

**INVITATION FOR BID**  
**July 8, 2025**

INVITATION FOR BID NUMBER	IFB 25-032
NAME OF BID	Purchase and Installation of Three (3) Vertical Turbine Flocculators for Stickney WTP
BIDS WILL BE RECEIVED AT	MAWSS Bid Box Donaghey Business Entrance 4725 Moffett Road Mobile, AL 36618  If sending bids by UPS/Fed Ex, deliver to the Warehouse: 1610 Shelton Beach Rd. Ext., Mobile, AL 36618
MANDATORY PRE-BID MEETING	July 30, 2025 at 10:00 am in the MAWSS Operations Center Board Room
BID OPENING DATE	August 12, 2025
BID CLOSING TIME	10:30 am Central Time
AWARD WILL BE MADE BY	Total Cost & Lead Time
MATERIAL DELIVERED TO	Stickney WTP 4800 Moffett Rd. Mobile, AL 36618
ADDITIONAL INFORMATION CONTACT	Markus Moore 251- 721-0828 Email: <a href="mailto:mamoore@mawss.com">mamoore@mawss.com</a> John Jordan 251-378-3492 Email: <a href="mailto:jjordan@mawss.com">jjordan@mawss.com</a>
APPLICABLE SDP POLICY	17-01

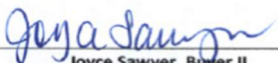
Sealed bids must be in the Purchasing Department no later than the time specified in order to be considered. Submissions received after the deadline will not be considered. Envelopes must bear the name of the supplier, company address and the words “IFB 25-032 Flocculator Equipment Upgrade” or “IFB 25-032 NO QUOTE.” Facsimile or email bids will not be accepted.

All bids must be submitted on the attached forms or your bid will be disqualified. Bidder shall furnish all the information required by the solicitation. The bidder’s name must be typed or printed on the bid sheet, and signed by the bidder or appropriate authorized executive officer of the bidder’s company. Bidders must initial any changes or erasures. Bidders should retain a copy of bids for their records.

Bidders shall acknowledge receipt of all addenda to this solicitation by signing and returning each addendum or by identifying the addendum number and the date on the bid form. Failure to acknowledge receipt of any addendum by a bidder will result in rejection of the bid if MAWSS determines that the addendum contains information that materially changes the requirements.

All bids shall be quoted FOB Destination, freight prepaid with no additional charges. Unless otherwise specified in the bid, all prices will be on a firm-fixed price basis and are not subject to adjustments based on costs incurred. MAWSS reserves the right to reject any or all bids submitted, to waive any informality in any bid or in the bid process, or to terminate the bid process at any time, if deemed by MAWSS to be in MAWSS’s best interest.

**A Purchase Order** and this “Invitation for Bid” with “Specifications,” “Conditions,” “Bid Form,” signed by the successful bidder’s authorized representative, and all attached drawings and other documents furnished by MAWSS to the bidders with the Invitation for Bid in order to illustrate the contract requirements, will constitute a contract for the goods and/or services to be purchased.

  
Joyce Sawyer, Buyer II  
Board of Water and Sewer Commissioners

## **IFB 25-032 FLOCCULATOR EQUIPMENT UPGRADE CONDITIONS**

The Board of Water and Sewer Commissioners of the City of Mobile will accept bids for the **Vertical Turbine Flocculator Units** in our Purchasing Department Bid Box located in the Business Entrance at 4725 Moffett Road, Mobile, AL. 36618 **no later than 10:30 a.m.** local time on **August 12, 2025**. Bids will be opened immediately after bid closing time in the Operations Center Board room located at the Customer Service entrance. Award will be by **Total Cost & Lead Time**. The bidder offers and agrees, if this bid is accepted, to furnish the items as defined in the specifications for the unit price set opposite each item. Pricing shall be FOB Mobile, Alabama. All items shall be delivered to **Stickney WTP located at 4800 Moffett Rd., Mobile, AL 36618** or to the job site as needed. The bidder shall state the expected length of delivery time on the Bid Form.

**A mandatory Pre-Bid meeting** will be held between representatives of Contractor and representatives of MAWSS prior to the bid opening. The Pre-Bid meeting is scheduled for **10:00 am on July 30, 2025** in the **MAWSS Operations Center Board Room** located at 4725 Moffett Rd., Mobile, AL 36618 at the Customer Service entrance.

Bidder understands and agrees that manufacturer and part numbers are provided for descriptive purposes only. Items of equal or better quality will be considered but must be approved by MAWSS in writing. Upon delivery, if the quality, durability or performance of any product represented as equal or better is determined by MAWSS to be unsatisfactory, MAWSS will require a suitable substitute or will require that the originally specified item be delivered, at the unit price originally offered by bidder. No substitution for items to be provided pursuant to this contract shall be permitted during the contract period without the express written consent of MAWSS. All items provided shall be for commercial use and for the purposes reflected in the contract documents.

No bid on closed out or discontinued item(s) will be accepted. Item(s) that have a determinable shelf life must be disclosed at the time of bid submittal. Bidder understands that his/her bid shall be good and may not be withdrawn for a period of sixty (60) calendar days after the scheduled closing time for receiving bids.

Bidder understands and agrees that quantities will be purchased by MAWSS on an "as needed" basis to replenish inventory. MAWSS shall not be committed to the purchase of a pre-established minimum quantity for any one item.

A bidder may not modify its bid after bid opening. Errors in the extension of unit prices stated in a bid or in multiplication, division, addition or subtraction in a bid may be corrected by the MAWSS Purchasing Buyer prior to award. In such cases, unit prices shall not be changed.

It is the responsibility of the bidder to determine prior to the bid opening whether any amendment, additions, deletions or changes of any type have been made to this Invitation for Bid, Conditions, Specifications, Bid Form or any of the other bid documents. Bid documents and any amendments made to this bid will be posted on our website at [www.mawss.com](http://www.mawss.com).

Invoicing Requirements: MAWSS is requiring additional information for all work performed and services provided. On the vendor's invoice for payment should be a detailed listing of work performed, services provided, dates completed, locations involved and any other pertinent information needed to verify the work and/or services were completed in accordance to the bid specs. This additional information can be supplied in the form of detailed invoices, work orders, checklists or any other documents used to track the work performed or services provided but details must be included on the actual invoice. A copy of the invoice and these additional details must be sent to the "ADDITIONAL INFORMATION CONTACT" found on Page 1 of the bid documents and a copy emailed to Accounts Payable at [AcctsPayable@mawss.com](mailto:AcctsPayable@mawss.com).

**END OF CONDITIONS**

**IFB 25-032 FLOCCULATOR EQUIPMENT UPGRADE  
INSURANCE REQUIREMENTS**

- A. **General:** The Supplier shall provide insurance in accordance with the required specifications. A current certificate of insurance must be provided with your bid. MAWSS does not need to be named as an additional insured on this certificate.
- B. **Supplier Coverage:** The Supplier shall not commence work under this Contract until he has obtained all insurance required under the following paragraphs and until such insurance has been approved by the Owner, nor shall the Supplier allow any subcontractor to commence work on his subcontract until all similar insurance required of the subcontractor has been obtained and approved. If the subcontractor does not take out insurance in his own name, the Supplier shall provide such insurance protection for the subcontractor and such subcontractor's employees.
- C. **Casualty Insurance:** The following insurance coverages (with limits not less than specified herein) shall be maintained by the Supplier for the duration of the Contract, affording coverage for any claim arising out of Supplier's operations herein, whether by the Supplier or by any subcontractor or by any Employee or Agent of either:
1. Claims of employees under Worker's Compensation and other similar employee benefit acts, including claims because of bodily injury, occupational sickness or disease, or death.
  2. Claims arising out of bodily injury, sickness, disease, or death of any person other than employee.
  3. Claims for damages arising out of libel, slander, false arrest, detention or imprisonment, malicious prosecution, defamation or violation of right of privacy, wrongful entry or eviction or other right of private occupancy, including claims as a result of an offense related to the employment of a claimant by Contractor (so-called "Personal Injury").
  4. Claims arising out of damage to or destruction of tangible property, including loss of use.
  5. The Supplier shall furnish certification of insurance and policies verifying that the above coverages are in effect before commencing any work, and that each policy is endorsed to give the Owner 30-day notice in writing in the event of cancellation or material change therein.

Policies of Insurance shall state that the Owner and the Owner's employees be named as additional insureds on the Supplier's Automobile Liability and Commercial General Liability policies. In respect to Worker's Compensation, a Waiver of Subrogation shall be issued in favor of the Owner. Where applicable, the U.S. Longshore and Harbor Workers' Compensation Act Endorsement shall be attached to the policy. Where applicable, the Maritime Coverage Endorsement (to include coverage under Jones Act) shall be attached to the policy. Both the U. S. Longshore and Harbor Workers and the Maritime Coverage shall have limits equal to or greater than the employer's liability coverage.

6. Rated by AM Best – A- or better. For non-admitted companies, a rating of A or better by AM Best.
  - a. At the discretion of the Board, worker's compensation insurance may be placed through a qualified worker's compensation self-insurance fund.

b. **Limits of Liability:**

<b>Worker's Compensation</b>	Statutory
<b>Employers' Liability</b>	\$500,000 Each Accident \$500,000 by Disease, Policy Limit \$500,000 by Disease, Each Employee
<b>Commercial Automobile</b>	\$1,000,000 Each Accident Bodily Injury and Property Damage Combined Business Auto Includes All Owned, Leased, Hired and Non-Owned Automobiles
<b>Commercial General Liability</b>	\$2,000,000 per Occurrence \$2,000,000 Personal & Advertising Injury \$5,000,000 General Aggregate per Project \$5,000,000 Products & Completed Operations Aggregate \$100,000 Fire Damage Liability

**Umbrella Liability:** In addition to the basic limits previously set out for Commercial General Liability, Products and Completed Operations, Automobile Liability and Worker's Compensation, coverage shall be issued with a "pay on behalf of" wording, including Personal Injury and other extensions, and provide coverage at least as broad as that afforded by the primary insurance policies.

**Extensions (only if applicable):**

Blanket Contractual Liability	Blanket Collapse and Underground Coverage
Personal Injury	Broad Form Property (including Completed Operations)
Host Liquor Liability	Employees as Additional Insureds
Non-owned Watercraft Liability	Incidental Medical Malpractice
Worldwide Products	Extended Bodily Injury (Assault and Battery)
Fire Legal Liability	
Newly Acquired Organizations	

When and if the use of explosives for blasting purposes appears necessary or desirable, such methods shall not be undertaken without written authorization of the Owner, and then only provided that acceptable extensions of liability coverage have been obtained specifically to include the explosion ("X") hazard and the collapse ("C") hazard. The policy of general liability shall include the special underground property damage coverage (providing the so-called "U" hazard) on a blanket basis.

- D. **Owner's Protective Liability:** The Supplier shall furnish from a carrier acceptable to the Owner, a policy of liability insurance, commonly called "Owner's Protective Liability" in the name of the Board of Water and Sewer Commissioners of the City of Mobile, d/b/a MAWSS, providing "Independent Contractor's Coverage" for the operations embraced by this Contract with limits of \$1,000,000 bodily injury and \$1,000,000 property damage. Policy shall be endorsed that the premium is to be paid by the named Supplier.

**END OF INSURANCE**

**IFB 25-032 FLOCCULATOR EQUIPMENT UPGRADE  
SDP POLICY ACKNOWLEDGEMENT\***

A copy of the SDP (Supplier Diversity Program) policy that applies to this Invitation For Bid has been included in this package. It is the responsibility of the bidder to read and make efforts to meet the goals of this policy. Please contact the Supplier Diversity Department at [supplier.diversity@mawss.com](mailto:supplier.diversity@mawss.com) for any questions regarding this policy. **Bidders MUST acknowledge receipt of this policy and submit the documentation with the bid proposal.**

Bidders shall take all necessary and reasonable steps in accordance with this Policy to ensure that Diverse Contractors/Suppliers have the maximum allowable opportunity to compete for subcontracts and contracts for services, supplies, or other goods. Bidders shall not discriminate in awarding subcontracts and supplier contracts on the basis of race, color, national origin, ethnicity, or sex, during the bid process as well as during the performance of a MAWSS contract.

**The following documentation must be included in the bid proposal.**

- SDP Policy Acknowledgement **and**
- Subcontracting Plan

Please refer to the attached policy for more information regarding these requirements as well as all other requirements, if participating in the SDP Program.

The signer declares under penalty of perjury that she/he is authorized to sign this document and bind the company or organization to all of the requirements of this policy.

Company Name \_\_\_\_\_

Submitted By \_\_\_\_\_ Title \_\_\_\_\_  
Please Print

Signature \_\_\_\_\_ Date \_\_\_\_\_

**\*Required to sign and return with bid**

**IFB 25-032 FLOCCULATOR EQUIPMENT UPGRADE  
SUBCONTRACTING PLAN/GOOD FAITH EFFORT\***

In order for your proposal to be considered, must complete all blanks in this Subcontracting Plan and sign with a handwritten signature where indicated below and include this form in your proposal.

**Failure to fill in the blanks on this Subcontracting Plan and/or to include a handwritten signature may cause for rejection of your bid.**

It is MAWSS's goal that in all contracts, contractors shall make a demonstrated good faith effort to award 15% of the contract amount to certified Diverse Contractors/Suppliers as subcontractors and/or suppliers performing commercially useful functions which are consistent with contract requirements.

Copies of MAWSS SDP Policy 16-01 (for public works projects), SDP/Supplier Diversity Policy 17-01 (for contracts for other goods and services), and links to organizations that have information on SDPs/Diverse Suppliers can be found by visiting our website at <https://www.mawss.com/bids/supplier-diversity-program/>.

STATE WHAT PERCENTAGE OF THE WORK FOR THIS CONTRACT YOU PLAN TO AWARD TO SDP/DIVERSE SUPPLIER SUBCONTRACTORS AND/OR VENDORS	TOTAL %
ESTIMATED TOTAL DOLLAR AMOUNT TO BE AWARDED TO SDP/DIVERSE SUPPLIER	TOTAL \$
AMOUNT BID FOR THIS CONTRACT	TOTAL \$

Please list below all subcontractors and suppliers which you plan to use for this contract. Also indicate which of these are SDPs / Diverse Suppliers by writing "Yes" or "No" where indicated. Also list for each the percentage of the total contract amount to be performed by each and the certification group the SDP / Diverse Supplier is certified with. Attach additional sheets if needed.

SUBCONTRACTOR/VENDOR NAME	SDP/DIVERSE SUPPLIER (Yes or No)	% OF CONTRACT	CERTIFICATION GROUP (ALDOT, ADECA, SRMSDC, BCIA, WBENC)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

**CAUTION: ACCURATELY COMPLETE ALL PARTS OF THIS FORM AND SIGN BELOW.**

**GOOD FAITH EFFORT ACKNOWLEDGEMENT/AFFIDAVIT**

**I/WE EXERCISED GOOD FAITH TO COMPLY WITH THIS PLAN AND MAWSS' SDP REQUIREMENTS.**

\_\_\_\_\_  
**BIDDER/COMPANY**

\_\_\_\_\_  
**BY (Signature)**

**\*Required to sign and return with bid**

**IFB 25-032 FLOCCULATOR EQUIPMENT UPGRADE  
 BID SHEET**

Purchase & Installation of Three (3) Vertical Turbine Flocculators	
Parts – Total Cost	
Installation – Total Cost	
Additional Costs such as shipping	
Total Cost*	

\*Must include all charges including installation, delivery fees, etc.  
 No others costs shall be added.

Mfr/Model \_\_\_\_\_

Warranty\* \_\_\_\_\_

\*Minimum 2-year warranty parts & labor

Delivery (ARO): \_\_\_\_\_

(After receipt of order)

Company Name \_\_\_\_\_ Payment Terms \_\_\_\_\_

Address \_\_\_\_\_

City, State, Zip \_\_\_\_\_

Submitted By: \_\_\_\_\_ Title \_\_\_\_\_

Please Print

Phone \_\_\_\_\_ Email Address \_\_\_\_\_

Please Print

The signer declares under penalty of perjury that she/he is authorized to sign this document and bind the company or organization to all of the terms and conditions of this agreement.

Signature \_\_\_\_\_ Date \_\_\_\_\_

**IFB 25-032 FLOCCULATOR EQUIPMENT  
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**SECTION 01 11 00**  
**SUMMARY OF WORK**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Location and description of Work.
2. Construction Contracts for this Project.
3. Work by Owner.
4. Sequence and progress of Work.

Related Requirements:

- B. Include, but are not limited to, the following:
- C. Section 01 14 16 - Coordination with Owner's Operations.
- D. Section 01 14 19 - Use of Site.
- E. Section 01 71 33 - Protection of the Work and Property.

**1.2 LOCATION AND DESCRIPTION OF WORK**

- A. The Work is located at the EM Stickney WTP, located at 4800 Moffett Rd., Mobile, AL 36618.
- B. This project includes the replacement of three (3) aging vertical turbine flocculators with new equipment.
- C. The Project includes constructing the Work broadly described below, in accordance with the Contract Documents, with all related appurtenances. Work shown on the Drawings, or indicated in the Specifications, or indicated elsewhere in the Contract Documents is part of the Work, regardless of whether indicated below. The Work includes, but is not limited to, the following:
1. Contractor will be responsible for the removal of any existing equipment, control panels, conduits, accessories, materials, or any other existing equipment and any required surface preparation needed for a high-quality installation of the new equipment. Existing equipment to be removed by the Owner is listed in Section 1.5 – Work by Owner. Contractor shall coordinate with the Owner on all equipment removals.
  2. Contractor to furnish and install three (3) Vertical Turbine Flocculator equipment packages into Flocculator Basin 3 at the Stickney WTP in accordance with specification 46 41 34 Vertical Turbine Flocculator Equipment.
- D. Contracting Method: The Project will be constructed under a single prime construction Contract.
- E. Site Conditions: Ambient temperatures for project site may range from 10° F to 100° F.

**1.3 CONSTRUCTION CONTRACTS FOR THIS PROJECT**

- A. Single Prime Construction Contract: The Contract requires all the Work for the Project not expressly allocated to Owner or others in the Contract Documents.

**1.4 OTHERS RETAINED BY OWNER FOR THE PROJECT**

A. Engineer:

1. Engineer is identified in the Agreement.
2. Engineer's responsibilities for the Project, relative to Contractor, are indicated throughout the Contract Documents.

## 1.5 WORK BY OWNER

- A. Owner will perform the following in connection with the Work:
1. Remove existing flocculator equipment: Existing drive motors, existing gear boxes, existing impeller and shaft, existing baseplates and mounting hardware.

## 1.6 SEQUENCE AND PROGRESS OF WORK

- A. Sequencing:
1. Incorporate sequencing of the Work into a Progress Schedule and submit to Owner.
  2. Sequencing Requirements:
    - a. Owner to remove existing flocculator equipment from Basin 3.
    - b. Contractor to submit equipment submittals for Engineer/Owner approval.
    - c. Contractor to remove existing conduits, panels, wires. This process shall include any required surface preparation.
    - d. Contractor to install new flocculator equipment, panels, controls as shown on the contract documents.
    - e. Contractor to test new flocculator equipment in Basin 3.
    - f. Owner and Engineer accept flocculator equipment installation.
- B. Contractor required to sequence and coordinate with the Owner's operations, including maintenance of facility operations during construction, and the requirements for tie-ins and shutdowns.

## 1.7 MANUFACTURER'S EQUIPMENT CERTIFICATION

- A. To assure that manufacturers and suppliers are aware of the use to which their equipment and products will be subjected, the Contractor shall require the manufacturer or manufacturer's representative to place the following certification on submittal data transmittals.

### MANUFACTURER'S CERTIFICATION

"This is to certify that we have examined the Plans and Specifications for this Project and have ascertained that this equipment or material is suitable for the Purpose and use intended."

\_\_\_\_\_  
Authorized Signature – Title/Date

## 1.8 CONTRACTOR'S USE OF SITE

- A. Use of Site - General:
1. Contractor will coordinate with the Owner the use of the Site for the entirety of the project.
  2. Contractors shall share use of the Site with other contractors and others specified in Articles 1.3 through 1.6 (inclusive) of this Section.
  3. Owner will designate Parking and/or Storage Areas.
  4. Relocate stored materials and equipment that interfere with operations of Owner, other contractors, and others performing work for Owner.
- B. Owner will occupy the Site jointly with Contractor during construction for performance of Owner's typical operations. Coordinate with Owner in all construction operations to minimize conflicts between Contractor and Owner's employees and others under Owner's control.

## PART 2 - PRODUCTS - (NOT USED)

## PART 3 - EXECUTION - (NOT USED)

### END OF SECTION

**SECTION 01 14 16**  
**COORDINATION WITH OWNER'S OPERATIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Requirements for coordinating with Owner's operations during the Project.
  2. Requirements for tie-ins necessary to complete the Work without impact on Owner's operations except as allowed in this Specifications section.
- B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to coordinate with Owner's operations during the Work in accordance with this Specifications section.
  2. Perform the Work such that Owner's facilities remain in continuous, satisfactory operation during the Project. Schedule and perform the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, cause odors or other nuisances, does not affect the public health, safety, welfare, and convenience, and does not adversely affect the environment resulting in violation of Laws or Regulations.
  3. Work not specifically addressed in this Specifications section or in referenced sections may, in general, be performed, to be completed within the Contract Times, at any time during regular working hours in accordance with the Contract Documents, subject to the requirements in this section.
- C. Related Requirements: Include but are not necessarily limited to:
1. Section 01 11 00 - Summary of Work.
  2. Section 01 75 00 - Checkout and Startup Procedures.
  3. Section 02 41 00 - Demolition.

**1.2 REFERENCES**

- A. Terminology:
1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Specifications section have the meaning indicated below:
    - a. The term "Owner" is used throughout this section. When the facility is operated or managed by an entity other than Owner, references in this section to "Owner" as the operator or manager of the facility will be interpreted as referring to the facility manager.
    - b. A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, conduit (including piping and ducting), has to be temporarily suspended or taken out of service to perform the Work.
    - c. A "tie-in" is a connection of new Work to existing facilities, including connecting to existing conduits (including piping and ducting), electrical systems, structural elements, process/mechanical elements, and other physical connections. Some tie-ins may require that the tie-in be made without an associated shutdown.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

#### **A. Coordination:**

1. Review construction procedures under other Specifications sections and coordinate Work that will be performed with or before the Work indicated in this Section.

#### **B. Sequencing and Scheduling:**

1. Refer to this Specifications sections articles on sequencing, tie-ins, and shutdowns.

### **1.4 SUBMITTALS**

#### **A. Informational Submittals: Submit the following:**

##### **1. Planning Submittal:**

- a. Submit an inventory of labor, materials, and equipment required to perform the installation and tie-in tasks, an estimate of time required to accomplish the installation including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work.
- b. Furnish submittal to Engineer not less than 30 days prior to proposed installation start date.

### **1.5 GENERAL CONSTRAINTS**

#### **A. New materials and equipment may be used by Owner after the specified field quality control activities are successfully completed and the materials or equipment are substantially complete in accordance with the Contract Documents.**

#### **B. The following constraints apply to coordination with Owner's operations:**

1. **Operational Access:** Owner's personnel shall have access to equipment and areas of the facility that remain in operation.
2. **Schedule and perform equipment and system start-ups in accordance with Section 01 75 00 - Checkout and Startup procedures.** Equipment and systems shall not be placed into operation on Friday, Saturday, Sunday, or holidays without prior approval of Owner, unless specifically indicated otherwise in the Contract Documents.
3. **Owner will assist Contractor in dewatering process tanks, basins, conduits, and other work areas to be dewatered.** Maintain clean, dry work area by pumping and properly disposing of fluid and other material that accumulates in work areas.
4. **Draining and Cleaning of Conduits, Tanks, and Basins:**
  - a. Unless otherwise shown or indicated in the Contract Documents, Contractor shall dewater process tanks, basins, conduits as needed for installations. Flush, wash down, and clean tanks, basins, conduits (including piping), and other work areas.
  - b. Contractor shall remove liquids and solids and dispose of them at appropriate location at the Site as directed by Engineer. Unless otherwise specified or indicated, contents of tanks, basins, and conduits (including piping) undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, temporary piping, temporary pumps, and other means provided by Contractor. Discharge of fluids across floors is not allowed.
  - c. Spillage shall be brought to Engineer's attention immediately, both orally and in writing, and reported in accordance with Laws and Regulations. Contractor shall wash down spillage to floor drains or sumps or other appropriate location

and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by Engineer, Contractor shall remove spillage by other means, such as vactor truck, sorbents, or other method acceptable to Engineer.

## **1.6 SEQUENCE OF WORK**

- A. Perform the Work in the indicated sequence. Certain phases or stages of the Work may require working 24 hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed substitute sequence, with Engineer's approval. Stages specified in this article are sequence-dependent.
- B. Stage I – Demolition and Removals:
  - 1. Owner to remove the existing Flocculators, Motors, Gears. Contactor to coordinate with Owner on the timing.
  - 2. Contractor to remove control panels, wires, and conduits needed for the installation of new control panels.
- C. Stage II – Install Flocculator Equipment and Controls:
  - 1. Contractor to install new flocculators, motors, gears, control panels, wires, conduits as needed for a complete installation.
  - 2. Perform required testing of equipment and controls.

## **1.7 SHUTDOWNS**

- A. The existing flocculation basins are not in service. Shut-down of basins will not be required.
- B. Work that may interrupt normal operations shall be accomplished at times convenient to Owner unless otherwise indicated in the Contract Documents.
- C. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.
- D. Fines and Penalties Imposed by Authorities Having Jurisdiction:
  - 1. Unscheduled interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not comply with requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in performing the Work and complying with applicable permits, Laws, and Regulations.
  - 2. Owner or Engineer may deduct as set-offs such amounts from payments due Contractor.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 SUBSTITUTE PROCEDURES**

- A. Proposal of Substitute Sequencing and Tie-Ins:
  - 1. As a substitute to the procedures indicated in this Specifications section, Contractor may propose providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to Owner, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and

equipment; that such additional temporary facilities do not adversely affect Owner's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.

2. Engineer will consider proposals for substitute procedures after the Effective Date of the Contract. All Bids shall be based on the requirements of the Contract Documents, including this section.
3. Substitution Requests:
  - a. When proposing a substitute procedure for a tie-in or shutdown or other requirements of this section, comply with the requirements of the General Conditions and Supplementary Conditions (regarding substitutes) and Section 01 25 00 - Substitution Procedures.
  - b. When deviation from specified sequence or procedures is proposed, Contractor's proposal shall explain in detail the proposed sequence and procedures and associated effects, including evidence that Owner's operations will not be adversely affected, to an extent greater than originally contemplated in the Contract Documents, by proposed substitution. List benefits of proposed substitution, including benefits to Progress Schedule.

### **3.2 GENERAL PROVISIONS FOR COORDINATING WITH OWNER'S OPERATIONS**

- A. Operation of Existing Systems and Equipment during the Work:
  1. Do not shut off or disconnect existing operating systems or equipment, unless accepted by Engineer in writing.
  2. Operation of existing systems and equipment will be by Owner unless otherwise specified or indicated.
  3. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both.
  4. Provide temporary watertight plugs, bulkheads, and line stops as necessary and as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.
- B. Performing the Work of this section constitutes Contractor's approval of underlying work and field conditions prevailing at the time of the Work.

### **3.3 PREPARATION**

- A. Coordinate preparations for removals with requirements of Section 02 41 00 - Demolition, as applicable.
- B. Shutdowns - General Preparation:
  1. Coordinate shutdowns with Owner and Engineer.
  2. Submit shutdown planning Submittals and shutdown notification Submittals in accordance with this Specifications section's "Submittals" Article.
  3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, materials, equipment, spare parts, both temporary and permanent, necessary to successfully perform the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to commencing the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with such requirements before commencing the shutdown.

4. Engineer shall have no duty to Contractor to advise Contractor of inadequate preparations by Contractor; Contractor is solely responsible for the means, methods, procedures, techniques, and sequences of construction.
- C. Shutdowns of Electrical Systems:
1. Comply with Laws and Regulations, including the National Electric Code.
  2. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cables and wires are de-energized to ground potential before starting other Work associated with the shutdown.
  3. Upon completion of shutdown Work, remove the locks and tags and advise Owner that facilities are available for use.

**END OF SECTION**

**SECTION 01 14 19**  
**USE OF SITE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Restrictions on Contractor's use of the Site and premises.
  - 2. Restrictions on use of existing buildings and structures, including:
    - a. Permanent utilities and sanitary facilities.
- B. Scope:
  - 1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to comply with restrictions on Contractor's use of the Site and other areas.
  - 2. Comply with requirements of MAWSS General Requirements Sections, regarding the Contractor's use of the Site and other areas.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B30.2, Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist).
    - b. B30.17, Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist).

**1.3 USE OF PREMISES**

- A. Limit use of premises at the Site to work areas shown or indicated on the Drawings and as specified in this Section. Do not disturb portions of the Site beyond areas of the Work.
  - 1. Limits:
    - a. Confine construction operations to the following areas:
      - 1) Basin 3 Flocculation Tanks.
    - b. Confine storage of materials and equipment, and locations of temporary facilities to the following areas:
      - 1) Equipment may be stored on-site as directed by the Owner, in the free space located inside the Stickney WTP west of the main entrance off of Moffett Road.
      - 2) Contractor's gang boxes and storage containers for tools in active use in the Work may be kept in reasonable quantity in the work areas as long as such items do not obstruct access to the facilities by Owner or occupants.
      - 3) Do not store items of any sort, whether temporarily or otherwise, in stairways and ramps, whether existing or under construction.
    - c. Do not enter the following areas:
      - 1) Areas outside of the work areas indicated in Paragraph A.1.a of the "Use of Premises" Article in this Specifications section, and outside of work areas indicated on the Drawings.
  - 2. Prohibitions:
    - a. Do not use the Site for the following:
      - 1) Conducting Contractor's business not related to the Project or other work for Owner.
      - 2) Overnight lodging or other, non-work use of the Site by workers or others for whom Contractor is responsible, whether housed in recreational vehicles, other vehicles,

tents, quarters in field offices or Contractor-furnished temporary structures, or in work areas, is unacceptable.

3. Access to Site, Access Roads, Parking Areas:

- a. Contractor may enter through main gate entrance off of Moffett Road or through East entrance off of Shelton Beach Road. Coordinate access and schedule with Owner prior to start of project.

B. Use of Existing Buildings and Structures: Maintain existing buildings and structures in weather-tight condition throughout construction unless otherwise indicated in the Contract Documents. Protect buildings, structures, and occupants during construction.

1. Use of Existing Utilities, Sanitary Facilities, and First-aid Facilities:

- a. Do not use permanent sanitary facilities, whether provided under the Project or existing prior to the Project, at the Site.
- b. Do not use permanent telephone, Internet, or other communications utilities and facilities at the Site, regardless of whether such services and facilities were provided under the Project or existed prior to the Project, except in cases of emergency.
- c. Do not use Owner's or occupants' first-aid facilities, except in cases of medical emergency. Promptly replenish used items and supplies with items identical to those used.

C. Promptly repair damage to premises, including existing structures, finishes, equipment, and other features, caused by construction operations. Upon completion of the Work, restore premises to specified condition; if condition is not specified, restore to pre-construction condition.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION - (NOT USED)**

**END OF SECTION**

**SECTION 01 25 00**  
**SUBSTITUTION PROCEDURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Requirements applicable to all substitution requests.
2. Provisions specific to Contractor's substitution requests for:
  - a. Materials and equipment to be incorporated into the Work.
  - b. Methods, procedures, and sequences indicated in the Contract Documents.

B. Scope:

1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals, and pay all costs associated with requests for approval of substitutes.
2. Where the Contract Documents expressly indicate that substitutes are not allowed, are unacceptable, or time-barred, do not submit substitution requests for such items or procedures.
3. Requirements for Contractor's proposal of "or-equals", where allowed by the Contract, are in Section 01 62 00 - Product Options.

C. Related Requirements:

1. Include, but are not necessarily limited to:
  - a. Section 01 62 00 - Product Options.

**1.2 REFERENCES**

A. Terminology:

1. The following terminology, although not indicated with initial capital letters, has the following meaning in this Section:
  - a. "Or-equal" and "or equal" each means material or equipment items to be incorporated into the completed Work as a functioning whole, or method, procedure, or sequence that, in Owner's sole opinion, are equivalent to that shown or indicated in the Contract Documents.
  - b. "Substitute" means a proposed materials or equipment to be incorporated into the completed Work as a functioning whole, or a proposed construction method, procedure, or sequence that is not, in Owner's sole opinion, equivalent to the associated, similar material or equipment item or method, procedure, or sequence shown or indicated in the Contract Documents, but accomplishes the same or similar purpose. Unless expressly indicated otherwise in the Contract Documents, Contractor's proposals for "value engineering" (and similar terms) are substitutes.
  - c. "Substitution request" means Contractor's written request for Owner's approval of a proposed substitute, in accordance with this Section. Substitution requests are separate from Shop drawings and other Submittals required by the Contract Documents.

**1.3 SUBSTITUTES - GENERAL**

A. This Article applies to all substitutes and substitution requests, whether for substitute materials or equipment, or for substitute methods, procedures, or sequences.

B. Time Limits for Submitting Substitution Requests:

1. Where the Contract allows Contractor's substitution requests, such proposals will be considered by Owner only during a period of 30 days after the date the Contract Times start to run, unless otherwise indicated.

2. Substitution requests will be accepted for consideration by Owner after the time limit indicated in the paragraph above this, when materials or equipment shown or indicated, and all associated “or-equals”, are either:
    - a. Unavailable; or
    - b. Despite Contractor’s due diligence, are unavailable in time for the Work to be completed within the Contract Times.
  3. The foregoing notwithstanding, substitutes will not be approved when received by Owner after Contractor has commenced the associated Work at the Site, where approval of the substitute would require rework or removing Work already installed.
- C. Contractor’s Representations:
1. In submitting each substitution request, Contractor represents that:
    - a. Contractor has read and understands the Contract’s provisions on substitutes, as indicated in this Section, and elsewhere in the Contract Documents.
    - b. Substitution request is complete and includes all documents and information required by the Contract Documents.
    - c. Contractor certifications required by this Section are valid and made with Contractor’s full knowledge, information, and belief.
    - d. Contractor will provide the same or better guarantees and warranties for substitute as for the specified materials, equipment, methods, procedures, and sequences (as applicable).
    - e. Contractor waives all rights for increasing the Contract Price or extending the Contract Times, related to the substitute, that subsequently may become apparent to Contractor after issuance of the associated Contract modification instrument approving such substitute, except for those associated with differing subsurface or physical conditions or discovery of a previously unforeseen Hazardous Environmental Condition associated with the Work involving the approved substitute.
- D. Submittal of Substitution Requests - General:
1. Substitution requests must be submitted by Contractor. Owner will not accept or review substitution requests from prospective or bona-fide Subcontractors or Suppliers.
  2. Submit separate substitution request for each proposed substitute.
  3. Submit substitution requests in accordance with requirements for Shop Drawings and other Submittals, as indicated in Section 01 33 00 - Submittal Procedures, and Section 01 31 26 - Electronic Communication Protocols.
  4. Do not submit substitution requests as any of the following (such substitution requests will be returned without review):
    - a. Shop Drawing, Sample, or other Submittal.
    - b. Request for approval of an “or-equal”.
    - c. Request for interpretation (RFI) or clarification.
    - d. Change Proposal without all other, required substitution request elements indicated below.
    - e. Other oral or written communication not in accordance with this Section.
  5. Each substitution request shall include:
    - a. Transmittal letter (one per substitution request) expressly indicating the communication is a substitution request.
    - b. Completed substitution request form, on the form attached to this Section.
    - c. Change Proposal, submitted in accordance with the Contract Documents. Clearly indicate the proposed changes in Contract Price and Contract Times if substitute is approved; if none, clearly so indicate on the Change Proposal.
    - d. Certifications and written representations required by the Contract Documents to accompany substitution requests.

- e. Other information: (1) required elsewhere in this Section and in other elements of the Contract Documents, and (2) deemed appropriate by Contractor to support Contractor's substitution request.
  6. When Owner requires additional information to evaluate a substitution request, furnish such information within five days of receipt of request, unless additional time is granted in writing.
  7. Owner has the right to rely upon the completeness and accuracy of information, documents, certifications, and representations in Contractor's substitution request. Contractor accepts full responsibility for completeness and accuracy of substitution requests.
- E. Review of Substitution Requests:
1. Owner has no obligation to approve any substitute.
  2. Substitutes will not be approved unless all of the following are satisfied for the associated substitute:
    - a. The Contract supports submittal of such substitution request; and
    - b. Substitute is reasonably consistent with design intent for the Project as a completed, functioning whole; and
    - c. As indicated in Paragraph 1.3.A.3 of this Section.
    - d. Substitute will not have an adverse effect on the work of other contractors, or existing or proposed construction; and
    - e. Substitution request is complete in accordance with the Contract Documents and Owner's requests, and
    - f. Owner agrees to the substitute; and
    - g. Associated changes in Contract Price and Contract Times, if any, are acceptable to Owner.
  3. Owner is not obligated to approve any substitute where such approval is conditioned on an increase in the Contract Price, the Contract Times, or both.
  4. Timeliness of Review:
    - a. Allow not less than 14 days for review of each substitute. Allow longer for larger, more-complex substitutes.
    - b. Owner will endeavor to perform timely review of substitution requests. However, Contractor is responsible for complying with the Contract Times, regardless of whether the substitute is approved.
    - c. Where approval of a substitute would necessitate other changes to the Project's design, additional time, beyond that indicated above, will be necessary for preparation of revisions to the design.
  5. When Design Changes are Required with Approval of Substitute:
    - a. Owner will advise Contractor promptly following review and comment on substitution request to indicate whether the substitute will be acceptable. Owner's advisory to Contractor will indicate whether changes in design are necessary and include a preliminary estimate of fee and time required for modifying the design and preparing an associated Proposal Request to Contractor.
    - b. Owner's preliminary estimates of fee and time for design modifications will be prepared in good faith, but are not binding on Owner.
    - c. Contractor shall reimburse Owner for costs incurred by Owner for design modifications necessitated by approval of substitute. Owner may deduct such amounts, as one or more set-offs, from payments due Contractor under the Contract.
    - d. Upon Contractor's receipt of estimate of fee and time for design modifications, contractor shall advise Owner, in writing, within three days whether Contractor will continue pursuing approval of the substitute.
    - e. Request to Contractor.
    - f. Owner may reject a substitute that would require substantial changes in the Project's design.

F. Approval of Substitutes:

1. Substitutes are approved only via issuance of an appropriate Field Order or Change Order in accordance with the contract documents and MAWSS General Requirements.
2. Approval of a substitute does not relieve Contractor from obligation to comply with the Contract Documents, including submitting Shop Drawings, Samples, and other Submittals in accordance with the Contract Documents.

**1.4 SUBSTITUTE MATERIALS AND EQUIPMENT**

A. In addition to other requirements of this Section and elsewhere in the Contract Documents, substitution requests for substitute materials or equipment shall include:

1. Manufacturer and Location:
  - a. Name and address of manufacturer of the proposed substitute. Indicate country where manufacturer is incorporated and owned.
  - b. Companies and brands owned by or affiliated with manufacturer.
  - c. Name of manufacturers of principal component items, such as motors, bearings, and similar items.
  - d. Location where the items would be manufactured, including country and address. Indicate the total percentage of the items' value that will be manufactured outside of the United States and its territories.
  - e. Name, address, and driving distance from the Site of:
    - 1) Manufacturer's sales representative.
    - 2) Nearest service center offering full array of service capabilities.
    - 3) Warehouse or other location where spare parts for the proposed substitute are available.
  - f. Number of years that manufacturer has actively participated the North American market.
2. Proposed Materials and Equipment:
  - a. Model designation and quantity of each proposed for the Work.
  - b. Manufacturer's literature for proposed substitute, with description of the materials and equipment.
  - c. Performance information and representative test data.
  - d. Indication of reference standards with which materials and equipment comply.
  - e. Preliminary process and instrumentation diagrams (P&ID), where applicable.
  - f. Identification of hazardous materials, including Constituents of Concern, used in the materials and equipment, and associated permitting or licensing required.
  - g. Manufacturer's standard warranty and applicable, proposed special or extended warranties, including indication of specific entities that will be beneficiary of such warranties.
  - h. Complete list of proposed deviations from requirements of the Contract Documents.
  - i. Itemized comparison of specified materials and equipment and proposed substitute, indicating:
    - 1) Size (physical dimensions) when: item is in use, when not in use, and space required for routine and major maintenance.
    - 2) Weight and loading at supports, when item is full and empty.  
Materials of construction.
3. Operation requirements, including:
  - a. Anticipated consumption of each item of: Electricity, other energy sources, water, chemicals (indicate each), and other needs for operation at the Site.
  - b. Typical labor required for operation and associated skill level.
  - c. Description of remote monitoring and control capabilities, as applicable.

4. Maintenance requirements, including:
  - a. Anticipated life in the service and environment required.
  - b. Frequency and general scope of routine and major maintenance typically necessary.
  - c. Typical labor requirements and general qualifications of personnel performing routine maintenance.
  - d. Major, associated equipment necessary for routing and major maintenance, including hoisting equipment type and capacity (when applicable).
  - e. Availability, scope, cost, and general conditions of service and maintenance contracts, if any.
5. References for similar projects on which the materials and equipment were used. Indicate for each:
  - a. Project owner name, name of facility where installed, and name of project.
  - b. City, state, and country of installation.
  - c. Model number/size and quantity furnished and installed.
  - d. Year of installation.
  - e. Contact information for owner and design professional, including telephone numbers.
6. Other information required by the Contract Documents.
7. Other information reasonably requested by Owner.

### **1.5 SUBSTITUTE CONSTRUCTION METHODS, PROCEDURES, OR SEQUENCES**

- A. In addition to other requirements of this Section and elsewhere in the Contract Documents, substitution requests for substitute methods, procedures, or sequences shall include:
  1. Clear identification of the method, procedure, or sequence shown or indicated in the Contract Documents for which substitute is requested.
  2. Detailed description of proposed substitute method, procedure, sequence, or combination thereof.
  3. Reasons why substitute is proposed and benefits to the Project should the substitute be approved.
  4. Detailed list of how the proposed substitute deviates from associated method, procedure, or sequence shown or indicated in the Contract Documents.
  5. Impact of the substitute, if approved, on Owner's or facility manager's operations, when the Work is at an existing facility.
  6. Effect on other contractors working at the Site, if substitute is approved.
  7. Description of temporary equipment and temporary facilities needed, should the substitute be approved, including quantity of items, capacities, performance characteristics, permitting and approvals required by authorities having jurisdiction, and proposed location at the Site.
  8. Written evaluation of how substitute method, procedure, or sequence complies with Laws and Regulations.
  9. Drawings illustrating method, procedure, or sequence.
  10. Materials to be used that contain Constituents of Concern or that have potential to cause or exacerbate a Hazardous Environmental Condition.
  11. Other information and data required by the Contract Documents.
  12. Other information reasonably required by Owner.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 ATTACHMENTS**

- A. The following, bound after this Section's "End of Section" designation, are part of this Specifications Section:

1. Exhibit A - Substitution Request Form (one page).

**END OF SECTION**



**SECTION 01 31 26**  
**ELECTRONIC COMMUNICATION PROTOCOLS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Procedures with which Users will comply regarding transmission or exchange of Electronic Documents for the Project.

B. Related Requirements:

1. In addition to the requirements of this Specifications Section, comply with the requirements for Electronic Documents in the following Specifications:
  - a. Section 01 33 00 - Submittals.

**1.2 DEFINITIONS**

A. The following terms are defined for use in this Specifications Section and are indicated herein using initial capital letters. The terms have the associated meaning regardless of whether indicated in singular or plural.

1. Electronic Documents Protocol (abbreviated as "EDP"): Procedures and requirements set forth in this Specifications Section for the exchange of Electronic Documents by Electronic Means.
2. Project Website: An internet-based software platform, such as a website or other project management information system (PMIS) designated by Contract or mutual consent of Users as the means of exchanging Electronic Documents during the Project.
3. System Infrastructure: Hardware, operating system(s) software, internet access, e-mail service and software, security software, and large-file transfer functions.
4. Users: Owner, Contractor, Engineer, and others exchanging Electronic Documents on the Project in accordance with the EDP.

**1.3 ADMINISTRATIVE REQUIREMENTS.**

A. Coordination:

1. Contractor shall require all Subcontractors and Suppliers to comply with the EDP established in the Contract Documents.

**1.4 GENERAL PROVISIONS OF ELECTRONIC DOCUMENT PROTOCOL**

A. EDP – General:

1. To the fullest extent practical, Users agree to and will transmit and accept Electronic Documents transmitted by Electronic Means in accordance with the requirements of this Specifications Section. Use of the Electronic Documents and any information contained therein is subject to requirements of this Specifications Section and other provisions of the Contract Documents governing transmittal of Electronic Documents.
2. Content of Electronic Documents will be the responsibility of transmitting User.
3. Unless otherwise provided in: (1) the EDP, (2) elsewhere in the Contract Documents, or (3) or other agreement between two or more Users governing use of Electronic Documents, Electronic Documents exchanged in accordance with the Contract Documents may be used in the same manner as paper or other printed versions of the same documents exchanged using other than Electronic Means, subject to the same governing requirements, limitations, and restrictions set forth in the Contract Documents.
4. Except as otherwise explicitly indicated in the EDP, the terms of this EDP will be incorporated into any other agreement or subcontract between a party and a third party for a portion of the Work or Project-related services, where such third party is, either directly or indirectly, required to exchange Electronic Documents with Owner, Contractor, or Engineer.

Nothing in this EDP modifies the requirements of the Contract Documents regarding communications between and among Owner, Contractor, and Engineer Subcontractors, Suppliers, consultants, and others for which each is responsible.

5. When transmitting Electronic Documents, transmitting User makes no representations regarding long-term compatibility, usability, or readability of the items resulting from the receiving User's use of software applications or System Infrastructure differing from those established in this EDP.
6. This EDP does not negate or mitigate any obligation: (1) in the Contract Documents to create, provide, or maintain an original paper record version of Drawings and Specifications, signed and sealed in accordance with Laws or Regulations; (2) to comply with Laws and Regulations governing signing and sealing of design documents or signing and electronic transmission of other documents; or (3) to comply with notice requirements of the General Conditions (as. May be modified by the Supplementary Conditions).
7. Modifications to EDP:
  - a. When modifications to the EDP are necessary to address issues affecting System Infrastructure, Users shall cooperatively resolve the issues.
  - b. If resolution within a reasonable time is not achieved, Owner is empowered to require reasonable and necessary changes to the EDP consistent with the original intent of the EDP.
  - c. If such changes result in additional cost or delay to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in the Contract Price, Contract Times, or both in accordance with the Contract Documents.

**B. System Infrastructure and Systems for Exchanging Electronic Document:**

1. Each User will provide System Infrastructure (as defined in this EDP) at its own cost and sufficient for complying with EDP requirements. Except for minimum standards set forth in this EDP [and explicit system requirements specified by attachment to this EDP], it is the obligation of each User to determine, for itself, such User's own System Infrastructure.
  - a. Maximum size of e-mail file attachment under this EDP is 8 megabytes (MB). Attachments larger than the maximum size indicated in this paragraph shall be exchanged via secure electronic transfer using method mutually acceptable to Owner, Engineer, and Contractor.
  - b. Each entity transmitting or receiving Electronic Documents has full responsibility for its own costs, delays, deficiencies, and errors associated with converting, translating, updating, verifying, licensing, and otherwise enabling its System Infrastructure for use in accordance with this EDP.
  - c. Each User will provide its own printing facilities and will be responsible for its own costs of printing Electronic Documents.
2. Each User is responsible for its own system operations, security, back-up, archiving, audits, and other technology and resources for operations of its System Infrastructure during the Project, including coordination with the User's individual(s) or subcontractor(s) responsible for managing its System Infrastructure and capable of addressing communications and other technology issues affecting exchange of Electronic Documents.
3. Security:
  - a. Each User will operate and maintain industry-standard, industry-accepted, ISO standard, commercial-grade security software and systems to protect against threats including software viruses and other malicious software including worms, trojans, adware; data breaches; loss of confidentiality; and other threats in transmission to, or storage of, Electronic Documents from other Users, including transmission of Electronic Documents by physical media including flash drives/thumb drives, hard drives, compact discs (CD), digital video discs (DVD), and other portable devices, whether connected physically or wirelessly.
  - b. To the extent that a User maintains and operates such security software and appropriate System Infrastructure, such User will not be liable to other Users participating in the Project for breach of system security.

