CONTRACT DOCUMENTS FOR:

ITB # 23-007

RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMP SYSTEM REPLACEMENT

March 2023

MAYOR: TERI JOHNSTON

COMMISSIONERS:

LISSETTE CAREY

BILLY WARDLOW

JIMMY WEEKLEY

CLAYTON LOPEZ

SAM KAUFMAN

MARY LOU HOOVER

PREPARED BY:
City of Key West
Utilities Department

CITY OF KEY WEST

KEY WEST, FLORIDA

CONTRACT DOCUMENTS

For

RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY RAS AND WAS PUMP SYSTEM REPLACEMENT

****

CONSISTING OF:
BID REQUIREMENTS
CONTRACT FORMS
CONDITIONS OF THE CONTRACT
GENERAL REQUIREMENTS
DRAWINGS

*****

KEY WEST, FLORIDA

MARCH 2023

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PART 1

BIDDING REQUIREMENTS

INVITATION TO BID

Sealed bids for the City of Key West ITB #23-007 RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY RAS AND WAS PUMP SYSTEM REPLACEMENT, addressed to the City of Key West, will be received at the Office of the City Clerk, 1300 White Street., Key West Florida, 33040 until 3:00 p.m. on **May 10, 2023** and then will be publicly opened and read. Any bids received after the time and date specified will not be considered.

Please submit one (1) original, and two (2) flash drives each with one single PDF file of the sections entitled "Bidding Requirements" and "Contract Forms". Bid package is to be enclosed in a sealed envelope, clearly marked on the outside "ITB #23-007 RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY RAS AND WAS PUMP SYSTEM REPLACEMENT addressed and delivered to the City Clerk at the address noted above.

The proposed project consists of providing all labor, equipment, and materials to remove and replace the pumps, valves, plumbing, meters, variable frequency drives, instrumentation, controls, and supports for the waste active sludge (WAS) and return activated sludge (RAS) systems at the Richard A. Heyman Environmental Protection Facility (RAHEPF).

Drawings and Specifications may be obtained from Demand Star by Onvia or City of Key West. Please contact Demand Star at www.demandstar.com or call 1-800-711-1712 or www.cityofkeywest-fl.gov

A mandatory pre - bid meeting will be held on **April 17, 2023** at 10 A.M at Richard A. Heyman Environmental Protection Facility, 100 Fleming Key Road, Key West, Florida, 33040, located at Naval Air Station Trumbo Point Annex. Remote attendance is not permitted.

Pre-bid Meeting Attendance Instructions
Access for contractors to visit the construction site on Truman Annex will require a day pass issued by NASKW Commercial Gate (Rockland Key). **The deadline for requests for passes is April 10, 2023.**

Instructions

1. Please provide to the City of Key West at cimcdowell@cityofkeywest-fl.gov the names and email addresses of all persons who will attend the pre-bid site visit. Names and email addresses must be provided one-week prior to the pre-bid site visit.
2. City of Key West will coordinate all access requests and provide an email with instructions. Access will be requested on the designated date and time for the contractor site visit.
3. Please print and bring a paper copy of the email to present to the security officer when requesting your access day-pass to Truman Annex Fort Street/Navy Beach tide valve for the pre-bid site visit. The email is the authorization to request access to job site.
4. Please present valid identification as per requirements. [Please refer to attached ID requirements to provide in ITB instructions.] Persons with a felony record will not be allowed on base. Vehicle registration and proof of insurance may be requested by NASKW security personnel and must be in the vehicle at all times.
5. Please be advised weapons are not allowed on base.
6. Location of the Commercial Gate is N.A.S. Truck Entrance, mile marker 9 (Rockland Key), U.S. 1 Overseas Highway. [Attached location map may be included in ITB document.]

EACH BID MUST BE SUBMITTED ON THE PRESCRIBED FORM AND ACCOMPANIED BY BID SECURITY AS PRESCRIBED IN THE INSTRUCTIONS TO BIDDERS, PAYABLE TO THE CITY OF KEY WEST, FLORIDA, IN AN AMOUNT NOT LESS THAN FIVE (5) PERCENT OF THE AMOUNT BID.

THE BIDDER MUST BE A LICENSED CONTRACTOR BY THE STATE OF FLORIDA AND SUBMIT PROOF OF SUCH WITH THE BID.

The successful Bidder shall furnish documentation showing that he is in compliance with the licensing requirements of the State and the provisions of Chapter 66 Section 87 of the Code of Ordinances of the City of Key West; within 10 days following the Notice of Award and must demonstrate that he holds at a minimum, the following licenses & certificates;

A. City of Key West Business Tax License Receipt
B. A valid Certificate of Competency issued by the Chief Building Official of Key West, Florida.

