the supplies not delivered, or the service not provided. This Contract shall be amended accordingly, and the Contractor shall be paid the agreed amount.

14.2.3. If the parties cannot agree on the amount to be paid to the Contractor by reason of termination under this clause, the Owner shall pay to the Contractor the amounts, as determined by the Owner's Project Manager as follows, without duplicating any amounts which may have already been paid under the preceding paragraph of this clause:

1. With respect to all Contract performance prior to the effective date of Notice of Termination, the total of:
 - A. Cost of work performed or supplies delivered;
 - B. The costs of settling and paying any reasonable claims as provided in Article 14.4; and
 - C. A mark-up of ten percent for profit and overhead. Neither the Contractor nor any Subcontractor shall be entitled to profit or overhead associated with the portion of the work not performed, nor to profit associated with costs of demobilization.
2. The total sum to be paid under .1 above shall not exceed the contract price, as reduced by the amount of payments otherwise made, and as further reduced by the contract price of work not done or supplies not delivered. The Owner may subtract from the amount claimed by the Contractor any claim the Owner has against the Contractor

14.2.4. If the Contractor is not satisfied with any payments that the Owner's Project Manager shall determine to be due under this clause, the Contractor may proceed in accordance with Article 7.4 "DISPUTES."

14.2.5. If the Contractor would have sustained a loss on the entire Contract had it been completed, no profit shall be included or allowed and an appropriate adjustment shall be made reducing the amount of the settlement to reflect the indicated rate of loss.

GENERAL CONDITIONS

14.3. DEFAULT TERMINATION

14.3.1. The Owner may, upon ten days written notice to the Contractor, terminate, without prejudice to any right or remedy of the Owner, the Contract for default, in whole or in part, and may take possession of the Work and complete the Work by contract or otherwise in any of the following circumstances:

1. The Contractor refuses or fails to prosecute the Work or any separable part thereof with such diligence as will ensure the Substantial Completion of the Work within the Contract Time, or fails to meet any milestones established in the Contract Documents or fails to substantially complete the Work within this period;
2. The Contractor is in default in carrying out any provision of the Contract for a cause within his or his Subcontractors' control;
3. The Contractor fails to supply a sufficient number of properly skilled workers or proper equipment or materials;
4. The Contractor fails to make prompt payment to Subcontractors or for materials or labor;
5. The Contractor disregards laws, permits, ordinances, rules, regulations, or orders of any public authority having jurisdiction;
6. The Contractor breaches any provision of the Contract Documents;
7. The Contractor voluntarily abandons the Project;
8. Upon at least thirty calendar days prior written notice by the Owner to the Contractor, at any time during the term of the Agreement, the Owner determines that maintaining the Agreement in force will harm, bring into disrepute, or affect the integrity of the Owner.

14.3.2. Upon termination of this Agreement under this Article, the Contractor shall remove all of his employees and property from the Project in a smooth, orderly, and cooperative manner.

14.3.3. The right of the Contractor to proceed shall not be terminated under Article 14.2 because of any delays in the completion of the Work due to unforeseeable causes beyond the control and without the fault or negligence of the Contractor or his Subcontractors as specifically set forth in Article 8, "DELAYS AND EXTENSIONS OF TIME."

GENERAL CONDITIONS

14.3.4. If, after the Contractor has been terminated for default pursuant to Article 14.3, it is determined that none of the circumstances set forth in Article 14.3.1 exist, then such termination shall be considered a termination for convenience pursuant to Article 14.1. In such case, the Contractor's sole remedy will be costs permitted by Article 14.2.

14.3.5. If the Owner terminates the Contract, the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds the cost of completing the Work including compensation for additional managerial, administrative and inspection services and any damages for delay, such excess amount shall be paid to the Contractor. If such expenses exceed the unpaid balance, the Contractor and his sureties shall be liable to the Owner for such excess amount.

14.3.6. If the right of the Contractor to proceed with the Work is partially or fully terminated, the Owner may take possession of and utilize in completing the Work such materials, appliances, supplies, plant and equipment as may be on the site of the terminated portion of the Work and necessary for the completion of the Work. If the Owner does not fully terminate the right of the Contractor to proceed, the Contractor shall continue to perform the part of the Work that is not terminated.