4. Principal means of exchanging Electronic Documents will be e-mail and files attached to e-mail, in accordance with the EDP.
- C. General Requirements and Limitations for Software for Electronic Document Exchange:
1. Software and file formats for exchange of Electronic Documents shall be as indicated in Article 1.5 of this Specifications Section.
  2. Software Versions:
    - a. Each User will acquire the software and associated licenses necessary to create, transmit, receive, read, and use Electronic Documents for the Project, using the software and file formats indicate in Article 1.5 of this Specifications Section.
    - b. Prior to using any updated version of the software required in the EDP for Electronic Document(s) transmitted to other User(s), the originating User will first notify and either (1) receive concurrence from receiving User(s) for use of the updated version, or (2) adjust its transmission to comply with the EDP.
  3. Preservation of Intellectual Property and Confidentiality of Electronic Documents:
    - a. Users agree to not intentionally edit, reverse-engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes Electronic Documents, and information and data contained therein, transmitted in a file format, including portable document format (PDF), intended by transmitting User to not be modified, unless the receiving User (1) obtains permission from owner of the Electronic Document and intellectual property contained therein, or (2) is expressly allowed by the EDP to edit or modify the Electronic Document.
    - b. Where modifying, editing, decryption, or reverse-engineering is allowed by the EDP, such use is conferred only for the Project.
    - c. The EDP does not transfer any ownership or rights of any sort regarding use outside of the Project of Electronic Documents.
    - d. Users shall not cite or quote excerpts of Electronic Documents for purposes outside of the Project unless required to do so by Laws and Regulations.
- D. Contractor's Requests for Electronic Documents in Other Formats:
1. Release of Electronic Documents in format(s) other than those indicated in in Article 1.5 of this Specifications Section and elsewhere in the Contract Documents will be at the discretion of Owner and subject to terms and conditions required by the owner of such files and documents, and the provisions indicated below.
  2. To extent determined by Owner, in its sole discretion, to be appropriate, release of Electronic Documents in alternative format(s) requested by Contractor ("Request") are subject to provisions of Owner's response to the Request and to the following:
    - a. Contractor's Request shall be in writing. Owner and others, as appropriate, will consider and respond to Request promptly, but neither Owner nor Engineer will be responsible for any time or cost impacts on Contractor associated with timing of the Request, or with Owner's decision associated therewith.
    - b. When Engineer is the owner of the Electronic Documents requested by Contractor in native format, prior to Engineer transmitting such Electronic Documents to Contractor, Contractor shall sign and deliver to Engineer, without modifying or amending, Engineer's "Electronic Media Release" agreement.
    - c. Content included in Electronic Documents created by Engineer and furnished in response to the Request was prepared by Engineer as an internal working document for Engineer's purposes solely and, when provided to Contractor, is on an "as-is" basis without warranties of any kind, including, but not limited to any implied warranties of fitness for purpose. Contractor acknowledges that content of Electronic Documents furnished in response to the Request may not be suitable for Contractor's purpose(s), or may require substantial modification and independent verification by Contractor. Content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented

intermediate revisions, and other shown or indicated information that may affect subsequent use by Contractor or others for whom Contractor is responsible.

- d. Electronic Documents containing text, graphics, metadata, or other types of data furnished by Engineer in response to the Request are only for Contractor's convenience and any and all conclusions or information obtained or derived from such Electronic Documents will be at Contractor's sole risk and expense. Contractor waives any and all claims against Engineer, Owner, or both arising from Contractor's use of Electronic Documents furnished in response to the Request.
  - e. Contractor shall indemnify and hold harmless Owner, Engineer, and their respective consultants and subconsultants from any and all claims, damages, losses, and expenses, including attorneys' fees and defense costs, fees and costs of engineers, architects, geologists, accountants, and other professionals, and any and all other costs, direct and indirect, resulting from Contractor's use, adaptation, or distribution of Electronic Document(s) furnished in response to the Request.
  - f. Contractor shall not sell, copy, transfer, forward, give away or otherwise distribute the Electronic Documents (in source format or modified file format) to any third party without direct written authorization of Engineer or other entity that owns the Electronic document(s), unless such distribution is specifically indicated in the Request and is limited to Subcontractors and Suppliers. Contractor warrants that subsequent use by Subcontractors and Suppliers complies with terms and conditions of the Contract Documents, Owner's response to the Request, and release agreement(s) (if any) by owner of the Electronic Documents (including Engineer, where applicable).
3. When the Request is for Electronic Documents in a format not other than that indicated in the Contract Documents, and Owner (and others, as applicable) decide to comply with the Request, and when the requested Electronic Documents are not easily available in the format(s) requested, Contractor shall reimburse Owner for costs incurred by Owner, either directly or indirectly, to furnish Electronic Documents in accordance with the Request at a rate of \$125 per labor-hour to furnish the requested format(s). In compensation, Owner may retain such amount(s) as set-off(s) under the Contract Documents.

**1.5 EXCHANGE OF ELECTRONIC DOCUMENTS**

- A. Comply with the Electronic Document formats, transmission methods, and permitted uses set forth in Table 01 31 26-A, Exchange of Electronic Documents, below, when transmitting or using Electronic Documents on the Project. Where a row in the table has no indicated means of transmitting Electronic Documents, use for such documents only paper copies transmitted to the receiving party via appropriate delivery method.

**TABLE 01 31 26-A – EXCHANGE OF ELECTRONIC DOCUMENTS**

Electronic Document Type	Format	Transmitting User	Transmission Method	Receiving User	Allowed Uses	Notes
1.5.A.1. Project communications						
General communications & correspondence	EM, PDF	O, E, C	EM, EMA	O, E, C	R	
Meeting notices and agendas	EM, PDF	E	EM, EMA	O, C	R	
Meeting minutes	PDF	E	EM, EMA	O, C	R	
1.5.A.2. Contractor's Submittals to Engineer						
Shop Drawings	PDF	C	EMA	E	M (1)	(1)
Product data Submittals, delegated design Submittals, and other action Submittals (except Samples)	PDF	C	EMA	E	M (1)	(1)
Informational and closeout Submittals:	PDF	C	EMA	E	M (1)	(1) (6)

Electronic Document Type	Format	Transmitting User	Transmission Method	Receiving User	Allowed Uses	Notes
Documentation of delivery of maintenance materials submittals	PDF	C	EMA	E	M (1)	
1.5.A.3. Engineer's return of reviewed Submittals to Contractor						
Shop Drawings	PDF	E	EMA	O., C	R	
Product data Submittals, delegated design Submittals, and other action Submittals	PDF	E	EMA	O., C	R	
Informational and closeout Submittals:	PDF	E	EMA	O., C	R	(6)
Documentation of delivery of maintenance materials submittals	PDF	E	EMA	O. C	R	
1.5.A.4. Contract Modifications Documents						
Requests for interpretation to Engineer	PDF	C., O	EMA	E	M (1)	(1)
Engineer's interpretations (RFI responses)	PDF	E	EMA	C, O	R	
Engineer's clarifications to Contractor	EM, PDF	E	EM, EMA	C, O	R	
Engineer's issuance of Field Orders	PDF	E	EMA	C, O	R	
Proposal Requests	PDF	E, O	EMA	C	R	
Change Proposals – submitted to Engineer	PDF	C	EMA	O, E	S	
Change Proposals – Engineer's response	PDF	E	EMA	C. O		
Work Change Directives (for Contractor signature)	PDF	E	EMA	C	R	(2)
Change Orders (for Contractor signature)	PDF	E	EMA	C	R	(2)
1.5.A.5. Applications for Payment						(3)
1.5.A.6. Claims and other notices						(4)
1.5.A.7. Closeout Documents						
Record drawings	DWG and PDF	C	EMA	E, O	M (5)	(5)
Other record documents	PDF	C	EMA	E. O	M (5)	(5)
Contract closeout documents						

1. Key to Table 01 31 26-A:
  - a. Data Format:
    - 1) EM: .msg, .htm, .txt, .rtf, e-mail text.
    - 2) W: .docx, Microsoft Word 2013 or later.
    - 3) EX: .xlsx, Microsoft Excel 2013 or later.
    - 4) PDF: .pdf. portable document format.
    - 5) DWG: .dwg. Autodesk AutoCAD 2014 drawing.
  - b. Transmitting User:
    - 1) O: Owner.

- 2) C: Contractor.
- 3) E: Engineer.
- c. Transmission Method:
  - 1) EM: Via e-mail.
  - 2) EMA: Attachment to e-mail transmission.
  - 3) PORT: Delivered via portable media such as flash drive/thumb drive, CD, or DVD
  - 4) PW: Posted to Project Website.
  - 5) FTP: FTP transfer to receiving FTP server.
- d. Receiving User:
  - 1) O: Owner.
  - 2) C: Contractor.
  - 3) E: Engineer.
- e. Permitted Uses:
  - 1) S: Store and view only.
  - 2) R: Reproduce and distribute.
  - 3) I: Integrate (incorporate additional electronic data without modifying data received)
  - 4) M: Modify as required to fulfill obligations for the Project.
- f. Notes:
  - 1) Modifications by Engineer to Contractor's Submittals and requests for interpretations are limited to printing, marking-up, and adding comment sheets.
  - 2) May be distributed only to affected Subcontractors and Suppliers. Print, sign document, and return signed paper originals to Engineer.
  - 3) Submit printed Applications for Payment with original ("wet") signatures.
  - 4) Submit notices, including Claims, in accordance with the notice provisions of the General Conditions, as may be modified by the Supplementary Conditions.
  - 5) Submit record drawings in native CAD format indicated when Contractor has signed Engineer's standard agreement for release of electronic media. In addition, always submit record drawings as PDF files. Comply with Contract Documents requirements for Project record documents.
  - 6) For operation and maintenance data, also submit paper copies as required by Section 01 78 23 - Operations and Maintenance Manuals.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION - (NOT USED)**

**END OF SECTION**

**SECTION 01 33 00**  
**SUBMITTAL PROCEDURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Definition of various types of Submittals.
2. Coordination requirements for Submittals.
3. General provisions concerning Submittals.
4. Contractor's preparation of Submittals, including:
  - a. Numbering.
  - b. Marking.
  - c. Organization and content.
  - d. Proposed "or-equals", substitutes, and deviations from Contract requirements.
  - e. Electronic Documents Submittals.
  - f. Contractor's review and approval of each Submittal.
  - g. Resubmittals.
5. Contractor's transmittal of Submittals, including transmittal letters, transmittal and delivery method, and delivery of Samples, Closeout Submittals, and Maintenance Materials Submittals.
6. Engineer's review, including:
  - a. Timing.
  - b. Meaning of Engineer's Submittal action code(disposition) assigned.
  - c. Delivery of Engineer's responses on Submittals.

B. Scope:

1. Contractor shall provide all labor, materials, equipment, tools, services, incidentals, and other effort necessary to furnish Shop Drawings, product data Submittals, Samples, and other Submittals in accordance with the Contract Documents.
2. This Section's Article, "General Provisions Concerning Submittals" includes a summary of the Contract Documents' locations of Submittals requirements.
3. Shop Drawings, product data Submittals, Samples, and other Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Engineer's approval or acceptance, as applicable, of a Submittal does not alter or modify the Contract Documents.
4. Engineer and Owner have the right to rely on Contractor's representations and certifications made regarding each Submittal.

C. Related Requirements: Include but are not limited to:

1. Section 01 25 00 - Substitution Procedures.
2. Section 01 31 26 - Electronic Communication Protocols.
3. Section 01 62 00 - Product Options.
4. Section 01 78 23 - Operations and Maintenance Manuals.

**1.2 REFERENCES**

A. References – Introduction:

1. This Article presents definitions and terminology used in this Section and throughout the Contract Documents.
  2. Applicability of the Term “Submittals”: Where reference is made to Shop Drawings, product data Submittals, Samples, or other Submittals in this Section and elsewhere in the Contract Documents, the term “Submittals”, as defined in the Contract Documents, is intended. The foregoing applies regardless of whether such term is indicated with an initial capital letter, unless context of the subject provision clearly indicates otherwise.
  3. Types of Submittals:
    - a. Submittal types are classified as follows: (1) Action Submittals, (2) Informational Submittals, (3) Closeout Submittals, and (4) Maintenance Materials Submittals.
    - b. Type of each required Submittal is indicated in the associated Specifications section. When Submittal type is not clearly indicated in the associated Specifications section, Submittal will be classified as indicated in this Article. Submit request for interpretation when Contractor is uncertain of required Submittal type.
- B. Action Submittals:
1. Action Submittals require an explicit, written approval or other appropriate action by Engineer (or other entity to whom the Submittal is required to be furnished, in accordance with the Contract Documents) before Contractor may release the associated item(s) for raw materials procurement, fabrication, production, and shipping.
  2. Unless otherwise indicated in the Contract Documents, Action Submittals include the following:
    - a. Shop Drawings.
    - b. Product data.
    - c. Samples.
    - d. Testing plans for quality control activities required by the Contract Documents.
    - e. Delegated Designs: Delegated design professional’s “instruments of service” Submittals required by the Contract Documents.
- C. Informational Submittals:
1. Informational Submittals are so indicated in the Contract Documents. Unless otherwise indicated, Informational Submittals include certifications, evaluation reports, results of source quality control activities, results of field quality control activities, Supplier instructions, reports of Suppliers’ visits to the Site, sustainable design Submittals (that are not Closeout Submittals), delegated design Submittals that are not “instruments of service” Submittals, qualifications statements, and others.
  2. Informational Submittals, when submitted in accordance with the Contract and indicating full compliance with the Contract Documents, do not require explicit response from Engineer (or other entity to whom the Submittal is to be delivered); Engineer’s (or other entity’s) acceptance thereof will be indicated in the Engineer’s Submittals log. Copy of Engineer’s Submittals log is available to Contractor upon Contractor’s written request.
  3. When Informational Submittal does not indicate full compliance with the Contract Documents, Engineer (or other entity to which Submittal is to be delivered) will indicate the non-compliance in a written response to Contractor.
- D. Closeout Submittals:

1. Closeout Submittals are so indicated in the Contract Documents and are, in general, required before the associated Work is completed, unless earlier submittal is required by the Contract Documents.
2. Unless indicated otherwise in the Contract Documents, Closeout Submittals include maintenance contracts, operation and maintenance data, warranties, bonds (other than performance and payment bonds required prior to the start of construction), record documents, sustainable design closeout Submittals, software, keys, and others.
3. Closeout Submittals are processed in the same manner as described above for Informational Submittals.

E. Maintenance Materials Submittals:

1. Maintenance materials include spare parts, extra materials, tools, and similar items required to be furnished in accordance with the Contract Documents.
2. Furnish required physical maintenance materials, delivered to Owner or facility manager (if other than Owner), as applicable, at the location(s) indicated in the Contract Documents, for the corresponding required Maintenance Materials Submittals.
3. Maintenance Materials Submittals are documentation of delivery to Owner's or facility manager, and their acceptance of, required physical maintenance materials.
4. Maintenance Materials Submittals are processed in the same manner as described above for Informational Submittals.

F. Additional Terms:

1. The following terms have the meanings indicated below, regardless of whether such terms are indicated using initial capital letters, and apply to singular and plural of each:
  - a. "Product data" means illustrations, standard schedules, performance charts, Supplier's published instructions, brochures, diagrams, and other information furnished by Contractor to illustrate or describe materials or equipment for some portion of the Work. In general, product data are manufacturers' pre-published information on the items proposed to be incorporated into the Work. Product data includes manufacturer's catalog pages and similar documents with contractor-made markings and indications of proposed products and proposed options.
  - b. The term "Shop Drawings", defined in the General Conditions, is supplemented by the following: Shop Drawings include: (1) fabrication and assembly drawings, usually having a title block, or (2) schedules, prepared specifically for the Project. Here, "schedules" means a Project-specific summary of systems and components, such as a schedule of HVAC equipment, schedules of doors and door hardware, or windows, or a schedule of paint systems by room and surface, or other, similar Project information in a tabular format. In contrast, construction Progress Schedules, Schedules of Submittals, and Schedules of Values are not Shop Drawings. Unless expressly required otherwise in the Contract Documents, Shop Drawings shall not be prepared from, or on, the Drawings or any other component of the Contract Documents.

### 1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Furnish Submittals well in advance of need for the associated material or equipment, or procedure (as applicable), in the Work and with ample time necessary for delivery of materials and equipment and to implement procedures following Engineer's approval or acceptance of the associated Submittal.

2. Work covered by a Submittal will not be included in payments by Owner until approval or acceptance (as applicable) of related Submittals has been obtained in accordance with the Contract Documents.

#### **1.4 GENERAL PROVISIONS CONCERNING SUBMITTALS**

##### **A. Locations of Requirements:**

1. Requirements concerning Submittals are generally located as follows:
  - a. This Section, which presents general requirements for Submittals applicable to the Project.
  - b. Other Division 01 Specifications that include general requirements for certain types of Submittals, such as Section 01 31 26 - Electronic Communications Protocols, Section 01 78 23 - Operation and Maintenance Data, and others.
  - c. The "Submittals" Article of the various Specifications sections, which indicates the required Submittals for the associated Work. Furnish all Submittals required by the Contract Documents regardless of whether explicitly indicated in the associated Specifications' "Submittals" Article.

#### **1.5 PREPARATION OF SUBMITTALS**

##### **A. Prior to Submittal Preparation:**

1. Obtain Owner's acceptance before entering into subcontracts and purchase orders for the Work.
2. Comply with the Contract Documents relative to terms and conditions of subcontracts and purchase orders for the Work.
3. Contractor's responsibilities include:
  - a. Obtaining field measurements and dimensions.
  - b. Determining and verifying required quantities.
  - c. Verifying compatibility of materials.
  - d. Apportioning the Work among Subcontractors, Suppliers, and Contractor.
  - e. Reconciling required materials, equipment, and other Contract requirements with Contractor's means, methods, techniques, sequences, and procedures of construction and with Contractor's safety and protection programs and precautions incident thereto.
  - f. Reviewing applicable provisions of the Contract Documents and obtaining from Engineer necessary interpretations or clarifications.

##### **B. Submittal Identification:**

1. Submittal Number: Shall be a unique number assigned to each individual Submittal. Assign Submittal numbers as follows:
  - a. First part of Submittal number shall be the applicable Specifications section number, followed by a hyphen.
  - b. Second part of Submittal number shall be a three-digit number (sequentially numbered from 001 through 999) assigned to each separate Submittal furnished under the associated Specifications section.
  - c. Example: Submittal number for the third Submittal furnished for Section 10 14 00 - Signage, would be "10 14 00-003".
2. Review Cycle Number: Each resubmittal of a given Submittal shall be indicated with a lower-case letter designation:
  - a. No letter designation for initial (first) submittal of the Submittal number.
  - b. "a" shall indicate first resubmittal of the Submittal number.

c. "b" shall indicate second resubmittal of the Submittal number.

3. Examples:

Example Description	Submittal Identification	
	Submittal No.	Review Cycle
Initial (first) review cycle of the third Submittal furnished under Section 10 14 00 – Signage	10 14 00-003-	
Second review cycle (first resubmittal) of third Submittal furnished under Section 10 14 00 - Signage	10 14 00-003-	a

C. Marking of Submittals:

1. Mark on each page of each Submittal and each individual component submitted with Submittal number and applicable Specifications paragraph.
2. Mark each page of each Submittal with the Submittal page number.
3. Each Shop Drawing sheet shall have title block with complete identifying information satisfactory to Engineer.
4. For product data Submittals, operation and maintenance data Submittals, and other Submittals:
  - a. Mark options to be furnished using broad, dark arrows or "clouds" clearly drawn around the relevant text or diagrams. Do not use highlighter for indicating options and features.
  - b. Indicate options and features not furnished using clear strikeouts through the text or diagrams.

D. Submittal Organization and Content – General:

1. Page or Sheet Size; Furnish Submittals with one or more of the following page or sheet sizes: (a) 8.5 inches by 11 inches; (b) 11 inches by 17 inches; (c) 22 inches by 34 inches; unless another sheet size is acceptable to Engineer.
2. Language: All parts of each Submittal shall be in the English language.
3. Units of Measurement: Clearly indicate units of measurement on Shop Drawings, product data Submittals, record documentation, and operation and maintenance data Submittals.
4. Organize each Submittal logically to facilitate ease of understanding and review.
5. To the extent practicable, arrange Submittal information in same order as requirements are written in the associated Specifications section.
6. Each Submittal shall cover Work under only one Specifications section.
7. To the extent practicable, package together Submittals for the same Specifications section. Do not furnish required information piecemeal.
8. For large or complex Submittals, include a title page and table of contents.
9. Include appropriately labeled fly sheets to separate distinct parts of each Submittal.
10. Ensure legibility of all pages in each Submittal.
11. Minimize extraneous and unnecessary information in Submittals for materials and equipment. Do not submit information not relevant to the Submittal and associated requirements of the Contract Documents.
12. Contractor's, Subcontractor's, and Supplier's written comments on Shop Drawings and product data diagrams shall be colored green

13. Do not submit under Specifications sections with title that includes either, "Common Work Results for" or, "Basic Requirements", unless the subject material or equipment is specified, in total, in a Specifications section with the words, "Common Work Results for" or, "Basic Requirements" in its title.
- E. Electronic Documents Submittals:
1. Format: Electronic Documents Submittals shall be "portable document format" (.PDF) files unless expressly required otherwise by applicable provisions of the Contract Documents.
  2. Electronic Documents Submittals must be electronically searchable when delivered to Engineer and other recipients.
  3. Organization and Content:
    - a. Each Electronic Documents Submittal shall be one file; do not divide individual Submittals into multiple Electronic Documents files each unless file size will exceed [20] MB.
    - b. When Submittal is large or contains multiple parts, furnish PDF file with suitably titled electronic bookmark for each section of the Submittal.
    - c. Content shall be identical to paper or other original Submittal. First page of each Electronic Documents Submittal shall be transmittal letter required in this's Paragraph 1.7.A.
  4. Quality and Legibility: Electronic Documents Submittal files shall be made from the original and shall be clear and legible. Markings applied by Contractor, Subcontractor, or Supplier shall be clear, distinct, and readily apparent. Electronic Documents file shall be full size of original documents. Properly orient all pages for convenient reading on a computer display; do not furnish pages sideways or upside-down..
  5. Provide sufficient internet service, software, and systems for Contractor with capability appropriate for transmitting the necessary files and receiving responses from Engineer or other entities.
  6. Check not less than once per day for distribution of Electronic Documents Submittals responses and related Electronic Documents correspondence.
- F. Proposed "Or-Equals", Substitutes, and Deviations from Contract Requirements:
1. "Or-Equals":
    - a. The meaning of "or-equal" is addressed in Section 01 25 00 - Substitution Procedures.
    - b. Contractor's request for approval of "or-equals" is to be presented via the associated Action Submittal(s) and shall include the information required in provisions governing "or-equals" in Section 01 62 00 - Product Options.
    - c. Expressly and prominently indicate, "Proposed Or-Equal" on the associated Action Submittals when Submittal is for an "or-equal".
    - d. Submittals requesting approval of an "or-equal" but not accompanied by the required, supplemental information will be deemed incomplete by Engineer and returned to Contractor without approval.
  2. Substitutes:
    - a. The meaning of "substitute" is indicated in Section 01 25 00 - Substitution Procedures.
    - b. Requests for approval of substitutes shall comply with Section 01 25 00 - Substitution procedures, and other relevant provisions of the Contract Documents.

- c. Contractor's request for approval of substitute is separate from the associated Action Submittal(s). Action Submittals that request approval of a substitute when a separate, formal substitution request (furnished in accordance with the Contract Documents) was not previously furnished to Engineer, followed by formal approval in via an appropriate contract modification (typically either a Field Order or Change Order), will be deemed by Engineer as non-compliant with the Contract Documents and will be returned to Contractor without approval.
  - d. Contractor is solely responsible for delays incurred due to substitutes proposed via Submittals that have not been previously duly approved via an appropriate Contract modification.
  - e. Action Submittals for items or procedures approved via an appropriate Contract modification shall include a copy of the Contract modification in which the substitute was approved.
3. Submittals with Proposed Deviations from Contract Requirements:
- a. When Submittal proposes deviations from requirements of the Contract Documents, the Submittal shall clearly and expressly indicate each proposed deviation.
  - b. Also comply with this Section's provision, in the Article below, on Contractor's transmittal letter expressly alerting Engineer to the proposed deviations.
  - c. Comply with requirements of the Contract regarding substitutes and "or-equals".
  - d. When deviation is proposed, also appropriately revise text of Contractor's approval, from that required below in this Article.
  - e. When Submittal includes deviations from Contract requirements and either the Submittal itself, Contractor's transmittal letter, or both, do not comply fully with Contract requirements for indicating deviations in Submittals and giving separate written notice thereof, Engineer's approval of such deviations will be deemed null and void unless Engineer's written response to the Submittal has expressly acknowledged such deviation and indicated Engineer's approval thereof.
  - f. Contractor is solely responsible for delays and costs incurred due to any and all Submittals with deviations from Contract requirements that were not properly, expressly indicated and approved in accordance with the Contract Documents. Deviations not duly approved in accordance with the Contract Documents may be deemed defective Work. Contractor is solely responsible for remedying defective Work and all associated cost and time impacts.
- G. Contractor's Approval of Submittals:
- 1. Contractor's Review: Before transmitting Submittals to Engineer, review each Submittal to:
    - a. Ensure proper coordination of the Work.
    - b. Determine that each Submittal is in accordance with Contractor's desires.
    - c. Verify that Submittal contains sufficient information for Engineer to determine compliance with the Contract Documents.
  - 2. Incomplete or inadequate Submittals will be returned without detailed review by Engineer.
  - 3. Contractor's Approval Stamp and Signature:
    - a. Each Submittal furnished shall bear Contractor's approval stamp (or facsimile thereof) and signature, as evidence that the Submittal has been reviewed and

approved by Contractor and verified as complete and in accordance with the Contract Documents.

- b. Submittals without Contractor's approval and signature (as required by the contract Documents) will be returned to Contractor without further review by Engineer and deemed incomplete.
- c. Engineer reserves the right to reject as incomplete Submittals where Contractor's approval signature appears computer-generated or reproduced without the active involvement or review of Contractor's signatory.
- d. Contractor's approval shall contain the following text:

Project Name: \_\_\_\_\_  
Contractor's Name: \_\_\_\_\_  
Contract Designation: \_\_\_\_\_  
Date: \_\_\_\_\_

----- *Reference* -----

Submittal Title: \_\_\_\_\_  
Specifications: \_\_\_\_\_  
Section: \_\_\_\_\_  
Page No.: \_\_\_\_\_  
Paragraph No.: \_\_\_\_\_  
Drawing No.: [ ] of \_\_\_\_\_  
Location of Work: \_\_\_\_\_

Submittal No. and Review Cycle: \_\_\_\_\_  
Coordinated by Contractor with Submittal Nos.: \_\_\_\_\_

I hereby certify that Contractor has satisfied Contractor's obligations under the Contract Documents relative to Contractor's review and approval of this Submittal, including: (1) reviewed and coordinated the Submittal with other Submittals and with the requirements of the Work and the Contract Documents; (2) determined and verified all: field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal, (b) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work, and (c) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; (3) confirmed the Submittal is complete with respect to all related data included in the Submittal; and (4) clearly and expressly indicated all proposed deviations (if any) from the requirements of the Contract Documents both in the Submittal itself and in the Submittal's transmittal letter. Accordingly, this Submittal is hereby approved for Contractor by:

Approved for Contractor by: \_\_\_\_\_

H. Resubmittals:

- 1. Refer to the General Conditions, as may be modified by the Supplementary Conditions, for requirements regarding resubmitting required Submittals.
- 2. In addition to limits on the quantity of resubmittals, as indicated in the General Conditions, Contractor shall furnish Submittals with such completeness, accuracy, and compliance with the Contract Documents to obtain Engineer's approval or

acceptance, as applicable, without the total quantity of Submittals furnished, including all initial Submittals and all resubmittals, exceeding [125] [150]% of the number of Submittals indicated on the Schedule of Submittals initially accepted by Engineer, plus a corresponding percentage of the quantity of Submittals required by Change Orders, Work Change Directives, and Field Orders.

3. Do not increase the scope of prior review cycle of the same Submittal.
4. Indicate on Contractor's transmittal letter how Submittal was revised from previous review cycle of the Submittal and where the revisions or corrections are located within the resubmittal.
5. Expressly address and provide response for all components previously transmitted by Engineer on prior review cycles of the subject Submittal. Where resubmittal lacks complete response to Engineer's prior comments, Engineer may deem such resubmittal as incomplete and return it to Contractor without further review.
6. Where part of the Submittal's prior review cycle was expressly approved or accepted, as applicable, by Engineer, do not include such items in subsequent resubmittals.
7. Indicate, "Not Yet Resolved—To Be Resubmitted at a Later Date" for any items not approved in prior review cycle of the Submittal for items not included in the subject resubmittal. Engineer reserves the right to deem incomplete Submittals "Not Approved" or "Revise and Resubmit". Furnishing incomplete or partial resubmittals is discouraged.
8. Resubmittal of Previously Approved or Accepted Items:
  - a. Do not resubmit on a given item previously approved or accepted, as applicable, by Engineer, without Engineer's advance consent. Consent will be given for bona-fide unavailability of a previously approved or accepted item where Contractor has acted in good faith in a timely manner with due diligence to comply with the Contract Times.
  - b. Destroy or conspicuously mark "SUPERSEDED" on all documents having previously received Engineer's approval or acceptance, as applicable, that are superseded by a resubmittal.

## **1.6 TRANSMITTAL OF SUBMITTALS BY CONTRACTOR**

### **A. Contractor's Transmittal Letters for Submittals:**

1. Furnish separate transmittal letter with each Submittal. Use transmittal form attached to this Section (as Exhibit 01 33 00-A) unless other transmittal form is acceptable to Engineer at the start of the Project's construction.
2. When transmittal form other than this Section's Exhibit 01 33 00-A is acceptable to Engineer, at beginning of each transmittal, include a reference heading indicating: Contractor's name, Owner's name, Project designation, Contract designation, transmittal number, and Submittal number (with review cycle).
3. "Or-Equals": When the Submittal is proposing an "or-equal", expressly so indicate on transmittal form submitted by Contractor.
4. Proposed Deviations from Contract Requirements: When the Submittal proposes deviations from requirements of the Contract Documents, transmittal letter shall specifically describe each proposed deviation.

### **B. Submittal Delivery Method:**

1. This provision presents general requirements for delivery of all Submittals unless otherwise required elsewhere in the Contract Documents.
2. Furnish Submittals as Electronic Documents delivered in accordance with Section 01 31 26 – Electronic Communication Protocols.

3. Furnish Submittals to Owner.
  4. Address Submittals to Owner as follows: MAWSS, to attention of Markus Moore, [mamoore@mawss.com](mailto:mamoore@mawss.com).
- C. Closeout Submittals –Transmittal and Delivery:
1. Furnish the following Closeout Submittals in accordance with general requirements for transmitting and delivering Submittals, indicated above in this Article: maintenance contracts; warranty bonds (when required) and other bonds required for specific materials, equipment, or systems; warranty documentation; and sustainable design closeout documentation (when required). On documents such as maintenance contracts and bonds, include on each document furnished original (“wet”) signature of entity issuing said document. When original “wet” signatures are required, furnish such Submittals to Engineer both on original paper and as Electronic Documents, and to other entities furnish as indicated above in this Article for general requirements for Submittals.
  2. Operations and Maintenance Manuals: Submit in accordance with Section 01 78 23 - Operation and Maintenance Data.
- D. Maintenance Materials Submittals – Delivery:
1. Deliver physical maintenance materials required by the Contract Documents in accordance with applicable provisions of the Contract.
  2. Submit documentation of delivery of (Maintenance Materials Submittals) in accordance with general requirements for Submittals as indicated in this Section.

## **1.7 ENGINEER’S REVIEW OF SUBMITTALS**

- A. This Article applies to review of all Submittals by Engineer or other entity to whom the Contract Documents require such Submittal be furnished.
- B. Timing:
1. Timing of Engineer’s review will be in accordance with the Schedule of Submittals accepted by Engineer.
  2. When Submittal is delivered to Engineer on a date other than that indicated in the Schedule of Submittals accepted by Engineer, duration of Engineer’s review may differ from that indicated in the Schedule of Submittals, based on Engineer’s availability and resources. Engineer will make good-faith effort to furnish responses to Submittals in a timely manner.
  3. Contractor is responsible for communicating to Engineer when a Submittal is on the Project’s critical path.
- C. Engineer’s Review:
1. Markings:
    - a. Comments or responses marked directly on Submittal by Engineer (or other entity reviewing Submittal) will be colored red.
    - b. Engineer may also present narrative comments on a comment sheet inserted by Engineer into the Submittal or included on Engineer’s transmittal letter for the Submittal. Such comments will be in black text. When a separate comment sheet is included by Engineer, such sheet will be clearly identified as Engineer’s comments.
  2. Engineer’s review and disposition assigned to Submittal are subject to the following:
    - a. Submittal disposition is subject to: Engineer’s comments on the Submittal; disclaimer language on Engineer’s Submittal transmittal letter; Engineer’s

Submittal review stamp (when used) or equivalent (when used); and this provision.

- b. Engineer's review is only for general compatibility with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents, and for general compliance with the information given in the Contract Documents.
  - c. Contractor shall be solely responsible for complying with the Contract Documents, as well as with Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations. Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.
  - d. Engineer is not responsible for resubmittals not yet furnished by Contractor or tracking Contractor's progress on resubmittals.
3. Documents not required by the Contract Documents but nonetheless furnished by Contractor as submittals will not be reviewed by Engineer.

D. Meaning of Submittal disposition Assigned by Engineer:

- 1. Action Submittals:
  - a. "Approved" (Action Code A): Upon return of Submittal marked "Approved", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of production-related qualifications statements and certifications, and required source quality control Submittals) or otherwise proceed with the Work in accordance with the Submittal and the Contract Documents.
  - b. "Approved as Noted" (Action Code B): Upon return of Submittal marked "Approved as Noted", order, ship, or fabricate materials and equipment included in the Submittal (pending Engineer's approval or acceptance, as applicable, of production-related qualifications statements and certifications, and required source quality control Submittals) or otherwise proceed with the Work in accordance with the Submittal and the Contract Documents, and in accordance with Engineer's comments and notes indicated in Engineer's Submittal response
  - c. "Revise and Resubmit" (Action Code C): Upon return of Submittal marked "Revise and Resubmit", make the revisions necessary and indicated and resubmit to Engineer for approval.
  - d. "Not Approved" (Action Code D): This disposition indicates material or equipment that cannot be approved. "Not Approved" disposition may also be applied to Submittals that are incomplete. Upon return of Submittal marked "Not Approved", repeat initial submittal procedure utilizing approvable material or equipment, with a complete Submittal clearly indicating all information required.
- 2. Informational, Closeout, and Maintenance Materials Submittals:
  - a. "Accepted" (Action Code F): Information included in Submittal complies with the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to such Submittal, and the Work covered by the Submittal may proceed. Materials and equipment with Submittals with this disposition may be shipped or operated, as applicable. Submittals assigned "Accepted" by Engineer (or other reviewing entity) does not indicate Engineer's acceptance of the associated Work, which is indicated

only as set forth in the General Conditions and Section 01 77 19 – Closeout Requirements.

- b. “Not Acceptable” (Action Code G): Submittal, or part thereof, does not indicate full compliance with applicable requirements of the Contract Documents and is not acceptable. Provide labor, materials, equipment, services, and incidentals necessary to properly and accurately revise Submittal and resubmit to indicate acceptability and compliance with the Contract Documents

3. Other:

- a. “Submittal Not Reviewed” (Action Code E): Documents so marked by Engineer are not required by the Contract Documents. Submittals may also be marked with this disposition when information in the document was previously reviewed and approved or accepted by Engineer, as applicable.

E. Distribution of Engineer’s Responses:

1. Unless otherwise indicated in the Contract Documents, Engineer will distribute written responses (as Electronic Documents) to Submittals to the following:
  - a. Contractor.
  - b. Owner.
  - c. Engineer’s file.
2. Engineer’s acceptance of Informational Submittals, Closeout Submittals, and Maintenance Materials Submittals will be recorded in Engineer’s Submittal log. Copy of Engineer’s Submittals log is available from Engineer upon written request of Owner or Contractor. If no such request is received by Engineer, Engineer will distribute copy of Engineer’s Submittals log once per month (when Submittals have been received or acted on by Engineer). Engineer may distribute copy of Engineer’s Submittals log as an Electronic Document or as handout at construction progress meetings.
3. Paper copies of Engineer’s Submittal responses will not be distributed unless otherwise required by the Contract Documents or otherwise agreed to by Engineer.
4. Contractor is responsible for forwarding Engineer’s Submittals responses to Subcontractors and Suppliers as appropriate, and for coordinating the Work of all trades.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION**

**3.1 ATTACHMENTS**

- A. The documents listed below, following this Section’s “End of Section” designation, are part of this Specifications Section:
  1. “Exhibit 01 33 00-A – Transmittal for Submittal No. ##” (one page).

**END OF SECTION**

# Transmittal for Submittal

No. \_\_\_\_\_ - \_\_\_\_\_

Project Name:		Date Received:			
Project Owner:		Checked By:			
Contractor:		HDR Engineering, Inc.		Log Page:	
Address:		Address:		HDR No.:	
				Spec Section:	
				Drawing/Detail No.:	
Attn (Contractor):		Attn (HDR):		Review Cycle	
Date Transmitted by Contractor:		Date of Engineer's Response Transmittal:			
Item No.	Submittal No.	Description (indicate number of copies where paper copies of physical Samples are returned)	Manufacturer	Supplier Dwg or Data No.	Engineer's Disposition (Action Code) *
1					
2					
3					
4					
<b>Contractor's Remarks</b> <i>(insert text)</i> :					
<b>Engineer's Remarks</b> <i>(insert text)</i> :					
<b>* Legend for Action Code</b> indicated above, assigned by Engineer:					
Action Submittal: A – Approved B – Approved as Noted C – Revise and Resubmit D – Not Approved		E – Submittal Not Reviewed  Informational, Closeout, or Maintenance Materials Submittal: F – Accepted (this code normally recorded in Engineer's Submittals log). G – Not Acceptable			
<b>Engineer's Disclaimer</b> (for Submittals that do <u>not</u> involve delegated design):					
a. Submittal action code is subject to: Engineer's comments on the Submittal, comment sheets (if any), and this transmittal letter; disclaimer language on Engineer's Submittal review stamp or equivalent; and Specifications Section 01 33 00 – Submittal Procedures.					
b. Engineer's review is only for general compatibility with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents, and for general compliance with the information given in the Contract Documents.					
c. Contractor shall be solely responsible for complying with the Contract Documents, as well as with Supplier instructions consistent with the Contract Documents, Owner's directions, and Laws and Regulations. Contractor is solely responsible for obtaining, correlating, confirming, and correcting dimensions at the Site; quantities; information and choices pertaining to fabrication processes; means, methods, sequences, procedures, and techniques of construction; safety precautions and programs incident thereto; and for coordinating the work of all trades.					
d. Engineer is not responsible for resubmittals or tracking progress of resubmittals.					
<b>Reviewed by:</b>				<b>Date of Engineer's Review:</b>	
<b>Distribution:</b>	Contractor	File	Field	Owner	Other

**SECTION 01 61 00**  
**COMMON PRODUCT REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Common requirements for materials and equipment.
  2. Compatibility of materials and equipment.

**1.2 REQUIREMENTS FOR MATERIALS AND EQUIPMENT**

- A. Unless otherwise indicated in the Contract Documents, furnish materials and equipment that:
1. have not been previously been incorporated into another project or facility; and.
  2. have not changed ownership after initial shipment from the manufacturer's factory or facility; and.
  3. if stored since their manufacture or fabrication, have, while in storage, been properly maintained and serviced in accordance with the manufacturer's recommendations for long-term storage; submit documentation as required by Owner that such maintenance and service has been performed; and.
  4. that the item(s) have not been subject to degradation or deterioration since manufacture; and.
  5. are the current model(s) or type(s) furnished by the Supplier.
- B. To the extent possible, furnish from a single source those materials and equipment that are of the same generic kind.
- C. Furnish materials and equipment complete with accessories, trim, finish, fasteners, and other items shown, indicated, or required for a complete installation for the indicated use and performance.
- D. Standard Items: When available, and unless custom or nonstandard options are specified or indicated, furnish standard materials and equipment of types that have been produced and used successfully in similar situations on other projects.
- E. Visual Matching: Where required in the Contract Documents, furnish materials and equipment that match (as determined by Owner) referenced existing construction, and mock-ups and Sample(s) approved by Owner.
- F. Where the Contract Documents include the phrase "as selected" for color of materials or equipment, finish pattern, option, or similar phrase, furnish materials and equipment selected by Owner as follows:
1. Standard Range: Where the Contract Documents include the phrase "standard range of colors, patterns, textures" or similar wording, furnish color, pattern, density, or texture selected by Owner from manufacturer's product line that does not include premium items.
  2. Full Range: Where the Contract Documents include the phrase "full range of colors, patterns, textures" or similar wording, Owner will select color, pattern, density, or texture from manufacturer's entire product line, including standard and premium items.

**1.3 COMPATIBILITY**

- A. Similar materials and equipment by the same Supplier shall be compatible with each other, unless otherwise indicated in the Contract Documents or approved by Owner.
- B. Furnish materials and equipment compatible with items previously selected or installed on the Project.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION - (NOT USED)**

**END OF SECTION**

**SECTION 01 61 03**  
**COMMON WORK RESULTS FOR EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.
- B. Related Sections include but are not necessarily limited to:
1. Section 03 15 19 - Anchorage to Concrete.
  2. Section 05 50 00 - Metal Fabrications.
  3. Section 10 14 00 - Identification Devices.
  4. Section 26 29 23 - Variable Frequency Drives - Low Voltage.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
1. American Bearing Manufacturers Association (ABMA).
  2. American Gear Manufacturers Association (AGMA).
  3. American Petroleum Institute
    - a. API 686 - Recommended Practice for Machinery Installation and Installation Design
  4. ASTM International (ASTM):
    - a. E1934, Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.
    - b. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  5. International Electrotechnical Commission (IEC).
  6. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
  7. International Organization for Standardization (ISO):
    - a. 1940, Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances.
    - b. 21940-11, Mechanical Vibration - Rotor Balancing - Part 11: Procedures and Tolerances for Rotors with Rigid Behavior.
  8. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. ICS 6, Enclosures for Industrial Control and System.
    - c. MG 1, Motors and Generators.
  9. InterNational Electrical Testing Association (NETA):
    - a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
  10. National Institute for Certification in Engineering Technologies (NICET).
  11. National Institute of Standards and Technology (NIST).

12. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
  13. Underwriters Laboratories, Inc. (UL).
    - a. 508, Standard for Safety Industrial Control Equipment.
    - b. 508A, Standard for Safety Industrial Control Panels.
    - c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
  14. Vibration Institute.
- B. Supplier's Vibration Analyst:
1. Supplier's vibration analyst shall prepare pre-Shop Drawing vibration analysis of equipment.
  2. Where required, Supplier's vibration analyst shall be either equipment manufacturer's qualified employee or independent business entity whose sole business, or principal part of its business, is evaluating and determining natural frequencies of rotating equipment.
  3. Shall possess not less than 10 years' relevant experience.
  4. Supplier's Vibration Analyst's Professional Engineer:
    - a. Vibration analysis shall be performed by, or under the direct, personal supervision of, professional engineer licensed and registered in the same jurisdiction as the Site experienced in preparing finite element analyses, rotordynamic analyses, and experimental modal analysis similar to that required for the Work.
    - b. Professional engineer shall possess not less than five years' combined experience in field testing and data analysis for vibration analysis.
    - c. Vibration analysis professional engineer's seal and signature, with indication of date seal and signature were applied to the subject document, shall clearly appear on all results and reports furnished as Submittals.
- C. Field Vibration Testing Subcontractor:
1. Field vibration testing Subcontractor shall, where required by the Contract Documents, perform vibration testing of equipment installed at the Site and perform associated vibration analyses.
  2. Vibration testing Subcontractor shall be an independent entity that has performed as its sole business, or principal part of its business, for not less than 10 years, inspection, testing, calibrating, adjusting equipment and systems, and performing vibration testing of equipment.
  3. Entities whose principal business is one or more of the following are not considered independent vibration testing entities and, therefore, shall not be field vibration testing Subcontractor:
    - a. Motor sales, service, or repairs.
    - b. Process equipment sales, service, or repairs.
  4. Acceptable entities include, but are not necessarily limited to:
    - a. AVS Engineering: <https://www.avseengineering.net/>
    - b. Engineering Testing Services: <https://etestinc.com/>
    - c. Maritech, LLC: <http://www.maritech-llc.com/contact.html>
    - d. Mechanical Solution, Inc. (MSI) [www.mechsol.com](http://www.mechsol.com)
    - e. Or equal.

5. Field vibration testing Subcontractor must have an established program for monitoring and testing equipment calibration, with accuracy traceable in an unbroken chain, in accordance with NIST requirements.
6. Field Personnel: Each person employed for field vibration testing on the Work shall possess not less than the following qualifications:
  - a. Three years' field experience covering all phases of field vibration testing and data gathering.
  - b. Current, valid Vibration Category II certification from Vibration Institute or a licensed, registered professional engineer [who need not be licensed and registered in the same jurisdiction as the Site].
7. Analysis Personnel: Personnel performing analysis for field vibration testing Subcontractor shall possess not less than the following qualifications:
  - a. Five years' combined field testing and data analysis experience.
  - b. Current, valid Vibration Category III certification from the Vibration Institute or a professional engineer [licensed and registered in in the same jurisdiction as the Site. Where required by Laws and Regulations, field vibration analysis report shall be sealed, signed, and dated by professional engineer who personally prepared, or exercised personal, supervisory control over subordinates in preparing, the field vibration analysis report].
8. Analysis Equipment: Field vibration testing Subcontractor shall have access to and use, where appropriate, the following testing equipment, properly maintained and calibrated:
  - a. Impact Hammer:
    - 1) Frequency Range: 1 kHz.
    - 2) Range (5v output) 5,000 pounds-force (22,200 newtons).
    - 3) Hammer sensitivity (approx.) 1mV/lbf (0.23 mV/N)
  - b. Analyzer:
    - 1) Frequency Range: 1 Hz to 10,000Hz.
    - 2) Frequency Accuracy: 0.02 percent.
    - 3) Non-Integrated Spectral Amplitude Accuracy: 5 percent, 3 Hz to 65 Hz.
    - 4) Single Integrated Spectral Amplitude Accuracy: 5 percent, 10 Hz to 20 Hz.
    - 5) Supports measurements of acceleration, velocity, and displacement.
  - c. Vibration Sensor:
    - 1) Sensitivity:  $\pm 5$  percent = 100 mV/g
    - 2) Acceleration Range:  $\pm 5$  g.
    - 3) Amplitude Nonlinearity:  $\pm 1$  percent
    - 4) Frequency Response:  $\pm 10$ Hz to 7kHz ( $\pm 3$  dB)
  - d. Data logging equipment for simultaneous recording of the following data points:
    - 1) Vibration in the X, Y, and axial planes (for all pumps pursuant to ANSI/HI Standard).
    - 2) Digital tachometer recording RPM.
    - 3) Discharge Pressure Transmitter
      - a) Accuracy: 0.3 percent of range
      - b) Fluid Temperature Range: 32 to 100 DegF
    - 4) Suction Pressure Transmitter (when other than submersible pump or vertical turbine (suspended) pump.
      - a) Accuracy 0.35 percent of range.