All bid bonds, insurance contracts, and certificates of insurance shall be either executed by or countersigned by a licensed resident agent of the Surety or Insurance Company having his place of business in the State of Florida, and in all ways complying with the insurance laws of the State of Florida. Further, the said Surety or Insurance Company shall be duly licensed and qualified to do business in the State of Florida.

Before a Contract will be awarded for the work contemplated herein, the CITY will conduct such investigation as is necessary to determine the performance record and ability of the apparent low Bidder to perform the size and type of work specified under this Contract. Upon request, the Bidder shall submit such information as deemed necessary by the CITY to evaluate the Bidder's qualifications.

Any request for information concerning this project must be made in writing, per City of Key West Ordinance Section 2-773, Cone of Silence, to Ian McDowell, Assistant Engineer, at cimcdowell@cityofkeywest-fl.gov**. The deadline for requests is one week before bid opening.**

As stated above at the time of the bid submittal the Bidder must provide satisfactory documentation of State Licenses. The Bidder shall furnish documentation showing that he is in compliance with the licensing requirements of County, and City licenses as would be required within ten days of the award. The successful Bidder must also be able to satisfy the CITY Attorney as to such insurance coverage and legal requirements as may be demanded by the Bid in question. The CITY may reject bids for any and/or all of the following reasons: (1) for budgetary reasons, (2) if the bidder misstates or conceals a material fact in its bid, (3) if the bid does not strictly conform to the law or is non-responsive to the bid requirements, (4) if the bid is conditional, or (5) if a change of circumstances occurs making the purpose of the bid unnecessary to the CITY. The CITY may also waive any minor formalities or irregularities in any bid, (6) if such rejection is in the best interest of the CITY.

INSTRUCTIONS TO BIDDERS

1. CONTRACT DOCUMENTS

A. FORMAT

The Contract Documents are divided into parts, divisions, and sections for convenient organization and reference. Generally, there has been no attempt to divide the sections into work performed by the various building trades, work by separate subcontractors, or work required for separate facilities in the project.

B. DOCUMENT INTERPRETATION

The separate sections contained within these Contract Documents are intended to be mutually cooperative and to provide all details reasonably required for the execution of the proposed work.

Should there be any doubt as to the meaning or intent of said Contract Documents, the Bidder should request of the ENGINEER, in writing (at least ten (10) calendar days prior to bid opening) an interpretation thereof. Any interpretation or change in said Contract Documents will be made only in writing in the form of Addenda to the documents which will be available to all registered holders of Contract Documents via Demand star. Bidders shall submit with their Bids, or indicate receipt of, all Addenda. The CITY will not be responsible for any other explanation or interpretations of said Documents.

2. GENERAL DESCRIPTION OF THE PROJECT

A general description of the work to be done is contained in the Invitation to Bid. The scope is specified in applicable parts of these Contract Documents.

3. QUALIFICATION OF CONTRACTORS

The prospective Bidders must meet the statutorily prescribed requirements before award of Contract by the CITY. Bidders must hold or obtain all licenses and/or certificates as required by the State and Local Statutes to bid and perform the work specified herein.

4. BIDDER'S UNDERSTANDING

Each Bidder must inform himself of the conditions relating to the execution of the work, and it is assumed that he will inspect the site and make himself thoroughly familiar with all the Contract Documents. Failure to do so will not relieve the successful Bidder of his obligation to enter a Contract and complete the contemplated work in strict accordance with the Contract Documents. It shall be the Bidder's obligation to verify for himself and to his complete satisfaction all information concerning site and subsurface conditions.

The CITY will make available to prospective Bidders upon request and at the office of the ENGINEER, prior to bid opening, any information that he may have as to subsurface conditions and surface topography at the worksite.

Each Bidder shall inform himself of, and the Bidder awarded a Contract shall comply with, federal, state, and local laws, statutes, and ordinances relative to the execution of the work. This requirement includes, but is not limited to, applicable regulations concerning minimum wage rates, nondiscrimination in the employment of labor, protection of public and employee safety and health, environmental protection, the protection of natural resources, fire protection, burning and non-burning requirements, permits, fees, and similar subjects.

5. TYPE OF BID

A. LUMP SUM

The BID for the work is to be submitted on a lump sum basis. Lump sum prices shall be submitted for all items of work set forth in the bid. All items required to complete the work specified but not included in the bid shall be considered incidental to those set forth in the bid.

The Bidder shall submit a Schedule of Values with the BID. It shall be broken down by trade/type of work and include the cost of all LABOR & MATERIALS for use as a basis for payment. A 5% allowance should be included among the line items.

6. PREPARATION OF BIDS

A. GENERAL

All blank spaces in the BID form must be filled in, as required, preferably in BLUE ink. All price information shall be shown in both words and figures where required. No changes shall be made in the phraseology of the forms. Written amounts shall govern in case of discrepancy between the amounts stated in writing and the amounts stated in figures. In case of discrepancy between unit prices and extended totals, unit prices shall prevail.