14.4. GENERAL TERMINATION PROVISIONS

14.4.1. After receipt of a Notice of Termination from the Owner, pursuant to Article 14.1 or 14.3, and except as otherwise directed by the Owner, the Contractor shall:

1. Stop Work under the Contract on the date and to the extent specified in the Notice of Termination;
2. Place no further purchase orders or subcontracts for materials, services, or facilities, except as may be necessary for completion of such portion of the Work under the Contract that is not terminated;
3. Terminate all purchase orders and subcontracts to the extent that they relate to the performance of Work terminated by the Notice of Termination;
4. At the option of the Owner, assign to the Owner in the manner, at the times and to the extent directed by the Owner, all of the rights in the contracts so terminated, in which case, the Owner shall have the right, at his discretion, to settle or pay any or all claims arising out of the termination of such purchase orders and subcontracts;
5. Settle all outstanding liabilities and all claims arising out of such termination of purchase orders and subcontracts, with the approval

GENERAL CONDITIONS

or ratification of the Owner, to the extent he may require, which approval or ratification shall be final for all the purposes of this Article;

6. Transfer title and deliver to the entity or entities designated by the Owner, in the manner, at the times and to the extent directed by the Owner to the extent specifically produced or specifically acquired by the Contractor for the performance of such portion of the Work as has been terminated, the following:
 - A. The fabricated or unfabricated parts, Work in progress, partially completed supplies and equipment, materials, parts, tools, dies, jigs, and other fixtures, completed work, supplies and other material produced as part of, or acquired in connection with the performance of, the Work terminated by the Notice of Termination; and
 - B. The completed or partially completed plans, drawings, Shop Drawings, submittals, information, releases, manuals, and other property related to the Work and which, if the Contract had been completed, would have been required to be furnished to the Owner.
7. Use his best efforts to sell, in the manner, at the times, to the extent and at the price or prices directed or authorized by the Owner or Owner's Project Manager, any property of the types referred to in Article 14.4.1.6; provided, however, that the Contractor:
 - A. Shall not be required to extend credit to any buyer; and
 - B. May acquire such property under the conditions prescribed by and at a price or prices approved by the Owner; and provided further that the proceeds of any such transfer or disposition shall be applied in reduction of any payments to be made by the Owner to the Contractor under the Contract or shall otherwise be credited to the Contract Price covered by the Contract or paid in such other manner as the Owner may direct;
8. Complete performance of such part of the Work as shall not have been terminated by the Notice of Termination; and
9. Take such action as may be necessary, or as the Owner or Owner's Project Manager may direct for the protection and preservation of

the property related to the Contract that is in the possession of the Contractor and in which the Owner has or may acquire an interest.

14.4.2. If the convenience termination, pursuant to Article 14.1, is partial, the Contractor may file with the Owner a claim for an equitable adjustment of the Contract Price relating to the continued portion of the Contract (the portion not terminated by the Notice of Termination) for costs increased because of such partial termination. Such equitable adjustment as may be agreed upon shall be made in the Contract Price. Any claim by the Contractor for an equitable adjustment under this Article must be submitted in writing to the Owner's Project Manager within sixty days from the Notice of Termination.

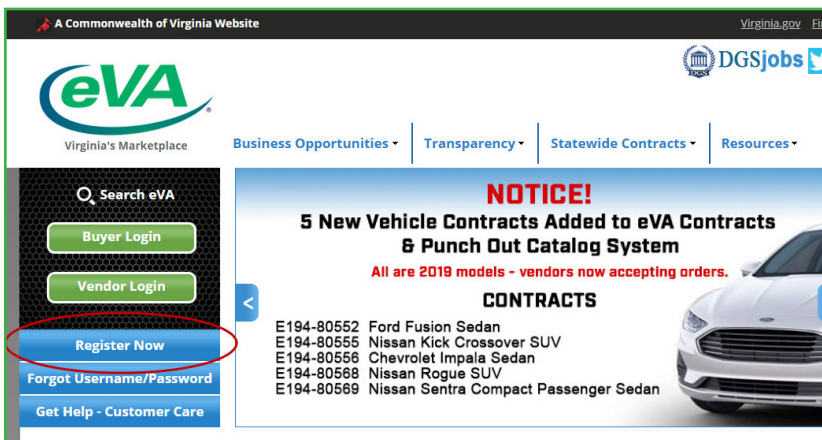
14.4.3. The Contractor shall refund to the Owner any amounts paid by the Owner to the Contractor in excess of costs reimbursed under Article 14.4 within sixty days of receipt of a written request from the Owner to do so.