- b) Fluid Temperature Range: 32 to 100 DegF.
- c) For submersible pumps and vertical turbine (suspended) type pumps, suction liquid surface level signal from Site's monitoring and control system (e.g., plant PLC/SCADA system).
- 5) For pumps, pumping rate (flow) signal from Site's monitoring and control system (e.g., plant PLC/SCADA system)
- 6) Equipment/motor bearing temperature signal from Site's monitoring and control system (e.g., plant PLC/SCADA system)).
- 7) Pump/motor vibration signal from Site's monitoring and control system (e.g., plant PLC/SCADA system).

D. Miscellaneous:

- 1. A single manufacturer of a "product" shall be selected and utilized uniformly throughout Project even if:
  - a. More than one manufacturer is listed for a given "product" in Specifications.
  - b. No manufacturer is listed.
- 2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 and defined in the Electrical specifications.
- 3. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and verify their compatibility.

**1.3 DEFINITIONS**

A. Product: Manufactured materials and equipment.

B. Major Equipment Supports - Supports for Equipment:

- 1. Located on or suspended from roofs with supported equipment weighing 500 pounds or greater, or;

C. Equipment:

- 1. One or more assemblies capable of performing a complete function.
- 2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.
- 3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.

D. Installer or Applicator:

- 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
- 2. Installer and applicator are synonymous.

E. Baseplate or equipment base plate or machine base

- 1. Are fabricated frames of structural shapes and plates with enough strength and sturdiness to serve as the surface to which other equipment is attached to and supported by. Baseplates can be directly mounted and grouted to concrete equipment support bases or machined and bolted to a sole plate.

F. Sole plate

- 1. A thick steel machined plate that is attached to and grouted to a concrete equipment support base.

2. Base plates are bolted to a sole plate when a sole plate is specified and/or provide.

#### 1.4 SUBMITTALS

##### A. Shop Drawings:

1. General for all equipment:
  - a. Data sheets that include manufacturer's name and complete product model number.
    - 1) Clearly identify all optional accessories that are included.
  - b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
  - c. Manufacturer's delivery, storage, handling, and installation instructions.
  - d. Equipment identification utilizing numbering system and name utilized in Drawings.
  - e. Equipment installation details:
    - 1) Location of anchorage.
    - 2) Anchorage setting templates.
    - 3) Manufacturer's installation instructions.
  - f. Equipment area classification rating.
  - g. Shipping and operating weight.
  - h. Equipment physical characteristics:
    - 1) Dimensions (both horizontal and vertical).
    - 2) Materials of construction and construction details.
  - i. Equipment factory primer and paint data.
  - j. Manufacturer's recommended spare parts list.
  - k. Equipment lining and coatings.
  - l. Equipment utility requirements include air, natural gas, electricity, and water.
2. Mechanical and process equipment:
  - a. Operating characteristics:
    - 1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
    - 2) Brake horsepower requirements.
    - 3) Copies of equipment data plates.
  - b. Piping and duct connection size, type and location.
  - c. Equipment bearing life certification.
  - d. Equipment foundation data:
    - 1) Equipment center of gravity.
    - 2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
    - 3) Type, size, and materials of construction of anchorage.
    - 4) Data required by Section 03 15 19 Anchorage to Concrete for anchor rod design.
3. Electric motor:
  - a. Motor manufacturer and model number.
  - b. Complete motor nameplate data.
  - c. Weight.

- d. NEMA design type.
- e. Enclosure type.
- f. Frame size.
- g. Winding insulation class and temperature rise.
- h. Starts per hour.
- i. Performance data:
  - 1) Guaranteed minimum efficiencies at 100 percent, 75 percent, and 50 percent of full load.
  - 2) Guaranteed minimum power factor at 100 percent, 75 percent, and 50 percent of full load.
  - 3) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.
  - 4) Starting, full load, and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.
- j. Bearing data and lubrication system.
- k. Natural frequency calculations for:
  - 1) Completed assembly including but not limited to the equipment base, rotating piece of equipment, and the rotating piece of equipment driver.
  - 2) Individual piece of rotating equipment.
  - 3) Equipment driver and connected gear reducer, if applicable.
- l. Thermal protection system including recommended alarm and trip settings for winding and bearing RTD's.
- m. Fabrication and/or layout drawings:
  - 1) Dimensioned outlined drawing.
  - 2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).
- n. Certifications:
  - 1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
  - 2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.
    - a) Include minimum speed at which the motor may be operated for the driven machinery.
- o. Electrical gear:
  - 1) Unless specified in a narrow-scope Specification Section, provide the following:
    - a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.
  - 2) Control panels:
    - a) Panel construction.
    - b) Point-to-point ladder diagrams.
    - c) Scaled panel face and subpanel layout.
    - d) Technical product data on panel components.
    - e) Panel and subpanel dimensions and weights.
    - f) Panel access openings.
    - g) Nameplate schedule.

- h) Panel anchorage.
    - i) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.
  - 4. Systems schematics and data:
    - a. Provide system schematics where required in system specifications.
      - 1) Acknowledge all system components being supplied as part of the system.
      - 2) Utilize equipment, instrument and valving tag numbers defined in the Contract Documents for all components.
      - 3) Provide technical data for each system component showing compliance with the Contract Document requirements.
      - 4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.
  - 5. For factory painted equipment, provide paint submittals in accordance with manufacturer's recommendations.
  - 6. Qualifications for:
    - a. Natural frequency analysis firm and personnel.
    - b. Vibration testing firm and personnel.
    - c. Infrared thermography testing firm and personnel.
    - d. Electrical equipment and connections testing firm and personnel.
  - 7. Equipment Monitoring and Testing plans, in accordance with PART 3 of this Specification Section:
    - a. Natural frequency analysis and calculations.
    - b. Vibration testing.
    - c. Thermography testing.
    - d. Electrical equipment and connection testing.
- B. Factory Test Reports:
1. Natural frequency bump test reports where required for rotating equipment.
    - a. Minimum characteristics of impact hammer.
      - 1) Frequency Range 1 kHz.
      - 2) Range (5v output) 5,000 pounds-force (22,200 N).
      - 3) Hammer Sensitivity (7pprox.) 1 mV/lbf (0.23 mV/N).
      - 4) Resonant Frequency 12 kHz
  2. Motor, equipment and final assembled equipment including motor.
    - a. Determine natural frequency of assembled motor prior to shipping to equipment manufacturer or job site.
      - 1) Individual motor fastened to an "infinitely rigid" mass at the same bolt circle as the final assembled equipment.
    - b. Determine natural frequency of the pump.
      - 1) Pump fastened to an "infinitely rigid" mass at the same bolt circle as the final assembled equipment.
    - c. Determine natural frequency of the pump/motor assembly.
      - 1) Pump/motor assembly fastened to an "infinitely rigid" mass at the same bolt circle as the final field assembled equipment.
    - d. For this use, the "infinitely rigid" mass shall be at least 10 times the weight of the equipment being tested.
  3. Submit natural frequency report(s) for approval prior to shipment.

4. Equipment performance tests.
  - a. As listed in individual equipment specifications.
- C. Contract Closeout Information:
  1. Operation and Maintenance Data:
    - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
  1. Notification, at least one week in advance, that testing will be conducted at factory.
  2. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
  3. Submit sample Manufacturer's Field Service Report (MFSR). Report shall use manufacturer's standard report or use the form in the Exhibits and have at least the following information:
    - a. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
    - b. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
    - c. Motor test reports.
    - d. Field noise testing reports if such testing is specified.
    - e. Preliminary field quality control testing format to be used as a basis for final field quality control reporting.
    - f. Provide three bound final written reports documenting natural frequency testing, vibration monitoring and testing for specified equipment.
      - 1) Include the acceptance criteria of all equipment tested.
      - 2) Provide individual tabbed sections for information associated with each piece of tested equipment.
    - g. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.
    - h. Testing and monitoring reports in accordance with PART 3 of this Specification Section.
    - i. Certification that driven equipment and VFD are compatible.
  4. Submit completed Manufacturer's Field Service Report (MFSR) for each piece of equipment supplied.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Motors:
    - a. ABB Baldor-Reliance.
    - b. General Electric.

- c. Hyundai Heavy Industries.
  - d. Marathon Electric.
  - e. Siemens.
  - f. TECO-Westinghouse.
  - g. Toshiba U.S.
  - h. U.S. Motors, Nidec Motor Corporation.
  - i. WEG.
2. Mechanical variable speed drives:
- a. Reeves.
  - b. U.S. Motors (VariDrive).

## 2.2 MANUFACTURED UNITS

### A. Electric Motors:

1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
2. Design for frequent starting duty equivalent to duty service required by driven equipment.
3. Design for full voltage starting.
4. Design bearing life based upon actual operating load conditions imposed by driven equipment.
5. Size for altitude of Project.
6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
7. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
8. AC electric motors 1-1/2 to 10 hp:
  - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
  - b. Permanently lubricated sealed bearings conforming to ABMA standards.
  - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
9. Severe duty motor to have the following minimum features:
  - a. All cast iron construction.
  - b. Gasketed conduit box.
  - c. Epoxy finish for corrosion protection.
  - d. Hydroscopic varnish on windings for corrosion protection.
  - e. Drain plug and breather.

### B. NEMA Design Squirrel Cage Induction Motors:

1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
2. Motors to meet NEMA MG 1 (NEMA Premium) [local jurisdiction] efficiencies.
3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
4. For use on variable frequency type adjustable speed drives, provide:
  - a. Induction motors that are in compliance with NEMA MG 1, Part 31.
  - b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.

- c. Insulated drive end bearing on all motors.
- d. Insulated non-drive end bearings, at a minimum, on all motors with horizontal shaft 100 hp and larger.
- e. An insulated bearing carrier on the non-drive end for vertical shaft motors 100 hp and larger.
- f. Shaft grounding ring on all motors:
  - 1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
  - 2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
- g. Have the following minimum turndown ratio without the use of additional cooling, such as a blower, to provide continuous supply of cooling air over the motor.
  - 1) Variable torque: 10:1.
  - 2) Constant torque: 6:1.
- 5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 degrees C ambient.
- 6. Design motors for continuous duty.
- 7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 percent greater than the maximum HP requirements of the driven equipment over its entire operating range.
  - a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
- 8. Motor enclosure and winding insulation application:
  - a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Unclassified Indoor Areas	[DPFG (for horizontal motors)], [WP-I (for vertical motors)] [Standard Insulation], [TEFC, Standard Insulation]
Wet indoor Areas	[TEFC, Standard Insulation] [TEFC, Encapsulated Windings] [WP-II (for vertical motors)]
Wet outdoor Areas	[TEFC, Extra Dip and Bake for Moisture] [TEFC Encapsulated Windings] [WP-II (for vertical motors)]
Corrosive Areas	TEFC, Severe/ Chemical Duty
Class I, Division 1 Areas	Explosion Proof, Approved for Class I Division 1 Locations
Class II, Division 1 Areas	Explosion Proof, Approved for Class II Division 1 Locations
Class I or Class II, Division 2 Areas	Explosion Proof, Approved for Division 1 Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area, [Extra Dip and Bake for moisture] [Encapsulated Windings]

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

- 9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
- 10. Balance motors to ISO G2.5 level.
  - a. Submit prior to shipping to equipment manufacturer or job site.

- C. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.
- D. V-Belt Drive:
  - 1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
  - 2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
  - 3. Provide staticproof belts.
- E. Mechanical Variable Speed Drives:
  - 1. Oil-lubricated shaft-mounted reduction gear drive capable of 300 percent shock load and providing a 1.5 service factor in accordance with AGMA.
  - 2. Assure infinite speed adjustment over a 10:1 range.
  - 3. Secure drive to equipment base.
  - 4. Flexible coupling between drive shaft and equipment shaft.
- F. Vibration Isolators:
  - 1. Provide all equipment subject to vibration with restrained spring type vibration isolators or pads according to the manufacturer's written recommendation.

## **2.3 COMPONENTS**

- A. Gear Drives and Drive Components:
  - 1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.
  - 2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.
  - 3. Design drive units for 24 hour continuous service, constructed so oil leakage around shafts is precluded.
  - 4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible couplings meeting applicable standards of AGMA.
  - 5. Gear reducers:
    - a. Provide gear reducer totally enclosed and oil lubricated.
    - b. Utilize antifriction bearings throughout.
    - c. Provide worm gear reducers having a service factor of at least 1.20.
    - d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

## **2.4 ACCESSORIES**

- A. Guards:
  - 1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
  - 2. Interior applications:
    - a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
    - b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 inches spacing.
    - c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
  - 3. Exterior applications:
    - a. Construct from 16 GA stainless steel or aluminum.
    - b. Construct to preclude entrance of rain, snow, or moisture.

- c. Roll to conform to shaft or coupling surface.
  - d. Connect to equipment frame with stainless steel bolts and wing nuts.
- B. Anchorage:
- 1. Cast-in-place anchorage:
    - a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
    - b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
    - c. Provide two nuts for each bolt.
  - 2. Drilled anchorage:
    - a. Adhesive anchors per Section 03 15 19.
    - b. Threaded rods same as cast-in-place.
- C. Data Plate:
- 1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
  - 2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.
- D. Lifting Eye Bolts or Lugs:
- 1. Provide on all equipment 50 pounds or greater.
  - 2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

## **2.5 FABRICATION**

- A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.
- B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.
- C. Furnish like parts of duplicate units to be interchangeable.
- D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.
- E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
  - 1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.
- F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
  - 1. Provide drain connection for 3/4 inches PVC tubing.
- G. Machine the mounting feet of rotating equipment.
- H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that cannot be properly prepared and painted.
  - 1. When such back to back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.

2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Section 07 92 00.
- I. Natural frequency/critical Speed:
    1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
    2. Excessive vibration is sufficient cause for equipment rejection.
    3. Ratio of all rotative speeds to natural frequency/critical speed of a unit or components: Greater than 1.2.
  - J. Equipment Base
    1. Adequate grout and vent openings to allow grout to flow under entire base.
  - K. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
    1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
    2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
    3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.
      - a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
    4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
      - a. Determine the SCCR rating by one of the following methods:
        - 1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
        - 2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
        - 3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
      - b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
      - c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

## **2.6 SHOP OR FACTORY PAINT FINISHES**

- A. Electrical Equipment:
  1. Provide factory-applied paint coating system(s) for all electrical equipment components except those specified to receive field painting.
    - a. Field painted equipment: Per manufacturer's factory applied primer/field paint compatibility requirements.
- B. Field paint other equipment in accordance with manufacturer's recommendations.

## **2.7 SOURCE QUALITY CONTROL**

- A. Motor Tests:
  1. Test motors in accordance with NEMA and IEEE standards.
  2. Provide routine test for all motors.

3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
  - a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
  - b. Pay all costs, including shipping and handling, for all motors failing the tests.
  - c. If two successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.

B. Balance:

1. Unless specified otherwise, for all equipment 10 hp or greater, all rotating elements in motors, pumps, blowers, and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. Balance all rotating elements to the following criteria, per ISO 21940-11:

$$U_{per} = \frac{G \times 6.015 \times W / 2}{N}$$

Where:

U<sub>per</sub> = Permissible residual unbalance for each correction plane in ounce-inches (OZ-IN). See ISO 21940-11 for acceptable values.

G = ISO Balance Quality Grade Number, per ISO 21940-11

W = Rotor weight in pounds

N = Maximum continuous operating RPM

- a. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install equipment as shown on the Drawings and other Contract Documents, in accordance with manufacturer's written instructions, and in accordance with Laws and Regulations. Where the Contract Documents, manufacturer's written instructions, or Laws and Regulations conflict, obtain interpretation or clarification from Engineer before proceeding.
- B. Utilize appropriate templates for anchorage placement for equipment installed on concrete.
- C. Coordination of Equipment Supports and Bases with Structures:
  1. Do not construct foundations until major equipment supports are approved by Owner.
- D. Equipment Lubrication Points:
  1. Extend all non-accessible or difficult-to-access lubrication fittings to reasonably accessible locations to facility operation and maintenance personnel without use of ladders or elevating devices, by providing stainless steel tubing (of appropriate wall thickness for the service and application) to a location which allows easy access of fittings from closest operating floor level.
- E. Concrete Equipment Support Bases:
  1. Install level in both directions, with acceptable vertical tolerance of 1/4-inch±.

2. At anchorage locations, install bases flat and level.
- F. Machine Bases / Sole Plates:
1. Grease or tape anchorages and jack screws to inhibit grout from adhering to bolts and other anchors.
    - a. Jack screws number and size by equipment manufacturer.
      - 1) Jack screw
        - a) 304 Stainless Steel minimum
        - b) 0.5 inches diameter minimum
      - 2) Jack Screw Pad
        - a) 2 inch diameter minimum
        - b) Anchored in place with a structural epoxy adhesive.
  2. Install machine base of rotating equipment on equipment base.
  3. Level in both directions using jack screws, with a machinist level, according to machined surfaces on base. Base shall be level within vertical tolerance of the lesser of (a) 0.005 inch per foot with no more than 0.0005 inches difference between any two points, or (b) equipment manufacturer's written instructions.
  4. Level machine base on equipment base and align couplings between driver and driven equipment.
- G. Couplings for Rotating Equipment:
1. Align in annular and parallel positions.
    - a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 inch tolerance for couplings four-inch size and smaller.
    - b. Couplings larger than four-inch size: Increase tolerance 0.0005 inch per inch of coupling diameter above four-inch; for example: for six-inch coupling, tolerance is 0.002 inch. For 10 inch coupling, required tolerance is 0.004 inch.
    - c. For equipment rotating at speeds greater than 1200 rpm, tolerance for both annular and parallel positions shall be rate of 0.00025 inch (or less) per inch of coupling diameter.
  2. If equipment is furnished by manufacturer as mounted unit , verify factory alignment after installation at the Site. Realign if as necessary, in accordance with equipment manufacturers' written instructions, to provide required factory tolerance..
  3. Inspect surfaces for runout before attempting to trim or align units.
- H. Grouting:
1. Level onto equipment base with jack screws in accordance with the Contract Documents, provide a dam or formwork around base to contain grout between equipment base and equipment support pad.
  2. Preparation:
    - a. Extend dam or formwork to cover leveling shims and blocks.
    - b. Anchor sleeves:
      - 1) Required for equipment (Pumps, Mixers, Blowers) greater than 50 hp
      - 2) If anchor sleeves were used, fill voids in anchor sleeves with foam or room temperature vulcanizing (RTV) silicone to keep grout from filling sleeves.
    - c. Do not use nuts below the machine base to level the unit.
    - d. Saturate top of roughened concrete surface with water before grouting.
  3. Grout Installation:

- a. Install grout until entire space under machine base is completely filled to underside of base. Voids are unacceptable.
- b. Puddle grout by working a stiff wire through the grout and vent holes, to ensure grout is installed properly and to release air entrained in grout or base cavity.
- 4. After Grout Installation:
  - a. When grout is sufficiently hardened, remove dam or formwork and finish exposed grout surface to fine, smooth surface.
  - b. Completely cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too-rapid evaporation of water from grout.
  - c. Check for voids by tapping along the top deck of the mounting plate. A solid thud indicates grout-filled areas while a drum-like hollow sound indicates a void requiring filling.
    - 1) Void areas are to be filled by drilling 1/8 inches NPT holes in opposite corners of each void area. Grout to be pumped into one void with a grout gun until grout emerges from the other vent hole.
  - d. When grout is fully hardened (after not less than seven days), remove jack screws, and tighten nuts on anchor bolts and similar anchors to required torque.
  - e. Inspect and verify levelness of machine base and, if not in accordance with requirements, remedy by removing base and reinstalling in accordance with the Contract Documents.
  - f. Inspect driver-driven equipment for proper alignment. When not in accordance with requirements, remedy so that the Work is not defective.

### **3.2 INSTALLATION CHECKS**

- A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
  - 1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.
- B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
  - 1. Has been properly installed and lubricated.
  - 2. Is in accurate alignment.
  - 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
  - 4. Has been operated under full load conditions and that it operated satisfactorily.
    - a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.
- C. No separate payment shall be made for installation checks.
  - 1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

### **3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS**

- A. Identify equipment and install hazard warning signs in accordance with Section 10 14 00.

### **3.4 FIELD PAINTING AND PROTECTIVE COATINGS**

- A. For required field painting and protective coatings, comply with manufacturers recommendations if not specifically identified in contract documents.

### **3.5 FIELD QUALITY CONTROL**

#### **A. General:**

1. Furnish equipment manufacturer's field quality control services and testing as specified in the individual equipment Specification Sections.
2. Execute pre-demonstration requirements in accordance with Section 01 75 00.
3. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
4. Provide testing for all equipment furnished or installed as part of the Work.
5. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptable standards.
6. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
  - a. Contract Drawings and Specifications.
  - b. Related construction change documentation.
  - c. Approved Shop Drawings.
  - d. Approved Operation and Maintenance Manuals.
  - e. Other pertinent information as required.

#### **B. Equipment Monitoring and Testing Plans:**

1. Approved in accordance with Shop Drawing submittal schedule.
2. Included as a minimum:
  - a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
  - b. List and description of testing and analysis equipment to be utilized.
  - c. List of all equipment to be testing, including:
    - 1) Name and tag numbers identified in the Contract Documents.
    - 2) Manufacturer's serial numbers.
    - 3) Other pertinent manufacturer identification,

#### **C. Instruments Used in Equipment and Connections Quality Control Testing:**

1. Minimum calibration frequency:
  - a. Field analog instruments: Not more than 6 months.
  - b. Field digital instruments: Not more than 12 months.
  - c. Laboratory instruments: Not more than 12 months.
  - d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
2. Carry current calibration status and labels on all testing instruments.
3. See individual testing programs for additional instrumentation compliance requirements.

#### **D. Testing and Monitoring Program Documentation:**

1. Provide reports with tabbed sections for each piece of equipment tested.
2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.

- a. Include legible copies of all forms used to record field test information.
  - 3. Prior to start of testing, submit one copy of preliminary report format for review and comment
    - a. Include data gathering and sample test report forms that will be utilized.
  - 4. In the final report, include as a minimum, the following information for all equipment tested:
    - a. Equipment identification, including:
      - 1) Name and tag numbers identified in the Contract Documents.
      - 2) Manufacturer's serial numbers.
      - 3) Other pertinent manufacturer identification,
    - b. Date and time of each test.
    - c. Ambient conditions including temperature, humidity, and precipitation.
    - d. Visual inspection report.
    - e. Description of test and referenced standards, if any, followed while conducting tests.
    - f. Results of initial and all retesting.
    - g. Acceptance criteria.
    - h. "As found" and "as left" conditions.
    - i. Corrective action, if required, taken to meet acceptance.
    - j. Verification of corrective action signed by the Contractor, equipment supplier, and Owner's representative.
    - k. Instrument calibration dates of all instruments used in testing.
  - 5. Provide three (3) bound final reports prior to Project final completion.
- E. Other Testing:
- 1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.
  - 2. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs, and cross members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
    - a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.
- F. Equipment Field Vibration Monitoring and Testing Program:
- 1. Perform vibration monitoring and testing for equipment specified in other Divisions during the Equipment Demonstration Period.
  - 2. Perform field vibration testing on each item of rotating and reciprocating equipment having driver [50] HP and greater
  - 3. Acceptability of equipment conditions, except pumps, based on ISO 1940-1 Balance Quality Grade G6.3 criteria.
  - 4. Acceptability of pumping equipment to be based on current ANSI/HI criteria:
    - a. ANSI/HI 11.6-2012 for Submersible Pumps in a Wet-pit or Dry-pit configuration.
    - b. ANSI/HI 9.6.4-2016 for all other centrifugal pumps.
  - 5. Utilize an Engineer approved 3<sup>rd</sup> party testing agency to perform vibration monitoring and testing on equipment.
  - 6. For variable speed equipment provide vibration testing at no more than 3 percent increments of maximum speed throughout entire operating range.

7. Provide machinery condition diagnosis based on an acceptable machinery vibration severity guide or machinery fault guide analysis provided by the testing agency.
8. Tolerances for pumping equipment shall be per HI published standards.
9. Repair or replace equipment shown to be out of range of the specified tolerance until the equipment meets the specified normal operation range required in the machinery fault guide analysis.
10. Document testing with written report.
  - a. Report to include initial testing results, acceptance criteria, corrective action taken to meet acceptance, verification of corrective action and acceptance report and baseline.
  - b. Natural frequency of installed equipment utilizing an impact hammer.
  - c. Report to include graphical plots of vibration signature for each test point at a scale which illustrates all vibration levels greater than 0.025 ips RMS.

### **3.6 DEMONSTRATION**

- A. Demonstrate equipment in accordance with Section 01 75 00.

### **3.7 ABBREVIATION TABLE**

- A. As indicated on the Drawings.

**END OF SECTION**

**EXHIBIT A**  
**MANUFACTURER FIELD SERVICE REPORT**

This field service report is generic in nature. An electronic copy of this form will be furnished upon request from the Owner. This report is to reflect that all requirements of the Operations and Maintenance Manual and the individual equipment specification requirements have been performed for the installation and operation and also to provide a baseline for amperage draw for each phase, vibration readings, rotation, alignment and all other applicable tests required to insure that the equipment has been installed properly. A MFSR will be required for each individual piece of equipment requiring a MFSR.

**Definitions of Reports:**

Initial service report: Required for construction preparations. Equipment delivered to site is in good condition and conforms to specification requirements. Anchor bolts, hardware and ancillary items (piping, flanges, conduits, fuel/power supply) are compatible with equipment.

Interim service report: Required for equipment installation onto base or foundation. Piping connections, electrical and control connections or structural attachment are complete. For equipment stored on site over four weeks, interim service report will document that manufacturer's long-term storage procedures have been incorporated and equipment has not been damaged, nor coatings deteriorated.

Final service report is to be completed when equipment can be started, electrical amperage and voltage draw measured, cold and hot alignments performed, vibration testing and monitoring performed and the equipment is found to be in compliance with Manufacturer's operating parameters and the requirements of the individual equipment specifications.

**PROJECT:** \_\_\_\_\_

**Report Status:**

Initial Service Report completed and submitted on \_\_\_\_\_

Interim Service Report completed and submitted on \_\_\_\_\_

Final Service Report completed and submitted on \_\_\_\_\_

Commencement of Warranty \_\_\_\_\_

**I Description**

A. Equipment Name and Identification: \_\_\_\_\_  
\_\_\_\_\_

B. Serial Number: \_\_\_\_\_

C. Specification Section Number: \_\_\_\_\_

D. Manufacturer: \_\_\_\_\_

E. Representative: \_\_\_\_\_

F. Type of Service: Initial  Interim  Final

**II General Review**

A. The above referenced equipment/material/supplies have been inspected, checked, and adjusted. Yes  No

Summary: \_\_\_\_\_  
\_\_\_\_\_

B. The above referenced equipment/material/supplies were placed upon properly prepared or suitable substrate. N/A  Yes  No

Summary: \_\_\_\_\_  
\_\_\_\_\_

C. The above referenced equipment/material/supplies are free from any undue stress imposed by any connected piping, anchor bolts or any other load. N/A  Yes  No

Summary: \_\_\_\_\_  
\_\_\_\_\_

D. The above referenced equipment/material/supplies have operated under design conditions. N/A  Yes  No

Summary: \_\_\_\_\_

\_\_\_\_\_

E. The above referenced equipment/material/supplies have been installed in accordance with the manufacturer's recommendations and the Procurement Documents, require no corrective work, and are hereby approved. Yes  No

Summary: \_\_\_\_\_

\_\_\_\_\_

F. The above referenced equipment/material/supplies are acceptable to the manufacturer as installed providing the following corrective action(s) are performed:

1. \_\_\_\_\_

2. \_\_\_\_\_

3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

**III Inspection Checklist**

Item	Acceptable (Yes/No)	Readings/Comments
Bearings (1)		
Belts (tension reading)		
Lubrication Levels		
Vibration (1) (2) (MILS/SEC)		
Infrared Thermography (1) (2)		
Starting AMPS		
Full Load AMPS		
Volts		
Rotation		
Jacket Temperature (DEGF)		
Seal Water Flow Rate (GPH or GPM)		
Seal Water Pressure (PSI)		
O-rings/Packing		
Alignment (1)		
Anchor Bolts		

Item	Acceptable (Yes/No)	Readings/Comments
Anchor Bolt Torque		
Grout		
Substrate Approval		
Sound level (4 feet from unit) (1) (dB)		
Other		

(1) Inspection or testing reports must be attached.  
(2) Provide vibration testing and monitoring procedures for review and approval prior to testing.

**IV O&M Manuals**

A. The O&M manual as presented contains all information required for proper operation, maintenance, and instruction of this system. N/A [ ] Yes [ ] No [ ]

Summary: \_\_\_\_\_  
\_\_\_\_\_

**V Preventive Maintenance**

A. The preventive maintenance summary outlined in the O&M manual is acceptable for operation of the system throughout the warranty period. N/A [ ] Yes [ ] No [ ]

Summary: \_\_\_\_\_  
\_\_\_\_\_

**VI Operator Training/Classroom Instruction**

A. Training and instruction have been performed in accordance with the requirements of the Procurement Documents. N/A [ ] Yes [ ] No [ ]

B. Final Training/Classroom Instruction Completed on: \_\_\_\_\_

Summary: \_\_\_\_\_  
\_\_\_\_\_

**VII Remarks**

\_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

**VIII Certification**

I hereby certify, that I, [\_\_\_\_], am a duly authorized representative of the manufacturer, that I am empowered by the manufacturer to inspect, approve, and operate his equipment, and that I am authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as modified herein. I also certify that all information contained herein is true and accurate.

By: \_\_\_\_\_  
(Authorized Representative)

For: \_\_\_\_\_

Date: \_\_\_\_\_

**IX Acknowledgments**

By: \_\_\_\_\_

For: \_\_\_\_\_  
(Contractor)

Date: \_\_\_\_\_

By: \_\_\_\_\_

For: \_\_\_\_\_  
(Owner)

Date: \_\_\_\_\_



**SECTION 01 62 00**  
**PRODUCT OPTIONS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Contractor's options for selecting materials and equipment.
  2. Requirements for consideration of "or equal" materials and equipment.

**1.2 CONTRACTOR'S PRODUCT OPTIONS**

- A. For materials and equipment specified only by reference standard or description, without reference to Supplier, furnish materials and equipment complying with such reference standard and descriptive requirements in the Contract Documents, by a Supplier or from a source that complies with the Contract Documents.
- B. For materials and equipment specified by naming one or more items or Suppliers, furnish the named materials and equipment that comply with the Contract Documents, unless an "or equal" or substitute item is approved by Engineer.
- C. For materials and equipment specified by naming one or more items or Suppliers and the term, "or equal", when Contractor proposes a material or equipment item or Supplier as an "or equal", submit to Engineer a request for approval of an "or equal" item or Supplier.
- D. For materials and equipment specified by naming only one item or manufacturer and followed by words indicating that no substitution or "or equal" is allowed, there is no option and no "or equals" or substitutes will be allowed or approved.

**1.3 "OR EQUAL" ITEMS**

- A. Procedure:
1. For proposed materials and equipment, whether or not indicated by name in the Contract Documents, and considered by Contractor as an "or equal", Contractor shall request in writing Engineer's approval of each proposed "or equal".
  2. Request for approval of an "or equal" item shall accompany the Shop Drawing, product data Submittal, or Sample for the proposed item. Engineer may reject or otherwise not approve or accept any such request or Submittal that is incomplete.
  3. Indicate on the Schedule of Submittals which Submittals were for proposed "or equals" and which were approved as "or equals".
  4. Clearly indicate in the associated Submittal transmittal whether the Submittal includes request for approval of a proposed "or equal".
  5. Comply with the Contract Documents' requirements to clearly indicate all proposed deviations from the requirements of the Contract Documents. Where the Contract Documents do not otherwise require such indication, Contractor shall indicate in detail, both in the Submittal for the "or equal" item and in separate, written correspondence, each proposed deviation from the requirements of the Contract Documents.
  6. Requirements for furnishing information and documents related to proposed "or equals" shall be furnished with the initial Submittal for that item and for all subsequent re-Submittals, if any.
  7. Engineer's approval, if any, of a proposed "or equal" will be indicated by the Engineer's approval of the associated Shop Drawing, product data Submittal, or Sample, as applicable, unless otherwise indicated on the associated Submittal.
  8. Should Engineer reject or otherwise not approve a proposed "or equal", Contractor may propose the item as a substitute, subject to the Contract Documents' requirements concerning requests for approval of substitute items or procedures.

- B. Contractor's request for approval of each proposed "or equal" shall include:
1. Contractor's written request that the proposed item be considered as an "or equal" in accordance with this Specifications section.
  2. Contractor's certifications of compliance with the contract documents.
  3. Documentation adequate to demonstrate to Engineer that proposed item does not require extensive revisions to the Contract Documents, that proposed item is consistent with the Contract Documents, and that proposed item will produce results and performance required in the Contract Documents, and that proposed item is compatible with other portions of the Work.
  4. Detailed comparison of significant qualities of proposed item with the materials and equipment and Suppliers named in the Contract Documents. Significant qualities include attributes such as performance, weight, size, durability, corrosion resistance in the service environment, visual and textural effect and attributes, and specific features and requirements shown or indicated.
  5. Evidence that proposed item's manufacturer will furnish warranty equal to or better than that specified, if any.
  6. List of similar installations for completed projects with project names and addresses, and names, address, telephone number, and e-mail address of design professionals and owners, when requested by Engineer.
  7. Samples, when requested by Engineer.
  8. Other information requested by Engineer.
- C. When used in the Contract Documents, the terms "or equal", "or-equal", and "or approved equal" have the same meaning and refer to materials or equipment proposed by Contractor for Engineer's approval as equivalent to materials or equipment indicated in the Contract Documents using the name of specific manufacturers or products. Such materials or equipment shall be incorporated into the Work only after being duly approved in writing by Engineer.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION - (NOT USED)**

**END OF SECTION**

**SECTION 01 65 00**  
**PRODUCT DELIVERY REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. General requirements for:
  - a. Coordination of deliveries.
  - b. Preparing materials and equipment for shipping from the production or fabrication facility, including packaging.
  - c. Shipment.
  - d. Delivery of materials and equipment to the Site.
  - e. Inspection upon delivery and remedy of damaged, deteriorated, or otherwise defective items, and remedy of missing or lost items.

B. Scope:

1. Contractor shall make all arrangements for packaging, shipping, delivering, inspecting upon delivery, and unloading upon delivery materials and equipment necessary and required for the Work.
2. Contractor shall provide all labor, materials, equipment, tools, incidentals, and services necessary to have materials and equipment properly packaged, shipped, and delivered to the Site, and all related Work required by the Contract Documents.

C. Related Requirements: Include but are not limited to:

1. Section 01 66 00 - Product Storage and Handling Requirements.

**1.2 ADMINISTRATIVE REQUIREMENTS**

A. Coordination:

1. To extent practicable, coordinate shipping and delivery of materials and equipment with anticipated shipping requirements, such as allowing sufficient time for customs inspections on international shipments, availability of shipping services and facilities, and seasonal concerns (such as shipments that may be influenced by major tropical storms and predictable, typical weather).
2. Coordinate shipping and delivery of materials and equipment to the Site and other locations where such items may be stored prior to delivery to the Site. Coordinate such shipments and deliveries with the progress of the Work and status of adequate facilities, whether temporary storage or permanent installation locations, necessary to properly store and safeguard materials and equipment to be incorporated into the Work.
3. Where possible, deliver to the Site materials and equipment as close as possible to when such items will be incorporated into appropriately protected, permanent installation location.

**1.3 PREPARATION FOR SHIPMENT**

A. Factory Assembly:

1. When practical, factory-assemble materials and equipment. Mark or tag separate parts and assemblies to facilitate field assembly.

B. Temporary Protection:

1. Appropriately cover, with strippable, protective coating or other material, machined parts and unpainted, uncoated, or unprotected surfaces subject to damage or deterioration caused by weather elements or environment,
2. To extent practical, strippable, removable, disposable protective materials shall be recyclable.

3. To extent practical, strippable, removable, and disposable protective items shall be type resulting in minimum waste and cleanup upon removal.
  4. Protection of Electrical Equipment, Instrumentation and Controls, Items with Computer Chips Solid-State Devices, and Other Electronics:
    - a. Provide appropriate temporary protection of electrical equipment, microprocessors, and other electronics from humidity, moisture, and corrosion by appropriate packaging, protection, desiccants, and volatile corrosion inhibitor (VCI) blocks.
    - b. Immediately prior to shipment, provide new, fresh desiccants and ensure integrity of other protective materials.
- C. Packaging:
1. Package materials and equipment to facilitate handling, and protect materials and equipment from damage during shipping, handling, and storage.
  2. Mark, label, or tag, on outside of each package, crate, and container, to indicate associated:
    - a. Purchase order number.
    - b. Bill of lading number.
    - c. Delivery address (including facility name, where applicable).
    - d. Owner's contract designation or Project name.
    - e. Contractor name.
    - f. Purchasing Subcontractor's name (as applicable).
    - g. Contents by name and designation within the Work (for example, "Influent Pump No. 1"),
    - h. Approximate weight of container, crate, package, including packaging.
    - i. Special instructions for handling and protection during shipment and unloading.
  3. The Site may be listed as the "ship to" or "delivery" address; but Owner shall not be listed as recipient of shipment unless otherwise directed in writing by Owner.
  4. Truthfully and accurately mark, label, or tag items for shipment and delivery.
  5. Include complete packing lists and bills of materials with each shipment.
  6. Protect materials and equipment with appropriate, temporary packaging or protection when such items may rotate or move during shipment.
  7. Protect materials and equipment from exposure to weather elements, adverse environments, and keep thoroughly dry and dust-free. Protect painted surfaces against impact, abrasion, discoloration, and other damage and deterioration.
  8. Lubricate bearings and other items requiring lubrication, in accordance with manufacturer's written instructions.

#### **1.4 SHIPPING**

- A. Notification of Shipments:
1. Keep Owner, informed of delivery of all materials and equipment to be incorporated into the Work.
  2. Upon receipt of Supplier's advance notice of shipment, not less than seven days prior to delivery of materials and equipment at the Site or Contractor's storage location, furnish Owner written notice of anticipated delivery date and specific location (at the Site or Contractor's storage location, as applicable) of the following:
    - a. Flocculator Equipment, Motor, Gear and Control Panels.
- B. Do not ship materials and equipment until:
1. Related Shop Drawings, product data, Samples, shop testing plan Submittals, and other Submittals required by the Contract Documents are approved by Owner, including, but not necessarily limited to, all Action Submittals associated with the materials and equipment being delivered.

2. Manufacturer's written instructions for handling, storing, and installing the associated materials and equipment have been submitted to and accepted by Owner, in accordance with the Specifications.
  3. Results of source quality control activities (factory testing and inspections), when required by the Contract Documents for the subject materials or equipment, have been submitted to and accepted by Owner.
  4. Facilities required for handling materials and equipment, in accordance with the Contract Documents and manufacturer's instructions, are in place and available at the delivery location.
  5. Required storage facilities and protection measures have been provided.
- C. Loss or Damage During Shipment:
1. Unless otherwise indicated in the Contract Documents (whether expressly or in provisions regarding builder's risk insurance), Contractor is responsible for all loss, damage, and deterioration to materials and equipment incurred during shipment and delivery.
  2. Contractor is not eligible for additional Contract Times or increase in the Contract Price due to delays or costs incurred due to loss, damage, or deterioration during shipment, unless Owner was responsible for shipping the subject materials or equipment to the Site or other delivery location.

## 1.5 DELIVERY

- A. Scheduling and Timing of Deliveries:
1. Arrange deliveries of materials and equipment in accordance with the Progress Schedule accepted by Owner and in ample time to facilitate inspection and observation prior to installation.
  2. Schedule deliveries to minimize space required for, and duration of, storage of materials and equipment at the Site or other delivery location, as applicable.
  3. Coordinate deliveries to avoid conflicting with the Work and conditions at the Site, and to accommodate the following:
    - a. Work of other contractors at or adjacent to the Site, Owner, and others.
    - b. Storage space limitations.
    - c. Availability of appropriate construction equipment and machinery, tools, and qualified personnel for inspecting, unloading, and handling materials and equipment.
    - d. Owner's use of premises.
  4. Deliver materials and equipment to the Site during regular working hours.
  5. Deliver materials and equipment to avoid delaying the Work and the Project.
- B. Deliveries:
1. Provide Contractor's telephone number to shipper; do not provide Owner's telephone number to shipper or carrier.
  2. Arrange for deliveries while Contractor's personnel are at the Site. Contractor shall receive and coordinate shipments upon delivery. Shipments delivered to the Site when Contractor is not present will be refused by Owner and Contractor shall be responsible for the associated delays and costs, including demurrage.
- C. Containers and Marking:
1. Have materials and equipment delivered in manufacturer's original, unopened, labeled containers.
  2. Clearly mark partial deliveries of component parts of materials and equipment to identify materials and equipment, to allow easy accumulation of parts, and to facilitate assembly.
- D. Inspection of Materials and Equipment Upon Delivery:
1. Immediately upon delivery, visually but critically inspect shipment to verify that:

- a. Materials and equipment comply with the Contract Documents and approved or accepted (as applicable) Submittals.
  - b. Quantities are correct.
  - c. Materials and equipment are undamaged and of required quality.
  - d. Containers and packages are intact and labels are complete and legible.
2. Eligibility for Payment:
- a. Materials and equipment are not eligible for payment until duly inspected and determined to be in accordance with the Contract Documents and Owner-approved Submittals, without damage or deterioration.
  - b. No payment can be made for damaged, deteriorated, or otherwise defective items.
  - c. No payment can be made for missing or lost items.
  - d. Other provisions of the Contract Documents may establish other preconditions for payment for delivered material and equipment.
3. Damaged, Deteriorated, and Otherwise Defective Items:
- a. Promptly remove from the Site damaged, deteriorated, or defective materials and equipment and expedite delivery of new, undamaged materials and equipment.
  - b. Promptly remedy incomplete or lost materials and equipment.
  - c. Furnish materials and equipment in accordance with the Contract Documents, to avoid delaying progress of the Work.
  - d. Promptly advise Owner in writing: (1) when damaged, deteriorated, incomplete, or otherwise defective materials and equipment are delivered, and (2) associated impact on the Progress Schedule.
- E. Handling of Materials and Equipment Upon Delivery:
1. Provide construction equipment and machinery, tools, and qualified personnel necessary to unload and handle materials and equipment, by methods that prevent damaging, defacing, and soiling materials and equipment and packaging.
  2. Comply with Section 01 66 00 – Product Storage and Handling Requirements.
  3. Provide additional protection during unloading and handling as necessary to prevent scraping, marring, and otherwise damaging materials and equipment and adjacent surfaces.
  4. Unload and handle materials and equipment by methods that prevent bending, warping, and overstressing.
  5. Lift heavy components only at designated lifting points.
  6. Unload and handle materials and equipment in safe manner and as recommended by manufacturer to prevent damage. Do not drop, roll, or skid materials and equipment off delivery vehicles or at other times during unloading and handling.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION - (NOT USED)**

**END OF SECTION**

**SECTION 01 66 00**  
**PRODUCT STORAGE AND HANDLING REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. General requirements for:
  - a. Payment considerations for stored materials and equipment.
  - b. Handling of materials and equipment.
  - c. Storage of materials and equipment, including:
    - 1) General provisions for storage.
    - 2) Storage locations.
    - 3) Protection of stored items.
    - 4) Storage of items containing Constituents of Concern.
    - 5) Outdoor, uncovered storage.
    - 6) Outdoor, covered storage.
    - 7) Fully-protected storage.
    - 8) Removal of temporary storage facilities and restoration of storage areas.
  - d. Maintenance of storage.

B. Scope:

1. Contractor shall provide all labor, materials, equipment, tools, services, lands, and incidentals necessary and required to store and handle materials and equipment to be incorporated into the Work, and other materials and equipment at the Site, adjacent areas, and offsite storage areas.
2. Comply with Section 01 71 33 - Protection of the Work and Property, relative to handling and storing materials and equipment.

C. Related Requirements: Include but are not limited to:

1. Section 01 65 00 - Product Delivery Requirements.
2. Section 01 71 33 - Protection of the Work and Property.

**1.2 PRICE AND PAYMENT PROCEDURES**

A. Measurement and Payment:

1. Materials and equipment delivered but not suitably stored and protected will not be eligible for payment.
2. Owner may reduce payments to Contractor ("set-offs") by an appropriate amount when stored items are subsequently revealed to be improperly stored or protected.
3. Payment for Suitably Stored Items:
  - a. Materials and equipment delivered and suitably stored, but not yet incorporated into the Work, will not be eligible for payment until the inspection upon delivery, required in Section 01 65 00 - Product Delivery Requirements, is completed and Owner concurs that such items generally appear to be in good condition, in accordance with the Contract Documents, and are of the required quality and quantity.

**1.3 SUBMITTALS**

A. Informational Submittals: Submit the following:

1. Affidavits of Inspection and Maintenance Performed on Mechanical and Electrical Equipment in Long-Term Storage:

- a. Submit in accordance with requirements of Article 3.1 of this Section.
2. Other Records of Inspection and Maintenance of Stored Materials and Equipment:
  - a. Establish and maintain such records as required by this Section.
  - b. Submit to Owner (as applicable) within three days of Contractor's receipt of such request.

#### **1.4 HANDLING**

##### **A. Handling of Materials and Equipment – General:**

1. Handle materials and equipment to be incorporated into the Work in accordance with the Contract Documents and manufacturer's written instructions.
2. During handling and assembling of materials and equipment:
  - a. Maintain validity of manufacturers' warranties.
  - b. Comply with:
    - 1) Section 01 65 00 - Product Delivery Requirements.
    - 2) Section 01 71 33 - Protection of the Work and Property.
  - c. Do not drop, drag (without appropriate rollers or skids), or scrape materials and equipment.
  - d. Use proper construction equipment and machinery, and tools, operated by sufficient number of qualified personnel.
  - e. Maintain materials and equipment in neutral position.
  - f. Do not exert undue stress on materials and equipment.
  - g. Do not deform, bend, or damage materials and equipment.
  - h. Do not deform or mar shafts, bearings, or other parts.

##### **B. Additional Requirements for Hoisting and Lifting:**

1. When lifting or hoisting, support materials and equipment from appropriate lifting points using proper hooks and suitable nylon lifting straps, chains, and cables. Do not mar or scrape surfaces of materials and equipment during handling.
2. Do not support rigging from building or structure without written approval of Owner.
3. Contractor is responsible for and shall remedy damage to building, structure, resulting from Contractor's operations, in accordance with Section 01 71 33 - Protection of the Work and Property.

#### **1.5 STORAGE**

##### **A. Storage – General:**

1. Contractor shall make all arrangements and provide all measures necessary and required for, and pay all costs associated with, storing materials and equipment.
2. Store materials and equipment in accordance with the Contract Documents and manufacturer's written instructions. In event of conflict between the Contract Documents and manufacturer's written instructions regarding storage and protection, comply with the more-stringent, more-protective requirements.
3. Comply with Section 01 71 33 - Protection of the Work and Property.
4. Records:
  - a. Establish and maintain up-to-date account of materials and equipment in storage, to facilitate preparation of progress payment requests, if the Contract Documents provide for payment for materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing.
  - b. Submit affidavits of inspection and maintenance of mechanical and electrical equipment in long-term storage in accordance with this Section's Article 3.1 ("Maintenance of Storage").