Any BID shall be deemed informal which contains omissions, erasures, alterations, or additions of any kind, or prices uncalled for, or in which any of the prices are obviously unbalanced, or which in any manner shall fail to conform to the conditions of the published Invitation to Bid.

Only one BID from any individual, firm, partnership, or corporation, under the same or different names, will be considered. Should it appear to the CITY that any Bidder is interested in more than one Bid for work contemplated; all Bids in which such Bidder is interested will be rejected.

B. SIGNATURE

The Bidder shall sign his BID in the blank space provided therefore. If Bidder is a corporation, the legal name of the corporation shall be set forth above, together with the signature of the officer or officers authorized to sign Contracts on behalf of the corporation. If Bidder is a partnership, the true name of the firm shall be set forth above, together with

the signature of the partner or partners authorized to sign Contracts in behalf of the partnership. If signature is by an agent, other than an officer of a corporation or a member of a partnership, a notarized power-of-attorney must be on file with the CITY prior to opening of Bids or submitted with the Bid, otherwise the Bid will be regarded as not properly authorized.

C. SPECIAL BIDDING REQUIREMENTS

The Bidder's attention is brought to the hiring practices and licenses and permits of the City of Key West. These are defined in the addition to Article 39, ORDINANCES, PERMITS, AND LICENSES, as set forth in the Supplementary Conditions.

The Bidder shall submit with his Bid his experience record showing his experience and expertise in the specified work. Such experience record shall provide at least five current or recent projects (within the past 5 years) of similar work, within the State Florida and preferably Monroe County. For each project the following information shall be provided:

1. Description and location of work.
2. Contract amount.
3. Dates work was performed.
4. Owner and name of Owner's contact person and phone number.
6. Designer and name of Designer's contact person and phone number.

The bidder shall submit with his bid a list of items to be performed by his own labor and that performed by subcontractors or others.

D. ATTACHMENTS

Bidder shall complete and submit the following forms with his bid:

Anti-Kickback Affidavit
Non-Collusion Affidavit
Public Entity Crimes Form
Indemnification Form
City of Key West Business License Tax Receipt
Local Vendors Form
Domestic Partnership Affidavit
Cone of Silence Affidavit
Vendor Certification Regarding Scrutinized Companies Lists
Bidders' Checklist

E. PUBLIC ENTITY CRIMES FORM

Pursuant to the requirements of Chapter 287.133, Laws of Florida, pertaining to the sworn statement on Public Entity Crimes and the Convicted Vendor List, all Bidders shall submit a signed and notarized statement with their Bid on the form provided herein.

7. STATE AND LOCAL SALES AND USE TAXES

Unless the Supplementary Conditions contains a statement that the CITY is exempt from state sales tax on materials incorporated into the work due to the qualification of the work under this Contract, the Contractor, as required by the laws and statutes of the state and its political subdivisions, shall pay all state and local sales and use taxes. Prices quoted in the Bid shall include all nonexempt sales and use taxes, unless provision is made in the Bid form to separately itemize the tax.

8. SUBMISSION OF BIDS

All BIDS must be submitted not later than the time prescribed, at the place, and in the manner set forth in the Invitation to Bid. BIDS must be made on the BID forms provided herewith, **submit one (1) ORIGINAL and two (2) FLASH DRIVES each containing a single PDF file of the entire bid package. File name shall include company name.**

Each BID must be submitted in a sealed envelope, so marked as to indicate the Bidder's name and its contents (project name and number) without being opened, and addressed in conformance with the instructions in the Invitation to Bid.

9. MODIFICATION OR WITHDRAWAL OF BIDS

Prior to the time and date designated for receipt of BIDS, any BID submitted may be withdrawn by notice to the party receiving BIDS at the place designated for receipt of BIDS. Such notice shall be in writing over the signature of the Bidder or by telegram. If by telegram, written confirmation over the signature of the Bidder shall be mailed and postmarked on or before the date and time set for receipt of BID. No BID may be withdrawn after the time scheduled for opening of BIDS, unless the time specified in paragraph AWARD OF CONTRACT of these Instructions to Bidders shall have elapsed.

10. BID SECURITY

BIDS must be accompanied by cash, a certified check, or cashier's check drawn on a bank in good standing, or a bid bond issued by a Surety authorized to issue such bonds in the state where the work is located, in the amount of five (5) percent of the total amount of the Bid submitted. This bid security shall be given as a guarantee that the Bidder will not withdraw his BID for a period of ninety (90) days after bid opening, and that if awarded the Contract, the successful Bidder will execute the attached Contract and furnish properly executed Performance and Payment Bonds, each in the full amount of the Contract price within the time specified. Agent and Surety phone numbers must be provided.