END OF ARTICLE 14



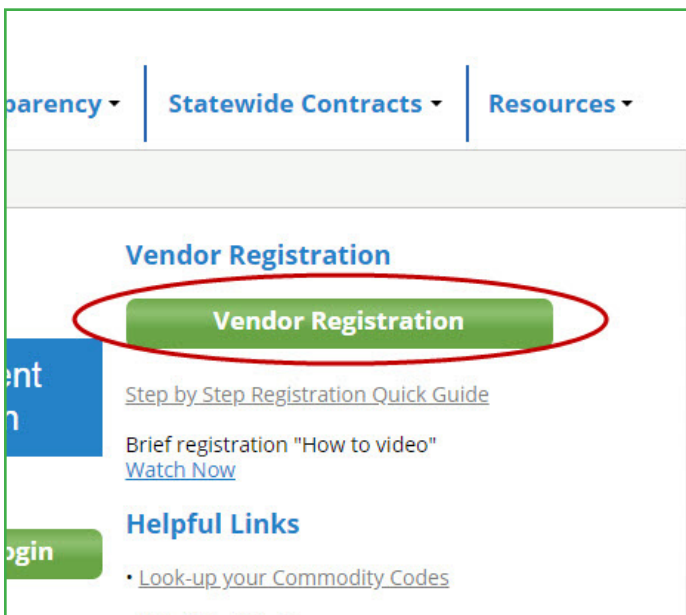
Step by Step Vendor Registration Instructions

Start by clicking the *Register Now* link on the eVA website homepage (www.eVA.virginia.gov).



Registration Checklist

1. **Company name** – Be sure to list a name that buyers will easily recognize.
2. **Federal Tax Identification Number (TIN)** – The 9 digit TIN or Social Security number that identifies your organization.
3. **Addresses & Contact information**
You will need street and/or PO box addresses, phone & fax numbers, and email addresses for orders, payments, bills, solicitations (business opportunities), and physical location.
4. **Commodity Codes** – Describes to buyers what your company sells. Use the *NIGP Code Look Up* link on the left hand menu of the eVA home page.



You can either begin a **New Registration**

Or you can choose **Add Location** or **Change Registration Type** to update an existing account

Search for your company location

Has your company done business with us in the past? If so, your company may already be in our database. Please use search.

Company Name:

Is your company listed ?

Yes, I found my Headquarters but not my Location → Click **Add Location** to create new Location for the existing Headq

Yes, my Account is activated but I don't know the login → Call Customer Care @ 1-866-289-7367 for help.

No, Register Now →

Headquarter Standard Name	Location Name	HQ Account	Registration Type	
Team MX	Tomahawk	No	Self-Registered	Add Location
Tom Gilbert	Michigan	Yes	Self-Registered	Add Location
Tom Tom Inc	Tom Tom Inc	Yes	Self-Registered	Add Location
✓ Tom's Taxidermy	HQ	Yes	State-Entered	Change Registration Type Add Location

For a new registration, you will start the registration process by reviewing & accepting eVA's Memorandum of Agreement then entering your company's EIN or SSN number.

eVA Memorandum Of Agreement (Effective 5/16/2006)

Thank you for joining the Commonwealth of Virginia eVA supplier community. You must agree to the terms defined below in order to:

- continue with the eVA registration process.
- avoid having an existing registration deactivated/canceled.

You are strongly encouraged to click on the "help & advice" button for more information.