5. Arrange stored materials and equipment to allow easy access for observation or inspection by Owner.
  6. Inspect and maintain stored materials and equipment in accordance with this Section's Article 3.1 ("Maintenance of Storage").
- B. Storage Location:
1. Area(s) available at the Site for storing materials and equipment are addressed in Section 01 14 19 - Use of Site.
  2. When onsite storage is insufficient, Contractor shall provide additional lands for storage facilities as necessary and required for the Work.
  3. Restrictions on Storage Locations:
    - a. Do not store materials or equipment in structures being constructed unless approved by Owner in writing.
    - b. Do not use lawns, landscaped areas, or private property for storage without written permission of property owner.
    - c. Comply with:
      - 1) Section 01 14 19 - Use of Site.
      - 2) Section 01 71 33 - Protection of the Work and Property.
- C. Protection of Stored Items – General:
1. Store materials and equipment indicated below to ensure preservation of quality and fitness for intended uses in the Work, including proper protection against damage and deterioration resulting from: water (including precipitation, flood, and other), moisture, humidity, wind, dust, freezing, and outdoor ambient air high temperature as high as 100 degrees F. Temperature and humidity inside crates, containers, storage structures, and packaging may be significantly higher than outdoor ambient air temperature.
  2. Store in indoor, climate-controlled storage all materials and equipment subject to damage or deterioration by water, moisture, humidity, heat, cold, and other elements, unless otherwise acceptable to Owner.
  3. Do not open manufacturer's crates, containers, and packaging until time of installation, unless recommended by the manufacturer or otherwise required in the Contract Documents.
  4. Store all materials and equipment off the ground (or floor) on raised supports such as skids or pallets.
  5. Electrical Equipment, Instrumentation and Controls, Items Containing Computer Chips, Solid-State Devices, and Other Electronics:
    - a. Contractor shall obtain, coordinate, and comply with specific temperature, humidity, and environmental limitations on materials and equipment, because temperature inside cabinets and components stored in warm temperatures can approach 200 degrees F.
    - b. Protect from water, moisture, humidity, dust, heat, cold, and other potentially harmful elements and environments. Space heaters provided in equipment shall be connected and operating at all times until equipment is connected to active, permanent, electrical power.
    - c. Provide inside each electrical panel, control panel, and other enclosures with electronic device(s) each of the following: (1) desiccant, (2) volatile corrosion inhibitor (VCI) blocks, (3) moisture indicator, and (4) maximum- and minimum-indicating thermometer.
    - d. Check panels and equipment not less than once per month. Replace desiccant, VCI, and moisture indicator the earlier of: (1) as often as necessary, or (2) every six months.
    - e. Establish and maintain certified record of daily maximum and minimum temperature and humidity in storage facility. Such records shall be available for Owner's inspection upon request. Certified record of monthly inspection, noting maximum and minimum temperature for month, condition of desiccant, VCI, and moisture indicator, shall be available to Owner upon request.
  6. Finished Surfaces:

- a. Protect finished surfaces against impact, abrasion, discoloration, and other damage.
  - b. Remedy, in accordance with requirements of item manufacturer and finishing system manufacturer damaged, marred, or deteriorated finishes, to Owner's satisfaction.
7. Contractor is fully responsible for loss, damage, and deterioration, including theft and vandalism, to stored materials and equipment.
- D. Storage of Materials or Equipment Containing Constituents of Concern:
- 1. Prevent contamination of personnel, storage areas, the Site, and adjacent areas.
  - 2. Comply with Laws and Regulations and other provisions of the Contract Documents relative to Constituents of Concern and Hazardous Environmental Conditions.
- E. Uncovered Storage:
- 1. The following materials may be stored outdoors without cover on supports, so there is no contact with the ground:
    - a. Reinforcing steel.
    - b. Precast concrete materials.
    - c. Structural steel.
    - d. Metal stairs.
    - e. Handrails and railings.
    - f. Grating.
    - g. Checker plate.
    - h. Metal access hatches, such as floor doors, roof hatches, and the like.
    - i. Castings.
    - j. Fiberglass items.
    - k. Rigid electrical conduit, except PVC-coated conduit.
    - l. Piping, except PVC or chlorinated PVC (CPVC) pipe.
- F. Covered Storage:
- 1. The following materials and equipment may be stored outdoors on supports and completely covered with covering impervious to water:
    - a. Grout and mortar materials.
    - b. Metal decking.
    - c. PVC and CPVC pipe.
    - d. PVC-coated electrical conduit.
  - 2. Properly and fully secure covers against coming loose in strong winds.
  - 3. Install coverings properly sloped to prevent accumulation of water.
- G. Fully-Protected Storage:
- 1. Store all materials and equipment not indicated in the provisions above regarding uncovered storage and covered storage on supports, in buildings, trailers, or other suitable temporary storage facility with concrete or wood flooring, solid and impervious roof, and fully closed walls on all sides.
  - 2. Covering with visqueen plastic sheeting or similar material in storage space without floor, roof, and walls is unacceptable.
  - 3. Provide heated storage for materials and equipment that could be damaged or deteriorate by low temperatures or freezing.
  - 4. Provide air-conditioned storage for materials and equipment that could be damaged or deteriorate by high temperature or humidity.
  - 5. Protect mechanical and electrical equipment from being contaminated by dust, dirt, and moisture.

6. Maintain temperature and humidity at levels recommended by materials and equipment manufacturers.
  7. Prevent infestation of stored items by pests and rodents. Promptly and properly remedy such infestation when apparent.
- H. Removal of Temporary Storage Facilities and Restoration of Storage Areas:
1. Completely remove temporary storage facilities when no longer necessary for the Work.
  2. Restore areas used for storage and areas occupied by temporary storage facilities, in accordance with the Contract Documents, including Section 01 71 33 - Protection of the Work and Property.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 MAINTENANCE OF STORAGE**

- A. On a scheduled basis, periodically inspect stored materials and equipment to ensure that:
1. Condition and status of storage facilities is adequate to provide required storage conditions.
  2. Required environmental conditions are maintained on continuing basis.
  3. Materials and equipment exposed to weather elements or other environment are not adversely affected.
- B. Mechanical and Electrical Equipment in Long-Term Storage:
1. Meaning of the term "long-term storage" is as established in written instructions of manufacturer of associated materials or equipment.
  2. Mechanical and electrical equipment requiring long-term storage shall have complete manufacturer's written instructions for servicing each item, with notice of enclosed instructions shown on exterior of crate, container, or packaging.
  3. Frequency of inspections and maintenance of stored items shall be in accordance with manufacturer's written instructions.
  4. For mechanical equipment with bearings and shafts, manually rotate shaft during inspection and maintenance, as recommended by equipment manufacturer.
  5. Space heaters that are part of electrical equipment shall be connected and operated continuously until equipment is connected to permanent electrical power supply.
  6. Other requirements for maintenance during storage of electrical equipment, instrumentation and controls, items with computer chips, solid-state devices and other electronics are in this Section's provision on general protection during storage.
- C. Affidavits:
1. Submit to Owner affidavit for each time maintenance and inspection was performed on materials and equipment in long-term storage. Affidavit shall be signed by Contractor and entity performing the inspection and maintenance on the stored items.
  2. Indicate on affidavit:
    - a. Date of inspection.
    - b. Personnel involved and employer of each.
    - c. Condition of storage environment.
    - d. Specific stored items inspected, equipment condition, problems observed, problems corrected, maintenance tasks performed, and other relevant information.
    - e. Signature of Contractor's person responsible for the inspection and maintenance.
    - f. Signed and notarized statement by items' manufacturer indicating whether storage conditions and tasks performed are suitable for continued compliance with manufacturer's warranties.

3. Submit each affidavit, complete, not later than seven days after performing associated inspection and maintenance.

**END OF SECTION**

**SECTION 01 71 33**  
**PROTECTION OF THE WORK AND PROPERTY**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. General requirements for protecting the Work and property, including:
    - a. Accessing or entering property.
    - b. Temporary barricades and temporary warning lights and signs.
    - c. Responsibility to remedy damaged property.
    - d. Protecting existing surface structures.
    - e. Protecting floors, walls, and roofs.
    - f. Protecting other installed items.
- B. Scope:
  - 1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals necessary and required for protecting the Work and property in accordance with the Contract Documents.
- C. Related Requirements: Include, but are not necessarily limited to:
  - 1. Section 01 65 00 - Product Delivery Requirements.
  - 2. Section 01 66 00 - Product Storage and Handling Requirements.
  - 3. Section 01 74 00 - Cleaning.

**1.2 PROTECTION - GENERAL**

- A. Contractor shall provide all precautions and programs and perform all actions necessary to protect personnel health and safety, and to protect the Work and all public and private property and facilities from damage, in accordance with the Contract Documents, Laws and Regulations, and other applicable requirements.
- B. To prevent damage, injury, and loss, Contractor's actions shall include the following:
  - 1. Providing measures for safety of all personnel at and adjacent to the Site, whether engaged in performing the Work, operating or maintaining the facility, or performing other functions for Owner or others.
  - 2. Storing construction equipment, machinery, tools, and similar items, materials and equipment to be incorporated into the Work, supplies, and other items in an orderly, safe manner that does not unduly interfere with progress of the Work or work of others, including Owner and facility manager (if other than Owner).
  - 3. Suitably storing materials and equipment to be incorporated into the Work, in accordance with the Contract Documents, including Section 01 66 00 - Product Storage and Handling Requirements.
  - 4. Placing upon the Work or any part thereof only loads consistent with the safety and integrity of that portion of the Work and existing construction and facilities.
  - 5. Frequently removing and disposing of rubbish, scrap materials, and debris, in accordance with the Contract Documents, including Section 01 74 00 - Cleaning, resulting from Contractor's operations.
  - 6. Providing temporary controls, including controlling pests and rodents, in accordance with the Contract Documents.

## **PART 2 - PRODUCTS**

### **2.1 TEMPORARY BARRICADES**

#### **A. Materials and Construction - General:**

1. Temporary barricades shall be of materials that are either new or of good quality and sufficient for the intended purpose, exposure, and duration of use.
2. Provide temporary barricades of sturdy materials of grade, thickness, and durability sufficient for the probable loads to which they will be subject. Temporary barricades intended for fall prevention, such as railings and handrails on temporary stairs and temporary walkways and at openings, shall be in accordance with Laws and Regulations, including the applicable building and safety codes.
3. Color: Use appropriately colored and reflective barricades, or paint barricades accordingly, to be visible at night and during periods of low visibility.

#### **B. Temporary Snow Fence-type Barriers:**

1. Unless shown or indicated otherwise, temporary barrier shall be not less than snow fence-type, four feet high, orange-colored or other high-visibility color. Polyethylene material or other, similar, durable material. Mesh size 1.25-inch by 1.5-inch.
2. Supports: Adequately support barriers to protect persons and property. Vertical supports may be timber, metal, or other appropriate material sufficient for the intended use, exposure, and duration of use. Properly secure fencing to supports with appropriate, stout, wire or other fastenings, sufficient to engage fencing for the intended use.

## **PART 3 - EXECUTION**

### **3.1 ACCESSING OR ENTERING PROPERTY**

#### **A. Accessing or Entering Property - General:**

1. Use and occupy only lands and easements furnished by Owner, unless appropriate consent from property owner and occupants is obtained by Contractor.
2. The foregoing applies to personnel, construction equipment and machinery, tools, vehicles, materials or equipment to be incorporated into the Work, supplies, temporary facilities, and other items or obstructions.

### **3.2 BARRICADES**

#### **A. Temporary Barricades and Temporary Warning Lights and Signs - General:**

1. All Work Areas:
  - a. Provide temporary barricades, warning lights, and warning signs for both indoor and outdoor Work, in accordance with Laws and Regulations and requirements of owners of affected property and facilities.
  - b. Provide temporary barriers where shown or indicated, and where necessary to protect persons and property. At minimum, provide temporary barriers for all excavations that remain open during non-working hours.
  - c. Promptly replace temporary barricades that are damaged or are otherwise no longer capable of serving their intended function.
2. Temporary Barriers for Areas Not Subject to Vehicular Traffic:
  - a. Provide temporary barriers around:
    - 1) Openings.
    - 2) Scaffolding.
    - 3) Temporary stairs and ramps.
    - 4) Around elevated walkways, slabs, and platforms.
    - 5) Other areas that may present a fall-hazard or hazard to persons and property.

- b. Provide appropriate temporary barriers, warning signs and, where necessary, warning lights, at ground level and other low elevations, and at higher elevations. Protect persons and property from fall-hazards and protect persons and property at lower elevations from falling objects.
  - 3. Duration of Temporary Barriers, Barricades, Signs, and Warning Lights:
    - a. Contractor's responsibility for maintaining temporary barriers, barricades, signs, and warning lights shall continue until the associated Work is substantially complete in accordance with the Contract Documents, unless other provision for protection are agreed to by the parties.
    - b. After Substantial Completion, protect Work and property during periods when Contractor is onsite: completing the remaining Work, performing correction period work, and performing warranty work.
- B. Temporary Snow Fence-type Barriers:
  - 1. Establish temporary barriers around areas as necessary for the protection of persons and property.
  - 2. Install snow fence-type barriers vertical for entire height of barrier.
  - 3. Maintenance:
    - a. Maintain temporary snow fence-type barriers as necessary.
    - b. Repair or replace when damaged, when barrier (or any section thereof) is no longer vertical, or when barrier (or any section thereof) is no longer properly supported for its full height and .
    - c. Reinstall barriers promptly following temporary removals for performing work and where barrier installation has degraded over original temporary barrier installation.
  - 4. Removal:
    - a. Remove temporary barriers from the Site when associated excavation is properly filled and the area is sufficiently safe for persons and other property.

### **3.3 RESPONSIBILITY TO REMEDY DAMAGED PROPERTY**

- A. Contractor to Remedy Damage:
  - 1. Contractor has full responsibility for preserving public and private property and facilities on and adjacent to the Site.
  - 2. Direct or indirect damage done by, or on account of, any act, omission, neglect (including inadvertent acts), or misconduct by Contractor (including any person or entity for whom contractor is responsible) in performing the Work, shall be promptly remedied by Contractor, at Contractor's expense, in accordance with the Contract Documents.
  - 3. If the Contract Documents do not show or indicate the required restoration, or remedy, restore or remedy the damage to condition equal or better than that existing before damage was done.
- B. Owner May Remedy:
  - 1. Should Contractor fail to protect and safeguard property and the Work after requests from Owner, Owner reserves the right to implement measures to protect property and the Work.
  - 2. Cost of such Owner-implemented measures shall be paid by Contractor. Owner may deduct from payments due Contractor such amounts as set-offs in accordance with the Contract Documents.
  - 3. Such right, however, does not obligate Owner to continuously monitor or have responsibility for protection of property and the Work, which responsibility is exclusively Contractor's.
  - 4. In exercising its rights under this provision, Owner will endeavor to give Contractor sufficient notice to allow Contractor to remedy the damage or defect within a reasonable time. However, if Owner deems that the situation requires prompt remedy, Owner may act as quickly as Owner deems appropriate, without infringing on or mitigating Owner's rights under this provision and elsewhere in the Contract Documents

### **3.4 PROTECTION OF EXISTING SURFACE STRUCTURES**

#### **A. Surface Structures – General:**

1. Surface structures are existing buildings, structures, and other facilities at or extending above ground surface, including their foundations and any extension below ground surface. Surface structures include, but are not limited to, buildings, tanks, walls, bridges, roads, dams, channels, open drainage routes, exposed piping and utilities, poles, exposed wires and cabling, posts, signs, markers, curbs, walks, fencing, and other facilities visible at or above ground surface.
2. Protect surface structures as necessary and promptly remedy damage and defects resulting or arising from Contractor's operations. Unless expressly shown or indicated otherwise in the Contract Documents, protect such items regardless of whether shown or indicated on the Drawings or elsewhere in the Contract Documents.
3. Protection of Overhead Utilities:
  - a. Protect visible, overhead utilities, including electrical power, communications, and piped utilities, and related supports, regardless of whether such items are shown or indicated in the Contract Documents.
  - b. When required by the Contract Documents or when acceptable to owner of such utility or facility, temporarily relocate overhead utilities or facilities as necessary perform the Work.
  - c. Provide temporary barriers, barricades, and warning signs identifying overhead utilities within reach of Contractor's construction equipment, machinery, or operations.

#### **B. Temporary Removals of Surface Structures:**

1. Existing surface facilities, including but not limited to guard rails, handrails, posts, guard cables, signs, poles, markers, curbs, and fencing, that are temporarily removed to facilitate the Work shall be replaced and restored promptly after the associated Work is performed.
2. Replace and restore such items in accordance with the Contract Documents. If not addressed in the Contract Documents, replace and restore such items to preconstruction condition or better.
3. Remedy damage to all items temporarily removed and later replaced and restored.
4. All such temporary relocations, replacement, and restoration is at Contractor's cost.

#### **C. Protection of Surface Structures:**

1. Sustain in their original location and protect from direct and indirect injury all surface structures located within or adjacent to the Site. Such sustaining and supporting shall be done carefully and as required by the party owning or controlling such structure or facility.
2. Before proceeding with the Work of sustaining and supporting such structure or facility, Contractor shall, upon Engineer's request, promptly satisfy Engineer that methods and procedures to be used have been approved by party owning the surface structure or facility.
3. Regardless of approval or acceptance by owner of property, structure, or facility, responsibility for protecting the Work and property is solely Contractor's.

### **3.5 PROTECTION OF FLOORS, WALLS, AND ROOFS**

#### **A. Protection of Floors, Walls, and Roofs – General:**

1. Use proper protective covering when moving equipment, handling materials or other loads, when painting, handling mortar or grout, and when cleaning walls, ceilings, or structure contents.
2. Use metal pans to collect oil and cuttings from piping, conduits, and rod threading machines, and under metal cutting machines.
3. Maintain at the Site and use spill kits and absorbent pads for remedying spills.
4. Do not load concrete floors less than 28 days after concrete placement without Owner's written permission.
5. Do not load slabs, floors, walls, or roofs in excess of design loading.

### **3.6 PROTECTION OF INSTALLED MATERIALS, EQUIPMENT, AND LANDSCAPING**

#### **A. General:**

1. Protect existing facilities and installed Work to prevent damage from subsequent operations.
2. Remove protective items when no longer needed, prior to Substantial Completion of the associated Work.
3. Where work will continue in adjacent area(s) after Substantial Completion of a portion of the Work, protect the substantially completed Work until all work in the area is complete.

#### **B. Control traffic (foot traffic, wheeled items such as carts, vehicles, and other traffic) to prevent damage to equipment, materials, and surfaces.**

#### **C. Coverings:**

1. Provide temporary coverings to protect materials and equipment from damage.
2. Fasten protective items without harming the Work. Use tape or adhesives that do not leave residue when removed.

**END OF SECTION**

**SECTION 01 74 00**  
**CLEANING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Requirements for keeping the Site free of accumulations of waste materials during construction (“progress cleaning”).
2. Cleaning for Substantial Completion and prior to final inspection (collectively, “closeout cleaning”).

B. Scope:

1. Contractor shall perform cleaning during the Project, including progress cleaning, as condition precedent to Substantial Completion, upon completion of the Work, and this Specifications section, and elsewhere in the Contract Documents.
2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

**1.2 QUALITY ASSURANCE**

A. Referenced Standards:

1. National Fire Protection Association (NFPA):
  - a. 241, Safeguarding Construction, Alteration, and Demolition Operations.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION**

**3.1 PROGRESS CLEANING**

A. Progress Cleaning – General:

1. Clean the Site, work areas, and other areas occupied by Contractor not less than weekly. Dispose of waste materials in accordance with the the following:
  - a. Comply with NFPA 241 for removing combustible waste materials and debris.
  - b. Do not hold non-combustible materials at the Site more than three days if the ambient air temperature is expected to rise above 80 degrees F. When ambient air temperature is less than 80 degrees F, dispose of non-combustible materials within seven days of their generation.
  - c. Provide suitable containers for storage of waste materials and debris. Avoid generation of odors and creation of nuisances.
  - d. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.

B. Progress Cleaning – Site:

1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
2. Not less than weekly, brush-sweep roadways and paved areas at the Site and adjacent areas used by construction vehicles or otherwise affected by construction activities.

C. Progress Cleaning – Work Areas:

1. Clean areas where the Work is in progress to maintain an extent of cleanliness necessary for proper execution of the Work and safety of personnel.
2. Remove liquid spills promptly. Where spills may have harmful effects on health, safety, protection of facilities, or the environment, immediately report spills to Owner and

authorities having jurisdiction, in accordance with the Contract Documents and Laws and Regulations.

3. Where dust would impair proper execution of or quality of the Work, broom-clean or vacuum entire work area, as necessary.
4. Concealed Spaces: Remove waste material and debris from concealed spaces before enclosing the space.

D. Progress Cleaning – Installed Work:

1. Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of installed materials and equipment, using only cleaning agents and methods specifically recommended by material or equipment Supplier.
2. If Supplier does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage or mar exposed surfaces.

E. Progress Cleaning – Exposed Surfaces:

1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.

F. Progress Cleaning – Cutting and Patching:

1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, trailings and cuttings, and similar materials.
2. Thoroughly clean piping, ductwork, conduits, and similar features before applying patching material, paint, or other finishing materials.
3. Restore damaged insulation and coverings on piping, cutwork, and similar items to its pre-construction condition.

G. Waste Disposal:

1. Properly dispose of waste materials (including surplus materials, debris, rubbish, and other waste) off the Site.
2. Do not burn or bury waste materials at the Site.
3. Remove waste material and rubbish from excavations before backfilling.
4. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers, gutters, sanitary sewers, or other location in the environment. Dispose of such materials in accordance with Laws and Regulations.
5. Do not discharge wastes to surface waters, drainage routes, or groundwater.
6. Contractor is solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste generated by Contractor's operations or brought to the Site by Contractor.

H. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering where necessary or required for protection from damage or deterioration, until Substantial Completion.

I. Clean completed construction as frequently as necessary throughout the construction period.

### **3.2 CLOSEOUT CLEANING**

A. Complete the following prior to requesting inspection for Substantial Completion:

1. Clean and remove from the Site waste material (including rubbish and debris) and other foreign and undesirable items and substances.
2. Remove spills and stains or petroleum, oils, solvents, other chemicals, and other foreign and undesirable deposits.
3. Hose-clean sidewalks and loading areas.

4. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign and undesirable substances.
  5. Remove waste material and surface dust from limited-access spaces.
  6. In unoccupied spaces, sweep concrete floors broom-clean.
  7. Remove non-permanent tags and labels.
  8. Surface Finishes:
    - a. Touch-up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
    - b. Do not paint over "UL" or similar labels, including mechanical and electrical nameplates.
  9. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign or undesirable substances.
  10. Leave the Site clean, and in neat, orderly condition, satisfactory to Owner and Engineer.
- B. Complete the following prior to requesting final inspection:
1. After Substantial Completion of all the Work, following completion of items of incomplete or damaged Work ("punch list Work"), clean "punch list Work areas in accordance with Paragraph 3.2.A of this Specifications Section.

**END OF SECTION**

**SECTION 01 75 00**  
**CHECKOUT AND START-UP PROCEDURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Administrative and procedural requirements for checkout and startup of equipment, systems, and facilities.
- B. Scope:
1. Contractor shall initially check out, start up, and place equipment and systems installed under the Contract into successful operation, in accordance with the material and equipment manufacturers' written instructions, Suppliers' recommendations at the Site, and the Contract Documents.
  2. Provide the following:
    - a. All labor, tools, materials, and equipment required to complete equipment and system checkout and startup.
    - b. Chemicals, lubricants, and other required operating fluids necessary for checkout, startup, and initial operation of the Work.
    - c. Filters and other temporary or consumable items necessary for checkout, startup, and initial operation of the Work.
    - d. Fuel, electricity, water, and other temporary utilities and temporary facilities necessary for checkout and startup of equipment and systems, unless otherwise specified.
- C. Related Sections include but are not necessarily limited to:
1. Section 01 78 23 - Operation and Maintenance Data
  2. Section 01 61 03 - Common Work Results for Equipment.
  3. Section 01 79 23 - Instruction of Operations and Maintenance Personnel.

**1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
1. Coordinate checkout and startup with other contractors, as necessary.
  2. Do not start up equipment or system(s) for continuous operation until all components of that equipment item or system, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
  3. Subject to the constraints of this Specifications section, Owner will furnish sufficient personnel to assist Contractor in starting up equipment and system(s), but responsibility for proper operation of the Work is Contractor's.
  4. Supplier shall be present during checkout, startup, and initial operation, unless otherwise acceptable to Engineer or otherwise required by the Contract Documents.
  5. For startup of heating equipment, air conditioning equipment, and other equipment and systems that provide temperature control, that are dependent upon the time of year, return to the Site at beginning of next heating or cooling season (as applicable) to recheck and start the appropriate equipment and system(s).
  6. Do not start up equipment and system(s), without submitting acceptable preliminary operations and maintenance manuals by Contractor in accordance with the Contract Documents.
- B. Checkout and Startup Planning Meeting:

1. Contractor, with appropriate Subcontractors and Suppliers, shall attend and participate in a meeting with Owner to discuss planning, scheduling, and coordination of checkout and startup activities.
  2. Upon mutual concurrence of Owner and Contractor, meeting may be concurrent with the training scheduling planning meeting required in Section 01 79 23 – Instruction of Operations and Maintenance Personnel.
  3. Attend meeting prepared to knowledgably and effectively discuss:
    - a. Status of the Work and schedule-to-complete for requirements prerequisite to checkout and startup.
    - b. Schedule for and status of training required for each equipment item and system.
    - c. Schedule for checkout, startup, and field quality control activities for the subject Work.
    - d. Status and quantities of required consumables, lubricants, and utility services necessary for checkout and startup.
  4. Comply with decisions made at the meeting and the Contract Documents.
- C. Sequencing:
1. Comply with Section 01 14 16 - Coordination with Owner's Operations, regarding staging (phasing) of the Work and allowable shutdowns.
- D. Scheduling:
1. Progress Schedule:
    - a. Clearly indicate in the Progress Schedule planned and actual dates for checkout, startup, and field quality control activities, including all demonstration testing activities addressed in this Specifications section and elsewhere in the Contract Documents. Separately indicate checkout, startup, and field quality control activities for each equipment item and system.
    - b. Perform startup and field quality control activities on the associated, scheduled dates, unless otherwise acceptable to Owner.
  2. Restrictions for Scheduling:
    - a. Checkout of materials, equipment, and systems by Contractor that do not involve or require Owner's personnel may be performed at any time during normal working hours.
    - b. Startup, including initial operation of materials, equipment, and systems, shall not be initiated on: Monday, Friday, Saturday, Sunday, Owen's holidays, the day immediately prior to a holiday, or the day immediately following a holiday, unless otherwise acceptable to Owner.
    - c. Unless otherwise indicated in the Contract Documents or acceptable to Owner, perform all startup during normal working hours of the day shift.
    - d. To the extent practicable, where extended-duration startup or field quality control activities are required by the Contract, avoid having such activities extend into evening, night, weekend, or holiday hours.
  3. Operation and Maintenance Data:
    - a. Comply with Section 01 78 23 - Operation and Maintenance Data.
    - b. A preliminary copy of all operation and maintenance manuals shall be received by Engineer prior to the start of the demonstration period.
  4. Training:
    - a. Comply with Section 01 79 23 - Instruction of Operations and Maintenance Personnel.
  5. Spare Parts, Tools, and Extra Materials.
    - a. Comply with Section 01 78 43 - Spare Parts and Extra Materials, for furnishing spare parts, tools, and extra materials to Owner and for documenting Owner's receipt of such items.
    - b. Deliver to Owner all required spare parts, tools, and extra materials prior to commencing the demonstration period, unless earlier delivery is required elsewhere in the Contract Documents.

### **1.3 QUALITY ASSURANCE**

#### **A. Regulatory Requirements:**

1. Do not start up equipment or systems or place into initial operation until required operating permits are obtained from authorities having jurisdiction.
2. Where Owner has applied for and obtained initial approvals or permits necessary for operation, Contractor shall furnish information and assistance to Owner for Owner to secure final approvals from authorities having jurisdiction for required operating permits.

#### **B. Qualifications:**

### **1.4 DEFINITIONS**

#### **A. The following defined terms are used in this Specifications Section:**

1. Instrumentation Supplier: Entity retained by Contractor, Subcontractor, or Supplier to furnish instrumentation or controls that will be part of the completed Work, including manufacturers, manufacturer representatives, wholesalers, retailers, and others, including entities retained to perform systems integration Work.
2. Project Classified System (PCS): An established, distinct part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, cabling, materials, and incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system. PCSs may be specifically indicated in this Specifications section or elsewhere in the Contract Documents, such as [Section 01 13 13 - Milestones,] Section 01 14 16 - Coordination with Owner's Operations, and others.
3. Demonstration Period: A period of time, of specified duration, during which the Contractor initiates process flow through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.

### **1.5 SUBMITTALS**

#### **A. Action Submittals: Submit the following:**

1. Data collection and reporting log for each required Demonstration Period.

#### **B. Informational Submittals: Submit the following:**

1. Progress Schedules indicating dates for checkout, startup, and field quality control activities.
2. Completed checkout and startup log required in Paragraph 3.2.C of this Specifications section.
3. Manufacturer's installation check letters (also known as Manufacturer's Field Services Report) required in Paragraph 3.2.C of this Specifications section.
4. Instrumentation Supplier's Instrumentation Installation Certificate, required in Paragraph 3.2.C of this Specifications section.
5. Letter verifying completion of all pre-demonstration startup activities, required in Paragraph 3.2.C of this Specifications section.
6. Report of data collected during each required Demonstration Period.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 CHECKOUT AND STARTUP – GENERAL**

#### **A. Facility Startup:**

1. Demonstration Period, including:
  - a. Demonstration of functional integrity of equipment, system, or PCS.

### 3.2 DEMONSTRATION PERIOD

#### A. Demonstration Period – General:

1. Demonstrate the operation and performance of mechanical, electrical, instrumentation, and control interfaces of the Work undergoing the Demonstration Period, in accordance with the Contract Documents.
2. Duration of Demonstration Period: 120 consecutive hours.
3. If, during the Demonstration Period, the aggregate time used for repair, alteration, or unscheduled adjustments to any part of the Work that renders the affected Work inoperative or operation outside of recommended ranges exceeds 10% of the Demonstration Period, the demonstration of operation and performance will be deemed unacceptable and Contractor shall provide appropriate adjustments and remedies and re-perform the Demonstration Test, at no additional cost to Owner, until acceptable results are obtained. Re-performance of the Demonstration Period shall comply with the same requirements as the original Demonstration Period.
4. Perform the demonstration of operation and performance of the Work under full operational conditions.
5. Owner's Personnel:
  - a. Owner will make available operations personnel to make process decisions affecting facility performance and compliance with applicable operating permits.
  - b. Owner's assistance will be available only for process decisions.
  - c. Contractor will perform all other functions associated with the Demonstration Period including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period in accordance with the Contract Documents.
6. Owner reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, and similar actions and events during the Demonstration Period to verify the operation and performance of the Work in automatic, manual, and other types of operating modes, backup systems, and alternate operating modes.
7. Prior to Starting Demonstration Period:
  - a. Prepare data collection and reporting log for sampling, analytical data, and data to be obtained by manually recording data from field or panel indicators. Not less than [30] days prior to the start of the Demonstration Period, submit the data collection and reporting log to Engineer for acceptance.
8. Timing of Start and End of Demonstration Period:
  - a. Schedule the end of the Demonstration Period at a convenient time such as midnight, so the Owner can assume operational responsibility on a new day beginning immediately after completion of the Demonstration Period.
  - b. Time of beginning and ending Demonstration Period shall be agreed upon by Contractor, Owner in advance of initiating Demonstration Period.

#### B. Demonstration Period, Evaluation, and Acceptance:

1. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's questions, provide final field instruction on select systems (where appropriate) and to respond to problems or failures of the Work.
2. Responsibilities for Data Reporting:
  - a. Submit data collected to Engineer for evaluation of acceptability of results.
3. Data Evaluation:
  - a. Owner as necessary, will evaluate the data collected during the Demonstration Period and other information obtained during the Demonstration Period for compliance with the Contract Documents.
  - b. Owner will advise Contractor in writing of whether the data and information obtained indicate that the Demonstration Period was successfully completed.
4. Criteria for Acceptance:

- a. Flocculator system meets the operating criteria outlined in the contract documents.
- C. Obtain Suppliers' certifications of the installed and operational Work, without restrictions, and submit to Engineer:
  - 1. Manufacturer's installation check letters (sometimes referred to as Manufacturer's Field Services Report).

**END OF SECTION**

**SECTION 01 78 23**  
**OPERATION AND MAINTENANCE DATA**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Requirements for Contractor-furnished, manufacturers' operation and maintenance (O&M) data, including:
  - a. Required operation and maintenance data groupings into operation and data manuals and timing of such Submittals.
  - b. Requirements for paper copies of operation and maintenance data and related Electronic Documents.
  - c. Content of operation and maintenance data Submittals.

B. Scope:

1. Contractor shall submit operation and maintenance data, and related information, in accordance with this Section and requirements elsewhere in the Contract Documents, as instructional and reference information for use by: (a) Owner's operation and maintenance personnel, and (b) others retained by or working for Owner.
2. In addition to operation and maintenance data expressly required elsewhere in the Contract Documents, also submit operation and maintenance data for:
  - a. All equipment and systems, including facility equipment, conveying equipment, electrical equipment, process equipment, and other equipment.
  - b. Instrumentation and control devices and systems.

C. Related Requirements:

1. Section 01 31 26 - Electronic Communication Protocols.
2. Section 01 33 00 - Submittal Procedures.
3. Section 01 75 00 - Checkout and Startup Procedures.

**1.2 SUBMITTALS**

A. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data:
  - a. Submit operation and maintenance data, required by the Contract Documents, grouped into operation and maintenance manual Submittals indicated in Table 01 78 23-A.
  - b. Where operation and maintenance data required by the Contract Documents, is not expressly indicated in table 01 78 23-A, obtain written clarification or interpretation from Engineer prior to preparing and transmitting such Submittal.
  - c. For each required operation and maintenance manual Submittal, furnish preliminary Submittal and final Submittal. Timing of preliminary and final operation and maintenance manual Submittals, and differences between preliminary and final Submittals, are indicated in this Section.

**Table 01 78 23-A**  
**Required Groupings of Operation and Maintenance Data Submittals**

Name of O&M Manual/Data	For Materials or Equipment Specified in Section(s)
Vertical Turbine Flocculator Equipment	Section 46 41 34
Variable Frequency Drives	Section 26 29 23

B. Timing of Submittals and Quantity Required:

1. Final Operation and Maintenance Manual Submittals: Furnish final Submittal prior to Substantial Completion of the associated Work, unless submittal is required prior to an interim Milestone.
  - a. Paper Copies: Three copies, exclusive of copies required for Contractor's use.
  - b. Electronic Documents: In accordance with Section 01 31 26 - Electronic Communication Protocols.
  - c. Work will not be eligible for Substantial Completion until associated, required final operation and maintenance data Submittals are accepted by Engineer.
  - d. If Contractor (whether or not via Subcontractor or Supplier), revises program code or configuration files between acceptance of Submittal by Engineer and end of the Contract's correction period and Contractor's general warranty obligation, furnish updated program code and configuration files to Owner. Before modifying program code and configuration files after Substantial Completion, verify with facility manager that Owner modifications of program code or configuration files were incorporated into the modified files, subject to the provisions of this Section.

**1.3 PAPER COPIES OF O&M MANUALS**

A. Binding and Cover:

1. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy, as necessary.
2. Binders shall be not less than one inch wide and maximum of three inches wide. Binders for each copy of each volume shall be same size and color.
3. Binders shall be locking three-ring ("D"-ring) type, or three-post type. Three-ring binders shall be riveted to back cover and include plastic sheet lifter (page guard) at front and back of each volume.
4. Do not overfill binders.
5. Covers shall be oil-, moisture-, and wear-resistant, including identifying information on cover and spine of each volume.
6. Indicate the following information on cover of each volume:
  - a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS". For submittal of preliminary operation and maintenance data, include the word, "PRELIMINARY" in the title.
  - b. Name or type of material or equipment covered in the manual.
  - c. Volume number, if more than one volume is submitted, listed as "Volume 1 of 2", with appropriate volume-designating numbers filled in.
  - d. Name of Project and, when applicable, Contract name and number.
  - e. Name of structure, as applicable.
7. Provide the following information on spine of each volume:

- a. Title: "OPERATING AND MAINTENANCE INSTRUCTIONS". For submittal of preliminary operation and maintenance data, include the word, "PRELIMINARY" in the title.
  - b. Name or type of material or equipment covered in the manual.
  - c. Volume number, when more than one volume is submitted, listed as "Volume 1 of 2", with appropriate volume-designating numbers filled in.
  - d. Project name and building or structure name.
- B. Pages:
1. Print pages in paper copies of operation and maintenance manuals on 30-pound (minimum) paper, 8.5-inch by 11-inch size.
  2. Reinforce binding holes in each individual paper sheet with plastic, cloth, or metal. When published, separately-bound booklets or pamphlets are part of manuals, reinforcing of pages within booklet or pamphlet is not required.
  3. Furnish each page with binding margin not less than 3/4-inch wide.
  4. Properly punch each paper page with holes suitable for associated binding. Provide not less than 3/8-inch of paper between outer edge of punched holes and edge of paper. Manuals with improperly punched holes will be returned to Contractor as unacceptable.
  5. In paper copies of manuals, each page in each copy shall be properly bound-through by the binder's rings or posts. Paper manuals where some pages are not so bound will be returned to Contractor as unacceptable.
- C. Drawings:
1. Bind into operation and maintenance manuals drawings, diagrams, and illustrations up to and including 11-inch by 17-inch size, with reinforcing and punched holes specified for paper pages.
  2. Drawings or sheets larger than 11-inch by 17-inch shall be:
    - a. Paper Copies: Neatly folded and inserted into clear plastic pockets bound into the manual. Neatly and permanently label each pocket with printed text indicating content and drawing numbers. Include not more than two drawings or sheets per pocket.
    - b. Electronic Documents Copies: Included in electronic file at appropriate location.
- D. Copy Quality and Document Clarity:
1. Provide original-quality copies. Documents in operation and maintenance manuals shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color. Manuals with copies that are unclear, not completely legible, off-center, skewed, or where text or drawings are cut by binding holes, are unacceptable. Pages that contain approval or date stamps, comments, or other markings that cover text or drawing are unacceptable.
  2. Clearly mark, using ink, to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished and cross out inapplicable content. Using highlighters to so indicate options furnished is unacceptable.
- E. Organization:
1. Indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

## **1.4 ELECTRONIC DOCUMENTS O&M MANUALS**

- A. Electronic Documents of Operation and Maintenance Manuals:
1. Each Electronic Document copy of operation and maintenance data shall include all information included in the corresponding paper copy.
  2. Submit Electronic Documents operation and maintenance data in accordance with Section 01 31 26 - Electronic Communication Protocols, and Section 01 33 00 - Submittal Procedures.
  3. File Format:
    - a. Unless otherwise required by Section 01 31 26 - Electronic Communication Protocols, or Section 01 33 00 - Submittal Procedures, operation and maintenance data Electronic Documents shall be "portable document format" (PDF) files.
    - b. Electronic Documents shall be electronically searchable upon delivery.
    - c. Electronic Documents shall not be password-protected and shall not be protected against Owner's or facility manager's copying and printing such files for Owner's or facility manager's use in operating and maintaining the facility.
    - d. Electronic Documents shall open to its first page.
    - e. Submit each operation and maintenance manual as a single Electronic Document file, unless file size is over-large, in which case divide into as few separate files, each with similar filename, as possible.
    - f. Within each Electronic Document, provide bookmarks for the following:
      - 1) Each chapter and subsection indicated in the corresponding printed copy document's table of contents.
      - 2) Each figure.
      - 3) Each table.
      - 4) Each appendix and attachment.

## **1.5 CONTENT OF OPERATION AND MAINTENANCE MANUALS**

- A. Operation and Maintenance Manual Content – General:
1. Prepare each operation and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-constructed drawings as applicable, bills of materials, technical information, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.
  2. Provisions of this Article were written for equipment. Where operation and maintenance data are required for building products, such as finishes, openings, thermal and moisture protection, and similar items, comply with this Article to the extent practical and reasonable for the associated item.
  3. Completeness and Accuracy:
    - a. Operation and maintenance manuals that include language stating or implying that the manual's content may be insufficient or stating that the manual's content is not guaranteed to be complete and accurate are unacceptable.
    - b. Operation and maintenance manuals shall be complete and accurate.

- c. Operation and maintenance manuals shall indicate the specific alternatives and features furnished, and the specific operation and maintenance provisions for the material or equipment furnished.
  - 4. Provide dividers and Include manufacturer's information, diagrams, schematics, and equipment cutaways. Avoid submitting catalog excerpts unless they are the only document available showing identification or description of particular component of the equipment. Where published documents, included in operation and maintenance data, pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.
  - 5. Identify each equipment item consistent with names and identification numbers shown or indicated in the Contract Documents, rather than manufacturer's model numbers.
  - 6. Neatly type data not furnished in computer-printed text. Handwriting, except for strikeouts, arrows, and the like, is unacceptable.
  - 7. Include copy of warranty in accordance with the Contract Documents.
  - 8. Include copy of proposed service contract, when applicable.
  - 9. When copyrighted material is used in operation and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.
- B. Differences Between Preliminary and Final Operation and Maintenance Manuals:
  - 1. In preliminary operation and maintenance manuals, include flysheet or placeholder for information to be included in final operation and maintenance manual Submittal.
  - 2. In final operation and maintenance manuals, include information such as the following, as applicable for the associated materials and equipment:
    - a. Equipment data that requires collection after startup, for example: (1) system and equipment balancing reports, including those for HVAC systems; and (2) final settings for electrical switchgear, automatic transfer switches, and circuit breakers: and (3) materials and equipment field testing results.
    - b. Equipment startup reports and Suppliers' field service reports (the latter on form in Section 01 75 00 - Checkout and Startup Procedures).
- C. Initial Documents in Operation and Maintenance Manuals:
  - 1. Table of Contents:
    - a. Provide table of contents in each volume of each operation and maintenance manual.
    - b. In table of contents and not less than once in each chapter or section, identify materials and equipment by their functional names. Thereafter, abbreviations and acronyms may be used if their meaning is clearly indicated in a table bound at or near beginning of each volume. Using material or equipment model or catalog designations for identifying items is unacceptable.
  - 2. Equipment Record:
    - a. Provide "Equipment Record" section of operation and maintenance manual immediately following the table of contents. "Equipment Record" section is not required for operation and maintenance data for other than equipment (such as building materials and finishes).
    - b. Provide "Equipment Record" on forms included as this Section's Attachments 1, 2, and 3.

- c. For instrumentation and control equipment, International Society of Automation (ISA) data sheets are acceptable in lieu of the forms included as this Section's Attachments 1, 2, and 3.
  - d. This Section's Attachments 1, 2, and 3 are available from Engineer as "fillable PDF forms".
  - e. Complete in detail each section of "Equipment Record". Merely referencing the associated equipment's operation and maintenance data for nameplate, maintenance, spare parts, lubricants, or other required information, is unacceptable.
  - f. For equipment or systems with multiple, separate components (for example, motor and gearbox), fully completed "Equipment Record" is required for each component.
  - g. Operation and maintenance data Submittals without complete and accurate "Equipment Record" sheets are unacceptable.
3. Supplier's Field Service Reports:
- a. Include in final operation and maintenance manuals copies of associated Supplier's field services reports in accordance with Section 01 75 00 - Checkout and Startup Procedures.
  - b. Include Supplier's completed field service reports in operation and maintenance manual in section immediately following "Equipment Record" section.
- D. Operation and Maintenance Instructions:
1. Safety Considerations:
    - a. Submit written descriptions of safety considerations relating to operation and maintenance procedures for materials and equipment.
    - b. Describe safety devices and alarms provided with materials and equipment and proper operation and use.
    - c. Indicate procedures for proper, safe operating and maintenance of materials and equipment furnished, including manufacturer's recommended personal protection equipment, apparatus, and devices not furnished under the Contract.
    - d. Describe recommended safety-related training for personnel operating and maintaining the subject materials or equipment.
    - e. Include in appendix to operation and maintenance manual manufacturers' relevant "safety data sheets" (SDS), formerly "material safety data sheets" (MSDS).
    - f. Engineer's review of operation and maintenance data expressly does not extend to adequacy, completeness, and accuracy of SDS or other safety and protection practices and procedures indicated in the operation and maintenance data.
  2. Operation:
    - a. Include in operation and maintenance data Submittals complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; and regulation and control. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.
    - b. Include pre-startup instructions and checklists and complete startup instructions for each material and equipment item.
    - c. Indicate recommended operating instructions for all operating modes and conditions, with associated recommendations for safe operation.
    - d. Explain available controls and instrumentation and associated function(s).

- e. Indicate required shutdown checklists and procedures for: normal shutdown, emergency shutdown, and long-term shutdowns.
  - f. Troubleshooting instructions.
3. Maintenance – General:
- a. Include in operation and maintenance data complete, written instructions for necessary and recommended maintenance, including mechanical maintenance and electrical/instrumentation and controls maintenance, as applicable.
  - b. Include in operation and maintenance data complete instructions for necessary assembly, disassembly, installation, re-installation, storage, and shipping for materials and equipment.
  - c. Tools: Include list of required maintenance tools and equipment.
  - d. Spare Parts and Extra Materials:
    - 1) Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number) that will expedite the ordering process.
    - 2) Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.
    - 3) Also refer to this Article's provision, "Bills of Materials", below, for additional requirements regarding ordering replacement parts.
4. Routine and Preventative Maintenance:
- a. Submit complete, detailed, written instructions for routine and preventive maintenance including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:
    - 1) Written explanations with illustrations for each routine and preventive maintenance task such as inspection, adjustment, anchor bolt torque checks, lubrication, calibration, cleaning, replacement of filters, and the like.
    - 2) Recommended schedule for each routine and preventive maintenance task.
    - 3) Lubricants:
      - a) Provide lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.
      - b) Table of alternative lubricants.
5. Major Maintenance:
- a. Include detailed, written instructions and illustrations for required periodic (non-routine, non-preventative) maintenance.
  - b. Indicate relative level of training and expertise required to perform such maintenance and recommended tools and equipment.
6. Special Maintenance:
- a. Include maintenance instructions for long-term shutdowns and storage.
- E. Bills of Materials:

1. Include in operation and maintenance manuals complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:
  2. Manufacturer's name, physical address, telephone number, internet website address.
  3. Manufacturer's local service representative's or local parts supplier's name, physical address, telephone number, internet website address, and e-mail addresses.
  4. Manufacturer's shop order and serial number(s) for materials, equipment or assembly furnished.
  5. For each part or piece include the following information:
    - a. Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.
    - b. Part name or description.
    - c. Manufacturer's part number.
    - d. Quantity of each part used in each assembly.
    - e. Current unit price of the part at the time the operation and maintenance manual is submitted. Price list shall be dated.
- F. Record Copy of Shop Drawings, Product data, and Other Previously Approved and Accepted Submittals:
1. Submit original-quality copies of each approved and accepted (as applicable) Shop Drawing, product data Submittal, written results of source quality control activities, and other Submittals, updated to indicate as-installed condition. Do not include prior Submittals that were not approved or were not accepted. Reduced drawings are acceptable only when reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.
- G. Electrical Schematics, Diagrams, and Information:
1. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.
  2. Include as-constructed drawings of layouts of electrical panels (such as switchgear and motor control centers) and control panels.
- H. NFPA 70 (National Electric Code) Documentation:
1. Include in operation and maintenance manuals for electrically-powered equipment documented calculations of: (1) arc-fault current, equipment available fault current and (2) short-circuit current rating (SCCR), provided as part of equipment Submittals.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 ATTACHMENTS**

- A. The following, bound after this Section's "End of Section" designation, are part of this Section:
1. Attachment 1 - Equipment Data and Spare Parts Summary form (one page)
  2. Attachment 2 - Recommended Maintenance Summary form (one page)

3. Attachment 3 - Lubrication Summary form (one page)

**END OF SECTION**





Lubrication Summary

Equipment Description	Project Equip. Tag No(s).
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Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

## SECTION 01 79 23

### INSTRUCTION OF OPERATION AND MAINTENANCE PERSONNEL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Administrative and procedural requirements for instruction of operation and maintenance personnel.
2. Qualifications requirements for Suppliers' training personnel.
3. General requirements for training.
4. Schedule of required training sessions.