The Attorney-in-Fact who executes this bond in behalf of the Surety must attach a notarized copy of his power-of-attorney as evidence of his authority to bind the Surety on the date of execution of the bond. Where State Statute requires, certification by a resident agent shall also be provided.

If the Bidder elects to furnish a Bid Bond, he shall use the Bid Bond form bound herewith, or one conforming substantially thereto in form and content.

11. RETURN OF BID SECURITY

Within 15 days after the award of the Contract, the CITY will return the bid securities to all Bidders whose BIDS are not to be further considered in awarding the Contract. Retained bid securities will be held until the Contract has been finally executed, after which all bid securities, other than Bidders' bonds and any guarantees, which have been forfeited, will be returned to the respective Bidders whose Bids they accompanied.

12. AWARD OF CONTRACT

Within 90 calendar days after the opening of Bids, the CITY will accept one of the Bids or will act in accordance with the following paragraphs. The acceptance of the Bid will be by written notice of award, mailed to the office designated in the Bid, or delivered to the Bidder's representative. In the event of failure of the lowest responsive, responsible Bidder to sign the Contract, provide additional documents, insurance certificate(s) and evidence of holding required licenses and certificates, the Owner may award the Contract to the next lowest responsive, responsible Bidder. Such award, if made, will be made within 120 days after the opening of Bids.

The CITY reserves the right to accept or reject any or all Bids, and to waive any informalities and irregularities in said Bids.

13. BASIS OF AWARD

The award will be made by the Owner on the basis of the BID from the lowest, responsive, responsible BIDDER which, in the Owner's sole and absolute judgment will best serve the interest of the Owner.

14. EXECUTION OF CONTRACT

The successful Bidder shall, within 10 working days after receiving Notice of Award, sign and deliver to the CITY an original Contract and two (2) copies in the form hereto attached, together with the insurance certificate as required in the Contract Documents and evidence of holding required licenses and certificates. Within 10 working days after receiving the signed Contract from the successful Bidder, the City's authorized agent will sign the Contract. Signature by both parties constitutes execution of the Contract.

16. FAILURE TO EXECUTE CONTRACT AND FURNISH BID BOND

The Bidder who has a Contract awarded to him and who fails to promptly and properly execute the Contract shall forfeit the bid security that accompanied his bid, and the bid security shall be retained as liquidated damages by the CITY, and it is agreed that this said sum is a fair estimate of the amount of damages the CITY will sustain in case the Bidder fails to enter into a Contract. Bid security deposited in the form of cash, a certified check, or cashier's check shall be subject to the same requirement as a Bid Bond.

17. TIME OF COMPLETION

The time of completion of the work to be performed under this Contract is the essence of the Contract. Delays and extensions of time may be allowed in accordance with the provisions stated

in the General Conditions.

When the Contractor receives a Notice to Proceed, he shall commence work as soon as possible and shall complete all work within the number of calendar days stipulated in this Bid.

The term of this contract will not exceed **270** calendar days.

NOTE TO BIDDER: Use preferably BLUE ink for completing this BID form.

PROPOSAL FORM

To: The City of Key West

Address: 1300 White Street, Key West, Florida 33040

Project Title: **RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY RAS AND WAS PUMP SYSTEM REPLACEMENT**
ITB# 23-007

Bidder's contact person for additional information on this BID:

Company Name: _____

Contact Name & Telephone #: _____

Email Address: _____

BIDDER'S DECLARATION AND UNDERSTANDING

The undersigned, hereinafter called the Bidder, declares that the only persons or parties interested in this Bid are those named herein, that this Bid is, in all respects, fair and without fraud, that it is made without collusion with any official of the Owner, and that the Bid is made without any connection or collusion with any person submitting another Bid on this Contract.

The Bidder further declares that he has carefully examined the Contract Documents for the construction of the project, that he has personally inspected the site, that he has satisfied himself as to the quantities involved, including materials and equipment, and conditions of work involved, including the fact that the description of the quantities of work and materials, as included herein, is brief and is intended only to indicate the general nature of the work and to identify the said quantities with the detailed requirements of the Contract Documents, and that this Bid is made according to the provisions and under the terms of the Contract Documents, which Documents are hereby made a part of this Bid.

CONTRACT EXECUTION

The Bidder agrees that if this Bid is accepted, he will, within 10 days, not including Sundays and legal holidays, after Notice of Award, sign the Contract in the form annexed hereto, and will at that time, deliver to the Owner evidence of holding required licenses and certificates, and will, to the extent of his Bid, furnish all machinery, tools, apparatus, and other means of construction and do the work and furnish all the materials necessary to complete all work as specified or indicated in the Contract Documents.

CERTIFICATES OF INSURANCE

Bidder agrees to furnish the Owner, before commencing the work under this Contract, the certificates of insurance as specified in these Documents.