This Memorandum Of Agreement (Agreement) sets forth the terms that have been established by the Commonwealth of Virginia, Department and Supply ("DPS") to govern all electronic procurement transactions made between your firm ("Vendor") and any agency or public body made, in whole or in part, utilizing the Commonwealth of Virginia's web-centric statewide electronic procurement solution (eVA).

For purposes of this Agreement:

- electronic procurement transaction is defined to include electronic quotations, bids, proposals, purchase orders, contracts, invoice procurement information, instruments and notices electronically transmitted, received, or posted using eVA in lieu of or in addition to paper.
- agency is defined as any department, authority, board, post, commission, division, institution, or office of State government of the Commonwealth of Virginia.
- public body is defined as any legislative, executive or judicial body, agency, office, department, authority, post, commission, committee, or board created by law in Virginia to exercise some sovereign power or to perform some governmental duty, and empowered by law to use eVA.
- eVA Fee Schedule is defined as a listing of eVA registration, transaction, and other fees (eVA fees) that are assessed to eVA users and published on the eVA Website. Each fee set forth on the eVA Fee Schedule is effective dated so eVA users, including Vendors, can

Provide the following and continue

Taxpayer ID & Type: EIN SSN

Company Zip:

Department of General Services • Division of Purchases and Supply • eProcurement Bureau
1111 East Broad Street • Richmond, VA 23218-1199 • Patrick Henry Building
For additional information, contact evacustomer@dgcs.virginia.gov or 1-866-289-7367.

Company Profile

Tell us about your company, including if you'd like to receive bidding opportunities and whether or not your company accepts charge cards.

Enter information as it appears on your W-9 form

▼ Company Profile

* Taxpayer ID Number(Type) : 451203698(EIN)

* Organization Type :

Supplemental Organization Type :

Company/DBA/Location Name: Check if same as above

* Company Legal Name :

* DBA/Location Name :

Web Address :

* Notification of Bids? :

* Accept Charge Cards? :

Tax Exempt :

Tax Address

* W-9 Address :

City/State/Zip :

Country :

Attachments - attach supporting files: W-9, W-8, etc.
Registration is not considered complete unless a Commonwealth of Virginia Substitute W-9 is received. Payments for goods or services may be impacted without a properly executed Commonwealth of Virginia Substitute W-9 form. Get the W-9 form here: http://www.doa.virginia.gov/General_Accounting/Forms/W9_COVSubstitute.pdf

Purchases under \$5,000 will be made via the Commonwealth's Small Purchase Charge Card (VISA). Standard vendor merchant fees apply.

Upload your W-9 here.

Registration is not considered complete unless the Commonwealth of Virginia Substitute W-9 is received. Payments for goods or services may be impacted without a properly executed Commonwealth of Virginia Substitute W-9 form found here:
http://www.doa.virginia.gov/General_Accounting/Forms/W9_COVSubstitute.pdf

User Information

By checking the box for *Notifications* you are requesting for the *User to be* sent bidding opportunities.

▼ Create your Login Profile

* First Name :

* Last Name :

* Email :

* Retype Email :

* Phone :

Fax :

Notifications : (Include this user for Bid Notifications)

* Password :

* Retype Password :

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For additional information, contact evacustomer@dgcs.virginia.gov or 1-866-289-7367.

Ordering Information

If your *Ordering Address* is the same as the *W-9 address* you entered above, then click *Copy Tax Address*.

If your *Ordering Contact* is the same as the *Login Profile* you entered above, then click *Copy Login Profile Info*.

▼ Address Information

Ordering Address (Copy Tax Address)	Ordering Contact: (Copy Login Profile Info)
* Street 1 : <input type="text"/>	* Contact First Name : <input type="text"/>
Street 2 : <input type="text"/>	* Contact Last Name : <input type="text"/>
* City/State/Zip : <input type="text"/> <input type="text"/> <input type="text"/>	* Email : <input type="text"/>
* Country : <input type="text"/>	* Retype Email : <input type="text"/>
* Method of Notification : Email	* Phone : <input type="text"/>
	* Fax : <input type="text"/>

Receive bid notifications electronically by selecting *email* from the drop down menu.

Leave the default as “Yes” if your other addresses are the same as your *Ordering Address*.