###### B. Scope:

1. Contractor shall furnish services of Suppliers' operation and maintenance training specialists to instruct Owner's personnel in recommended operating and maintenance procedures for materials and equipment furnished, in accordance with the Contract Documents.
2. Each Supplier shall provide a combination of classroom and field training at the Site, unless otherwise required elsewhere in the Contract Documents.  
Owner reserves the right to record training sessions on video for Owner's later use in instructing Owner's personnel.

##### 1.2 ADMINISTRATIVE REQUIREMENTS

###### A. Scheduling of Training Sessions:

1. General:
  - a. Contractor shall coordinate training services with checkout, startup, and initial operation of materials and equipment on days and times, and in manner, acceptable to Owner, in accordance with the Contract Documents.
  - b. Training may be required outside of normal business hours to accommodate schedules of operation and maintenance personnel. Provide training services at the required days and times at no additional cost to Owner.
2. Prerequisites to Training:
  - a. Training of facility operation and maintenance personnel shall commence after preliminary operation and maintenance data has been submitted and accepted, and the Work required in Section 01 75 00, Checkout and Startup Procedures, is complete.
  - b. At option of Owner, training may be allowed to take place before, during, or after checkout and startup of materials and equipment.
3. Training Schedule Submittal:
  - a. Training Schedule Required: Contractor shall prepare and submit proposed training schedule for review and acceptance by Owner. Proposed training schedule shall show and indicate all training required in the Contract Documents, and shall demonstrate compliance with specified training requirements relative to number of hours of training for various elements of the Work, number of training sessions, and scheduling.
  - b. Owner reserves the right to modify personnel availability for training in accordance with process or emergency needs at the facility.
4. Attendance is mandatory for the following:
  - a. Contractor's project manager.
  - b. Project manager of Subcontractors responsible for furnishing materials and equipment for which training of operation and maintenance personnel is required.
  - c. Suppliers invited by Contractor.

- d. Owner's Site Representative (OSR).
5. Contractor shall prepare minutes summarizing the discussions of conference, decisions made, and agreements and disagreements, and distribute the minutes to each conference attendee and others as appropriate.

### 1.3 QUALITY ASSURANCE

#### A. Qualifications:

1. Supplier's Instructors:
  - a. Shall be factory-trained by manufacturer of material or equipment.
  - b. Supplier's instructors shall be proficient and experienced in performing training of the types required.
  - c. Instructors shall be proficient, clear, and easily understandable in spoken and written English language.
  - d. Qualifications of instructors are subject to acceptance by Owner. If Owner does not accept qualifications of proposed instructor, provide services of replacement instructor with acceptable qualifications.

### 1.4 SUBMITTALS

#### A. Action Submittals: Submit the following:

1. Training Schedule: Detailed schedule of training sessions, demonstrating compliance with number of training sessions, hours required in the Contract Documents, and complying with the Contract Times. Submit training schedule Submittals in accordance with time frames specified in this Specifications section.
2. Minutes of training scheduling conference.

### 1.5 LESSON PLAN

- A. Supplier's lesson plan shall describe specific instruction topics, system components for which training will be provided, and training procedures. Handouts, if any, to be used in training shall be included with the lesson plan. Describe in lesson plan "hands-on" demonstrations planned for training sessions.
- B. Submit acceptable lesson plan not less than [21] days prior to starting associated training.
- C. Indicate in lesson plan estimated duration of each training segment.
- D. Lesson plan shall include the following:
  1. Material and Equipment Overview (required for all types of operation and maintenance training):
    - a. Describe material and equipment's operating (process) function and performance objectives.
    - b. Describe material and equipment's fundamental operating principles and dynamics.
    - c. Identify equipment's mechanical, electrical, and electronic components and features. Group related components into subsystems and describe function of subsystem and subsystem's interaction with other subsystems.
    - d. Identify all support materials and equipment associated with operation of subject equipment, such as air intake filters, valve actuators, motors, and other appurtenant items and equipment.
    - e. Identify and describe safety precautions and potential hazards related to operation.
    - f. Identify and describe in detail safety and control interlocks.
  2. Operations Personnel Training:
    - a. Material and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.
    - b. Operation:
      - 1) Describe operating principles and practices.

- 2) Describe routine operating, startup, and shutdown procedures.
  - 3) Describe abnormal or emergency startup, operating, and shutdown procedures that may apply.
  - 4) Describe alarm conditions and responses to alarms.
  - 5) Describe routine monitoring and recordkeeping procedures.
  - 6) Describe recommended housekeeping procedures.
  - c. Troubleshooting:
    - 1) Describe how to determine if corrective maintenance or an operating parameter adjustment is required.
3. Mechanical Maintenance Training:
- a. Material and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.
  - b. Material and Equipment Preventive Maintenance:
    - 1) Describe preventative maintenance inspection procedures required to:
      - a) Inspect materials and equipment in operation.
      - b) Identify potential trouble symptoms and anticipate breakdowns.
      - c) Forecast maintenance requirements (predictive maintenance).
    - 2) Define recommended preventative maintenance intervals for each component.
    - 3) Describe lubricant and replacement part recommendations and limitations.
    - 4) Describe appropriate cleaning practices and recommend intervals.
    - 5) Identify and describe use of special tools required for maintenance of materials and equipment.
    - 6) Describe component removal, installation, and disassembly and assembly procedures.
    - 7) Perform “hands-on” demonstrations of preventive maintenance procedures.
    - 8) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
    - 9) Define recommended torqueing, mounting, calibrating, and aligning procedures, tolerances, and settings, as appropriate.
    - 10) Describe recommended procedures to check and test equipment following corrective maintenance.
  - c. Troubleshooting:
    - 1) Define recommended systematic troubleshooting procedures.
    - 2) Provide component-specific troubleshooting checklists.
    - 3) Describe applicable materials and equipment testing and diagnostic procedures to facilitate troubleshooting.
    - 4) Describe common corrective maintenance procedures with “hands-on” demonstrations.
4. Instrumentation/Controls and Electrical Maintenance Training:
- a. Materials and Equipment Overview: As described in Paragraph 1.5.D.1 of this Specifications section.
  - b. Preventative Maintenance and Troubleshooting of Instrumentation and Control Systems: Owner may grant waiver(s) to allow all training for a given system to be at the location of Owner’s training facility.
  - c. Preventative Maintenance and Troubleshooting of Other Electrical Systems: In accordance with requirements for Paragraph 1.5.D.3 of this Specifications section.

## **1.6 TRAINING AIDS**

- A. Supplier's instructor(s) shall incorporate training aids as appropriate to assist in the instruction. Provide handouts of text, tables, graphs, and illustrations as required. Other appropriate training aids include:
  - 1. Audio-visual aids, such as videos, Microsoft PowerPoint presentations, overhead transparencies, posters, drawings, diagrams, catalog sheets, or other items.
  - 2. Equipment cutaways and samples, such as spare parts and damaged equipment.
  - 3. Tools, such as repair tools, customized tools, and measuring and calibrating instruments.
- B. Handouts:
  - 1. Supplier's instructor(s) shall distribute and use descriptive handouts during training. Customized handouts developed especially for training for the Project are encouraged.
  - 2. Photocopied handouts shall be good quality and completely legible.
  - 3. Handouts shall be coordinated with the instruction, with frequent references made to the handouts.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 TRAINING DELIVERY**

- A. Training Delivery – General:
  - 1. Instructors shall be fully prepared for the training sessions. Training delivery shall be communicative, clear, and proceed according to lesson plan accepted by Owner, with lesson content appropriate for trainees. If Owner deems that training delivery does not comply with the Contract Documents, training shall be postponed, rescheduled, and re-performed in acceptable manner at no additional cost to Owner.
- B. "Hands-on" Demonstrations:
  - 1. Supplier's instructor(s) shall present "hands-on" demonstrations of operation and maintenance of materials and equipment for each training session, in accordance with lesson plan accepted by Owner.
  - 2. Contractor and manufacturer shall furnish tools necessary for demonstrations.

### **3.2 SCHEDULE OF REQUIRED TRAINING**

- A. Supplier shall provide not less than the hours of training and number of sessions indicated in each applicable specification section. Travel time and expenses are responsibility of Supplier and are excluded from required training time indicated in the Contract Documents.

## **END OF SECTION**

**SECTION 02 41 00**  
**DEMOLITION**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. General provisions applicable to all demolition and removals.
  2. Electrical demolition and removals.
  3. Disposal of demolition debris, materials, and equipment.

**1.2 REFERENCES**

- A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to, the following:
1. National Fire Protection Association (NFPA):
    - a. 241 - Safeguarding Construction, Alteration, and Demolition Operations.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
1. Comply with Section 01 14 16 - Coordination with Owner's Operations.
  2. Review procedures under this and other Sections and coordinate the Work that will be performed with, or before, demolition and removals.

**1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
1. Comply with requirements of authorities having jurisdiction and relevant permits, if any, required and obtained for demolition Work.
- B. Qualifications:
1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician(s) legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.

**1.5 SUBMITTALS**

- A. Informational Submittals: Submit the following:
1. Procedure Submittals:
    - a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
      - 1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
      - 2) General indication of intended approach for performing demolition Work, including how proposed demolition will affect Owner and others, including owners and occupants of properties at and adjacent to the Site and the public.
      - 3) Detailed schedule of demolition Work in accordance with the Progress Schedule accepted by Owner.
  2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.B of this Section.
  3. Qualifications Statements:
    - a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
    - b. Name and qualifications of entity performing plumbing removals.

## **1.6 FIELD CONDITIONS**

### **A. Existing Conditions:**

1. Owner makes no representation of condition or structural integrity of areas to be demolished or where removals are required by the Contract Documents.

## **PART 2 - PRODUCTS - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

#### **A. Notification:**

1. Not less than 48 hours prior to commencing demolition or removal, advise Owner in writing of planned start of demolition Work. Do not start removals when Owner furnishes reasonable objection in a timely manner.
2. In accordance with Laws and Regulations, and applicable permits, furnish to authorities having jurisdiction, including emergency services as necessary, appropriate notices of planned demolition and removals.

#### **B. Protection of In-Place Conditions:**

1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, buildings, structures, and properties, unless allowed by the Contract Documents or otherwise allowed in writing by Owner.
2. Closing or obstructing sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Perform the Work with minimum interference to vehicular and pedestrian traffic.
3. Provide temporary partitions between demolition work areas and (a) areas that will be occupied during demolition and removals, and (b) areas accessible to the public or visitors. Temporary partitions shall be sturdy, braced plywood in good condition, of dimensions sufficient to adequately screen demolition work from view of occupants, public, and visitors. Maintain temporary partitions in place until demolition and removal Work in the subject area is complete or until other work requires removal of temporary partitions.
4. Provide appropriate temporary barriers, lighting, and other necessary protection.
5. Repair damage to facilities not subject to demolition or removal when such damage results from Contractor's action or inaction.

#### **C. Existing Utilities: In addition to requirements of Section 01 71 33 - Protection of the Work and Property, and other Division 01 Specifications, perform the following:**

1. Cooperate with utility owners in keeping adjacent services and facilities in operation.
2. Coordinate with utility owners relative to demolition and removal Work. Where utility owner requires that only the associated utility owner modify, disconnect, cap, or any combination thereof, its associated utility service, pay the utility owner for performing such modification, disconnection, capping, or other necessary work.
3. Shutdown of utility services shall be coordinated by Contractor, assisted by Owner as required relative to contacting utility owners.

### **3.2 DEMOLITION - GENERAL**

#### **A. General, Common Requirements for Demolition and Removal Work:**

1. Contractor shall provide all labor, materials, construction equipment and machinery, tools, services (including professional services when necessary), and incidentals as shown, specified and required for demolition, removals, and disposal Work.
2. The Work under this Section includes, but is not necessarily limited to:

- a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of electrical and mechanical systems and equipment, and similar existing materials, equipment, and items.
  - 3. Demolition and removals indicated in other Sections shall comply with requirements of this Section.
  - 4. Perform demolition Work as shown or indicated on the Drawings and as indicated elsewhere in the Contract Documents.
  - 5. Pay for transporting and, as applicable, disposing of materials and equipment resulting from demolition and removals Work.
  - 6. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.
- B. Pollution Controls:
- 1. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the Section 01 74 00 - Cleaning.
- C. Salvage and Ownership:
- 1. No Items are required to be salvaged.

### **3.3 STRUCTURAL REMOVALS**

- A. Removal of Anchorages and Protruding Metals:
- 1. Where equipment or material anchored to concrete or masonry are removed, and anchors are not to be re-used, and where existing metals (and to be removed) protrude from concrete, remove anchors and other metal to not less than 1.5 inches beneath surface of concrete or masonry member. Repair resulting hole, with repair mortar (for concrete), or grout (for masonry), so that filled hole is flush with adjacent surface.
  - 2. At Contractor's option, when anchor is stainless steel, anchor may be cut flush with surface of concrete or masonry, when so approved by Owner.
- B. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Section, unless specified elsewhere in the Contract Documents.

### **3.4 ELECTRICAL REMOVALS**

- A. Electrical Demolition Work Includes Performing the Following Activities and Removing Existing Electrical Items as follows:
- 1. Disconnecting cabling from motors, electrical sources, control panels, control stations, instrumentation and control items, and similar devices and equipment.
  - 2. Conduits, raceways, cable trays, hangers and supports, cabling, and related items.
  - 3. Switches, panelboards, control stations, and similar items.
  - 4. Transformers, distribution switchboards, control panels, motors, starters, variable speed controllers, and similar items.
  - 5. Appurtenances and miscellaneous electrical equipment, as shown, specified, or required.
- B. Electrical Removals – General:
- 1. Comply with Laws and Regulations, including applicable electrical construction codes.
  - 2. Lock Out and Tagging:
    - a. Contractor shall lock out and tag circuit breakers and switches operated by Owner or facility manager (if other than Owner), and shall verify that affected cabling are de-energized to ground potential before commencing electrical removals Work.
    - b. Upon completion of electrical removals Work, remove locks and tags and promptly advise Owner that existing facilities are available for use.

3. Remove existing electrical equipment, fixtures, and systems while avoiding damaging items required to remain. Unless shutdown is expressly allowed in Section 01 14 16 - Coordination with Owner's Operations, keep existing electrical systems in operation. Maintain integrity of grounding systems.
  4. Disconnect and remove motors, control panels, and other electrical items where shown or indicated.
  5. Store removed motors, microprocessors and electronics, and other electrical items to be reused in accordance with its manufacturer's recommendations and requirements of the Contract Documents.
- C. Removal of Cabling, Conduits, Raceways and Similar Items:
1. Verify the function of each cable before disconnecting and removing.
  2. Remove cabling, conduits, hangers and supports, and similar items back to the power source or control panel, unless otherwise shown or indicated.
  3. Remove cabling, conduits, and similar items where shown or indicated for removal. Abandoned conduits concealed in floors, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to Owner.
  4. Disassemble and remove exposed conduits, junction boxes, other electrical appurtenances, and their supports.
  5. Repair all areas of the Work to prevent rusting on exposed surfaces.

### **3.5 DISPOSAL OF DEMOLITION DEBRIS**

- A. Disposal – General:
1. Promptly remove from the Site all debris, waste, rubbish, material, and equipment resulting from demolition and removal Work. Promptly upon completion of demolition and removal Work, remove from the Site construction equipment used in demolition Work.
  2. Do not sell at, or adjacent to, the Site demolition materials or removed equipment and items. If materials, equipment or debris will be sold by Contractor, remove the items from the Site and adjacent areas, and perform the sale or transaction elsewhere, in accordance with Laws and Regulations.
  3. Cleaning and Removal of Debris: Comply with the General Conditions, Supplementary Conditions, and Section 01 74 00 - Cleaning.
- B. Transportation and Disposal:
1. Non-Hazardous Materials, Equipment, and Debris: Properly transport and dispose of non-hazardous demolition materials, equipment, and debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Constituents of Concern such as (but not limited to) asbestos, PCBs, petroleum, hazardous waste, radioactive material, or other material designated as hazardous in Laws or Regulations.
  2. Hazardous Materials, Equipment, and Debris: When handling and disposal of items containing Constituents of Concern is included in the Work, properly transport and dispose of such items in accordance with the Contract Documents and Laws and Regulations.

**END OF SECTION**

**SECTION 03 15 19**  
**ANCHORAGE TO CONCRETE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Requirements for anchorages in concrete, including: anchor rods, reinforcing anchorage adhesive, and post-installed concrete anchors required for the Project but not specified elsewhere in the Contract Documents.
2. Delegated design requirements for concrete anchors not expressly shown or indicated on the Drawings or elsewhere in the Contract Documents, including, but not limited to, anchorages in concrete for the following structural and nonstructural components:
  - a. Structural members and accessories.
  - b. Metal, wood, and plastic fabrications.
  - c. Mechanical and electrical Work, including process-mechanical Work, site and infrastructure Work, electrical Work, communications Work, electronic safety and security systems Work, and others.
  - d. Other components requiring anchorages to concrete.

**1.2 REFERENCES**

A. Definitions and Terminology:

1. This provision presents definitions and terminology, which have the meanings indicated in this provision, applied to the singular or plural thereof, and without regard to use of initial capital letters.
  - a. Adhesive Anchors:
    - 1) Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
    - 2) Includes anchors using acrylics, epoxy and other similar adhesives.
  - b. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.
  - c. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.
  - d. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.
  - e. Galvanizing: Hot-dip galvanizing in accordance with ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 ounces of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by reference standard.
  - f. Hardware: As defined in [ASTM A153] [ASTM F2329].
  - g. MPII: Manufacturer's printed installation instructions.
  - h. Mechanical Anchors:
    - 1) Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
    - 2) Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
    - 3) Drop-in anchors and other similar non-ICC ES approved anchors are unacceptable.
  - i. Post-Installed Anchor: Adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

B. Reference Standards:

1. American Concrete Institute (ACI):
  - a. 318, Building Code Requirements for Structural Concrete and Commentary.

2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
  - a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
3. American Institute of Steel Construction (AISC):
  - a. 303, Code of Standard Practice for Steel Buildings and Bridges.
  - b. 355.2, Seismic Testing of Post-Installed Concrete and Masonry Anchors in Cracked Concrete.
  - c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
4. ASTM International (ASTM):
  - a. A36, Standard Specification for Carbon Structural Steel.
  - b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
  - c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - d. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - e. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  - f. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
  - g. A563, Standard Specification for Carbon and Alloy Steel Nuts.
  - h. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - i. F436, Standard Specification for Hardened Steel Washers.
  - j. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - k. F594, Standard Specification for Stainless Steel Nuts.
  - l. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
  - m. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
5. International Code Council Evaluation Service (ICC-ES):
  - a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
  - b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

#### **A. Coordination:**

1. For post-installed anchors and other anchorages installed in existing concrete, comply with manufacturer's recommendations.

### **1.4 QUALITY ASSURANCE**

#### **A. Regulatory Requirements:**

1. Code-required Special Instructions:
  - a. Special Inspection is required in accordance with the building code for all concrete anchorages.
  - b. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
  - c. See the "Field Quality Control" Article in "Part 3 – Execution" of this Section for additional requirements.

#### **B. Qualifications:**

1. Installer:
  - a. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Owner.

- b. Installer for adhesive anchors installed in horizontal, upward incline, or overhead applications shall be certified by ACI-CRSI Adhesive Anchor Installation Certification Program.

## 1.5 SUBMITTALS

### A. Action Submittals: Submit the following:

1. Shop Drawings:
  - a. Submit schedule (table or listing) of types, sizes (diameter, length, embedment length), material, finish, and proposed manufacturers of anchorages to concrete to be provided.
  - b. For anchorages for which final design is by delegated design professional, include on such Shop Drawing delegated design professional's approval stamp.
2. Product Data: For anchorages to concrete for which final design is by delegated design professional, submit as Informational Submittals bearing approval stamp of delegated design professional.
  - a. Manufacturer's express, written acknowledgement that proposed items comply with referenced standards indicated in this Section and, as applicable, by delegated design professional.
  - b. Manufacturer published data and information for each anchor.
    - 1) Clearly indicate items that are proposed for the Work. Neatly strike out or obscure materials and products not proposed.
  - c. Manufacturer's published installation instructions and instructions for code-required special inspections and tests.
  - d. Post-Installed Anchors: In addition, submit for each post-installed anchor system current ICC-ES report, indicating the following:
    - 1) Manufacturer's certification that anchors comply with requirements indicated in the Contract Documents.
    - 2) Performance data indicating that anchor is approved by its manufacturer for use in cracked concrete.
    - 3) Seismic design categories for which anchor system is approved by ICC-ES report.
  - e. Anchorage layout drawings and details:
    - 1) Drawings showing location, configuration, spacing and edge distance.
3. Submit for each anchorage to concrete for which final design is by delegated design professional:
  - a. Certification of compliance. Indicate design tension and shear loads used for anchor design.
  - b. Delegated design professional's drawings.
  - c. Delegated design professional's specifications, if any, when prepared by delegated design professional.
  - d. Post-Installed Anchors (for which final design is by delegated design professional): Submittal shall also include the following for post-installed anchors for which final design was by delegated design professional:
    - 1) Show diameter, embedment depth and edge distance of each anchor.
    - 2) Indicate compliance with ACI 318 Chapter 17,
    - 3) Type of post-installed anchor system used.
      - a) Provide manufacturer's ICC-ES report for the following:
        - (1) Mechanical anchorage per ICC-ES AC193.
        - (2) Adhesive anchorage per ICC-ES AC308.

### B. Informational Submittals: Submit the following:

1. Shop Drawings and Product Data Approved by Delegated Design Professional:

- a. Submit with delegated design professional's approval stamp those Shop Drawings and product data Submittals indicated in this Article but for which final design was performed by delegated design professional.
2. Calculations by Delegated Design Professional:
  - a. Submit sealed and signed calculations for sizing and determining embedment length of anchorages to concrete not fully designed by Engineer.
  - b. Post-Installed Anchors Designed by Delegated Design Professional: In addition, also submit design calculations:
    - 1) Indicate design load to each anchor.
    - 2) When design load is not indicated on the Drawings, include calculations to develop anchor forces based on performance and design criteria indicated in this Section.
3. Supplier's Instructions:
  - a. Submit manufacturer's published instructions for installation.
4. Field Quality Control Submittals:
  - a. Submit written results of required field quality control activities indicated in this Section.
5. Reports of Supplier's Visits to Site:
  - a. Submit each written report of visit to the Site by Supplier's factory trained representative and delegated design professional. For each, indicate date and time of visit, purpose of visit, observations made, decisions made, problems encountered, and other pertinent information.
6. Qualifications Statements:
  - a. Delegated design professional.
  - b. Each installer.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS – ALL ANCHORAGES**

- A. Materials – General:
  1. This Article applies to all anchorages to concrete, regardless of whether fully designed by Engineer or delegated design professional. Requirements for delegated designs are in the following Article.
  2. For structural applications, do not use powder actuated fasteners and other types of bolts or fasteners not specified in this Section unless approved by Engineer or otherwise required by the Contract Documents.
- B. Description:
  1. Provide anchorages to concrete, of the types shown or indicated, to secure to concrete materials, equipment, and appurtenances installed as part of the Work.
  2. Locations where anchorages are required are generally shown or indicated on the Drawings. Where not shown or indicated on the Drawings provide anchorages or the types required for materials, equipment, and systems where such materials, equipment, and systems are shown on the Drawings.
  3. Anchorages required include those for materials, equipment, and systems shown on the structural Drawings and Drawing other than the structural Drawings.
  4. Design loads for concrete anchorages are shown or indicated on the Drawings for anchorages where design responsibility is delegated to Contractor's delegated design professional. For such anchorages, embedment depths are not shown or indicated.
- C. Post-Installed Mechanical and Adhesive Concrete Anchors:
  1. Submerged application: ASTM F593, Type 316, minimum yield strength of 45,000 psi with matching nut and washer.
  2. Non-submerged application: ASTM F593, Type 304 or Type 316, minimum yield strength of 45,000 psi with matching nut and washer.

3. Post-installed anchors and related materials shall be listed by ICC-ES or Owner-approved equivalent.
- D. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.
- E. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.
- F. Washers:
  1. ASTM F436 unless indicated otherwise, finish to match bolt.
  2. When stainless steel anchorage is provided for cast-in-place anchorages, provide washers of the same material and alloy as in the associated anchorage.
  3. Plate washers: Minimum 1/2 inch thick fabricated ASTM A36 square plates as required.
  4. Comply with manufacturer's written instructions for all post-installed anchorages.
- G. Nuts:
  1. ASTM A563 for cast-in-place anchorages.
  2. When stainless steel anchorages are provided for cast-in-place anchorages, nuts shall comply with ASTM F594 and shall match material and alloy of the associated anchorage.
  3. Follow manufacturer's requirements if using post-installed anchorage.
- H. Galvanizing Repair Paint:
  1. High zinc dust content paint for regalvanizing welds and abrasions.
  2. ASTM A780.
  3. Zinc content: Minimum 92 percent in dry film.
  4. Products and Manufacturers: "ZRC Cold Galvanizing", by ZRC; or "High Performance Zinc Spray", by Clearco; or equal.
- I. Dissimilar Materials Protection: Comply with Section 09 96 00 - High-Performance Industrial Coatings.

## **2.2 DELEGATED DESIGN ANCHORAGES TO CONCRETE**

- A. Manufacturers:
  1. Post-installed anchor systems for indicated manufacturers are acceptable only when a current ICC-ES evaluation report is furnished as a Submittal and the subject anchorage system is approved by delegated design professional.
    - a. Hilti.
    - b. Dewalt.
    - c. Simpson Strong-Tie.
    - d. Or equal.
- B. Description: Perform delegated design for anchorages when one or more of the following applies:
  1. Design load for concrete anchorage is shown or indicated on the Drawings and anchorage embedment depth is not shown or indicated.
  2. When specifically required by the Contract Documents.
  3. When an anchorage is necessary but is not shown or indicated on the Drawings.
  4. Anchorages shown on the Drawings other than the structural Drawings.
- C. Performance and Design Criteria for Delegated Design Anchorages:
  1. Determine design loads, including wind and seismic loads, in accordance with applicable building code and other Laws and Regulations.
  2. For anchorage of equipment and non-structural components, use actual dead load and operating loads obtained by Contractor or delegated design professional from

manufacturer. Design loads shall include operating conditions when equipment or element of the Work is in operation, dynamic loads, and other loads as appropriate or required by the building code or other Laws or Regulations.

3. Design assuming cracked concrete.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Prior to installation, inspect and verify areas and conditions under which concrete anchorages will be installed.
  1. Notify Owner of conditions detrimental to proper and timely completion of the Work.
  2. Do not proceed with the Work until unsatisfactory conditions are properly remedied.

### **3.2 INSTALLATION**

- A. Installation Requirements - General:
  1. Install items in accordance with the Contract Documents, manufacturer's written instructions, and Laws and Regulations.
  2. Perform the following unless shown or indicated otherwise:
    - a. Provide stainless steel anchorages for connecting aluminum and steel members to concrete and masonry.
    - b. Provide washers for all anchorages.
    - c. Where exposed, extend threaded anchorage a maximum of 0.75 inch and a minimum of 0.5 inch above top of fully-engaged nut. If anchorage is cut off to required maximum height, dress the threads to allow nuts to be removed without damage to nuts.
  3. Tightening of nuts: Do the following after nuts are snug-tightened down:
    - a. Upset anchorage threads to prevent nuts from backing off. Provide double nut or lock nut in lieu of upset threads for items that may require future removal.
    - b. When two nuts are used per concrete anchor above the base plate, tighten top nut an additional 1/8 turn to "lock" the two nuts together.
    - c. For post-installed anchorages, comply with MPII.
  4. Secure architectural components to avoid aesthetic distortion and to avoid overstressing fasteners from expansion, contraction, or installation.
- B. Mechanical Anchorages:
  1. Use only where specifically indicated on the Drawings or when approved for use by the Owner.
  2. Do not use where subjected to vibration.
  3. May be used in overhead applications.
  4. Contact Owner for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.
- C. Post-installed Anchorages:
  1. For post-installed anchors, comply with MPII regarding hole diameter and depth required to fully develop the tensile strength of anchor or reinforcing bar.
  2. Use hammer drills to create holes.
  3. Properly clean out holes in accordance with the associated ICC-ES report using non-metallic, fiber bristle brush and compressed air, or as otherwise necessary to remove all loose material from each hole prior to installing anchor in the presence of Special Inspector.
  4. Adhesive Anchorages:
    - a. Provide only where specifically indicated on the Drawings or when approved for use by Owner.
    - b. May be provided where subjected to vibration or at buried or submerged locations.

- c. Do not install for overhead applications or sustained tension loading conditions such as utility hangers.
- d. Install adhesive anchors in concrete aged not less than 21 days.

D. Finishes:

- 1. Coat aluminum surfaces in contact with dissimilar materials in accordance with manufacturer's recommendations.
- 2. Repair of damaged galvanized surfaces:
  - a. Prepare damaged surfaces by abrasive blasting or power sanding.
  - b. Repair damaged galvanized surfaces in accordance with ASTM A780.
  - c. Apply galvanizing repair paint to not less than 6 mils dry film thickness in accordance with galvanizing repair material manufacturer's instructions and ASTM A780.

- E. Ensure that embedded items are protected from damage and are not filled in with concrete or related materials.

**3.3 FIELD QUALITY CONTROL**

A. Supplier's services:

- 1. Post-installed anchor manufacturer's representative shall demonstrate and observe the proper installation procedures for the post-installed anchors.

B. Defective Work:

- 1. Anchorages that do not successfully pass required field tests and inspections or that are otherwise deemed defective by Owner shall be remedied, in accordance with the Contract Documents, at no cost to Owner.

**3.4 CLEANING**

- A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.

**END OF SECTION**

**SECTION 10 14 00**  
**IDENTIFICATION DEVICES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Tag, tape and stenciling systems for equipment and similar items.
  - 2. Hazard and safety signs.
- B. Related Specification Sections include but are not necessarily limited to:

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. A13.1, Scheme for the Identification of Piping Systems.
  - 2. The International Society of Automation (ISA).
  - 3. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. Z535.1, Safety Color Code.
    - b. Z535.2, Environmental and Facility Safety Signs.
    - c. Z535.3, Criteria for Safety Symbols.
    - d. Z535.4, Product Safety Signs and Labels.
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
    - b. 704, Standard System for the Identification of Hazards of Materials for Emergency Response.
  - 5. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Catalog information for all identification systems.
    - b. Acknowledgement that products submitted meet requirements of standards referenced.
  - 2. Identification register, listing all items in PART 3 of this Specification Section to be identified, type of identification system to be used, lettering, location and color.
  - 3. Schedule of Hazard and Safety Signage indicating text and graphics.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. W.H. Brady Co.
  - 2. Panduit.
  - 3. Seton.
  - 4. National Band and Tag Co.
  - 5. Carlton Industries, Inc.

## 2.2 MANUFACTURED UNITS

- A. Type A1 - Round Metal Tags:
  - 1. Materials:
    - a. Aluminum or stainless steel.
    - b. Stainless steel shall be used in corrosive environments.
  - 2. Size:
    - a. Diameter: 1-1/2 inches minimum.
    - b. Thickness: 0.035 inches (20 GA) minimum.
  - 3. Fabrication:
    - a. 3/16 inches minimum mounting hole.
    - b. Legend: Stamped and filled with black coloring.
  - 4. Color: Natural.
- B. Type A2 - Rectangle Metal Tags:
  - 1. Materials: Stainless steel.
  - 2. Size:
    - a. 3-1/2 inches x 1-1/2 inches minimum.
    - b. Thickness: 0.036 inches (20 GA) minimum.
  - 3. Fabrication:
    - a. 3/16 inches minimum mounting hole.
    - b. Legend: Stamped and filled with black coloring.
  - 4. Color: Natural.
- C. Type A3 - Metal Tape Tags:
  - 1. Materials: Aluminum or stainless steel.
  - 2. Size:
    - a. Width 1/2 inches minimum.
    - b. Length as required by text.
  - 3. Fabrication:
    - a. 3/16 inches minimum mounting hole.
    - b. Legend: Embossed.
  - 4. Color: Natural.
- D. Type B1- Square Nonmetallic Tags:
  - 1. Materials: Fiberglass reinforced plastic.
  - 2. Size:
    - a. Surface: 2 x 2 inches minimum.
    - b. Thickness: 100 mils.
  - 3. Fabrication:
    - a. 3/16 inches mounting hole with metal eyelet.
    - b. Legend: Preprinted and permanently embedded and fade resistant.
  - 4. Color:
    - a. Background: Manufacturer standard or as specified.
    - b. Lettering: Black.
- E. Type B2 - Nonmetallic Signs:
  - 1. Materials: Fiberglass reinforced or durable plastic.
  - 2. Size:

- a. Surface: As required by text.
    - b. Thickness: 60 mils minimum.
  - 3. Fabrication:
    - a. Rounded corners.
    - b. Drilled holes in corners with grommets.
    - c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
  - 4. Color:
    - a. Background: Manufacturer standard or as specified.
    - b. Lettering: Black.
  - 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- F. Type C - Laminated Name Plates:
- 1. Materials: Phenolic or DR (high impact) acrylic.
  - 2. Size:
    - a. Surface: As required by text.
    - b. Thickness: 1/16 inches.
  - 3. Fabrication:
    - a. Outdoor rated and UV resistant when installed outdoors.
    - b. Two layers laminated.
    - c. Legend: Engraved through top lamination into bottom lamination.
    - d. Two drilled side holes, for screw mounting.
  - 4. Color: Black top surface, white core, unless otherwise indicated.
  - 5. Color: White with black lettering or as specified.
  - 6. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.

## 2.3 ACCESSORIES

- A. Fasteners:
- 1. Bead chain: #6 brass, aluminum or stainless steel.
  - 2. Plastic strap: Nylon, urethane or polypropylene.
  - 3. Screws: Self-tapping, stainless steel.
  - 4. Adhesive, solvent activated.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION

- A. Install identification devices at specified locations.
- B. All identification devices to be printed by mechanical process, hand printing is not acceptable.
- C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.
- D. Attach tags with 1/8 inches round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.
  - 1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.
- E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.

1. Several items of equipment mounted in housing to be individually tagged inside the compartment.

### 3.2 SCHEDULES

#### A. Hazard and Safety Signage:

1. Miscellaneous OSHA hazard signage:
  - a. Tag Type: Type B2 - Nonmetallic Signs.
  - b. Fastener: Screw or adhesive.
  - c. Size: 10 inches x 14 inches.
  - d. Location: As indicated on Drawings.
  - e. Location: Field located as directed by [Engineer] [or] [Owner].
    - 1) Allowance: Provide [10] OSHA Danger, Caution, Safety Instruction or Biohazard signs as directed by [Engineer] [or] [Owner].
  - f. Legend:
    - 1) Description of hazard shall be determined by [Engineer] [or] [Owner].
    - 2) Provide international graphic symbology where indicated.
2. Process equipment (e.g., pumps, pump motors, blowers, air compressors, bar screens, clarifier drive mechanism, etc.):
  - a. Tag type:
    - 1) Type B2 - Nonmetallic Signs.
    - 2) Type D - Self-Adhesive Tape Tags and Signs.
    - 3) Type G - Stenciling System.
  - b. Fastener:
    - 1) Self.
    - 2) Screws.
    - 3) Adhesive.
  - c. Legend:
    - 1) Letter height: 1/2 inches minimum.
    - 2) Equipment designation as indicated on the Drawings (e.g., "Primary Sludge Pump P-xxx").

#### B. Instrumentation Systems:

1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
  - a. Tag type:
    - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
    - 2) Indoor noncorrosive:
      - a) Type A1 - Round Metal Tags.
      - b) Type B1 - Square Nonmetallic Tags.
    - 3) Indoor corrosive:
      - a) Stainless steel Type A1 - Round Metal Tags.
      - b) Type B1 - Square Nonmetallic Tags.
  - b. Fastener:
    - 1) Type A1: Chain of the same material.
    - 2) Type B1: Stainless steel chain.
  - c. Legend:
    - 1) Letter height: 1/4 inches minimum.
    - 2) Equipment ISA designation as indicated on the Drawings (e.g., "FIT-xxx").
2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):

- a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height: 1/2 inches minimum.
    - 2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").
3. Components inside equipment enclosure, (e.g., PLC's, control relays, contactors, and timers):
- a. Tag type: Type D - Self-Adhesive Tape Tags.
  - b. Fastener: Self.
  - c. Legend:
    - 1) Letter height: 3/16 inches minimum.
    - 2) Description or function of component (e.g., "PLC-xxx" or "CR-xxx").
- C. Electrical Systems:
1. Switchgear, switchboards and motor control centers:
- a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Main equipment legend:
    - 1) Letter height:
      - a) First line: 1 inch minimum.
      - b) Subsequent lines: 3/8 inches minimum.
    - 2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSBxxx").
    - 3) Second line:
      - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
      - b) Include the building name or number if the source is in another building.
    - 4) Third line: System voltage and phase (e.g., "480/277 V, 3PH").
    - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
  - d. Main and feeder device legend:
    - 1) Letter height: 3/8 inches minimum.
    - 2) Description of load (e.g., "MAIN DISCONNECT", "PUMP Pxxx" or "PANELBOARD HPxxx").
2. Safety switches, separately mounted circuit breakers and motor starters, VFD's, etc.:
- a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height: 1/4 inches minimum.
    - 2) First line: Description of load equipment is connected to (e.g., "PUMP Pxxx").
    - 3) Second line:
      - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
      - b) The source of power room number is only required when there are multiple electrical rooms, if the source is in another building, the building name or number shall be used.
3. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
- a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height: 1/2 inches minimum.

- 2) Equipment name (e.g., "LIGHTING CONTROL PANEL LCPxxx").
4. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
  - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
  - b. Fastener: Self.
  - c. Legend:
    - 1) Letter height: 3/16 inches minimum.
    - 2) Description or function of component (e.g., "M-xxx", "CR-xxx" or "TR-xxx").
5. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
  - a. Tag type: Type C - Phenolic Name Plates.
  - b. Fastener: Screws.
  - c. Legend:
    - 1) Letter height: 1/4 inches minimum.
    - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").

**END OF SECTION**

## SECTION 26 05 19

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes:

1. Material and installation requirements for:
  - a. Building wire.
  - b. Shielded VFD cable.
  - c. Wire connectors.
  - d. Insulating tape.
  - e. Pulling lubricant.

##### 1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. Insulated Cable Engineers Association (ICEA):
  - a. S-58-679, Standard for Control Cable Conductor Identification.
2. National Electrical Manufacturers Association (NEMA):
  - a. ICS 4, Industrial Control and Systems: Terminal Blocks.
3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
  - a. WC 57/S-73-532, Standard for Control Cables.
  - b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
4. National Fire Protection Association (NFPA):
  - a. 70, National Electrical Code (NEC).
  - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
5. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
  - a. 568, Commercial Building Telecommunications Cabling Standard.
6. Underwriters Laboratories, Inc. (UL):
  - a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
  - b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
  - c. 467, Standard for Safety Grounding and Bonding Equipment.
  - d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
  - e. 486C, Standard for Safety Splicing Wire Connections.
  - f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
  - g. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

##### 1.3 DEFINITIONS

- A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- B. Shielded VFD Cable: Multi-conductor, insulated, with shield, drain wire and building wires, No. 12 and larger.

C. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

## **1.4 SUBMITTALS**

A. Shop Drawings:

1. Product technical data:

- a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
  - 1) Wire connectors.
  - 2) Insulating tape.
  - 3) Cable lubricant.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

A. Equipment shall be stored by manufacturer until Contractor is ready to install.

B. Equipment shall be stored and protected in accordance with the Manufacturers' recommendations.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Building wire:
  - a. Aetna Insulated Wire.
  - b. Alphawire.
  - c. Cerrowire.
  - d. Encore Wire Corporation.
  - e. General Cable.
  - f. Okonite Company.
  - g. Southwire Company.
2. Shielded VFD cable:
  - a. Belden Inc.
  - b. General Cable.
  - c. Okonite Company.
  - d. Olfex Wire and Cable, Inc.
  - e. Priority Wire and Cable (Prysmian).
  - f. Rockbestos-Surprenant Cable Corp.
  - g. Southwire Company.
3. Wire connectors:
  - a. Burndy Corporation.
  - b. Buchanan.
  - c. Ideal.
  - d. IIsco.
  - e. 3M Co.
  - f. Teledyne Penn Union.
  - g. Thomas and Betts.
  - h. Phoenix Contact.
4. Insulating and color coding tape:
  - a. 3M Co.

- b. Plymouth Bishop Tapes.
- c. Red Seal Electric Co.

## 2.2 MANUFACTURED UNITS

### A. Building Wire:

- 1. Conductor shall be copper with 600 V rated insulation.
- 2. Conductors shall be stranded.
- 3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
- 4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.

### B. Electrical Equipment Control Wire:

- 1. Conductor shall be copper with 600 V rated insulation.
- 2. Conductors shall be stranded.
- 3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
- 4. Conform to UL 44 for Type SIS insulation.
- 5. Conform to UL 83 for Type MTW insulation.

### C. Shielded VFD Cable:

- 1. Conductor shall be copper, stranded with 600 V rated insulation.
- 2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
- 3. Cables No. 1 AWG and less:
  - a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type RHW-2 or XHHW-2 insulation with an overall PVC jacket.
  - b. Shielding: 85% tinned copper braid, full size tinned copper drain wire and 100% foil shield.
  - c. Number of conductors: 3 PH and 1 full size ground.
- 4. Cables No. 12 through 750 kcmil:
  - a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 type XHHW-2 insulation.
  - b. Shielding: 5 mil copper tape, longitudinally applied with a minimum overlap of 15%.
  - c. Number of conductors: 3 PH and 3 equally spaced ground conductors.
- 5. Individual conductor color coding:
  - a. ICEA S-58-679, Method 4.
  - b. See PART 3 of this Specification Section for additional requirements.
- 6. When installed exposed outdoors, UL listed and marked as sunlight resistant.
- 7. For continuously corrugated cable, use manufacturer approved fittings.
- 8. Conform to NFPA 70, Type TC and IEEE 1202 or CSA FT-4.

### D. Wire Connectors:

- 1. Twist/screw on type:
  - a. Insulated pressure or spring type solderless connector.
  - b. 600 V rated.
  - c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
  - d. Phase and neutral conductors: Conform to UL 486C.
- 2. Compression and mechanical screw type:
  - a. 600 V rated.
  - b. Ground conductors: Conform to UL 467.
  - c. Phase and neutral conductors: Conform to UL 486A.

3. Terminal block type:
  - a. High density, screw-post barrier-type with white center marker strip.
  - b. 600 V and ampere rating as required, for power circuits.
  - c. 600 V, 20 ampere rated for control circuits.
  - d. 300 V, 15 ampere rated for instrumentation circuits.
  - e. Conform to NEMA ICS 4 and UL 486A.
  
- E. Insulating and Color Coding Tape:
  1. Pressure sensitive vinyl.
  2. Premium grade.
  3. Heat, cold, moisture, and sunlight resistant.
  4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
  5. For cold weather or outdoor location, tape must also be all-weather.
  6. Color:
    - a. Insulating tape: Black.
    - b. Color coding tape: Fade-resistant color as specified herein.
  7. Comply with UL 510.
  
- F. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Permitted Usage of Insulation Types:
  1. Type XHHW-2:
    - a. For power from 480v panel to VFD
    - b. Building wire and power and control cable in architectural and non-architectural finished areas.
    - c. Building wire and power and control cable in conduit in outdoor areas and below grade.
    - d. Building wire and power and control cable in cable tray in outdoor areas.
  2. Type SIS and MTW:
    - a. For wiring inside of VFD panel
    - b. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.
  3. Type VFD:
    - a. For wiring between VFD and motor (in conduit in outdoor areas).
  
- B. Conductor Size Limitations:
  1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.
  2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
  
- C. Color Code All Wiring as Follows:
  1. Building wire:

	240 V, 208 V, 240/120 V, 208/120 V	480 V, 480/277 V
Phase 1	Black	Brown
Phase 2	Red *	Orange

Phase 3	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

\* Orange when it is a high leg of a 120/240 V Delta system.

- a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.
  - b. Conductors larger than No. 6 AWG:
    - 1) Insulated phase and neutral conductors shall be identified by one of the following methods:
      - a) Continuous colored outer finish along its entire length.
      - b) 3 inches of colored tape applied at the termination.
    - 2) Insulated grounding conductor shall be identified by one of the following methods:
      - a) Continuous green outer finish along its entire length.
      - b) Stripping the insulation from the entire exposed length.
      - c) Using green tape to cover the entire exposed length.
    - 3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.
2. Power cables ICEA S-58-679, Method 4 with:
    - a. Phase and neutral conductors identified with 3 inches of colored tape, per the Table herein, applied at the terminations.
    - b. Ground conductor: Bare.
  3. Control cables ICEA S-58-679, Method 1, Table E-2:
    - a. When a bare ground is not provided, one of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
    - b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 inches of colored tape, per the Table herein, applied at the terminations.
- D. Install all wiring in raceway.
- E. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway.
- F. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.
1. Motor terminal boxes:
    - 1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
    - 2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.
  2. Control circuits:
    - a. Junction and pull boxes: Terminal block type connector.
    - b. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.
  3. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.
- G. Insulating Tape Usage:
1. For insulating connections of No. 8 AWG wire and smaller: 7 mil vinyl tape.
  2. For insulating splices and taps of No. 6 AWG wire or larger: 10 mil vinyl tape.
  3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape.

H. Color Coding Tape Usage: For color coding of conductors.

**END OF SECTION**

**SECTION 26 05 33**  
**RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Material and installation requirements for:
    - a. Conduits.
    - b. Conduit fittings.
    - c. Conduit supports.
    - d. Pull and junction boxes.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
1. Aluminum Association (AA).
  2. American Iron and Steel Institute (AISI).
  3. ASTM International (ASTM):
    - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - c. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
  4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
    - c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
    - d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
    - e. TC 14.AG, Aboveground Reinforced Thermosetting Resin Conduit and Fittings.
    - f. TC 14.BG, Belowground Reinforced Thermosetting Resin Conduit and Fittings.
  5. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. C80.1, Electric Rigid Steel Conduit (ERSC).
    - b. C80.3, Steel Electrical Metallic Tubing (EMT).
    - c. C80.5, Electrical Aluminum Rigid Conduit (ERAC).
    - d. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  6. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  7. Underwriters Laboratories, Inc. (UL):
    - a. 1, Standard for Flexible Metal Conduit.
    - b. 6, Electrical Rigid Metal Conduit - Steel.
    - c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
    - d. 360, Standard for Liquid-Tight Flexible Metal Conduit.
    - e. 467, Grounding and Bonding Equipment.
    - f. 514A, Metallic Outlet Boxes.

- g. 514B, Conduit, Tubing, and Cable Fittings.
- h. 651, Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
- i. 797, Electrical Metallic Tubing - Steel.
- j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
- k. 1203, Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
- l. 2420, Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- m. 2515, Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
      - 1) Conduit fittings.
      - 2) Support systems.
  - 2. Fabrication and/or layout drawings:
    - a. Identify dimensional size of pull and junction boxes to be used.

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Equipment shall be stored by manufacturer until Contractor is ready to install.
- B. Equipment shall be stored and protected in accordance with the Manufacturers' recommendations.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Rigid metal conduits:
    - a. Allied Tube and Conduit.
    - b. Western Tube and Conduit Corporation.
    - c. Wheatland Tube.
    - d. Patriot Aluminum Products, LLC.
  - 2. PVC coated rigid metal conduits:
    - a. Robroy Industries.
    - b. Atkore - Calbond
  - 3. Flexible conduit:
    - a. AFC Cable Systems.
    - b. Anamet, Inc.
    - c. Electri-Flex Company.
    - d. International Metal Hose Company.
    - e. Southwire Company, LLC.
  - 4. Conduit fittings and accessories:
    - a. Appleton by Emerson Electric Co.
    - b. Carlon by Thomas & Betts.
    - c. Cantex, Inc.
    - d. Crouse-Hinds by Eaton.
    - e. Killark by Hubbell.