START OF CONSTRUCTION AND CONTRACT COMPLETION TIME

The Bidder further agrees to begin work within 10 calendar days after the date of the Notice to proceed and to complete the project, in all respects within 270 calendar days after the date of the Notice to Proceed.

LIQUIDATED DAMAGES

In the event the Bidder is awarded the Contract and shall fail to complete the work within the time limit or extended time limit agreed upon, as more particularly set forth in the Contract Documents, liquidated damages shall be paid to the Owner at the rate of $1,000.00 per day for all work awarded until the work has been satisfactorily completed as provided by the Contract Documents.

ADDENDA

The Bidder hereby acknowledges that he has received Addenda No's. _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____,
(Bidder shall insert No. of each Addendum received) and agrees that all addenda issued are hereby made part of the Contract Documents, and the Bidder further agrees that his Bid(s) includes all impacts resulting from said addenda.

SALES AND USE TAXES

The Bidder agrees that all federal, state, and local sales and use taxes are included in the stated bid prices for the work.

LUMP SUM

The Bidder further proposes to accept as full payment for the work proposed herein the amounts computed under the provisions of the Contract Documents and based on the following lump sum amounts. The Bidder agrees that the lump sum represent a true measure of the labor and materials required to perform the work, including all allowances for overhead and profit for each type and unit of work called for in these Contract Documents.

RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY RAS AND WAS PUMP SYSTEM REPLACEMENT:

LUMP SUM REPAIR AND REPLACEMENT OF RAS AND WAS SYSTEM PUMPS, PLUMBING, VALVES, METERS, INSTRUMENTATION, DRIVES, WIRING, SUPPORTS, AND APPURTENANCES

$_____

In Words:

_____Dollars &_____Cents

Payment for materials & equipment authorized by the Owner in a written Change Order but not listed in the Schedule of Values will be provided at suppliers' invoice plus 15 %.

List items to be performed by CONTRACTOR's own forces and the estimated total cost of these items. (Use additional sheets if necessary.)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

SUBCONTRACTORS

The Bidder further proposes that the following subcontracting firms or businesses will be awarded subcontracts for the following portions of the work if the Bidder is awarded the Contract:

_____
Name

_____, _____, _____, _____
Street City State Zip

Name

_____, _____, _____ ,_____
Street City State Zip

_____
Name

_____, _____, _____,_____
Street City State Zip

_____
Name

_____, _____, _____,_____
Street City State Zip

SURETY

_____ whose address is

_____, _____, _____,_____
Street City State Zip

BIDDER

The name of the Bidder submitting this Bid is

_____ doing business at

_____, _____, _____, _____
Street City State Zip

which is the address to which all communications concerned with this Bid and with the Contract shall be sent.

The names of the principal officers of the corporation submitting this Bid, or of the partnership, or of all persons interested in this Bid as principals are as follows:

_____ _____

_____ _____

_____ _____

_____ _____

If Sole Proprietor or Partnership

IN WITNESS hereto the undersigned has set his (its) hand this _____ day of _____ 2023.

_____
Signature of Bidder

_____
Title

If Corporation

IN WITNESS WHEREOF the undersigned corporation has caused this instrument to be executed and its seal affixed by its duly authorized officers this _____ day of _____ 2023.

(SEAL)

_____
Name of Corporation

_____
By

_____
Title

_____
Attest

Sworn and subscribed before this _____ day of _____, 20____

NOTARY PUBLIC, State of _____, at Large

My Commission Expires: _____

****

EXPERIENCE OF BIDDER

The Bidder states that he is an experienced CONTRACTOR and has completed similar projects within the last 5 years.

(List similar projects, with types, names of OWNERs, construction costs, ENGINEERs, and references with phone numbers. Use additional sheets if necessary.

FLORIDA BID BOND

BOND NO._____

AMOUNT: $_____

KNOW ALL MEN BY THESE PRESENTS, that _____

_____

hereinafter called the PRINCIPAL, and _____

_____

a corporation duly organized under the laws of the State of _____

having its principal place of business at _____

_____in the State of _____,

and authorized to do business in the State of Florida, as SURETY, are held and firmly bound unto

_____

hereinafter called the OBLIGEE, in the sum of_____

DOLLARS ($_____) for the payment for which we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these present.

THE CONDITION OF THIS BOND IS SUCH THAT:

WHEREAS, the PRINCIPAL is herewith submitting his or its Bid for **ITB # 23-007/ RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY RAS AND WAS PUMP SYSTEM REPLACEMENT** said Bid, by reference thereto, being hereby made a part hereof.

WHEREAS, the PRINCIPAL contemplates submitting or has submitted a bid to the OBLIGEE for the furnishing of all labor, materials (except those to be specifically furnished by the CITY), equipment, machinery, tools, apparatus, means of transportation for, and the performance of the work covered in the Bid and the Contract Documents, entitled:

ITB # 23-007 / RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY RAS AND WAS PUMP SYSTEM REPLACEMENT

WHEREAS, it was a condition precedent to the submission of said bid that a cashier's check, certified check, or bid bond in the amount of five (5) percent of the base bid be submitted with said bid as a guarantee that the Bidder would, if awarded the Contract, enter into a written Contract with the CITY for the performance of said Contract, within 10 working days after written notice having been given of the award of the Contract.