If one of the addresses is NOT the same as your *Ordering Address* then select “No” from the drop down menu for that address type and complete all required fields.

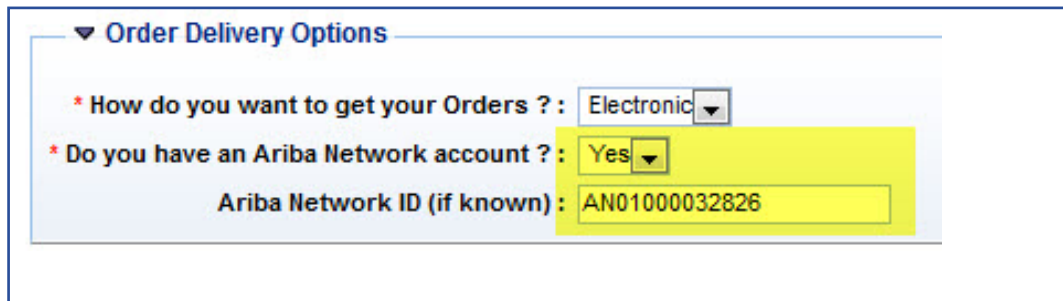
Solicitation Address/Contact(same as Ordering?) Yes	
Physical Address/Contact(same as Ordering?) No	Physical Contact: (Copy Login Profile Info)
* Street 1 : <input type="text"/>	* Contact First Name : <input type="text"/>
Street 2 : <input type="text"/>	* Contact Last Name : <input type="text"/>
* City/State/Zip : <input type="text"/> <input type="text"/> <input type="text"/>	* Email : <input type="text"/>
* Country : <input type="text"/>	* Retype Email : <input type="text"/>
* Method of Notification : <input type="text"/>	* Phone : <input type="text"/>
	* Fax : <input type="text"/>
Payment Address/Contact(same as Ordering?) Yes	
Billing Address/Contact(same as Ordering?) Yes	

Order Delivery Options

Receive your Orders Electronically

The Commonwealth of Virginia uses the Ariba Network, an Internet based service, to transmit Purchase Orders to our Vendors electronically. Electronic order routing is the preferred method of the Commonwealth.

If you have an Ariba Network Account choose “Electronic.” Select “Yes” to *Do you have an Ariba Network account?* and be sure to list your Ariba Network ID.



▼ Order Delivery Options

* How do you want to get your Orders ? : Electronic ▼

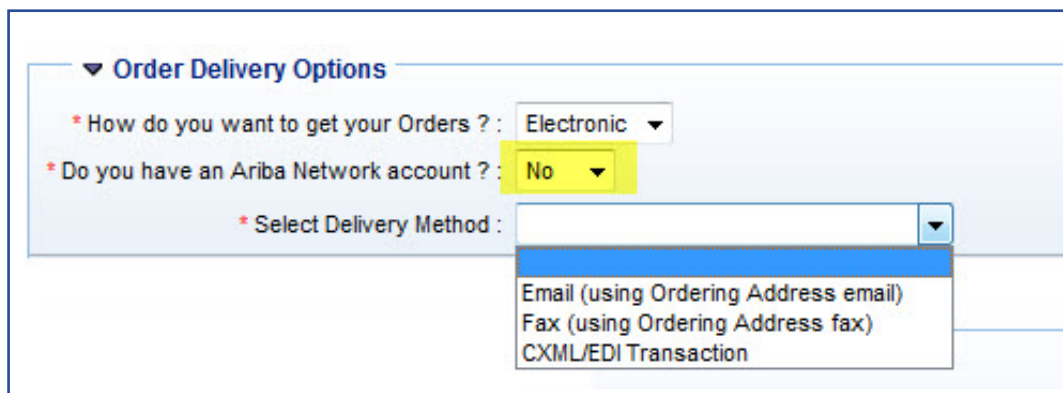
* Do you have an Ariba Network account ? : Yes ▼

Ariba Network ID (if known) : AN01000032826

If you do not have an Ariba Network Account choose “Electronic.” Select “No” to *Do you have an Ariba Network Account?* and select Email or Fax as your Delivery method. Orders will be routed to the Email or Fax you listed in your Ordering Address details.