- f. Osburn Associates, Inc.
  - g. O-Z/Gedney by Emerson Electric Co.
  - h. Raco by Hubbell.
  - i. Steel City by Thomas & Betts.
  - j. Thomas & Betts.
5. Support systems:
- a. Unistrut by Atkore International, Inc.
  - b. B-Line by Eaton.
  - c. Kindorf by Thomas & Betts.
  - d. Minerallac Company.
  - e. CADDY by Pentair.
  - f. Superstrut by Thomas & Betts.
6. Pull and junction boxes:
- a. Appleton by Emerson Electric Co.
  - b. Crouse-Hinds by Eaton
  - c. Killark by Hubbell.
  - d. O-Z/Gedney by Emerson Electric Co.
  - e. Steel City by Thomas & Betts.
  - f. Raco by Hubbell
  - g. Bell by Hubbell.
  - h. Hoffman Engineering.
  - i. Wiegmann by Hubbell.
  - j. B-Line by Eaton.
  - k. Adalet.
  - l. RITTAL North America LLC.
  - m. Stahlin by Robroy Enclosures.

## 2.2 RIGID METAL CONDUITS

- A. Rigid Galvanized Steel Conduit (RGS):
- 1. Mild steel with continuous welded seam.
  - 2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
  - 3. Threads galvanized after cutting.
  - 4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
  - 5. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6.
- B. PVC-Coated Rigid Steel Conduit (PVC-RGS):
- 1. Nominal 40 mil Polyvinyl Chloride Exterior Coating:
    - a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
    - b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
  - 2. Nominal 2 mil, minimum, urethane interior coating.
  - 3. Urethane coating on threads.
  - 4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
  - 5. Female Ends:
    - a. Have a plastic sleeve extending a minimum of one pipe diameter or 2 inches, whichever is less beyond the opening.

- b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
  - 6. Pass high temperature water PVC coating adhesion test and be ETL Verified PVC-001.
  - 7. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6, NEMA RN 1.
- C. Rigid Aluminum Conduit (RAC):
  - 1. AA Type 6063 aluminum alloy, T-1 temper.
  - 2. Maximum copper content of 0.10%.
  - 3. Extruded, seamless.
  - 4. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.5, UL 6.

## 2.3 FLEXIBLE CONDUIT

- A. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
  - 1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
  - 2. Extruded PVC outer jacket positively locked to the steel core.
  - 3. Liquid and vaportight.
  - 4. Standard: NFPA 70 Type LFMC, UL 360.

## 2.4 CONDUIT FITTINGS AND ACCESSORIES

- A. Fittings for Use with RGS and RAC:
  - 1. Locknuts:
    - a. Threaded steel or malleable iron.
    - b. Gasketed or non-gasketed.
    - c. Grounding or non-grounding type.
  - 2. Bushings:
    - a. Threaded, insulated metallic.
    - b. Grounding or non-grounding type.
  - 3. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
  - 4. Couplings:
    - a. Threaded straight type: Same material and finish as the conduit with which they are used on.
    - b. Threadless type: Gland compression or self-threading type, concrete tight.
  - 5. Unions: Threaded galvanized steel or zinc plated malleable iron.
  - 6. Conduit bodies (ells and tees):
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Standard and mogul size.
    - c. Cover:
      - 1) Clip-on type with stainless steel screws.
      - 2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.
  - 7. Conduit bodies (round):
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast copper free aluminum.
  - 8. Sealing fittings:
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Standard and mogul size.
    - c. With or without drain and breather.

- d. Fiber and sealing compound: UL listed for use with the sealing fitting.
- 9. Expansion couplings:
  - a. 2 inches nominal straight-line conduit movement in either direction.
  - b. Galvanized steel with insulated bushing.
  - c. Gasketed for wet locations.
  - d. Internally or externally grounded.
- 10. Expansion/deflection couplings:
  - a. 3/4 inches nominal straight-line conduit movement in either direction.
  - b. 30 degrees nominal deflection from the normal in all directions.
  - c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
  - d. Internally or externally grounded.
  - e. Watertight, raintight and concrete tight.
- 11. Standards: UL 467, UL 514B, UL 1203.
- B. Fittings for Use with PVC-RGS:
  - 1. The same material and construction as those fittings listed under paragraph "Fittings for Use with RGS and RAC" and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RGS)."
- C. Fittings for Use with FLEX-LT:
  - 1. Connector:
    - a. Straight or angle type.
    - b. Metal construction, insulated and gasketed.
    - c. Composed of locknut, grounding ferrule and gland compression nut.
    - d. Liquid tight.
  - 2. Standards: UL 467, UL 514B.
- D. Weather and Corrosion Protection Tape:
  - 1. PVC based tape, 10 mils thick.
  - 2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
  - 3. Used with appropriate pipe primer.
- E. PULL AND JUNCTION BOXES
- F. NEMA 4X Rated (metallic):
  - 1. Body and cover: 14 GA Type 304 or 316 stainless steel.
  - 2. Seams continuously welded and ground smooth.
  - 3. No knockouts.
  - 4. External mounting flanges.
  - 5. Hinged door and stainless steel screws and clamps.
  - 6. Door with oil-resistant gasket.
- G. Miscellaneous Accessories:
  - 1. Rigid handles for covers larger than 9 square feet or heavier than 25 pounds.
  - 2. Split covers when heavier than 25 pounds.
  - 3. Weldnuts for mounting optional panels and terminal kits.
  - 4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.
- H. Standards: NEMA 250, UL 50.

## 2.5 SUPPORT SYSTEMS

- A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:

1. Material requirements.
  - a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.
  - b. Stainless steel: AISI Type 316.
  - c. PVC coat galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.
- B. Single Conduit Support Fasteners:
  1. Material requirements:
    - a. Zinc plated steel.
    - b. Stainless steel.
    - c. Malleable iron.
    - d. PVC coat malleable iron or steel: 20 mil PVC coating.
    - e. Steel protected with zinc phosphate and oil finish.

## **2.6 CONDUIT ANTI-SLIP COVERS**

- A. Hi-traction anti-slip conduit covers for exposed piping routed along ground, walkway, or floor.
  1. 3/16" pultruded fiberglass, 1/4" heavy duty aluminum 60/61 T Marine Grade.
  2. Length and width as required for application
  3. Seal edges to deter corrosion.
  4. Suitable for wet location, ASTM D4587.
  5. Color: safety yellow with black contrasting stripe.

## **PART 3 - EXECUTION**

### **3.1 RACEWAY INSTALLATION - GENERAL**

- A. Shall be in accordance with the requirements of:
  1. NFPA 70.
  2. Manufacturer instructions.
- B. Size of Raceways:
  1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
  2. Unless specifically indicated otherwise, the minimum raceway size shall be:
    - a. Conduit: 3/4 inches.
- C. Field Bending and Cutting of Conduits:
  1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
  2. Do not reduce the internal diameter of the conduit when making conduit bends.
  3. Prepare tools and equipment to prevent damage to the PVC coating.
  4. Degrease threads after threading and apply a zinc rich paint.
  5. Debur interior and exterior after cutting.
- D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
- E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
  1. Repair galvanized components utilizing a zinc rich paint.
  2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.

3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.
    - a. Total nominal thickness: 40 mil.
  4. Repair surfaces which will be inaccessible after installation prior to installation.
- F. Remove moisture and debris from conduit before wire is pulled into place.
1. Pull mandrel with diameter nominally 1/4 inches smaller than the interior of the conduit, to remove obstructions.
  2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
  3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.
- G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

### **3.2 RACEWAY ROUTING**

- A. Raceways shall be routed in the field unless otherwise indicated.
1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
  2. Run in straight lines parallel to or at right angles to building lines.
  3. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
  4. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.
- B. All conduits within a structure shall be installed exposed.
- C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 feet:
1. Between instrumentation and telecommunication: 1 inch.
  2. Between instrumentation and 125 V, 48 V and 24 VDC, 2 inches.
  3. Between instrumentation and 600 V and less AC power or control: 6 inches.
  4. Between instrumentation and greater than 600 VAC power: 12 inches.
  5. Between telecommunication and 125 V, 48 V and 24 VDC, 2 inches.
  6. Between telecommunication and 600 V and less AC power or control: 6 inches.
  7. Between telecommunication and greater than 600 VAC power: 12 inches.
  8. Between 125 V, 48 V and 24 VDC and 600 V and less AC power or control: 2 inches.
  9. Between 125 V, 48 V and 24 VDC and greater than 600 VAC power: 2 inches.
  10. Between 600 V and less AC and greater than 600 VAC: 2 inches.
  11. Between process, gas, air and water pipes: 6 inches.
- D. Conduits shall be installed to eliminate moisture pockets.
1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.

### **3.3 RACEWAY APPLICATIONS**

- A. Permitted Raceway Types Per Wire or Cable Types:
1. Power wire or cables: All raceway types.
  2. Control wire or cables: All raceway types.
  3. Motor leads from a VFD: RGS, RAC.
- B. Permitted Raceway Types Per Area Designations:
1. Outdoor and Wet areas:

- a. RGS.
  - b. RAC.
- C. FLEX-LT conduits shall be installed as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
- 1. The maximum length shall not exceed:
    - a. 3 feet to motors.
    - b. 2 feet to all other equipment.

### **3.4 CONDUIT FITTINGS AND ACCESSORIES**

- A. Install Expansion Fittings:
- 1. Where conduits are exposed to the sun and conduit run is greater than 200 feet.
  - 2. Elsewhere as identified on the Drawings.
- B. Install Expansion/Deflection Fittings:
- 1. Where conduits enter a structure.
    - a. Except electrical manholes and handholes.
    - b. Except where the ductbank is tied to the structure with rebar.
  - 2. Where conduits span structural expansions joints.
- C. Threaded connections shall be made wrench-tight.
- D. Conduit joints shall be watertight:
- 1. Where subjected to possible submersion.
  - 2. In areas classified as wet.
  - 3. Underground.
- E. Terminate Conduits:
- 1. In metallic outlet boxes:
    - a. RGS and RAC:
      - 1) Conduit hub and locknut.
      - 2) Insulated bushing and two locknuts.
      - 3) Use grounding type locknut or bushing when required by NFPA 70.
  - 2. In NEMA 4X rated enclosures:
    - a. Watertight, insulated and gasketed hub and locknut.
- F. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

### **3.5 CONDUIT SUPPORT**

- A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
- 1. Wet areas:
    - a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.
    - b. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
  - 2. Conduit type shall be compatible with the support system material.
    - a. Galvanized steel system may be used with RGS.
    - b. Stainless steel system may be used with RGS and RAC.
    - c. PVC coated galvanized steel system may be used with PVC-RGS and RAC.

- d. Aluminum system may be used with RAC and PVC-RGS.
- B. Permitted single conduit support fasteners per area designations and conduit types:
  - 1. Architecturally finished areas:
    - a. Material: Zinc plated steel, or steel protected with zinc phosphate and oil finish.
    - b. Types of fasteners: Spring type hangers and clips, straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
    - c. Provide anti-rattle conduit supports when conduits are routed through metal studs.
  - 2. Wet areas:
    - a. Material: Stainless steel
    - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
  - 3. Conduit type shall be compatible with the support fastener material.
    - a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS.
    - b. Stainless steel system may be used with RGS, PVC-RGS, and RAC.
    - c. PVC coated fasteners may be used with PVC-RGS and RAC.
- C. Conduit Support General Requirements:
  - 1. Maximum spacing between conduit supports per NFPA 70.
  - 2. Support conduit from the building structure.
  - 3. Do not support conduit from process, gas, air or water piping; or from other conduits.
  - 4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 pounds.
    - a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
  - 5. Conduit support system fasteners:
    - a. Do not use concrete nails and powder-driven fasteners.

### **3.6 PULL BOX INSTALLATION**

- A. General:
  - 1. Install products in accordance with manufacturer's instructions.
  - 2. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
  - 3. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.
- B. Pull Boxes:
  - 1. Install pull boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
    - a. Make covers of boxes accessible.
  - 2. Permitted uses of NEMA 4X metallic enclosure:
    - a. Pull or junction box surface mounted in areas designated as wet.

### **END OF SECTION**

**SECTION 26 29 23**  
**VARIABLE FREQUENCY DRIVES - LOW VOLTAGE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. Variable frequency drives (VFDs) for operation of inverter duty motors.

**1.2 QUALITY ASSURANCE**

A. Referenced Standards:

1. American National Standards Institute (ANSI).
2. ETL Testing Laboratories (ETL).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - a. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
  - b. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
  - c. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
4. National Electrical Manufacturer's Association (NEMA):
  - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - b. MG 1, Motors and Generators.
5. National Fire Protection Association (NFPA):
  - a. 70, National Electrical Code (NEC):
    - 1) Article 430, Motors Motor Circuits, and Controllers..
6. Occupational Safety and Health Administration (OSHA).
7. Underwriters Laboratory, Inc. (UL):
  - a. 508, Standard for Industrial Control Equipment.
  - b. 508A, Standard for Industrial Control Panels.

B. Qualifications:

1. Provide drives that are listed and labeled by UL, ETL, or other Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.
2. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 and UL 508A or equivalent NRTL standard.
  - a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" or equivalent NRTL label prior to shipment to the jobsite.
3. VFD Supplier shall maintain an authorized service organization within 100 miles of the Project Site.

C. Coordination:

1. The intent of this Specification Section is to allow the VFD manufacturer to provide the best solution for the harmonic and motor protection outlined herein.
  - a. This solution shall include, but not be limited to, all aspects of the distribution system including standby generation, motor feeder cable type and available floor space.
2. Motor and VFD coordination: See Specification Section 46 41 34 for motor information. Contractor shall have single source responsibility for coordination of all equipment compatibility, which shall include the Flocculator, Motor and VFD, written Certification shall be provided with submittals.

3. VFD shall be supplied complete with all required control components.
  - a. Provide control as indicated:
    - 1) On the electrical drawings.
    - 2) As specified in this Specification Section.
  - b. VFD manufacturer shall review the application and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range.
    - 1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
  - c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.
4. Field verify dimensions in accordance with equipment space requirements as indicated by the manufacturer and on the attached Drawings.
  - a. Equipment that reduces clear work space below the minimums established by the NFPA 70 will not be acceptable.

### 1.3 DEFINITIONS

- A. Variable Torque (VT):
  1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as speed is reduced below full rated.
  2. This type of load permits the VFD and the motor to operate at reduced output current at reduced speed.
- B. Constant Torque (CT):
  1. Defines a load characteristic in which the torque delivered from the motor to the load remains constant as speed is varied.
  2. This type of load requires the VFD to be able to continuously deliver rated output current over the entire speed range.
- C. Constant Horsepower:
  1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as the speed is increased.
  2. This characteristic is required for operation of the VFD and motor above rated frequency to maintain output current within the rated value.
- D. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.
- E. Standard Motor: An AC induction motor that fails to comply with one or more requirements of NEMA MG 1 Part 31.
- F. Low Voltage: 600 VAC or less.

### 1.4 SUBMITTALS

- A. Shop Drawings:
  1. Provide a schedule for each VFD including the following information:
    - a. Equipment Tag Number.
    - b. VFD Complete Catalog Number.
    - c. VFD Amp Frame Size.
    - d. Variable or Constant Torque Rating Basis.
    - e. Rated Input Current.
    - f. Rated Continuous Output Current.
    - g. Rated Short Circuit Current.
    - h. VFD cable type specified (shielded or non-shielded).

- i. VFD Maximum Motor Lead Length for the type of cable used.
  - j. Motor Manufacturer.
  - k. Motor Frame Size.
  - l. Motor Full Load Amps.
  - m. Motor Service Factor.
  - n. As installed motor Lead Length.
  - o. VFD options provided to meet harmonic or motor protection specifications.
2. Submit VFD Shop Drawings concurrently with driven equipment and motor Shop Drawings.
  3. Product technical data:
    - a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
    - b. Maximum rate of heat rejection from VFD and all related components and associated cooling requirements.
    - c. Manufacturer's installation instructions.
    - d. Manufacturer's programming and operating instructions.
  4. Fabrication and/or layout drawings:
    - a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
    - b. Identify minimum clearances from other VFDs or electrical equipment required for proper cooling at top, bottom, side and back of enclosure.
    - c. Three-line diagrams showing AC schematic of VFD, input, output and bypass devices including device ratings.
    - d. Interior layout drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.
    - e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.
    - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
  5. Certifications:
    - a. Submit with Shop Drawings:
      - 1) Identification and location of closest authorized service organization.
    - b. Submit prior to shipment:
      - 1) Certified factory test reports confirming compliance with specified requirements.
    - c. Submit after installation:
      - 1) Certified field service reports showing:
        - a) Each VFD is operational.
        - b) Each VFD and its driven equipment motor are compatible.
        - c) Each VFD responds correctly to the input control signals.
        - d) Critical frequencies of the drive system and that the VFD has been set to lockout these frequencies.
        - e) Measured harmonic levels per Harmonic Protection Requirements Article.
        - f) Measured motor terminal peak voltages per Motor Protection Requirements Article.
- B. Contract Closeout Information:
1. Operation and Maintenance Data.
  2. Manufacturer's instruction manuals.

3. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.
4. Connection data to permit removal and installation of recommended smallest field-replaceable parts.
5. Recommended spare parts list.
6. Commissioning sheets showing “as-left” values of all user-programmable or adjustable drive parameters.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Allen Bradley.
  2. ABB.
  3. Eaton.
  4. Danfoss.
  5. Siemens/Robicon.
  6. Siemens.
  7. Square D Company.
  8. Toshiba.
  9. Yaskawa.

### **2.2 GENERAL**

- A. VFDs shall consist of a rectifier-DC bus-inverter combination producing a sine-coded pulse-width-modulated (PWM) output voltage waveform.
- B. VFDs, whether installed in motor control center (MCC) construction or separately mounted, shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
  1. Motor control.
  2. Motor overload protection.
  3. Motor and motor branch circuit short circuit and ground fault protection.
  4. Motor and controller disconnecting means.
- C. It is the intent of this Specification that VFDs shall be an “engineered” or “configured” drive package in which the VFD chassis, all input, output and bypass power devices, VFD accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory-assembled and -tested by the VFD manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

### **2.3 PERFORMANCE AND DESIGN REQUIREMENTS**

- A. Application:
  1. VFD(s) shall be of sufficient capacity and shall provide a quality of output waveform for stepless motor control from 10 to 100% of base speed of the driven equipment.
  2. VFDs shall be compatible with:
    - a. Inverter duty induction motors.
  3. VFDs shall be suitable for Constant Torque (CT) or Variable Torque (VT) applications.
    - a. VFD manufacturer shall coordinate with the manufacturer of the driven equipment to identify CT and VT applications.
  4. VFDs shall be designed to operate successfully under the following site conditions:

- a. Ambient:
    - 1) Temperature: 0-50 degrees C.
    - 2) 95% non-condensing relative humidity.
  - b. Power supply characteristics:
    - 1) 480Vac, 3 PH, 60 Hz, 3 wire, ( $\pm 10\%$ ).
    - 2) Effectively grounded.
- B. Ratings and Performance Specifications:
- 1. Voltage rating:
    - a. Nominal: 460 or 480VAC, 3 PH, 60 Hz.
    - b. Range for continuous full load operation:  $\pm 10\%$  of nominal.
    - c. Voltage imbalance tolerance for full load operation: 3% minimum.
  - 2. Current ratings:
    - a. Continuous:
      - 1) Equal to or greater than the motor nameplate full load.
    - b. Short-term overload:
      - 1) VT: 110% for 1 minute.
      - 2) CT: 150% for 1 minute.
      - 3) Permissible for 1 minute every 10 minutes continuously.
    - c. Short circuit:
      - 1) Where a short circuit rating is not indicated or specified for individual VFDs, each VFD shall have a rating not less than indicated on the Drawings for the panelboard the VFD is supplied from.
      - 2) Where specified short circuit rating indicates additional input impedance is required to protect semiconductors, provide input AC line reactors, whether required to meet harmonic performance specifications or not.
  - 3. Efficiency:
    - a. 97%, minimum, at full speed and full load.
    - b. 93%, minimum at 1/2 speed and full load.
  - 4. Displacement power factor:
    - a. 95%, minimum from 50% to 100% speed and load.
  - 5. Efficiency and power factor criteria apply from the input terminals to the output terminals of the VFD alone, excluding losses of input and output power circuit accessories.
  - 6. Frequency drift:
    - a.  $+0.5\%$  of set frequency.
  - 7. Speed regulation (motor dependent): 3%.
  - 8. Speed range: 10:1.
  - 9. Control type:
    - a. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
      - 1) When operating under voltage boost.
      - 2) At frequencies over 60 Hz.
- C. Operational Features:
- 1. Insensitive to input phase sequence.
  - 2. Continued operation with momentary voltage dips of 25% of rated voltage, or single phase condition: 4 seconds, minimum.
  - 3. Controls power loss ride-through: 500 MSEC, minimum.
  - 4. Electronic reversing.
  - 5. DC injection braking.

6. Anti-windmilling: Synchronization of VFD starting frequency with spinning or coasting load, forward or reverse.
  7. Critical frequency band lockout:
    - a. Minimum of three settings.
    - b. Adjustable bandwidth, 1 - 5 Hz.
  8. Capable of operating without the motor connected for start-up and troubleshooting.
- D. The VFD shall be provided with the following minimum user-programmable parameters:
1. Carrier frequency.
  2. Independent maximum and minimum speeds for forward and reverse operation.
  3. Start frequency and hold time.
  4. Independent linear acceleration and deceleration time.
  5. Preset "jog" speed.
  6. Three critical frequency bands.
  7. One preset speed selectable by logic input.
  8. Volts/Hertz ratio.
  9. Voltage boost, magnitude and frequency range.
  10. Process controller gain, offset and bias.
  11. Current limit.
  12. Overcurrent pickup.
  13. Overcurrent delay.
  14. Ground fault pickup.
  15. DC injection level and time.
- E. The VFD shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:
1. General:
    - a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the VFD-motor system shall be provided with automatic reset, with shutdown cause logged in memory:
      - 1) Input under voltage.
      - 2) Input over voltage.
      - 3) Input under frequency.
      - 4) Input over frequency.
      - 5) Input Phase loss.
      - 6) DC Bus under voltage.
    - b. Shutdown conditions which indicate overload or fault within the VFD, the output circuit, or the motor shall require local manual reset at the VFD, requiring operator intervention.
      - 1) Over temperature.
      - 2) Blown fuse.
      - 3) Component failure.
      - 4) Overload.
      - 5) Short circuit.
      - 6) Ground fault.
      - 7) DC Bus over voltage.
      - 8) External safety input (e.g., motor thermal protection).
      - 9) Logic fault.
    - c. When automatic shutdown occurs, VFD shall restart immediately upon reset, whether automatic or manual.

- d. VFD shall hold cause of trip data for a minimum of four shutdowns in memory.
  - 1) Data to be accessible through the keypad, local communication link and remotely.
- 2. Input protection:
  - a. Input circuit breaker or current-limiting fuses with externally operable disconnect.
    - 1) Fault current interrupting rating equal to or greater than the specified withstand rating of the VFD.
    - 2) Handle padlockable in the OFF position.
  - b. Provide full protection for semiconductors integral to the VFD; units requiring current-limiting fuses or circuit breakers in the supply circuit are not acceptable.
  - c. Incoming line transient suppression.
    - 1) 6000V peak per IEEE C62.41.
    - 2) Phase-to-phase and phase-to-ground protection.
  - d. Sustained over voltage trip.
- 3. Internal protection:
  - a. Surge suppression and power device snubbers.
  - b. Power devices rated at 2.5 times line voltage.
  - c. Instantaneous over current trip.
  - d. DC bus over voltage trip.
  - e. Power device over temperature trip.
  - f. Control logic circuit malfunction trip.
- 4. Output protection:
  - a. Inverse-time overload trip:
    - 1) UL Class 10 characteristic.
  - b. Over voltage trip.
  - c. Over frequency trip.
  - d. Short circuit trip.
    - 1) Line to line and line to ground.
  - e. Ground fault trip.

## **2.4 OPERATOR AND REMOTE CONTROL INTERFACE**

- A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
  - 1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.
- B. Control circuits shall be 120 VAC or 24 VAC or 24 VDC. Coordination with all components provided shall be indicated on provided submittals.
  - 1. 120 VAC supplied by CPT in the VFD.
    - a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
    - b. CPT shall have two fuses on the primary side and one fuse on the secondary side.
    - c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.
  - 2. 24 VAC or 24 VDC supplied by Class 2 power supply in the VFD.
    - a. Power supply shall have minimum additional capacity of 33% greater than that required by control devices.
    - b. Provide two current-limiting fuses on the AC supply to the power supply.
    - c. Power supply shall have surge protection on the primary side independent of any other surge protection in the VFD.

C. Operator Interface:

1. Door mounted sealed keypad, membrane type with LED or LCD display.
  - a. Messages shall be in English and engineering units.
  - b. Drive operating parameters shall be programmable.
  - c. Menu driven.
  - d. Password security.
  - e. Display fault and diagnostic data.
  - f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
  - g. Gold plated plug-in contacts.
  - h. Weather protective cover over HMI display.
2. Provide indication and control interface, integral in the keypad, as required in the sequence of operation and Drawings.
  - a. Minimum indications:
    - 1) Run.
    - 2) Stop.
    - 3) Ready.
    - 4) Alarm.
    - 5) Fault.
    - 6) Local control.
    - 7) Remote control.
    - 8) Control source local.
    - 9) Control source remote.
    - 10) Speed indication.
  - b. Minimum control functions:
    - 1) Local/Remote switch.
    - 2) Stop button.
    - 3) Start button.
    - 4) Reset button.
    - 5) Speed control buttons.
3. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.
  - a. On occurrence of more than one condition, each shall be recorded or indicated by the diagnostics.

D. Remote Control Interface:

1. Local portable computer interface via RS232/RS242 serial communications port:
  - a. Capability to:
    - 1) Start-Stop VFD.
    - 2) Control VFD Speed.
    - 3) Access fault and diagnostic data.
2. Contacts:
  - a. Contacts shall be rated 2 A inductive at 120 VAC.
  - b. All contacts shall be wired to field wiring terminal boards.
3. Drive shutdown on external fault input:
  - a. Provide isolated input for dry contact from external motor or system safety devices to cause immediate shutdown of VFD.

- b. Safety shutdown to be operable in all operating modes of drive, including local operation from keypad.
- 4. Network communications capability:
  - a. Provide VFD with capability for future communication card, protocol and required programming for digital communication of all VFD program and operational parameters to plant control system via:
    - 1) Ethernet IP.

## 2.5 PILOT DEVICES

### A. MANUFACTURERS

- 1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 2. Pilot devices, relays, contactors, and termination equipment:
  - a. Allen-Bradley by Rockwell Automation, Inc.
  - b. Phoenix Contact.
  - c. Siemens Corporation.

### B. PILOT DEVICES

- 1. General Requirements:
  - a. Standards: NEMA ICS 5, UL 508.
  - b. Heavy-duty NEMA 4/13 watertight/oiltight.
  - c. Heavy-duty NEMA 4/4X corrosion resistant.
  - d. Mounting hole: 30.5 MM.
  - e. Contact blocks: 10 amp, NEMA A600 rated, number as required to fulfill functions shown or specified.
  - f. Legend plate.
- 2. Selector Switches:
  - a. Two, three- or four-position rotary switch as required to fulfill functions shown or specified.
  - b. Maintained contact type.
  - c. Knob or lever type operators.
  - d. Pushbuttons:
    - e. Non-illuminated type:
      - 1) Protective boot.
      - 2) Momentary contact.
      - 3) Standard flush and mushroom operators.
      - 4) Black colored buttons for START or ON and red color for STOP or OFF.
- 3. Indicating Lights:
  - a. Allowing replacement of bulb without removal from control panel.
  - b. Lamp: LED, 120 V or 24 V as required.
  - c. Full voltage type.
  - d. Push-to-test indicating lights.
  - e. Plastic lens.
  - f. Color code lights as follows:
    - 1) Green: OFF or stopped.
    - 2) Amber: Alarm or fault.
    - 3) Red: ON or running.

## 2.6 HARMONIC PROTECTION REQUIREMENTS

- A. All VFDs shall be capable of satisfactory operation from a source having voltage distortion and notch characteristics identified as acceptable for a “dedicated system” in IEEE 519 Table 10.2.
- B. With all VFDs operating under worst-case harmonic current conditions, and the facility supplied from either or both the utility and generator sources, the VFDs shall not produce harmonic effects in excess of the following limits at any point of common coupling (PCC).
  - 1. Voltage distortion and notch characteristics: IEEE 519 Table 10.2 for General System.
  - 2. Current distortion: IEEE 519 Table 10.3 based on  $I_{sc}/I_L < 20$ .
- C. VFD manufacturer shall determine, for their proposed equipment, uncorrected harmonic distortion levels and mitigation techniques required to meet the specified limits and shall furnish the VFD types and all accessory items and equipment necessary to do so, whether specified herein or not.

## 2.7 MOTOR PROTECTION REQUIREMENTS

- A. The VFD shall produce a quality of output waveform adequate to allow the motor to produce rated torque at rated RPM continuously without exceeding the temperature rise given in NEMA MG 1 Table 31-2.
- B. Provide motor overload, short circuit and ground fault protection integral to drive electronics.
- C. The VFD shall not produce voltage spikes in excess of the following values at the motor terminals when operated with the feeder types shown on the Drawings and the actual installed feeder lengths.
  - 1. If unmitigated voltage peaks exceed the specified limits, provide output line reactors, filters, or other devices as required to meet the specified limits:
    - a. Inverter duty motors: 1280 V.
    - b. Rise time shall be greater than or equal to 0.1 microsecond.

## 2.8 EQUIPMENT CONSTRUCTION

- A. Fabrication and Assembly:
  - 1. Each VFD system shall be factory-assembled in an enclosure for remote mounting, and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.
    - a. Factory assembly shall be performed by the VFD manufacturer or authorized agent.
    - b. Systems fabricated or assembled in whole or in part by parties other than the VFD manufacturer or authorized agent will not be acceptable.
  - 2. Reactors and/or filters, where required, shall be mounted within enclosure.
  - 3. Cooling fans, as required, shall be provided to run when drive is running.
  - 4. Enclosures for separately mounted VFD's:
    - a. NEMA Type 4X stainless steel for installations in wet, damp or outdoor areas.
      - 1) Provide enclosure cooling if required to not exceed drive temperature ratings.
- B. Wiring:
  - 1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire ways are not practical.
    - a. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base.
    - b. Bases with a self-sticking back will not be allowed.
  - 2. All plug-in contacts shall be gold-plated.
  - 3. Provide terminal boards for all field wiring and inter-unit connections, including analog signals.

- a. Provide terminals for shield continuity where required.
  - 4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
    - a. Non-brittle, interlocking, track-mounted type.
    - b. Screw terminals will not be allowed.
    - c. A terminal for each conductor of external circuits plus one ground for each shielded cable.
    - d. For free-standing panels, 8 inches of clearance shall be provided between terminals and the panel base for conduit and wiring space.
    - e. Not less than 25% spare terminals shall be provided.
    - f. Terminals shall be labeled to agree with identification indicated on the suppliers submittal drawings.
    - g. Individually fuse each control loop or system and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
  - 5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal.
    - a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
  - 6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coded.
    - a. Markings or color code shall match the manufacturer's drawings.
  - 7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connections shall be stranded copper, type MTW or SIS, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.
- C. Nameplates:
- 1. All devices mounted on the face of the drive shall be provided with a suitable nameplate.
  - 2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.
  - 3. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.
- D. Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at least one (1) coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

## 2.9 COMPONENTS AND ACCESSORIES

- A. Reactors:
- 1. Impedance: As required.
  - 2. Continuous current: Not less than drive rating.
  - 3. Current overload: 150% for 1 minute.
  - 4. Insulation temperature rating: 180 degrees C.
  - 5. Copper windings.
  - 6. Saturation current rating: 3.5 to 5 times rated current.
  - 7. Hi-potential rating: 2500 VAC line to ground and line to line, for 1 minute.
  - 8. Noise reduction features:
    - a. Epoxy over cast coil.
    - b. Extra dips and bakes of varnish over continuous wound coil.

## 2.10 SOURCE QUALITY CONTROL

- A. Factory Tests:

1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.

## **2.11 MAINTENANCE MATERIALS**

- A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).
- B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.
- B. Provide separately mounted VFD enclosure with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
  1. Determine the SCCR rating by one of the following methods:
    - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
    - b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
    - c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
  2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
  3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.
- C. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.
- D. Provide services of manufacturer's representative to perform start-up services.
- E. The selection of input and output harmonic and voltage spike protection shall also be made on the available physical space.
  1. The space available on the Drawings shall not be exceeded.

### **3.2 START UP**

- A. Pre-start-up Services:
  1. Shall consist of:
    - a. Physical and electrical installation check.
    - b. Final adjustments and calibration of drive parameters.
    - c. VFD operation from simulated input signals.
  2. Shall be complete when VFD(s) are fully operational.
- B. Instruct Owner's designated personnel:
  1. Minimum of 4 hours at the jobsite.
  2. Instructions shall include proper operation and maintenance procedures including, but not limited to:
    - a. Lubrication.
    - b. Troubleshooting.
    - c. Repair and replacement.
    - d. Parts inventory.
    - e. Maintenance records.

**SECTION 46 41 34**  
**VERTICAL TURBINE FLOCCULATOR EQUIPMENT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Mixers as indicated:
    - a. Flocculation mixers.
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 01 - General Requirements.
  - 2. Section 03 15 19 – Anchorage to Concrete.
  - 3. Section 26 29 23 – Variable Frequency Drives – Low Voltage
  - 4. Section 10 14 00 – Identification Devices.
- C. Referenced Standards:
  - 1. American Bearing Manufacturers Association (ABMA):
    - a. Standard 9, Load Ratings and Fatigue Life for Ball Bearings
    - b. Standard 11, Load Ratings and Fatigue Life for Roller Bearings.
  - 2. American Gear Manufacturers Association (AGMA):
    - a. 2000-A88, Gear Classification and Inspection Handbook - Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
  - 3. American Iron and Steel Institute (AISI).

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Bearing Manufacturers Association (ABMA):
    - a. 9, Load Ratings and Fatigue Life for Ball Bearings
    - b. 11, Load Ratings and Fatigue Life for Roller Bearings.
  - 2. American Gear Manufacturers Association (AGMA):
    - a. 2000-A88, Gear Classification and Inspection Handbook - Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
  - 3. American Iron and Steel Institute (AISI).

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. See Section 01 61 03
  - 3. Product technical data:
    - a. Make, model, and weight of each major item of equipment.
    - b. Complete drawings and descriptive literature on the equipment and any exceptions to the Specifications.
    - c. List of recommended spare parts.
    - d. Provide calculations supporting all shaft and impeller design criteria (stresses and critical speed).
    - e. Submit all loadings, torques, and forces imposed by operating equipment.
    - f. Pumping capacity and water horsepower at delivered power.
    - g. Impeller power consumption, side loads, and pumping characteristics.
    - h. Complete motor nameplate data.

- B. Operation and Maintenance Manuals:
  - 1. Include two Operation and Maintenance manuals for each unique piece of equipment installed.
    - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Field Services Inspection Report and Certifications
- D. Warranty Information

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- A. See Section 01 65 00 & Section 01 66 00
- B. Equipment shall be stored and protected in accordance with the manufacturer's recommendations.

#### **1.5 WARRANTY**

- A. Provide manufacturers' standard two-year warranty from Owner/Engineer acceptance.

### **PART 2 - PRODUCTS**

#### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Flocculators:
    - a. Mixtec
    - b. Ekato
    - c. Philadelphia
    - d. Lightnin
    - e. Pre-approved equal
- B. Submit request for substitution in accordance with Specification Section 01 62 00.

#### **2.2 PERFORMANCE AND DESIGN REQUIREMENTS**

- A. Basin 3 Flocculation mixers:
  - 1. Location: Flocculation Basin 3.
  - 2. Number of Stages in Basin 3: 3 stages
  - 3. Water flow rate: 3.9 to 11.7 MGD per basin. Average Daily Flow: 7.1 MGD
  - 4. Water Volume per Stage: 165,063 gallons
  - 5. Velocity gradient (G) for flocculation mixers: The mixer shall meet the following velocity gradients and the range between them:
    - a. 60 Seconds-1 at design water temperature.
    - b. 20 Seconds-1 at design water temperature.
  - 6. Design speed (Maximum): 24 rpm.
  - 7. Design Impeller Tip Speed (Maximum): 10 ft/s
  - 8. Impeller Type: Hydrofoil
  - 9. Shaft Length: Per the Manufacturer's recommendation
  - 10. Direction of Rotation: Refer to Asbuilts.
  - 11. Distance from water surface to top of structure: Refer to Asbuilts; Field Verify.
  - 12. Mixer configuration: Vertical mounted above flocculation basin. Refer to Asbuilts.
  - 13. Mixer flow direction relative to mixer shaft: Axial, upward; or per manufacturer's recommendations.
  - 14. Number of impellers per mixer: 1.
  - 15. Motor size: 5 HP
  - 16. Drive type: Variable speed
  - 17. Motor speed: 1,200 or 1,800 rpm.

- B. Mixers will be installed in basins with dimensions as shown on the Drawings.
- C. Mixing units will be mixing raw water with alum solution. Water characteristics are as follows:
  - 1. Fluid temperature range: 10 to 38°C.
  - 2. Fluid pH range: 6 to 8.
  - 3. Design water temperature: 22°C.

### 2.3 MATERIALS

- A. Mixer Housings: Fabricated steel or cast iron.
- B. Impeller Shaft: Stainless steel, AISI Type 316.
- C. Impeller: Stainless steel, AISI Type 316.
- D. Miscellaneous wetted parts: Stainless steel, AISI Type 316.
- E. Bolts, nuts, and connection accessories: AISI Type 316 stainless steel.
- F. Anchor bolts and hardware: Per Section 03 15 19.

### 2.4 FABRICATION AND MECHANICAL REQUIREMENTS – FLOCCULATORS

- A. Gear Box:
  - 1. Designed and rated per AGMA standards with AGMA nameplate.
  - 2. Type:
    - a. Right angle or Parallel gear drive.
      - 1) Right Angle drives will require a support pedestal.
    - b. Hollow quill-type output shaft
    - c. Combination helical, spiral bevel, and pinion drive gears.
    - d. Totally enclosed.
    - e. Worm gears not acceptable.
  - 3. Service factor: 2.0 of nameplate on motor.
  - 4. Gearing: AGMA quality number 10 or better ANSI/AGMA 2000-A88.
  - 5. Bearing design:
    - a. Antifriction type, ball or roller, oil or grease lubricated.
    - b. All shaft bearings located outside of tankage.
    - c. All bearings minimum ABMA L-10 life of 100,000 HRS at full motor nameplate HP at design speed.
  - 6. Lifting lugs: provide as required to support entire unit weight during lifting.
  - 7. Lubrication:
    - a. NSF 61 food-grade oil or grease lubricated.
    - b. Positive lubrication of all gears and bearings.
    - c. Maintain recommended thermal rating of reducer. Provide cooling system and oil pumps if required.
    - d. Dipstick oil level indicators or sight glass.
    - e. Adequate separation between oil and grease lubricated parts.
    - f. Oil breather located above possible oil foam level.
  - 8. Lubricating provisions:
    - a. Oil drain.
    - b. Grease fittings protected by removable neoprene cover and easily accessible.
    - c. Greased bearings with seal to retain grease.
  - 9. Reducer agitator and output shaft and impeller shaft.
    - a. Agitator shaft with easily accessible coupling.
    - b. Maximum indicated runout at lower end of impeller shaft not to exceed 1/8 IN for every 10 FT of overhang as measured when turning by hand.

- c. Maximum stress: 8,000 psi at maximum load.
  - d. Full load noise level not to exceed 85 dB at 3 FT from any part of the drive assembly.
- B. Impeller:
- 1. Axial flow hydrofoil high efficiency design.
  - 2. 3-blade design
  - 3. Design impeller tip speed (Maximum): 10 ft/s
  - 4. Design impeller diameter versus tank/effective tank (D/T) ratio shall be 0.2 or greater D/T.
  - 5. Dynamically and hydraulically stable.
  - 6. Blades bolted to hub, impeller hook keyed to impeller shaft.
  - 7. Maximum stress on impeller component not to exceed 11,000 psi under maximum operation load.
  - 8. Use of stabilizing rings or fins will not influence stress limitations specified.
  - 9. Shaft impeller system design: operating speed does not exceed 70 percent of its first critical speed.
- C. Shaft Coupling:
- 1. The mounting arrangement shall be a raised baseplate design which places the rigid coupling above the mounting deck with sufficient space to bolt the coupling together during installation and removal.
  - 2. Designed to transmit 200 percent of full torque and 150 percent of axial load.
  - 3. Located outside tankage.
  - 4. No match marks required for alignment.
- D. Motor:
- 1. 460 V, 3 PH, 60 HZ
  - 2. TEFC, C-face, constant torque, inverter duty rated with a minimum 10:1 turndown
  - 3. See Section 01 61 03.
- E. Support Pedestal:
- 1. Provide cast iron or fabricated steel pedestal support for gear reducer and motor assembly as required by manufacturer and as needed for installation. Support shall be designed for all loads appropriate for the seismic zone in which the project is located.
  - 2. Right angle drives shall be installed with a support pedestal under motor for support.

## 2.5 MAINTENANCE MATERIALS

- A. Special tools:
- 1. Furnish all special tools required for normal maintenance.
- B. Furnish the following extra parts for each style of flocculator:
- 1. One full set of bearings, seals, gaskets, and O-rings for each unit.

## 2.6 SOURCE QUALITY CONTROL

- A. Mixers shall be given manufacturer's standard quality control inspections and tests to ensure the quality of materials used in the manufacture of the units and workmanship conform to the specified requirements and highest industry practice, the units operate properly, and the units have been correctly and adequately prepared for shipment, long term site storage and initial operation.

## 2.7 COATINGS

- A. Coating: (non-stainless steel and non-aluminum metal surfaces)
- 1. Field painted equipment: Per manufacturer's factory applied primer/field paint compatibility requirements.
- B. For non-stainless steel and non-aluminum metal surfaces, prepare, prime, and finish coat in accordance with manufacturer's recommendations.
- C. Stainless steel, aluminum, packing glands, flexible connectors, and mechanical mating and bearing surfaces shall not be primed or painted.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Manufacturer's field services.
  - 1. Provide services of manufacturer's field representative.
  - 2. Field representative to:
    - a. Be present during installation and alignment of equipment.
    - b. Inspect and verify equipment properly installed as specified and per manufacturer's recommendations. Perform modifications as necessary.
    - c. Direct initial startup and instruct plant personnel in proper operation and maintenance of equipment.
    - d. Preside at field test of equipment.
    - e. Instruct Owner's personnel in operation and maintenance of equipment.
    - f. Submit a certification of proper installation and satisfactory performance.
    - g. Provide field representative for a minimum of two days for equipment startup.

### **3.2 FIELD QUALITY CONTROL**

- A. Operating checks.
  - 1. Pre-operation checks.
    - a. Impeller shaft alignment.
    - b. Speed reducer – bearing lubrication.
    - c. Impeller rotation.
    - d. Motor shaft – input shaft alignment.
    - e. Water level.
    - f. Ensure mixing chambers/tanks are clear of debris which could damage the impellers.
  - 2. Post-operation checks.
    - a. Check bearing temp against manufacturer's recommendation.
    - b. Check for motor overload.
    - c. Check shaft alignment.
      - 1) Test impeller shaft by hand turn operation.
      - 2) Deflection: Not to exceed 1/8 IN per 10 FT of length.
    - d. Check vibration.
      - 1) Test gearbox unit for vibration when operated by motor.
      - 2) Maximum allowable deflection: 5 mils anywhere on motor or speed reducer.

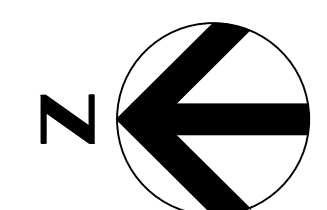
### **3.3 START-UP AND OPERATOR TRAINING**

Manufacturer's Field Service Representative shall be present at the job site for a minimum of two days, travel time excluded, for installation assistance, functional testing, and certification of the installation, and shall provide a field services/inspection report to be submitted to the Owner.

**END OF SECTION**

**ATTACHMENT A:**  
**E.M. STICKNEY WATER TREATMENT PLANT**  
**ELECTRICAL UPGRADE DRAWINGS – FLOCCULATOR BASIN 3**



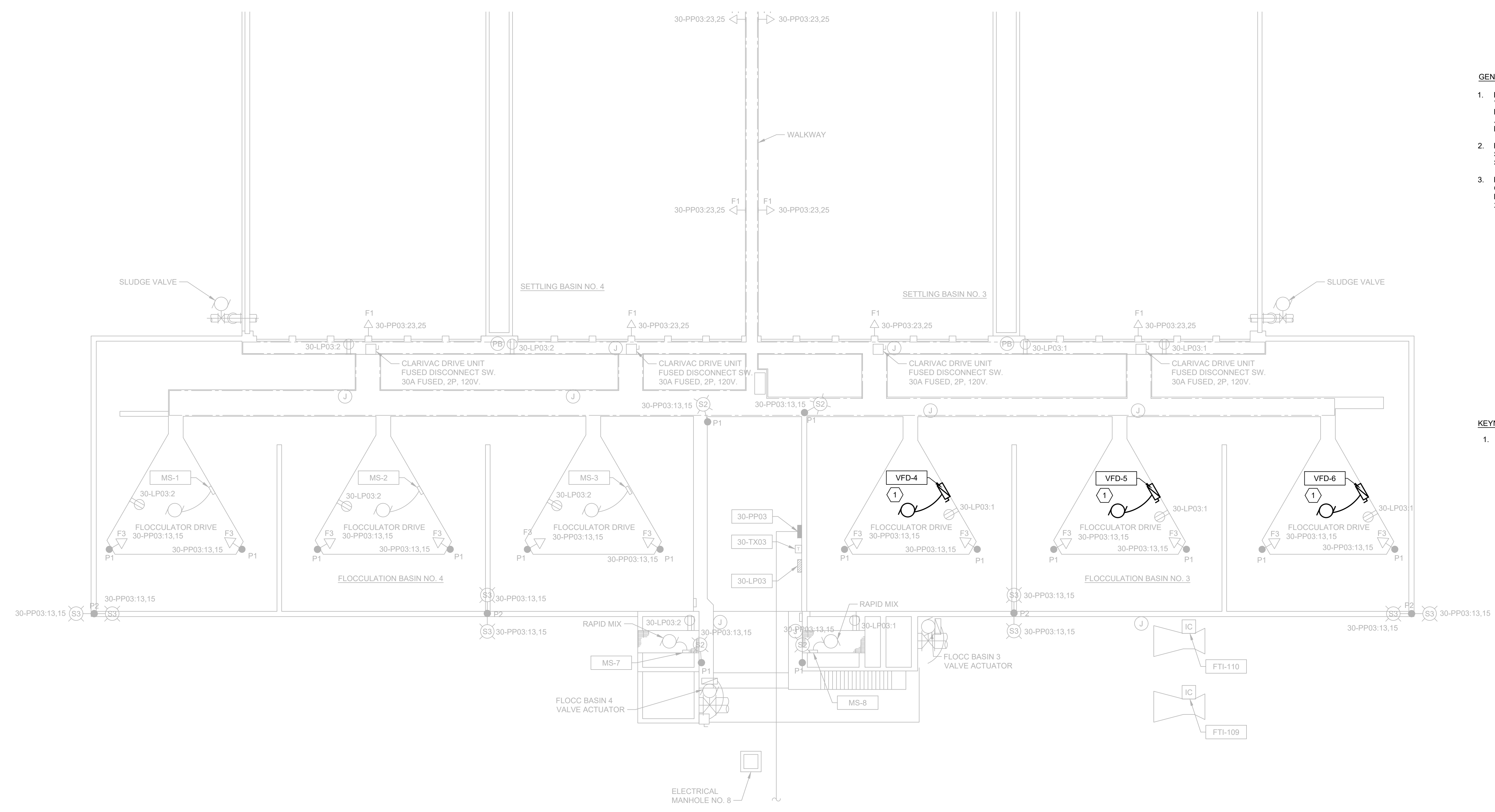


**GENERAL NOTES:**

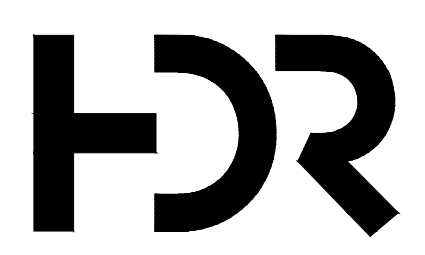
- EXISTING EXPOSED CONDUIT CAN BE RE-USED IF VERIFIED THAT IT IS IN GOOD CONDITION, NOT BROKEN, NOT CORRODED, AND ADEQUATE SIZED AS SHOWN ON THE DRAWINGS AND AS REQUIRED BY NEC.
- FOR CIRCUIT INFORMATION SEE PANEL SCHEDULES ON FLOCCULATOR PANELBOARD SHEET.
- IF REQUIRED, INSTALL TRIP HAZARD REDUCING CONDUIT COVERS FOR WALKWAY PLATFORM MOUNTED CONDUITS PER SPECIFICATION SECTION 26 05 33.