NOW, THEREFORE, the conditions of this obligation are such that if the PRINCIPAL within 10 consecutive calendar days after written notice of such acceptance, enters into a written Contract with the OBLIGEE and furnishes the Performance and Payment Bonds**,** each in an amount equal to 100 percent of the base bid, satisfactory to the CITY, then this obligation shall be void; otherwise the sum herein stated shall be due and payable to the OBLIGEE and the Surety herein agrees to pay said sum immediately upon demand of the OBLIGEE in good and lawful money of the United States of America, as liquidated damages for failure thereof of said PRINCIPAL.

Signed and sealed this _____ day of _____ ,2023.

PRINCIPAL

_____ STATE OF _____)

By : SS

COUNTY OF _____)

_____

SURETY

_____

By

ANTI – KICKBACK AFFIDAVIT

STATE OF _____ _ _____ _ _)

:

SS COUNTY OF _____)

I, the undersigned hereby duly sworn, depose and say that no portion of the sum herein bid will be paid to any employees of the City of Key West as a commission, kickback, reward or gift, directly or indirectly by me or any member of my firm or by an officer of the corporation.

By: _____

Sworn and subscribed before me this _____day of _____, 2023.

NOTARY PUBLIC, State of _____ at Large

My Commission Expires:

NON-COLLUSION AFFIDAVIT

STATE OF _____)
: SS
COUNTY OF _____)

I, the undersigned hereby declares that the only persons or parties interested in this Proposal are those named herein, that this Proposal is, in all respects, fair and without fraud, that it is made without collusion with any official of the Owner, and that the Proposal is made without any connection or collusion with any person submitting another Proposal on this Contract.

By: _____

Sworn and subscribed before me this

_____ day of _____, 2023.

_____
NOTARY PUBLIC, State of Florida at Large

My Commission Expires: _____

SWORN STATEMENT UNDER SECTION 287.133(3)(A)
FLORIDA STATUTES, ON **PUBLIC ENTITY CRIMES**

THIS FORM MUST BE SIGNED IN THE PRESENCE OF A NOTARY PUBLIC OR OTHER OFFICER AUTHORIZED TO ADMINISTER OATHS.

1. This sworn statement is submitted with Bid or Bid for _____

   _____

2. This sworn statement is submitted by_____
   (Name of entity submitting sworn statement)
   _____

   whose business address is _____

   _____

   and (if applicable) its Federal Employer Identification Number (FEIN) is _____

   _____

   (If the entity has no FEIN, include the Social Security Number of the individual

   signing this sworn statement _____

3. My name is _____
   (Please print name of individual signing)

   and my relationship to the entity named above is _____

4. I understand that a "public entity crime" as defined in Paragraph 287.133(1)(g), Florida Statutes, means a violation of any state or federal law by a person with respect to and directly related to the transaction of business with any public entity or with an agency or political subdivision of any other state or with the United States, including but not limited to, any bid or contract for goods or services to be provided to any public or an agency or political subdivision of any other state or of the United States and involving antitrust, fraud, theft, bribery, collusion, racketeering, conspiracy, material misrepresentation.

5. I understand that "convicted" or "conviction" as defined in Paragraph 287.133(1)(b), Florida Statutes, means a finding of guilt or a conviction of a public entity crime, with or without an adjudication guilt, in any federal or state trial court of record relating to charges brought by indictment information after July 1, 1989, as a result of a jury verdict, nonjury trial, or entry of a plea of guilty or nolo contendere.

6. I understand that an "affiliate" as defined in Paragraph 287.133(1)(a), Florida Statutes, means

a. A predecessor or successor of a person convicted of a public entity crime; or

b. An entity under the control of any natural person who is active in the management of the entity and who has been convicted of a public entity crime. The term "affiliate" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in the management of an affiliate. The ownership by one person of shares constituting controlling interest in another person, or a pooling of equipment or income among persons when not for fair market value under an arm's length agreement, shall be a prima facie case that one person controls another person. A person who knowingly enters into a joint venture with a person who has been convicted of a public entity crime in Florida during the preceding 36 months shall be considered an affiliate.

7. I understand that a "person" as defined in Paragraph 287.133(1)(8), Florida Statutes, means any natural person or entity organized under the laws of any state or of the United States with the legal power to enter into a binding contract and which bids or applies to bid on contracts for the provision of goods or services let by a public entity, or which otherwise transacts or applies to transact business with public entity. The term "person" includes those officers, directors, executives, partners, shareholders, employees, members, and agents who are active in management of an entity.