By selecting “Electronic,” a free Ariba Network account will be pre-enabled for you. You will receive instructions on how to activate your Ariba account with your first order. With an Ariba account you will have access to Ariba’s vast network of users to whom you can also market your goods and services.

Choose “US Mail” only if the above methods do not fit your needs.



▼ Order Delivery Options

* How do you want to get your Orders ? : Electronic ▼

* Do you have an Ariba Network account ? : No ▼

* Select Delivery Method : ▼

- Email (using Ordering Address email)
- Fax (using Ordering Address fax)
- CXML/EDI Transaction

Service Area(s)

Tell Buyers where you do business

By choosing Zone 10, Statewide, you'll receive bid notifications from all over the state, not only from your area—providing you greater access to opportunities.

▼ **Service Area(s) and Commodity Profile**

Select Area(s) where you sell goods/services

Select Area(s)

Delete Service Area Zone

Choose

Select one or more Service Areas to associate to your company. To search for your Service Area, enter in a valid service area and click Search. Please click OK to save your changes.

Clear

Service Area Zone : Search

Service Area Zone
<input checked="" type="checkbox"/> Statewide
<input type="checkbox"/> Cities: Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg. Counties: Isle of Wight, James City, Southampton, Surry, Sussex, and York.
<input type="checkbox"/> Cities: Colonial Heights, HopeWell, Petersburg, and City of Richmond. Counties: Charles City, Chesterfield, Dinwiddie, Goochland, Hanover, Henrico, King William, New Kent, Powhatan, and Prince George.
<input type="checkbox"/> City: Fredericksburg. Counties: Caroline, Culpeper, Essex, Gloucester, King and Queen, King George, Lancaster, Madison, Mathews, Middlesex, Northumberland, Orange, Richmond County, Spotsylvania, and Stafford.
<input type="checkbox"/> Cities: Alexandria, Fairfax, Falls Church, Manassas, Manassas Park and Winchester. Counties: Arlington, Clarke, Fairfax, Fauquier, Frederick, Loudoun, Page, Prince William, Rappahannock, Shenandoah, and Stafford.
<input type="checkbox"/> Cities: Charlottesville, Harrisonburg, Staunton, and Waynesboro. Counties: Albemarle, Augusta, Fluvanna, Greene, Highland, Louisa, Nelson, and Rockingham.
<input type="checkbox"/> City: Emporia. Counties: Amelia, Brunswick, Buckingham, Charlotte, Cumberland, Greensville, Halifax, Lunenburg, Mecklenburg, Nottoway, and Prince Edward.
<input type="checkbox"/> Cities: City of Bedford, Buena Vista, Clifton Forge, Covington, Danville, Lexington, and Lynchburg. Counties: Alleghany, Amherst, Appomattox, Bath, Bedford County, Botetourt, Campbell, Pittsylvania, and Shenandoah.
<input type="checkbox"/> Cities: Galax, Martinsville, Radford, City of Roanoke, and Salem. Counties: Carroll, Craig, Floyd, Franklin, Giles, Henry, Montgomery, Patrick, Pulaski, and Roanoke County.
<input type="checkbox"/> Cities: Bristol and Norton. Counties: Bland, Buchanan, Dickenson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe.
<input type="checkbox"/> Counties: Accomack and Northampton

First Prev Next Last

OK Cancel

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For additional information, contact evacustomer@dgsc.virginia.gov or 1-866-289-7367.

Commodity Codes

Enter the Commodity Codes that best describe what you sell.

TIPS! Do you provide all of the goods/services listed under a main category? If you said yes, then simply select only the main class code for your Vendor Account and you will receive notification for every opportunity for every item code under that main class!

(Required) Select NIGP codes to describe goods/services you sell

Delete	NIGP Code	Description
<input type="checkbox"/>	23227	Dried Flowers and Plants
<input type="checkbox"/>	23235	Floral Supplies: Artificial Flowers, Floral Tape, etc.
	flower	
	39367	Nuts, Edible (Incl. Sunflower Seeds)
	59515	Bulbs and Seeds (Incl. Flower Seeds)
	59528	Flowers, Fresh
	59557	Plants, Non-Flowering
	59566	Shrubbery, Flowering
	59588	Vases, Flower Pots, Pottery, etc.