**KEYNOTES** #

- PREVIOUSLY INSTALLED CONDUIT AND CIRCUIT TO 30-PP03 CAN BE REUSED IF FOUND TO BE OF ADEQUATE LENGTH AND IN GOOD CONDITION. DEMOLISH EXISTING CONTROL PANELS AS NEEDED.



Puckett, Tyler  
6/19/2025 2:01 PM



DESIGNED BY	QC	
DRAWN BY		
PROJECT NUMBER		
ISSUE	DATE	DESCRIPTION
1	06/2025	

PROJECT MANAGER	
DESIGNED BY	
QC	
DRAWN BY	
PROJECT NUMBER	

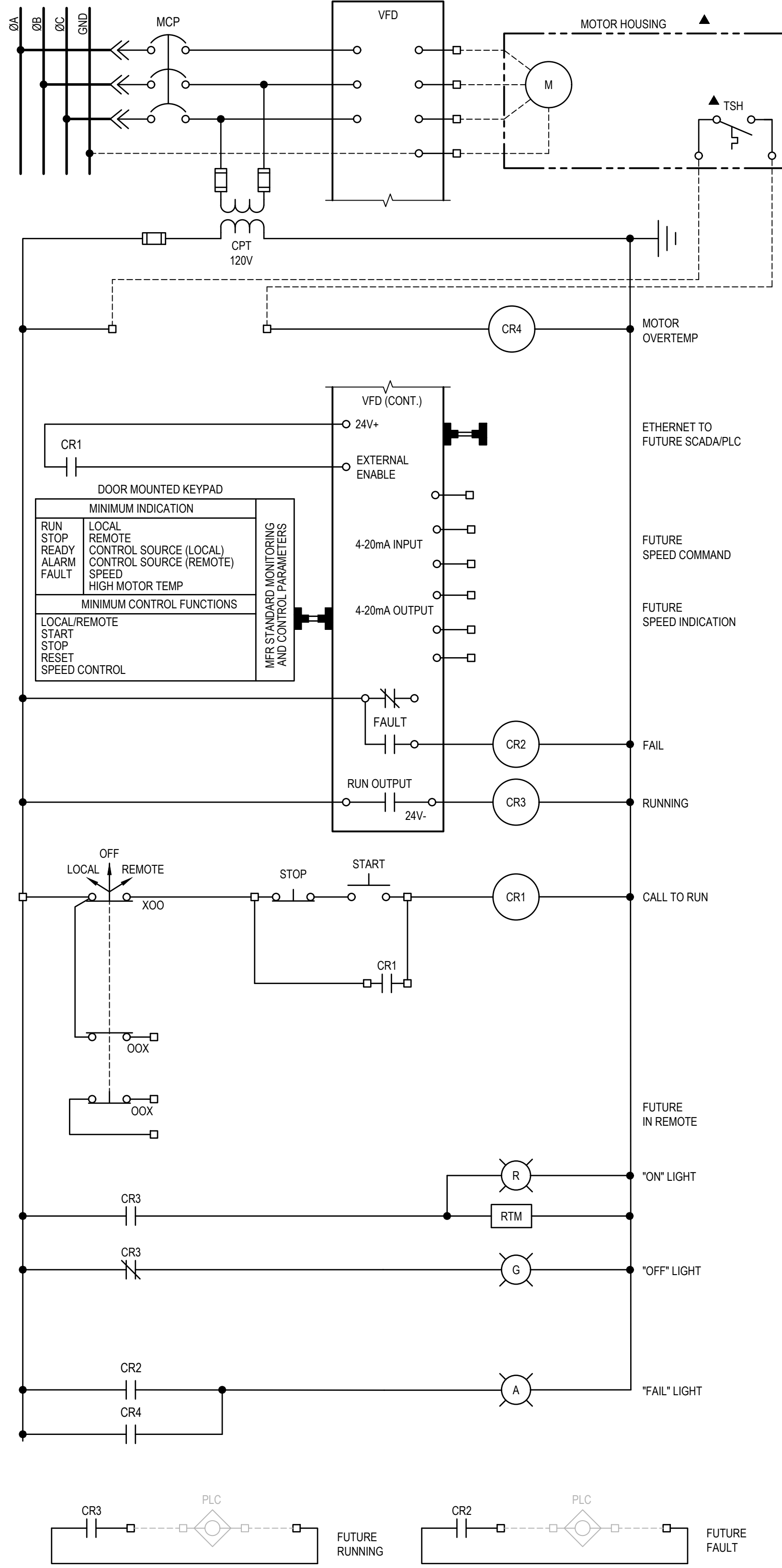


**FLOCCULATORS NO. 3 & NO. 4 ELECTRICAL PLAN**



FILENAME | Plan.dwg  
SCALE | 3/32" = 1'-0"

SHEET  
**Plan**



**LEGEND:**

- ▲ LOCATED IN FIELD
- TERMINAL
- FIELD WIRING

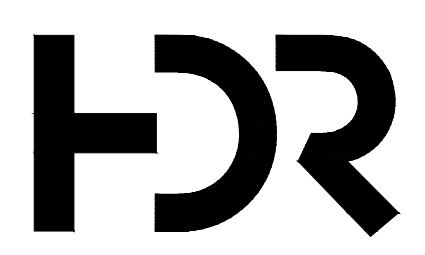
**GENERAL NOTES:**

1. DEVICES AND CONTACTS SHOWN IN UNPOWERED STATE.
2. VFD PANEL TO BE CONFIGURED FOR LOCAL CONTROL ONLY WITH CAPABILITIES FOR FUTURE CONNECTION TO SCADA/PLC.
3. VFD SHALL BE ULTRA-LOW HARMONIC.
4. VFD PANEL SHALL HAVE DISCONNECT CAPABLE OF INSTALLATION OF LOCK FOR LOCK-OUT CAPABILITIES.
5. FINAL WIRING DIAGRAM TO BE COORDINATED WITH MANUFACTURER AND CONTROL VOLTAGE SELECTED.

**FLOCCULATOR CONTROL DIAGRAM**

1 SHOWN, TYPICAL FOR ALL

6/19/2025 2:01 PM Puckett, Tyler



ISSUE	DATE	DESCRIPTION
1	06/2025	

PROJECT MANAGER	
DESIGNED BY	
QC	
DRAWN BY	
PROJECT NUMBER	



**FLOCCULATOR SCHEMATIC DIAGRAMS**



FILENAME | VFD.dwg  
SCALE | NONE

SHEET  
**VFD**

**KEYNOTES** #

1. WIRE AND CONDUIT SHALL BE 3#10, #10G, 3/4".

**GENERAL NOTE:**

1. EXISTING EXPOSED CONDUIT CAN BE RE-USED IF VERIFIED THAT IT IS IN GOOD CONDITION, NOT BROKEN, NOT CORRODED, AND ADEQUATE SIZED AS SHOWN ON THE DRAWINGS AND AS REQUIRED BY NEC.

PANEL DESIGNATION: 30-PP01										SPD TYPE 3		LOCATION: EAST FLOCCULATORS 1 & 2									
VOLTAGE: 277/480V, 3PH, 4W, 35KAIC												MAIN: 200/3 MAIN CIRCUIT BREAKER									
AMPERES: 250												PANEL MOUNTING: SURFACE, NEMA 4X									
LOAD SERVED	CONNECTED LOAD (KVA)			CIRCUIT BREAKER		CKT NO.	SEE MAIN			CKT NO.	CIRCUIT BREAKER		CONNECTED LOAD (KVA)			LOAD SERVED					
	A	B	C	AMPS	POLES		POLES	AMPS	A		B	C									
BASIN #2 INFLUENT VALVE	0.58			20	3	1				2					SPARE						
		0.58				3				4	3	20									
			0.58			5				6											
TRANSFORMER 30-TX01	5.00			25	3	7				8											
		5.00				9				10	3	20			SPARE						
			5.00			11				12											
30-PP02	14.86			150	3	13				14			0.58		BASIN #1 INFLUENT VALVE						
		14.86				15				16	3	20		0.58							
			14.86			17				18				0.58							
SPARE				20	3	19				20					SPARE						
						21				22	3	20									
						23				24											
SPARE				20	3	25				26	2	20	3.46		FLOC & SET BASINS 1& 2 POLE LIGHTS						
						27				28			3.46								
						29				30	-	-			SPACE						
SPACE				-	-	31				32	-	-			SPACE						
SPACE				-	-	33				34	-	-			SPACE						
SPACE				-	-	35				36	-	-			SPACE						
SPACE				-	-	37				38	-	-			SPACE						
SPACE				-	-	39				40	-	-			SPACE						
SPACE				-	-	41				42	-	-			SPACE						
SUB-TOTAL			20.4	20.4	20.4					4.0			4.0	0.58	SUB-TOTAL						
L1: 24.5 KVA																TOTAL CONNECTED LOAD= 70 KVA					
L2: 24.5 KVA																FED FROM 20-MCC02					
L3: 21.0 KVA																					

PANEL DESIGNATION: 30-PP02										SPD TYPE 3		LOCATION: EAST FLOCCULATORS 1 & 2									
VOLTAGE: 277/480V, 3PH, 4W, 35KAIC												MAIN: MAIN LUGS ONLY									
AMPERES: 250												PANEL MOUNTING: SURFACE, NEMA 4X									
LOAD SERVED	CONNECTED LOAD (KVA)			CIRCUIT BREAKER		CKT NO.	SEE MAIN			CKT NO.	CIRCUIT BREAKER		CONNECTED LOAD (KVA)			LOAD SERVED					
	A	B	C	AMPS	POLES		POLES	AMPS	A		B	C									
BASIN #2 RAPID MIX	2.11			20	3	3				4	3	20	2.11		BASIN #1 RAPID MIX						
		2.11				5				6				2.11							
			2.11			7				8				2.11							
FLOC 2-1	1.33			20	3	9				10	3	20	1.33		FLOC 1-1						
		1.33				11				12				1.33							
			1.33			13				14			1.33		FLOC 1-2						
FLOC 2-2	1.33			20	3	15				16	3	20	1.33		FLOC 1-2						
		1.33				17				18				1.33							
			1.33			19				20			1.33		FLOC 1-4						
FLOC 2-3	1.33			20	3	21				22	3	20	1.33		FLOC 1-4						
		1.33				23				24				1.33							
			1.33			25				26			1.33		FLOC 1-3						
FLOC 2-4	1.33			20	3	27				28	3	20	1.33		FLOC 1-3						
		1.33				29				30				1.33							
SPACE				-	-	31				32	-	-			SPACE						
SPACE				-	-	33				34	-	-			SPACE						
SPACE				-	-	35				36	-	-			SPACE						
SPACE				-	-	37				38	-	-			SPACE						
SPACE				-	-	39				40	-	-			SPACE						
SPACE				-	-	41				42	-	-			SPACE						
SUB-TOTAL			7.4	7.4	7.4					7.4			7.4	7.4	SUB-TOTAL						
L1: 14.9 KVA																TOTAL CONNECTED LOAD= 45 KVA					
L2: 14.9 KVA																FED FROM 30-PP01					
L3: 14.9 KVA																					

PANEL DESIGNATION: 30-LP01										SPD TYPE 3		LOCATION: EAST FLOCCULATORS 1 & 2									
VOLTAGE: 120/208V, 3PH, 4W, 10KAIC												MAIN: 60/3 MAIN CIRCUIT BREAKER									
AMPERES: 100												PANEL MOUNTING: SURFACE, NEMA 4X									
LOAD SERVED	CONNECTED LOAD (VA)			CIRCUIT BREAKER		CKT NO.	SEE MAIN			CKT NO.	CIRCUIT BREAKER		CONNECTED LOAD (VA)			LOAD SERVED					
	A	B	C	AMPS	POLES		POLES	AMPS	A		B	C									
SPARE				20	1	1				2	1	20			SPARE						
SPARE				20	1	3				4	1	20			SPARE						
SPARE				20	1	5				6	1	20			SPARE						
SPARE				20	1	7				8	1	20	500		CLARI-VAC W.						
SPARE				20	1	9				10	1	20	500	500	CLARI-VAC W.						
RECEPTACLE W.			1440	20	1	11				12	1	20		1500	SLUDGE VALVES E.						
CLARI-VAC W.	500			20	1	13				14	1	20	500		CLARI-VAC E.						
CLARI-VAC W.		500		20	1	15				16	1	20	500		CLARI-VAC E.						
SLUDGE VALVES W.			1500	20	1	17				18	1	20			SPACE						
CLARI-VAC E.	500			20	1	19				20	1	20			SPACE						
CLARI-VAC E.		500		20	1	21				22	1	20			SPACE						
RECEPTACLE E.			1440	20	1	23				24	-	-			SPACE						
SPACE				-	-	25				26	-	-			SPACE						
SPACE				-	-	27				28	-	-			SPACE						
SPACE				-	-	29				30	-	-			SPACE						
SUB-TOTAL			1000	1000	4380					1000			1000	1500	SUB-TOTAL						
L1: 2.0 KVA																TOTAL CONNECTED LOAD= 9.9 KVA					
L2: 2.0 KVA																FED FROM 30-PP01					
L3: 5.9 KVA																					

PANEL DESIGNATION: 30-PP03										SPD TYPE 3		LOCATION: WEST FLOCCULATORS 3 & 4									
VOLTAGE: 277/480V, 3PH, 4W, 35KAIC												MAIN: 200/3 MAIN CIRCUIT BREAKER									
AMPERES: 250												PANEL MOUNTING: SURFACE, 4X									
LOAD SERVED	CONNECTED LOAD (KVA)			CIRCUIT BREAKER		CKT NO.	SEE MAIN			CKT NO.	CIRCUIT BREAKER		CONNECTED LOAD (KVA)			LOAD SERVED					
	A	B	C	AMPS	POLES		POLES	AMPS	A		B	C									
XFMR 30-TX03	7.5			40	2	1				2			4.22		RAPID MIXER (WEST FLOC. BASINS)						
		7.5				3				4	3	40		4.22							
SPARE				20	1	5				6				4.22							
WEST FLOC NO. 3 FLOCCULATORS	2.02			30	3	7				8			1.33		WEST FLOC NO. 4 FLOCCULATORS						
		2.02				9				10	3	30		1.33							
			2.02			11				12				1.33							
FLOC BASIN 3&4 POLE LIGHTS	2.63			20	2	13				14			3.99		WEST FLOC NO. 4 INFLUENT VALVE						
		2.63				15				16	3	20		3.99							
			3.99			17				18				3.99							
FLOC NO. 3 (SOUTH) INFLUENT VALVE	3.99			20	3	19				20	-	-			SPACE						
		3.99				21				22	-	-			SPACE						
SED BASIN 3&4 FLOODLIGHTS	2.65			20	2	23				24	-	-			SPACE						
		2.65				25				26	-	-			SPACE						
SPACE				-	-	27				28	-	-			SPACE						
SPACE				-	-	29				30	-	-			SPACE						
SUB-TOTAL			16.2	16.2	8.7					9.5			9.5	9.5	SUB-TOTAL						
L1: 25.7 KVA																TOTAL CONNECTED LOAD= 67 KVA					
L2: 25.7 KVA																FED FROM 20-MCC02					
L3: 18.2 KVA																					

PANEL DESIGNATION: 30-LP03										SPD TYPE 3		LOCATION: WEST FLOCCULATORS 3 & 4									
VOLTAGE: 120/240V, 1PH, 3W, 10KAIC												MAIN: 80/2 MAIN CIRCUIT BREAKER									
AMPERES: 100												PANEL MOUNTING: SURFACE, NEMA 4X									
LOAD SERVED	CONNECTED LOAD (VA)		CIRCUIT BREAKER		CKT NO.	SEE MAIN			CKT NO.	CIRCUIT BREAKER		CONNECTED LOAD (VA)		LOAD SERVED							
	L1	L2	AMPS	POLES		POLES	AMPS	L1		L2											
FLOC BASIN 3 REC	1080		20	1	1				2	1	20	1080		FLOC BASIN 4 REC							
SPARE			20	1	3				4	1	20	500		RAW SAMPLER							
SPARE			20	1	5				6	1	20			SPACE							
SPARE			20	1	7				8	1	20			SPACE							
SPARE			20	1	9				10	1	20			SPACE							
SPARE			20	1	11				12	1	20			SPACE							
SPARE			20	1	13				14	1	20			SPACE							
NORTHWEST VALVE		1920	20	1	15				16	1	20			SPACE							
SPARE			20	1	17				18	1	20			SPACE							
SPARE			20	1	19				20	1	20	500		#9 CLARI-VAC							
SPARE			2																		

**ATTACHMENT B:**  
**E.M. STICKNEY WATER TREATMENT PLANT**  
**EXISTING SITE PHOTOS – FLOCCULATOR BASIN 3 & 4**



**PHOTOGRAPH 1: STICKNEY WTP – FLOCCULATOR BASINS 3 & 4**



**PHOTOGRAPH 2: EXISTING FLOCCULATOR TYPICAL INSTALLATION**

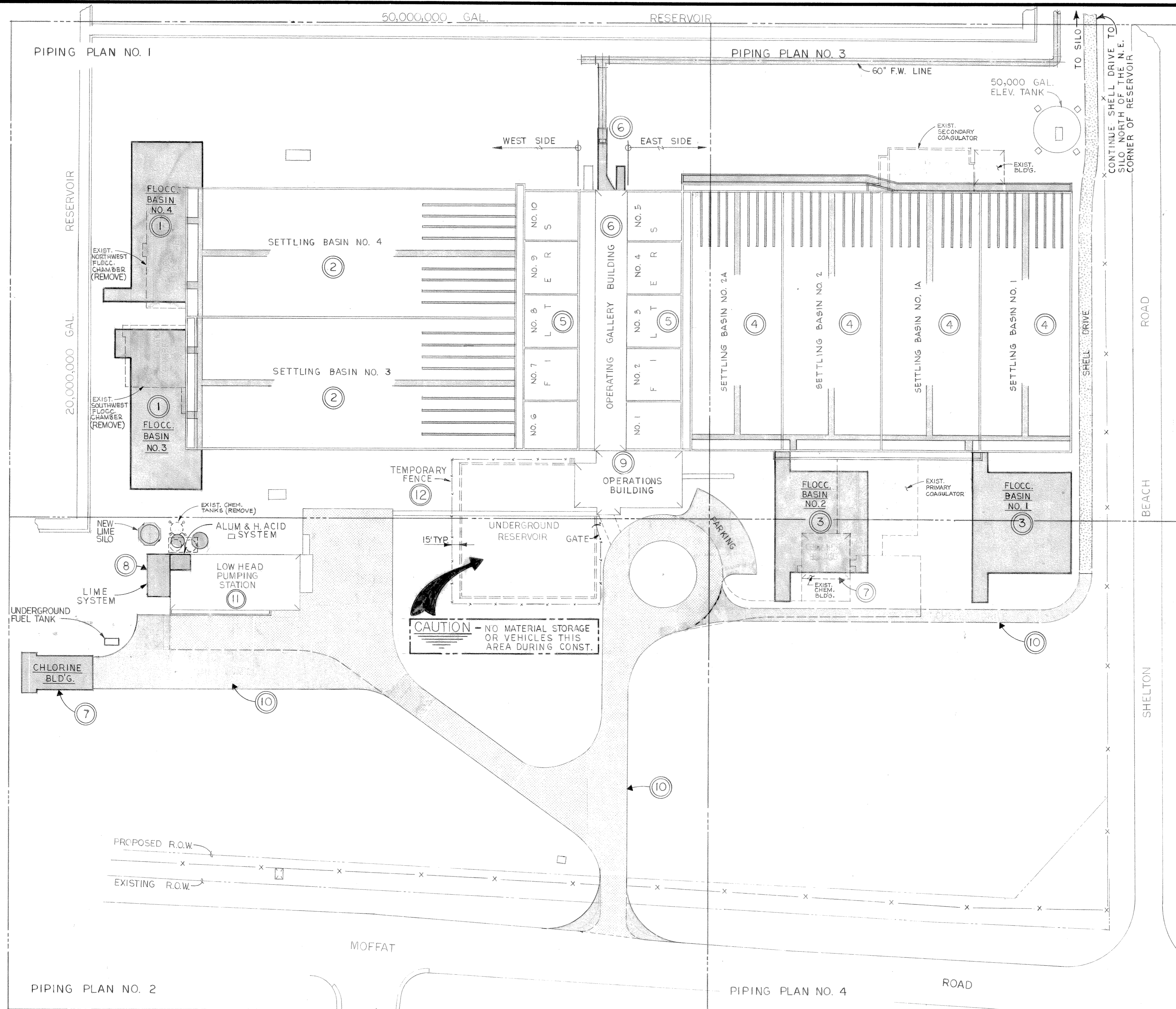


**PHOTOGRAPH 3: EXISTING FLOCCULATOR MOTOR AND GEAR REDUCER**



**PHOTOGRAPH 4: EXISTING FLOCCULATOR TYPICAL CONTROL PANEL**

**ATTACHMENT C:**  
**E.M. STICKNEY WATER TREATMENT PLANT**  
**ASBUILTS FOR FLOCCULATORS BASIN 3**



**GENERAL RENOVATIONS & ADDITIONS TO FILTER PLANT:**

(THE FOLLOWING ARE MAJOR ITEMS INCLUDED IN THIS WORK)

- ① WEST SIDE FLOCCULATORS - REMOVE EXISTING UNITS AND CONSTRUCT NEW BASINS NO. 3 & NO. 4.
- ② WEST SIDE SETTLING BASINS - BASIN MODIFICATIONS AND INSTALLATION OF SLUDGE REMOVAL SYSTEM.
- ③ EAST SIDE FLOCCULATORS - REMOVE EXISTING PRIMARY AND SECONDARY COAGULATORS AND CONSTRUCT NEW BASIN NO. 1 & NO. 2.
- ④ EAST SIDE SETTLING BASINS - BASIN MODIFICATIONS AND INSTALLATION OF SLUDGE REMOVAL SYSTEM.
- ⑤ FILTERS - REMOVAL AND REPLACEMENT OF EXISTING SAND MEDIA, FILTER AGITATORS, PUMPS, PIPING, AND WASH TROUGH.
- ⑥ FILTER OPERATING GALLERY - REMOVAL AND REPLACEMENT OF EXISTING PIPING, CONSTRUCT NEW FINISH AND WASTE WATER FLUMES. REMOVE EXISTING BUILDING AND REPLACE WITH WALKWAY CANOPY. INSTALL 60" FINISH WATER LINE.
- ⑦ CHLORINE BUILDING - CONSTRUCT NEW CHLORINE FEED AND STORAGE BUILDING, PROVIDE EQUIPMENT AND PIPING. REMOVE EXISTING CHLORINE SYSTEM ONCE NEW SYSTEM IS IN OPERATION.
- ⑧ LIME AND H. ACID FEED SYSTEMS - PROVIDE NEW LIME, ALUM AND H. ACID STORAGE TANKS, FEEDING SYSTEM AND PIPING. REMOVE EXISTING STORAGE TANKS AND FEED SYSTEM AFTER NEW SYSTEM IS IN OPERATION.
- ⑨ OPERATIONS BUILDING - RENOVATE INTERIOR & EXTERIOR. PROVIDE NEW LIGHTING, HEATING AND VENTILATION EQUIPMENT. PROVIDE NEW CENTRAL COMPUTER SYSTEM.
- ⑩ ROADWAYS - EXTEND AND RESURFACE ROADWAYS AND PARKING AREAS.
- YARD PIPING - CONSTRUCT NEW FORCE MAINS, DRAINS AND CHEMICAL FEED LINES. REMOVE OR ABANDON LINES AS REQUIRED.
- ELECTRICAL - PROVIDE NEW PLANT DISTRIBUTION SYSTEM, LIGHTING AND CONTROLS. PROVIDE NEW STAND-BY GENERATOR AND FUEL STORAGE TANK.
- ⑪ LOW HEAD PUMP STATION - REMOVE AND REPLACE 60" Ø SUCTION HEADER, 2 PUMPS & MOTORS, RENOVATE BUILDING AND INSTALL GENERATOR.
- ⑫ PROVIDE TEMPORARY 4 FT. HIGH FIELD FENCE WITH CREOSOTE POSTS @ 10 FT. SPACING. PROVIDE 10 FT. ACCESS GATE.

SEE PLANS AND SPECIFICATIONS FOR COMPLETE DETAILS OF ABOVE ITEMS AND OTHER ITEMS OF WORK.

**LEGEND:**

	NEW WORK (THIS PROJECT)
	OVERLAY EXIST. CONC. ROADWAY WITH ASPHALT
	NEW ASPHALT PAVING
	NEW SHELL DRIVE

FINAL CHECKED BY CLASS AS CONSTRUCTION  
 NAME: A.B. DATE: 4-1-81

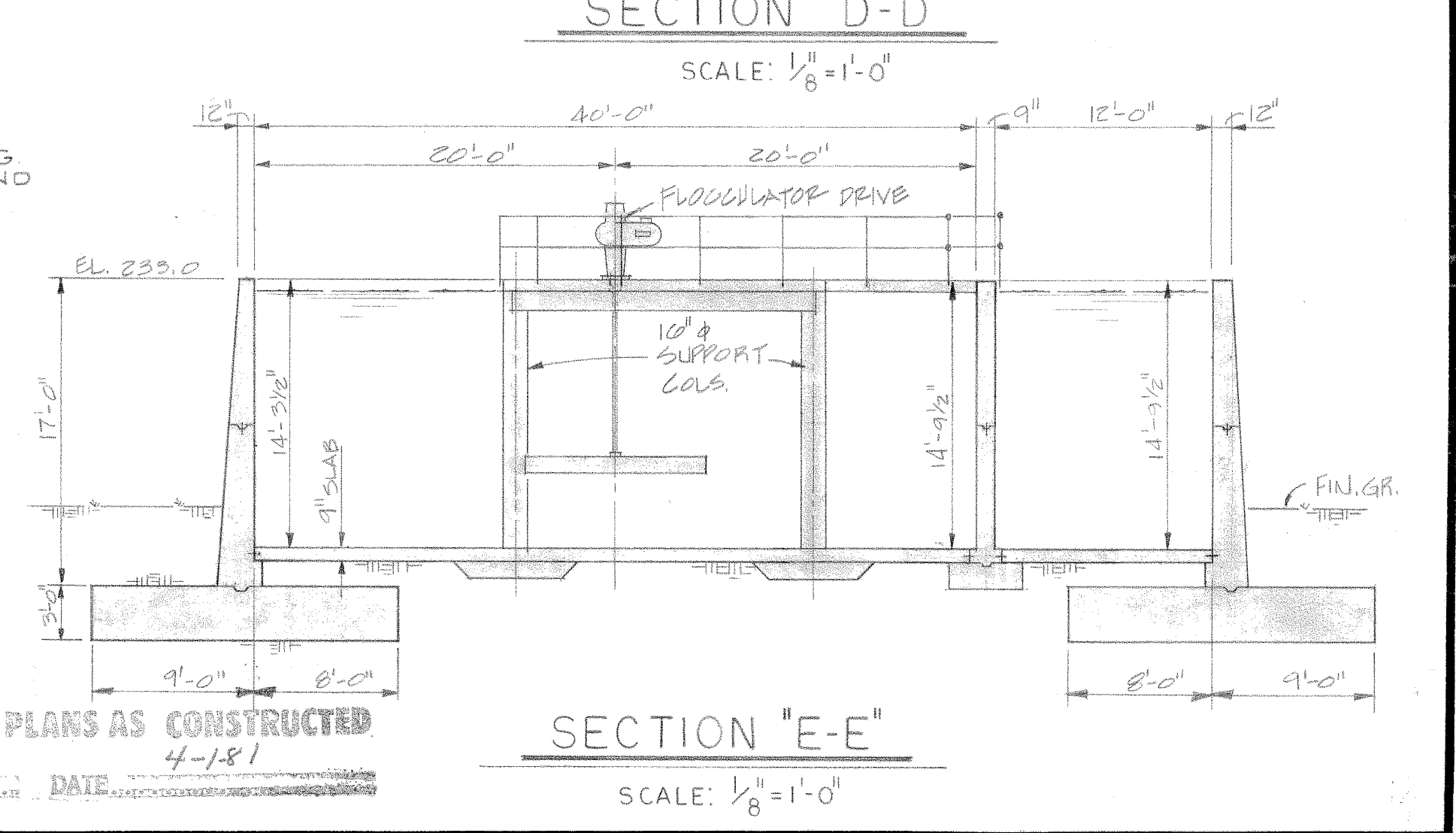
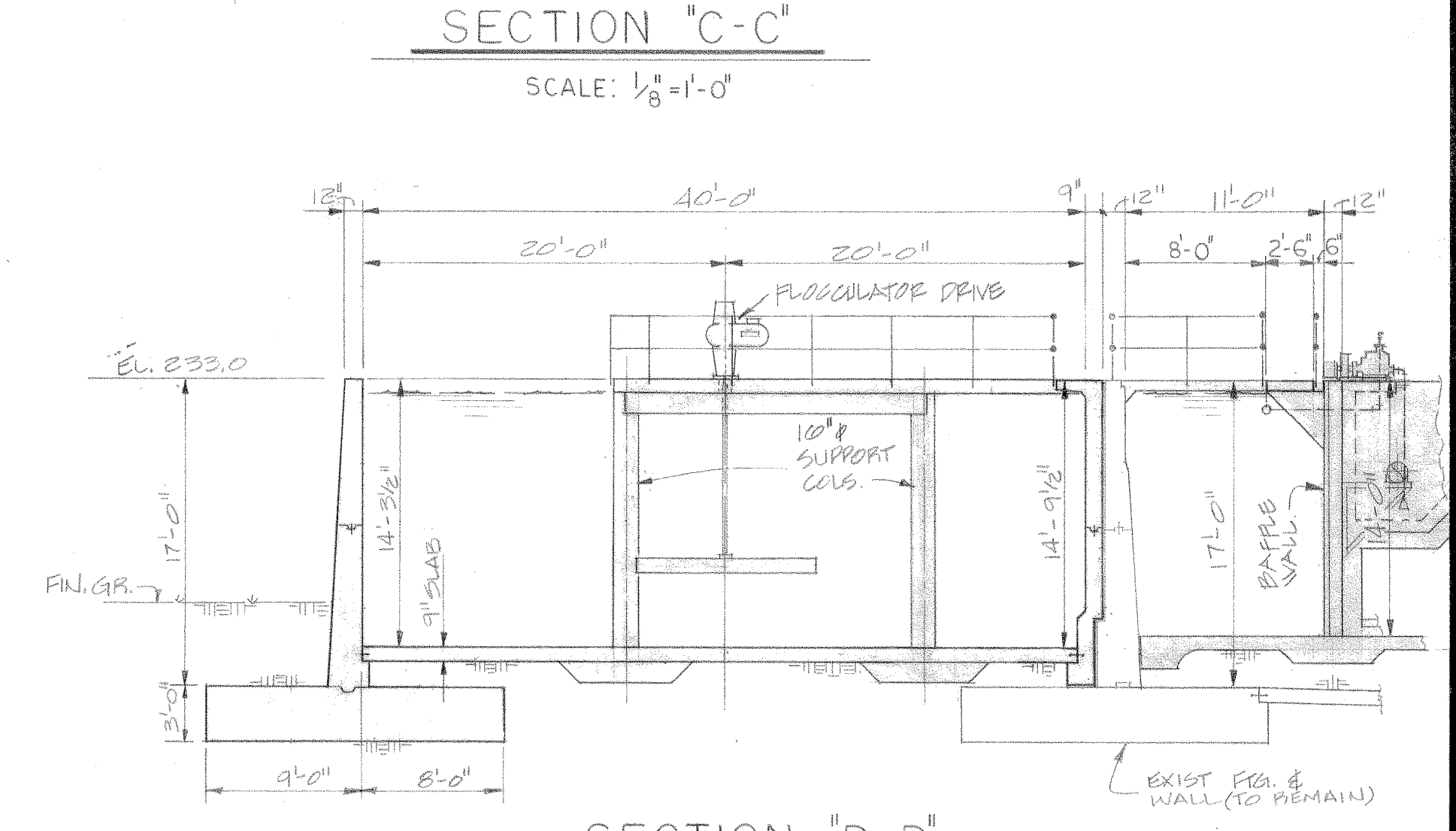
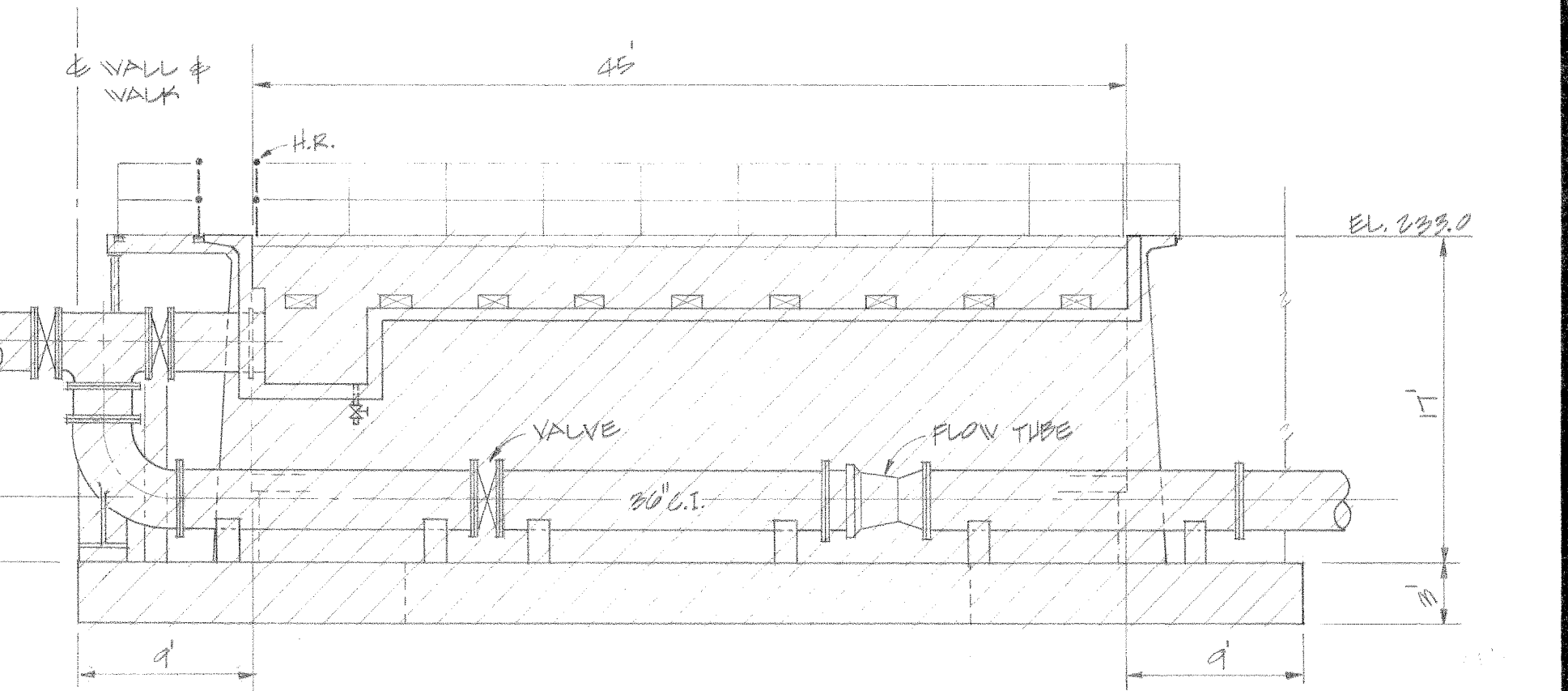
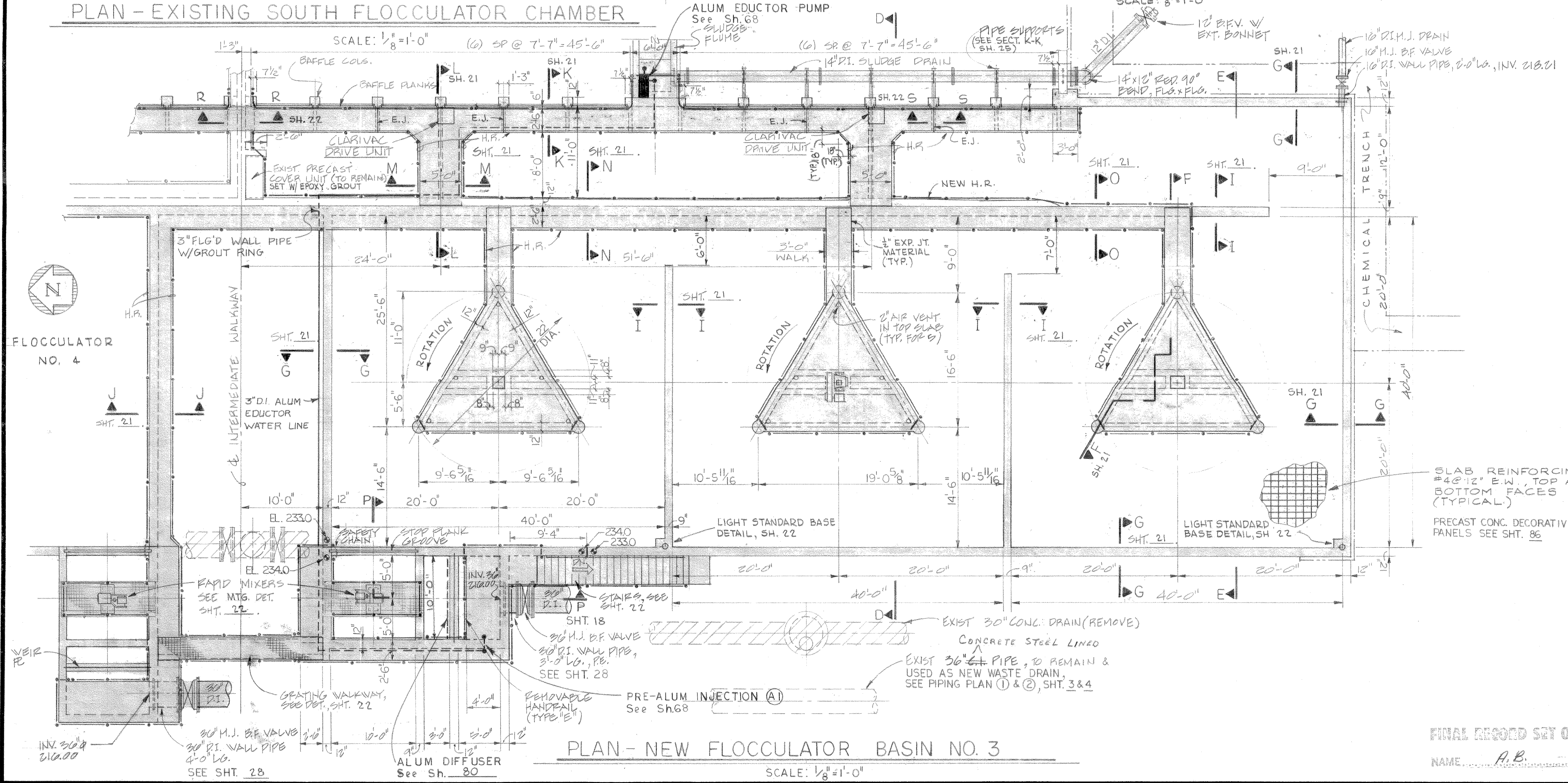
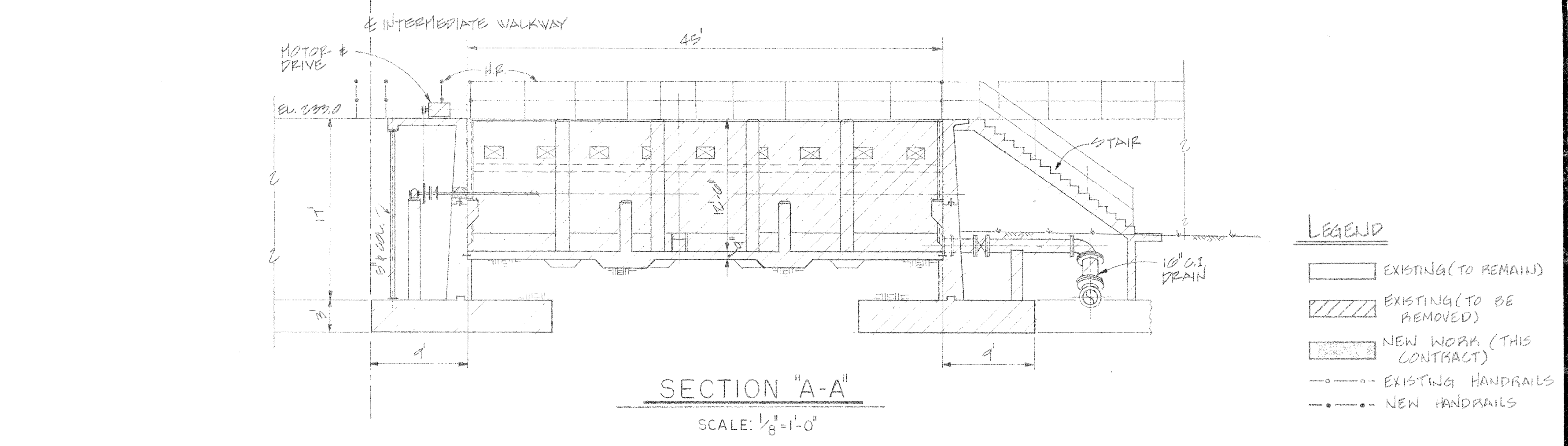
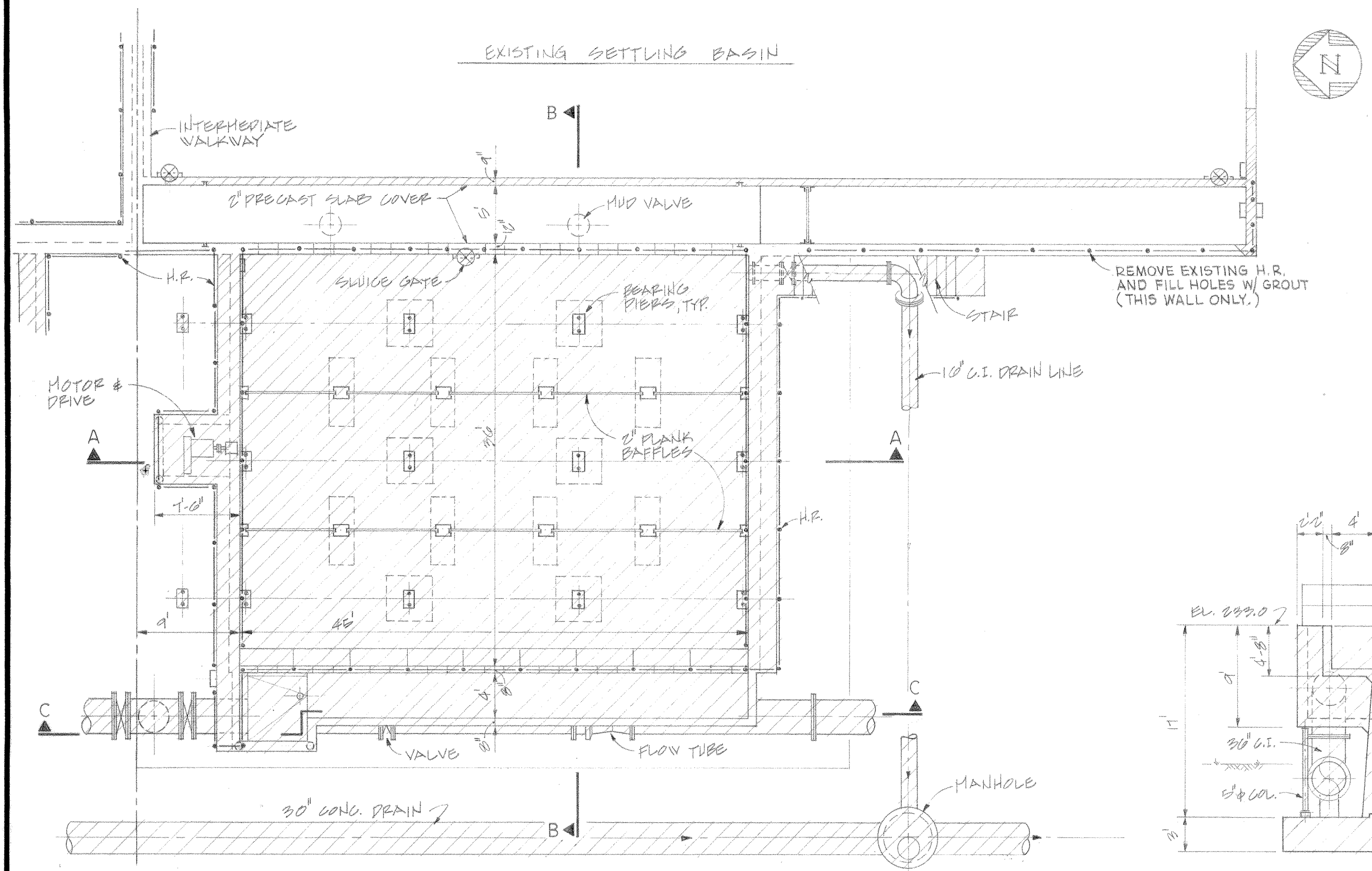
**J. B. Converse & Co. Inc.**  
 Consulting Engineers  
 Mobile, Alabama

CLIENT: BOARD OF WATER AND SEWER COMMISSIONERS OF THE CITY OF MOBILE, ALABAMA  
 WATER TREATMENT PLANT EXPANSION  
 TITLE: GENERAL ARRANGEMENT PLAN

DRAWING NUMBER: IA2-18.7  
 SHEET: 1 OF 115

DRAFTSMAN: H.R.R.		Montgomery Birmingham		
CHECKED BY: K.W.L.				
APPROVED BY: C.H.S.				
DATE: NOV 1976	SCALE: 1" = 40'			
NO.	DESCRIPTION	DATE	ENGR.	REVISIONS

Panama City  
 Albany



NO.	DESCRIPTION	DATE	ENGR.