8. Based on information and belief, the statement which I have marked below is true in relation to the entity submitting this sworn statement. (Please indicate which statement applies).

____Neither the entity submitting this sworn statement, nor any officers, directors, executives, partners, shareholders, employees, members, or agents who are active in management of the entity, nor any affiliate of the entity have been charged with and convicted of a public entity crime subsequent to July 1, 1989, AND (Please indicate which additional statement applies.)

_____There has been a proceeding concerning the conviction before a hearing of the State of Florida, Division of Administrative Hearings. The final order entered by the hearing officer did not place the person or affiliate on the convicted vendor list. (Please attach a copy of the final order.)

_____The person or affiliate was placed on the convicted vendor list. There has been a subsequent proceeding before a hearing officer of the State of

Florida, Division of Administrative Hearings. The final order entered by the hearing officer determined that it was in the public interest to remove the person or affiliate from the convicted vendor list. (Please attach a copy of the final order.)

_____The person or affiliate has not been put on the convicted vendor list. (Please describe any action taken by or pending with the Department of General Services.)

_____
(Signature)

_____
(Date)

STATE OF_____

COUNTY OF_____

PERSONALLY, APPEARED BEFORE ME, the undersigned authority,

_____who, after first being sworn by me, affixed his/her
(Name of individual signing)

Signature in the space provided above on this_____day of _____ , 2023.

My commission expires:

_____
NOTARY PUBLIC

INDEMNIFICATION

To the fullest extent permitted by law, the CONTRACTOR expressly agrees to indemnify and hold harmless the City of Key West, their officers, directors, agents, and employees (herein called the "indemnitees") from liabilities, damages, losses and costs, including, but not limited to, reasonable attorney's fees and court costs, such legal expenses to include costs incurred in establishing the indemnification and other rights agreed to in this Paragraph, to persons or property, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of the CONTRACTOR, its Subcontractors or persons employed or utilized by them in the performance of the Contract. Claims by indemnitees for indemnification shall be limited to the amount of CONTRACTOR's insurance or $1 million per occurrence, whichever is greater. The parties acknowledge that the amount of the indemnity required hereunder bears a reasonable commercial relationship to the Contract and it is part of the project specifications or the bid documents, if any.

The indemnification obligations under the Contract shall not be restricted in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the CONTRACTOR under workers' compensation acts, disability benefits acts, or other employee benefits acts, and shall extend to and include any actions brought by or in the name of any employee of the CONTRACTOR or of any third party to whom CONTRACTOR may subcontract a part or all of the Work. This indemnification shall continue beyond the date of completion of the work.

CONTRACTOR: _____ SEAL:

_____
Address

_____
Signature

_____
Print Name

_____
Title

DATE: _____

LOCAL VENDOR CERTIFICATION PURSUANT TO CKW ORDINANCE 09-22 SECTION 2-798

The undersigned, as a duly authorized representative of the vendor listed herein, certifies to the best of his/her knowledge and belief, that the vendor meets the definition of a "Local Business." For purposes of this section, "local business" shall mean a business which:

a. Principle address as registered with the FL Department of State located within 30 miles of the boundaries of the city, listed with the chief licensing official as having a business tax receipt with its principle address within 30 miles of the boundaries of the city for at least one year immediately prior to the issuance of the solicitation.

b. Maintains a workforce of at least 50 percent of its employees from the city or within 30 miles of its boundaries.

c. Having paid all current license taxes and any other fees due the city at least 24 hours prior to the publication of the call for bids or request for Bids.

- Not a local vendor pursuant to Ordinance 09-22 Section 2-798
- Qualifies as a local vendor pursuant to Ordinance 09-22 Section 2-798

If you qualify, please complete the following in support of the self-certification & submit copies of your County and City business licenses. Failure to provide the information requested will result in denial of certification as a local business.

Business Name _____ Phone: _____

Current Local Address: _____ Fax:_____
(P.O Box numbers may not be used to establish status)

Length of time at this address:_____

_____ Date: _____
Signature of Authorized Representative

STATE OF_____ COUNTY OF_____

The foregoing instrument was acknowledged before me this _____day of_____, 2023.

By_____, of _____
(Name of officer or agent, title of officer or agent) (Name of corporation acknowledging)

or has produced identification_____as identification
(Type of identification)

_____
Signature of Notary

_____
Print, Type or Stamp Name of Notary

Return Completed form with
Supporting documents to:
City of Key West Purchasing

_____
Title or Rank

EQUAL BENEFITS FOR DOMESTIC PARTNERS AFFIDAVIT

STATE OF _____)
: SS
COUNTY OF _____)

I, the undersigned hereby duly sworn, depose and say that the firm of _____ provides benefits to domestic partners of its employees on the same basis as it provides benefits to employees' spouses per City of Key West Ordinance Sec. 2-799.