For help understanding how Commodity Codes are categorized and used, reference the [Understanding Commodity Codes](#) guide located in the *Vendor Resource Center* under *Tools*.

If you need help identifying your Commodity Codes, use the [NIGP Code Lookup](#) located on the *I Sell to Virginia* page of the eVA website also found under the *Tools* section.

NIGP Code Starting With: Please enter a NIGP Code or leave blank!

Search Description:

[Search](#) [View All](#)

Class	Description
28500	ELECTRICAL EQUIPMENT AND SUPPLIES (EXCEPT CABLE AND WIRE)
NIGP Code	Description
28500	ELECTRICAL EQUIPMENT AND SUPPLIES (EXCEPT CABLE AND WIRE)
28501	Automated Meter Reading Systems (AMR)
28502	Analyzer, Electric Power Demand
28503	Arresters, Lightning
28504	Back-up Systems, Battery Operated (Emergency)
28505	Beacon Light Systems Complete For Buildings, Roadside, etc. (See Class 120 for Marine Beacons)

Change your mind?
It's easy to edit the Commodity Codes you have selected!

(Required) Select NIGP codes to describe goods/services you sell

Delete	NIGP Code	Description
<input checked="" type="checkbox"/>	23227	Dried Flowers and Plants
<input type="checkbox"/>	23235	Floral Supplies: Artificial Flowers, Floral Tape, etc.

Submit Registration!

Your eVA registration is complete and a username has been created for you.

Welcome aboard!

Thank You!

[help & advice](#)

Congratulations, you have completed the registration process. You may now login to VSS using the User Name and Password you just created.

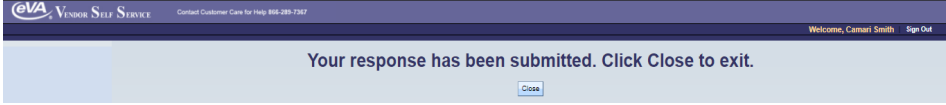
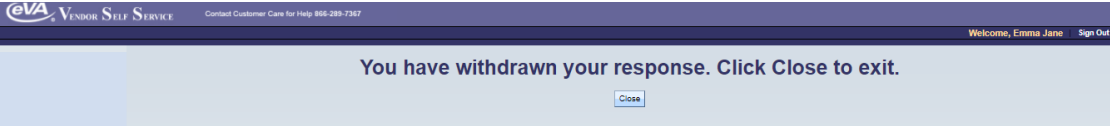
Your User Name is: tjohn

You Should

- Review your confirmation email from eVA (NoReturn@dgs.virginia.gov)
- Obtain an Ariba account for electronic orders (see guidance below)
- Login to review Account Maintenance features

[Login](#)

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<p>Amend Response (cont'd)</p>	<p>viii. Review response and click Submit.</p> <p>ix. Confirm submission of response by clicking the Submit button on pop up.</p> <p>NOTE: You will receive a “Your response has been submitted. Click Close to exit.” confirmation screen once your response has successfully submitted.</p>  <p>x. Click the Close button</p>
<p>7 Withdraw Response</p>	<p>i. From the Home page, click the My Business dropdown box and click the Responses link (top of page).</p> <p>ii. Find the latest version of your solicitation response and click the View/Edit Response button.</p> <p>iii. Click Withdraw (top of page)</p> <p>iv. Confirm and click Withdraw on pop up</p> <p>NOTE: You will receive a “You have withdrawn your response. Click Close to exit.” confirmation screen once your response has successfully submitted.</p>  <p>v. Click Close</p> <p>vi. Status under Response will now be Withdrawn</p>
<p>8 Print Response</p>	<p>i. From the Home page, click the My Business dropdown box and click the Responses link (top of page).</p> <p>ii. Find the latest version of your solicitation response and click the View/Edit Response button.</p> <p>iii. Click the Next button to navigate to Step 4: Review & Submit</p> <p>iv. Click Print</p> <p>v. Click Exit</p>