DRAFTSMAN:	W.H.P.
CHECKED BY:	K.W.L.
APPROVED BY:	C.H.S.
DATE:	NOV. 1976
SCALE:	AS NOTED

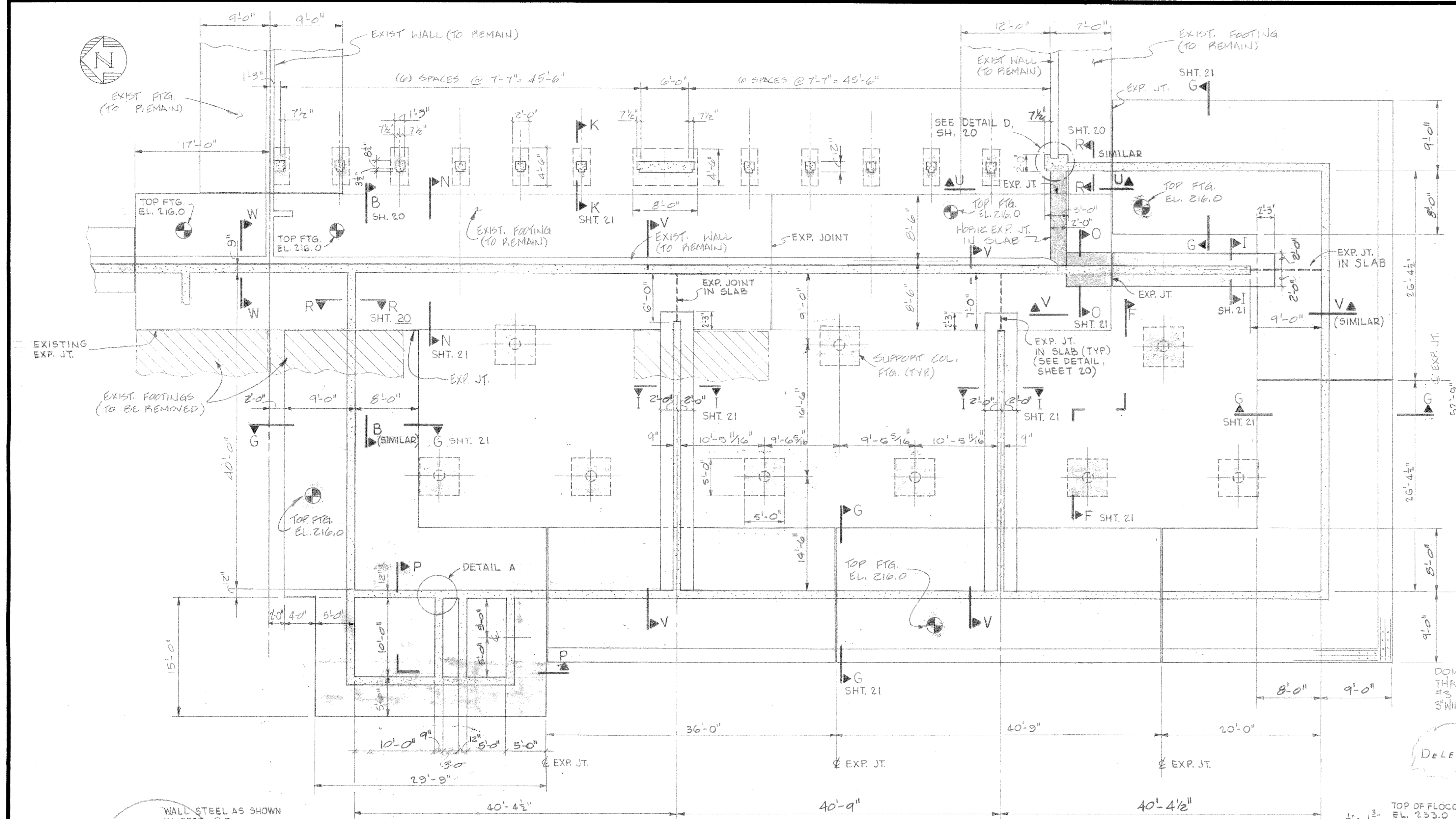
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 Mobile, Alabama

Panama City  
 Albany

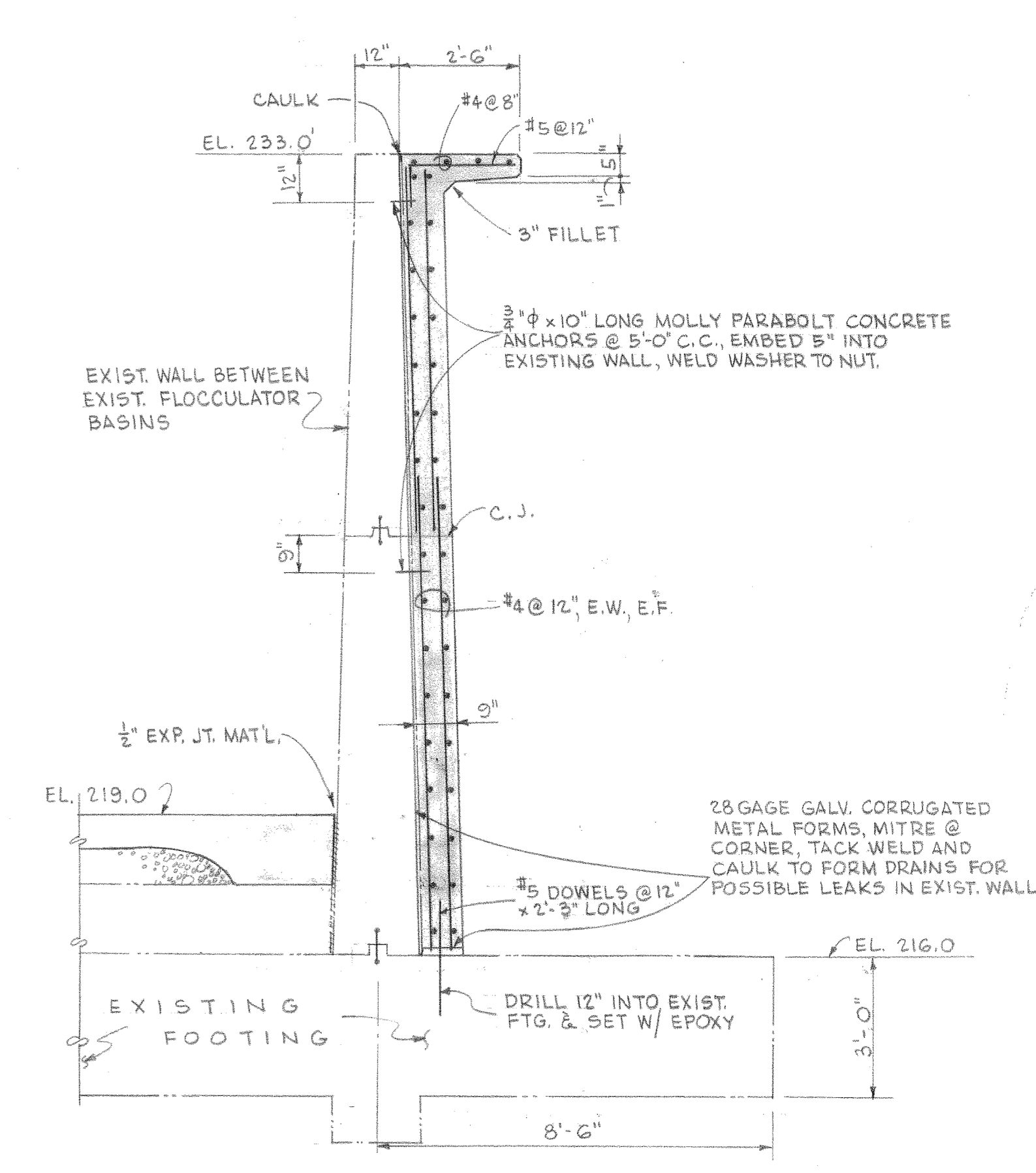
CLIENT: BOARD OF WATER AND SEWER COMMISSIONERS  
 OF THE CITY OF MOBILE, ALABAMA  
 WATER TREATMENT PLANT EXPANSION

TITLE: FLOCCULATOR NO. 3  
 PLAN & SECTIONS

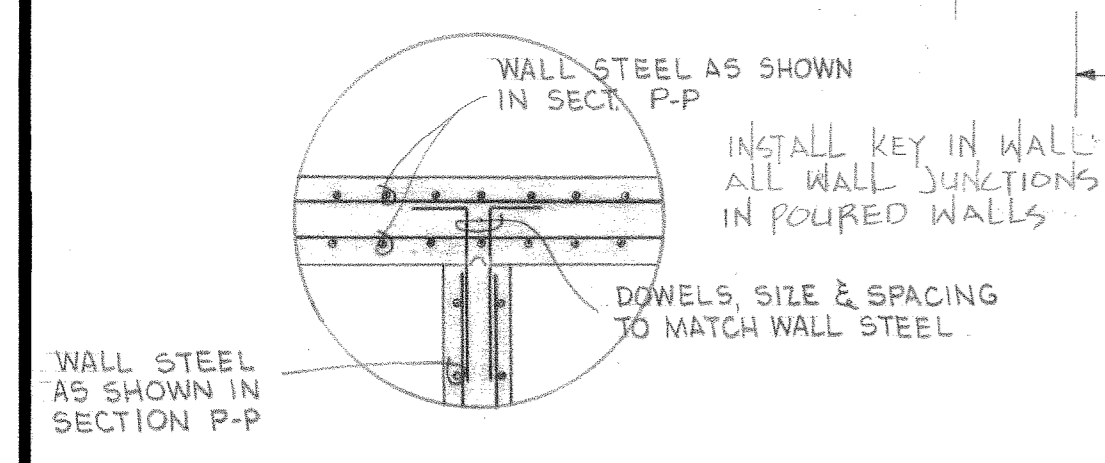
DRAWING NUMBER: IA2-18.7  
 SHEET: 17 OF 115



FOUNDATION PLAN - FLOCCULATOR BASIN NO. 3  
SCALE: 1/8" = 1'-0"

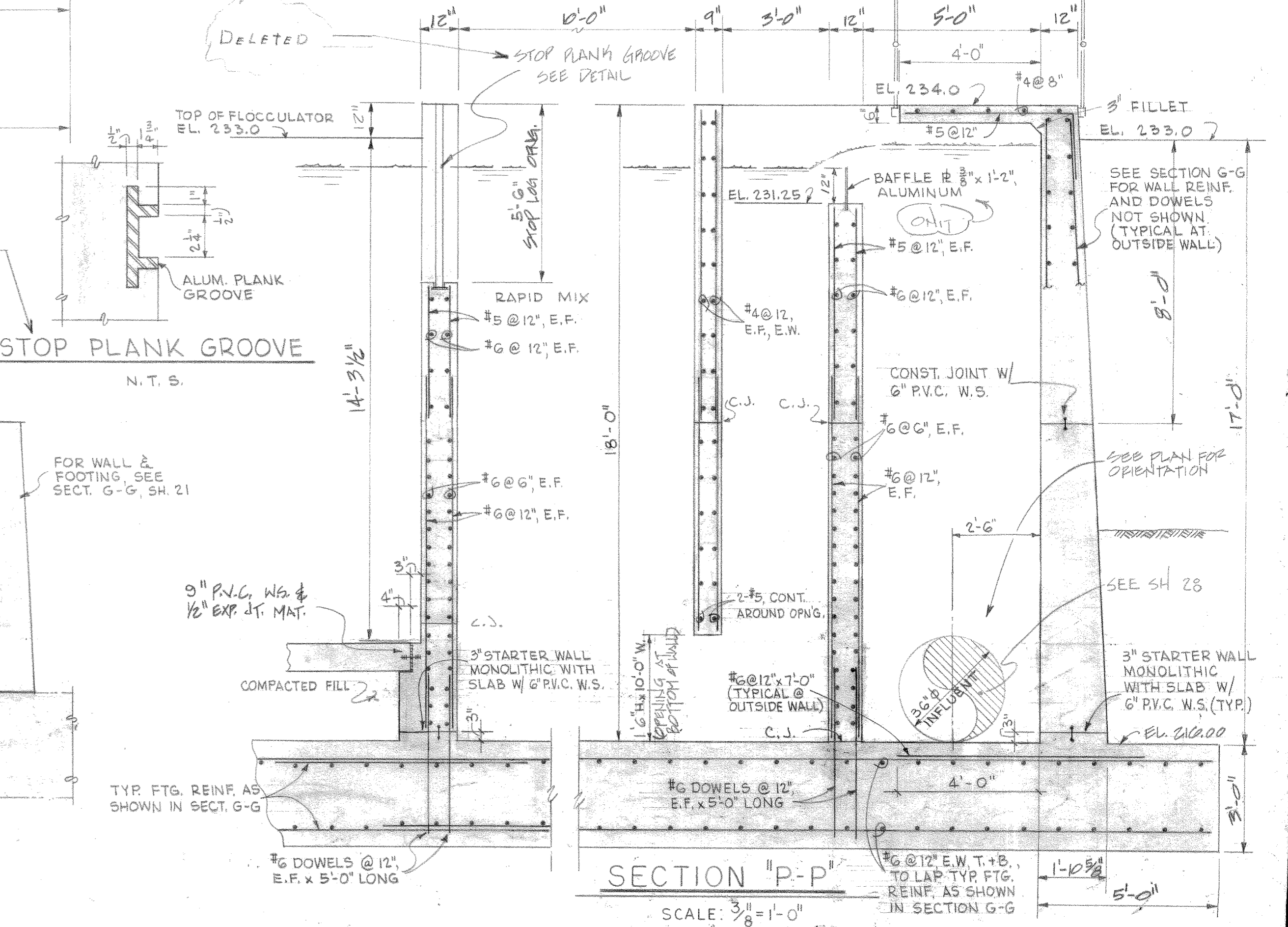


SECTION W-W  
SCALE: 3/8" = 1'-0"

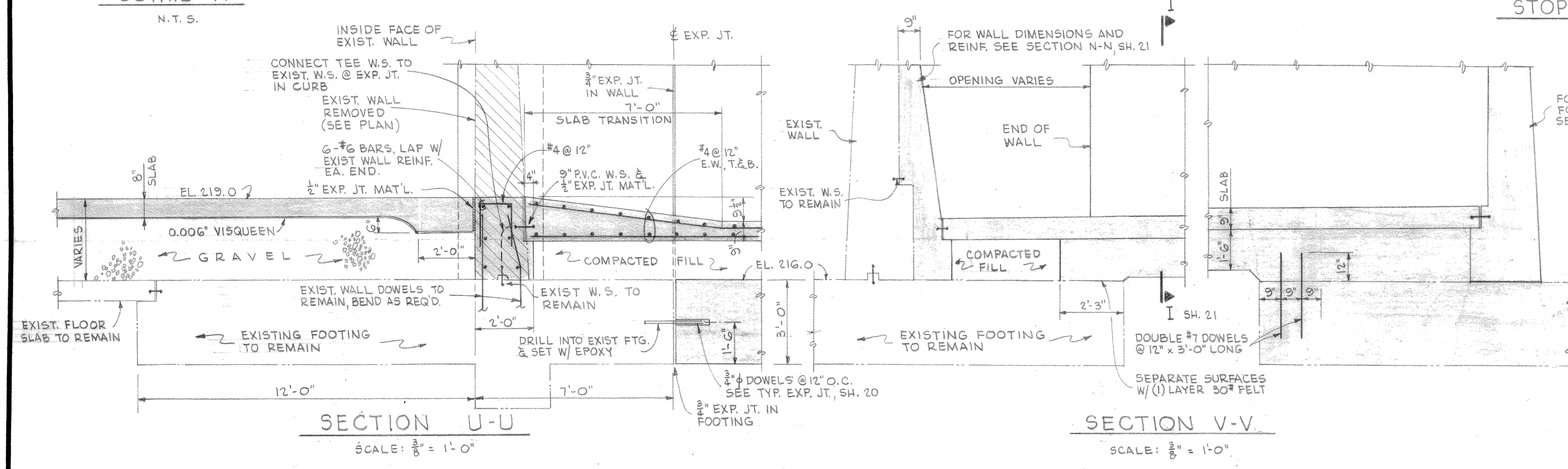


DETAIL A  
N.T.S.

DOWELS & KEYWAYS TO ANCHOR THRUST BLOCK 36" MAIN TO #3 FLOCCULATOR 3" WIDE x 3" DEEP x 3" LONG KEYWAYS #4 DOWELS



SECTION P-P  
SCALE: 3/8" = 1'-0"



SECTION U-U  
SCALE: 3/8" = 1'-0"

SECTION V-V  
SCALE: 3/8" = 1'-0"

NO.	DESCRIPTION	DATE	ENGR.

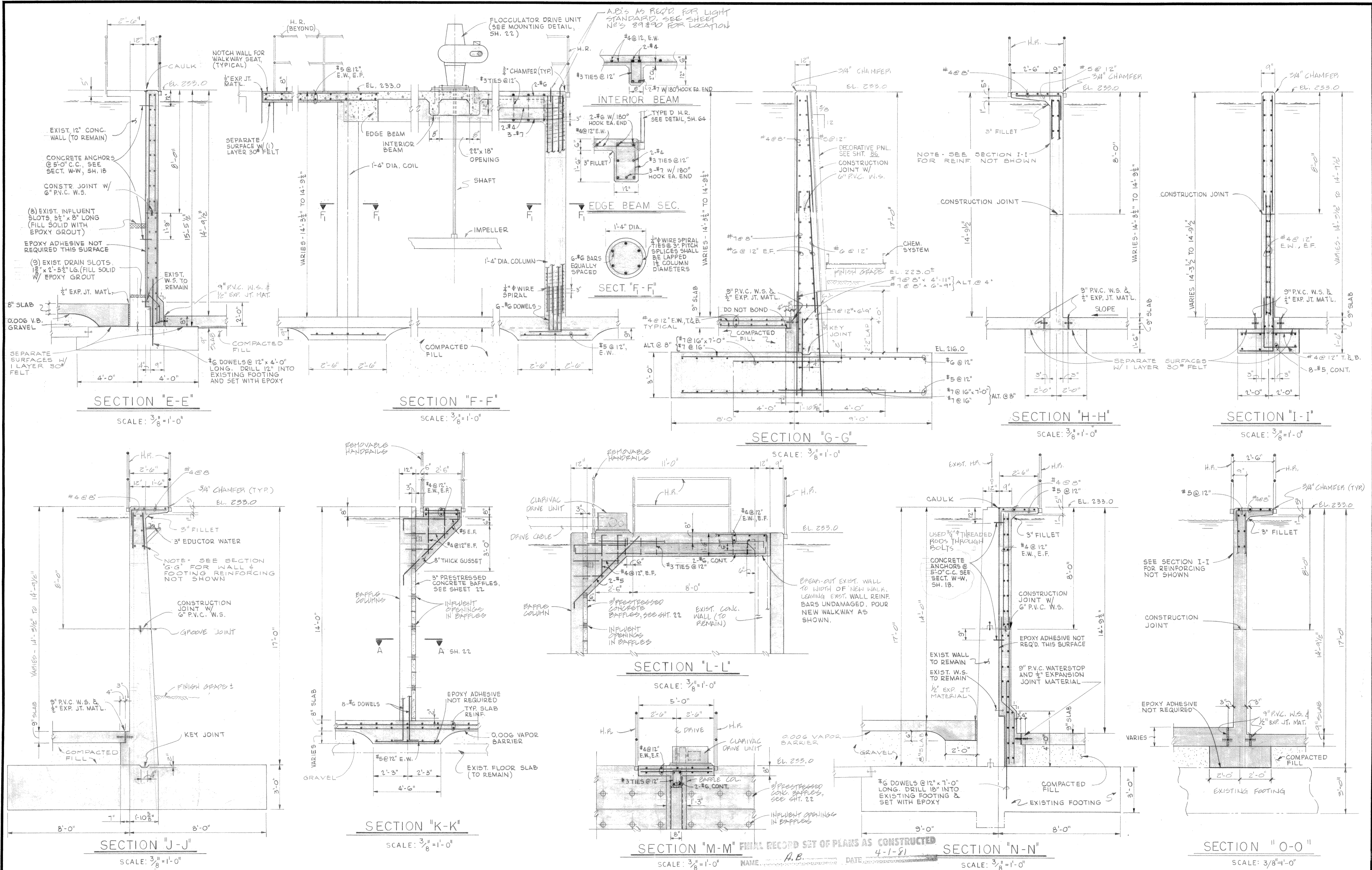
DRAFTSMAN:	C.A.G.
CHECKED BY:	J.G.S.
APPROVED BY:	C.H.S.
DATE:	NOV. 1976
SCALE:	AS NOTED

**J. B. Converse & Co. Inc.**  
Consulting Engineers  
Mobile, Alabama

Panama City  
Albany

CLIENT:	BOARD OF WATER AND SEWER COMMISSIONERS OF THE CITY OF MOBILE, ALABAMA WATER TREATMENT PLANT EXPANSION
TITLE:	FLOCCULATOR NO. 3 FOUNDATION PLAN & DETAILS

DRAWING NUMBER:	IA2-18.7
SHEET:	18 OF 115



NO.	DESCRIPTION	DATE	ENGR.

DRAFTSMAN: W.H.P.
CHECKED BY: J.G.S.
APPROVED BY: C.H.S.
DATE: NOV 1976
SCALE: AS NOTED

**J. B. Converse & Co. Inc.**  
 Consulting Engineers  
 Mobile, Alabama

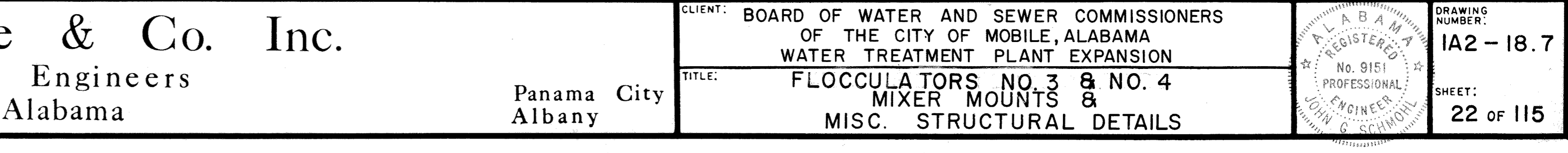
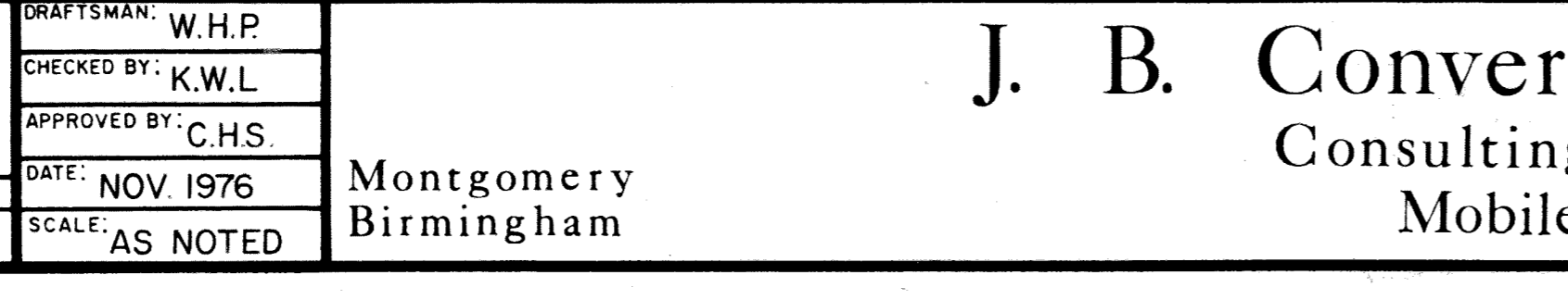
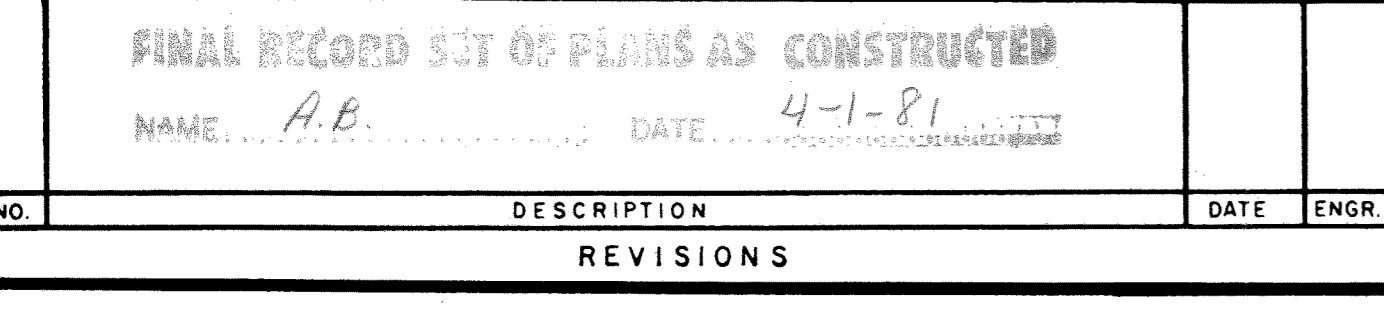
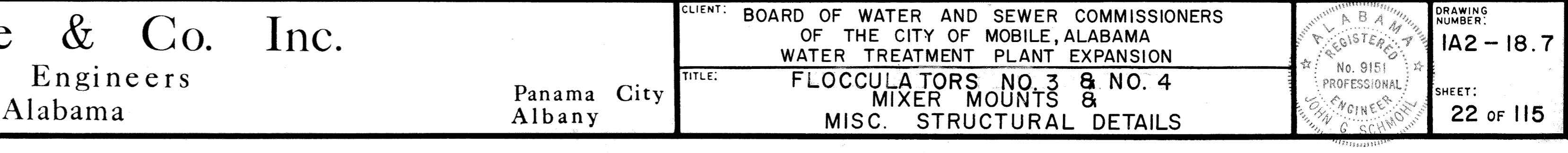
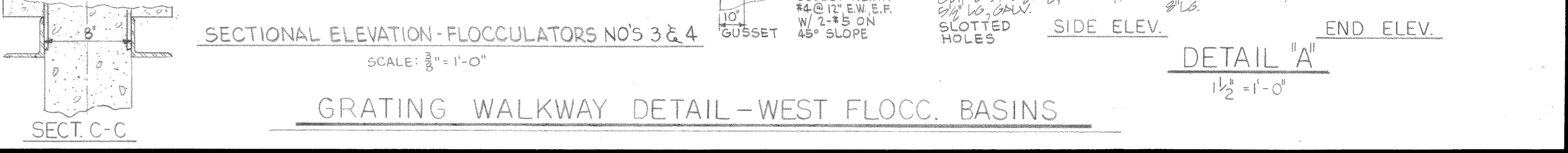
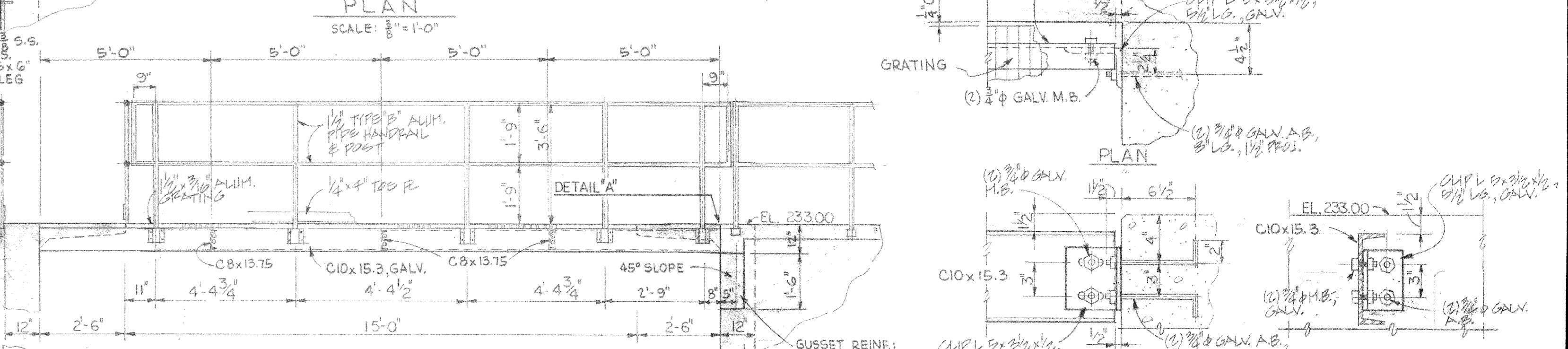
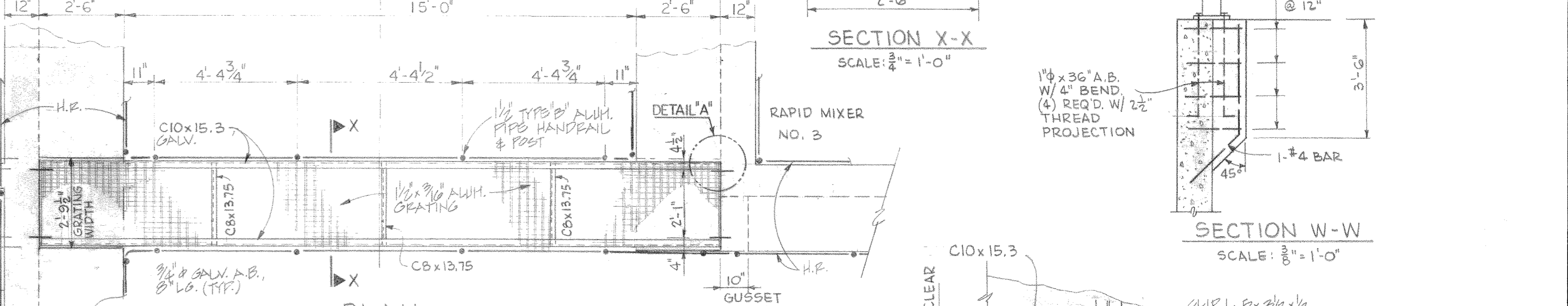
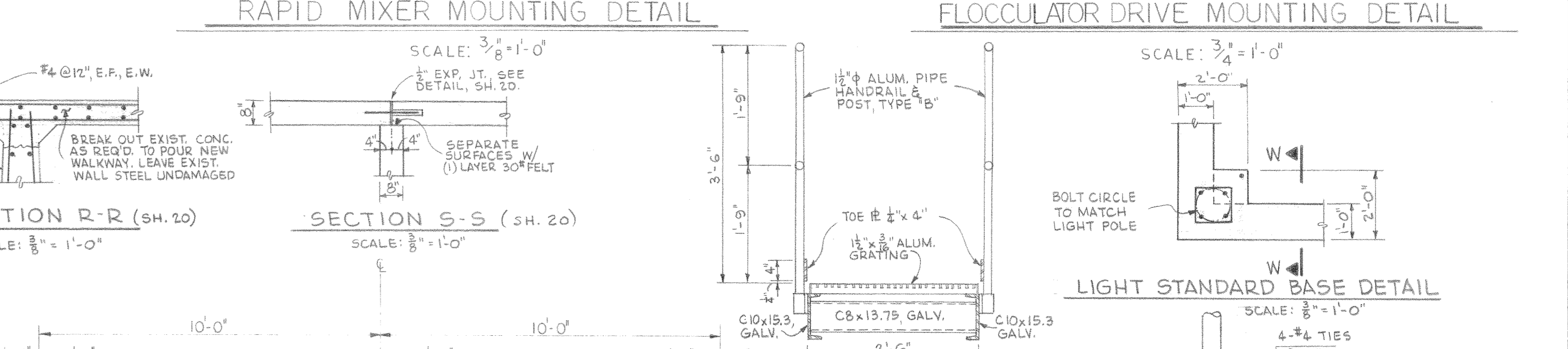
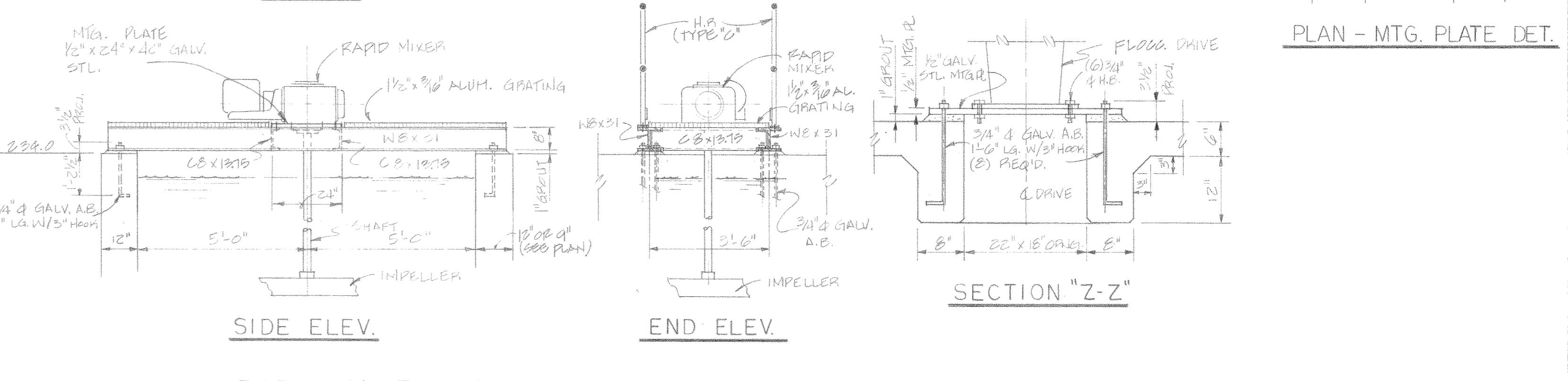
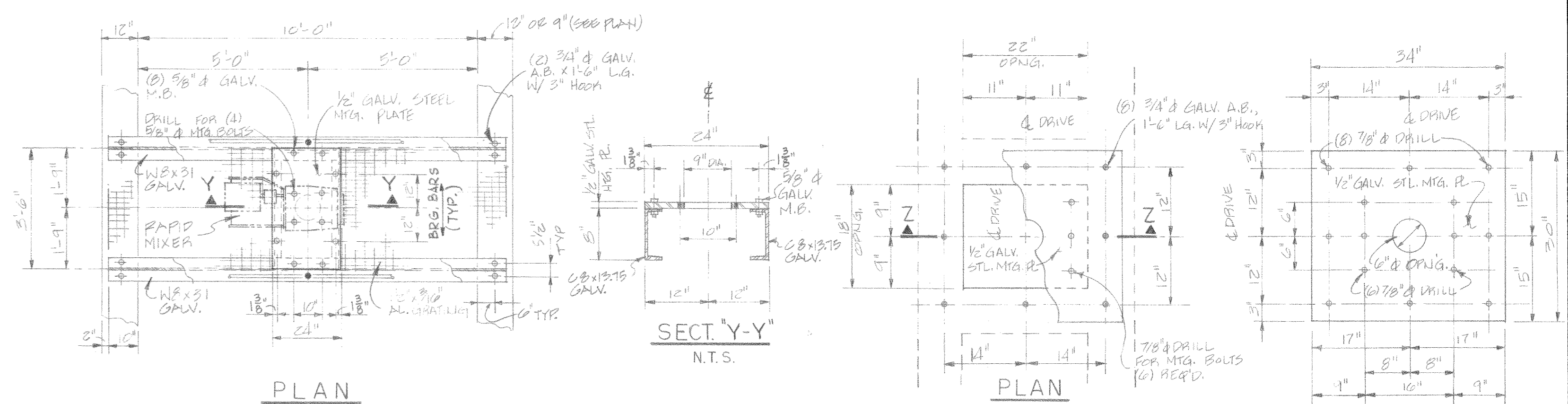
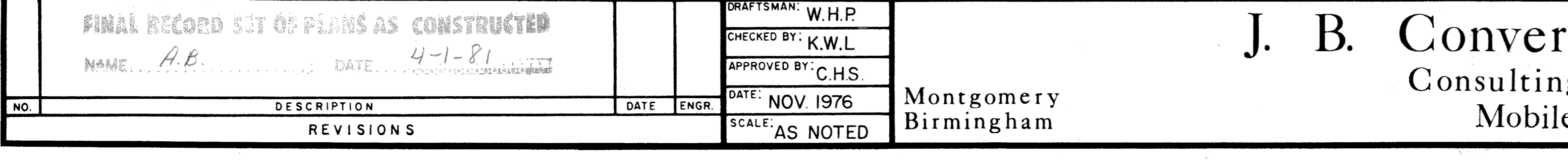
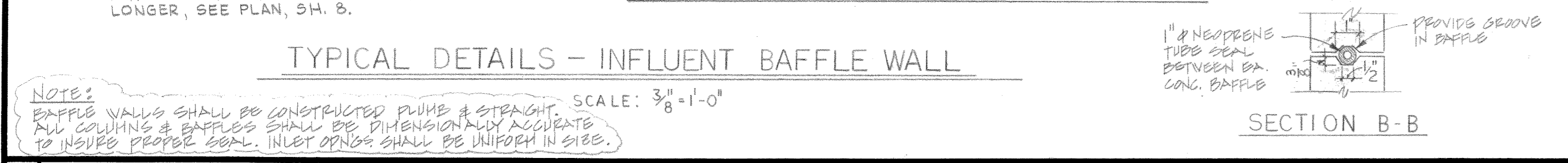
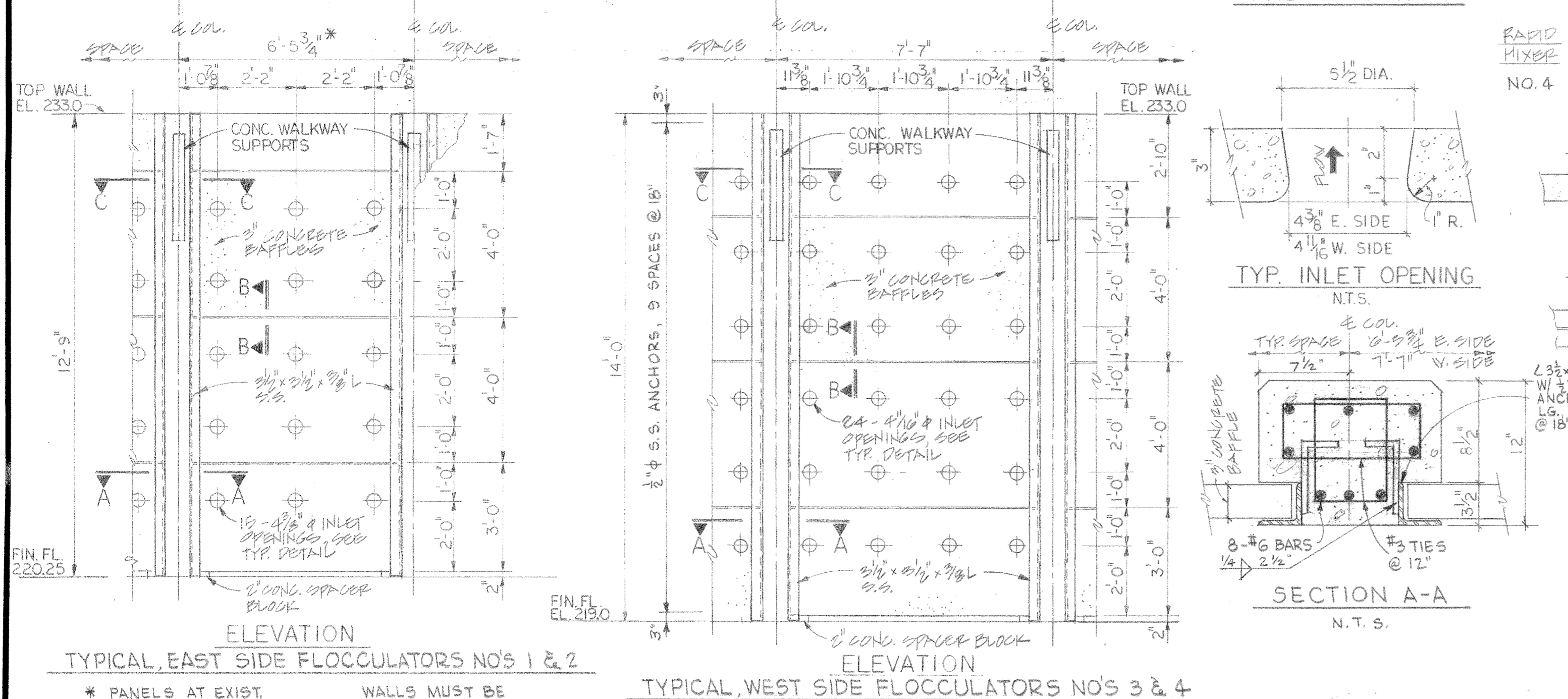
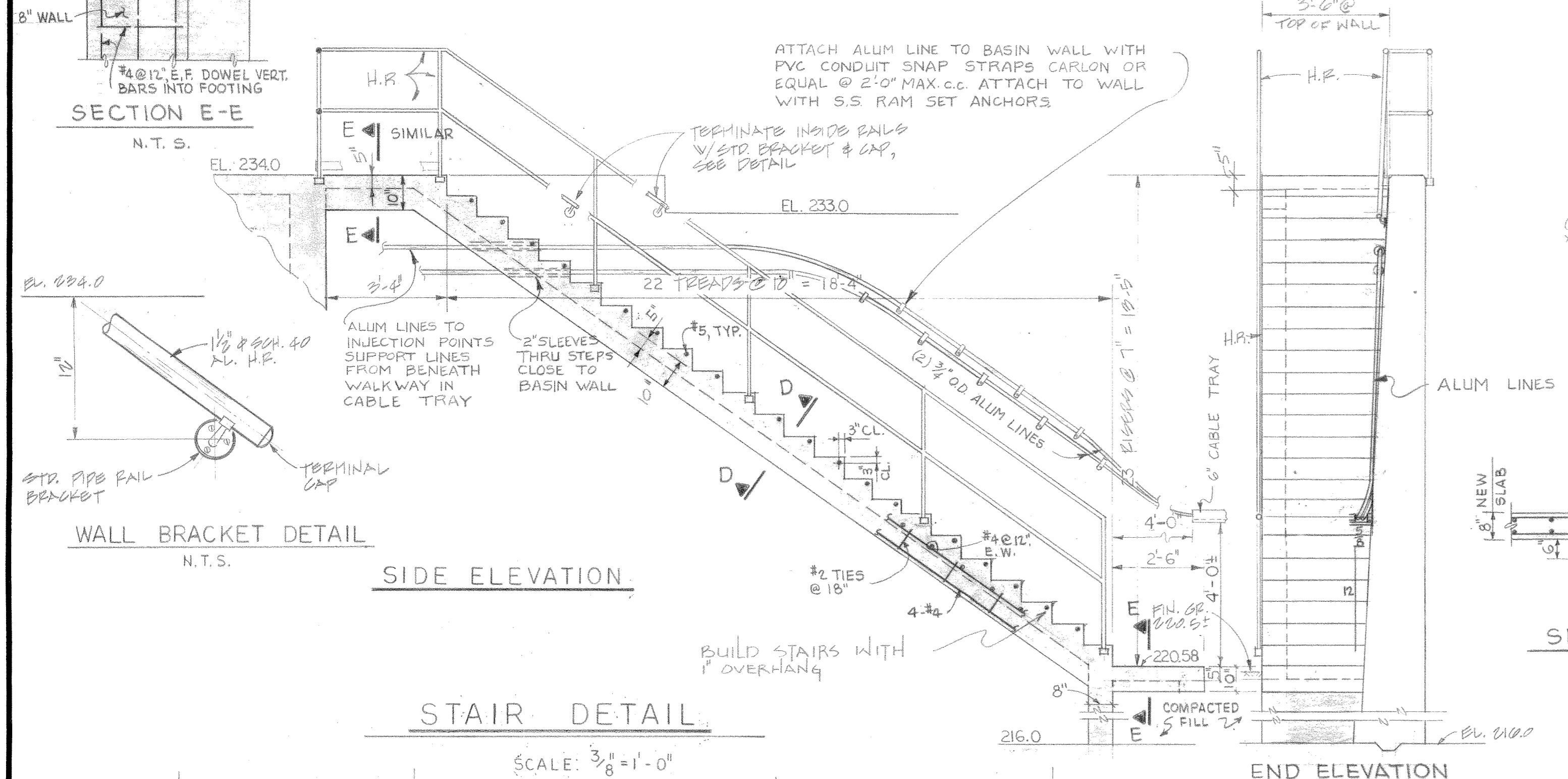
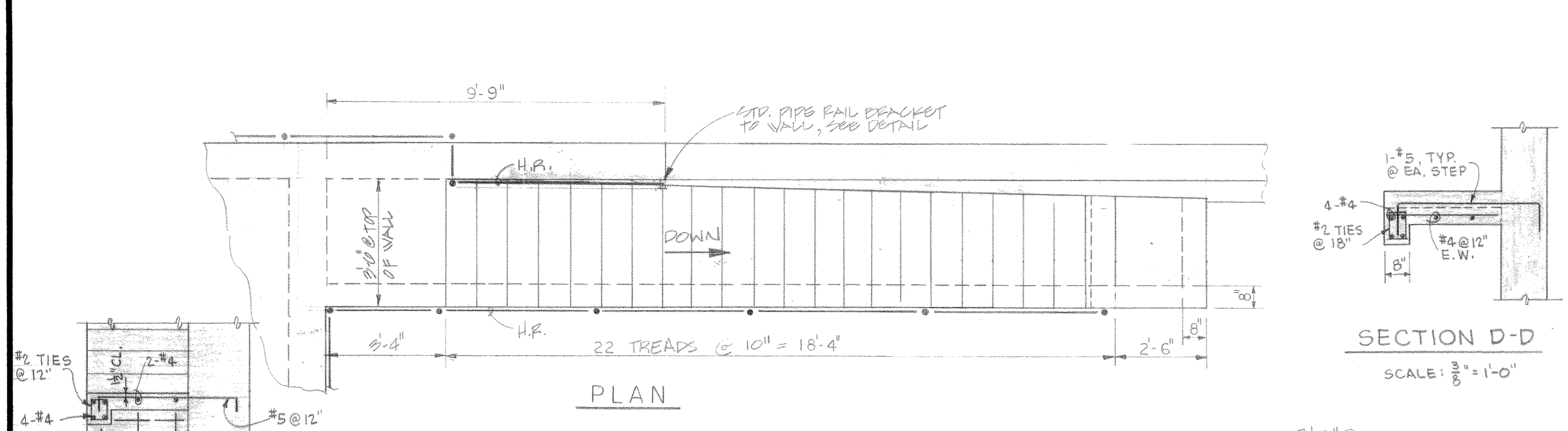
Panama City  
 Albany

CLIENT: BOARD OF WATER AND SEWER COMMISSIONERS  
 OF THE CITY OF MOBILE, ALABAMA  
 WATER TREATMENT PLANT EXPANSION

TITLE: FLOCCULATORS NO. 3 & NO. 4  
 WALL SECTIONS

ALABAMA REGISTERED PROFESSIONAL ENGINEER  
 No. 9151

DRAWING NUMBER: 1A2-18.7  
 SHEET 21 OF 115



NOTE:  
BAFFLE WALLS SHALL BE CONSTRUCTED PLUMB & STRAIGHT.  
ALL CORNERS & BAFFLES SHALL BE DIMENSIONALLY ACCURATE  
TO INSURE PROPER FLOW. INLET OPENINGS SHALL BE UNIFORM IN SIZE.

ATTACH ALUM LINE TO BASIN WALL WITH  
PVC CONDUIT SNAP STRAPS CARLON OR  
EQUAL @ 2'-0" MAX. C.C. ATTACH TO WALL  
WITH S.S. RING SET ANCHORS.

TERMINATE INODE BALES  
W/ STD BRACKET & CAP,  
SEE DETAIL.

ALUM LINES TO  
INJECTION POINTS  
SUPPORT LINES  
FROM BENEATH  
WALKWAY IN  
CABLE TRAY

2" SLEEVES  
THRU STEPS  
CLOSE TO  
BASIN WALL

FIN. FL. EL. 220.25

FIN. FL. EL. 219.0

FIN. FL. EL. 223.0

FIN. FL. EL. 223.00

FIN. FL. EL. 223.00

\* PANELS AT EXIST. WALLS MUST BE LONGER, SEE PLAN, SH. B.

1" # NEOPRENE TUBES SHALL PROVIDE GROOVE IN BAFFLE

1" # NEOPRENE TUBES SHALL PROVIDE GROOVE IN BAFFLE

1" # NEOPRENE TUBES SHALL PROVIDE GROOVE IN BAFFLE

1" # NEOPRENE TUBES SHALL PROVIDE GROOVE IN BAFFLE

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