By: _____

Sworn and subscribed before me this

_____ Day of _____, 2023.

_____

NOTARY PUBLIC, State of _____ at Large

My Commission Expires: _____

CONE OF SILENCE AFFIDAVIT

STATE OF _____)
: SS
COUNTY OF _____)

I the undersigned hereby duly sworn depose and say that all owner(s), partners, officers, directors, employees and agents representing the firm of _____ have read and understand the limitations and procedures regarding communications concerning City of Key West issued competitive solicitations pursuant to City of Key West Ordinance Section 2-773 Cone of Silence.

Sworn and subscribed before me this

_____ Day of _____, 2023.

_____

NOTARY PUBLIC, State of _____ at Large

My Commission Expires: _____

VENDOR CERTIFICATION REGARDING
SCRUTINIZED COMPANIES LISTS

Respondent Vendor Name: _____

Vendor FEIN: _____

Vendor's Authorized Representative Name and Title: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone Number: _____

Email Address: _____

SECTION 287.135(2)(A), FLORIDA STATUTES, PROHIBITS A COMPANY FROM BIDDING ON, SUBMITTING A PROPOSAL FOR, OR ENTERING INTO OR RENEWING A CONTRACT FOR GOODS OR SERVICES OF ANY AMOUNT IF, AT THE TIME OF CONTRACTING OR RENEWAL, THE COMPANY IS ON THE SCRUTINIZED COMPANIES THAT BOYCOTT ISRAEL LIST, CREATED PURSUANT TO SECTION 215.4725, FLORIDA STATUTES, OR IS ENGAGED IN A BOYCOTT OF ISRAEL. SECTION 287.135(2)(B), FLORIDA STATUTES, FURTHER PROHIBITS A COMPANY FROM BIDDING ON, SUBMITTING A PROPOSAL FOR, OR ENTERING INTO OR RENEWING A CONTRACT FOR GOODS OR SERVICES OVER ONE MILLION DOLLARS ($1,000,000) IF, AT THE TIME OF CONTRACTING OR RENEWAL, THE COMPANY IS ON EITHER THE SCRUTINIZED COMPANIES WITH ACTIVITIES IN SUDAN LIST OR THE SCRUTINIZED COMPANIES WITH ACTIVITIES IN THE IRAN PETROLEUM ENERGY SECTOR LIST, BOTH CREATED PURSUANT TO SECTION 215.473, FLORIDA STATUTES, OR THE COMPANY IS ENGAGED IN BUSINESS OPERATIONS IN CUBA OR SYRIA.

AS THE PERSON AUTHORIZED TO SIGN ON BEHALF OF RESPONDENT, I HEREBY CERTIFY THAT THE COMPANY IDENTIFIED ABOVE IN THE SECTION ENTITLED "RESPONDENT VENDOR NAME" IS NOT LISTED ON EITHER THE SCRUTINIZED COMPANIES THAT BOYCOTT ISRAEL LIST, SCRUTINIZED COMPANIES WITH ACTIVITIES IN SUDAN LIST OR THE SCRUTINIZED COMPANIES WITH ACTIVITIES IN THE IRAN PETROLEUM ENERGY SECTOR LIST I UNDERSTAND THAT PURSUANT TO SECTION 287.135, FLORIDA STATUTES, THE SUBMISSION OF A FALSE CERTIFICATION MAY SUBJECT SUCH COMPANY TO CIVIL PENALTIES, ATTORNEY'S FEES, AND/OR COSTS AND TERMINATION OF THE CONTRACT AT THE OPTION OF THE AWARDING GOVERNMENTAL ENTITY.

CERTIFIED BY: _____,
PRINT NAME *PRINT TITLE*

WHO IS AUTHORIZED TO SIGN ON BEHALF OF THE ABOVE REFERENCED COMPANY.

Authorized Signature:_____.

BIDDER'S CHECKLIST

(Note: The purpose of this checklist is to serve as a reminder of major items to be addressed in submitting a bid and is not intended to be all inclusive. It does not alleviate the Bidder from the responsibility of becoming familiar with all aspects of the Contract Documents and proper completion and submission of his bid.)

1.	All Contract Documents thoroughly read and understood.	[ ]
2.	All blank spaces in Bid filled in, using blue ink.	[ ]
3.	Total and unit prices added correctly and attached Schedule of Values	[ ]
4.	Addenda acknowledged.	[ ]
5.	Subcontractors are named as indicated in the Bid.	[ ]
6.	Experience record included.	[ ]
7.	Bid signed by authorized officer and notarized.	[ ]
8.	Bid Bond completed and executed, including power-of-attorney dated the same date as Bid Bond.	[ ]
9.	Bidder familiar with federal, state, and local laws, ordinances, rules and regulations affecting performance of the work.	[ ]
10.	Bidder, if successful, able to obtain and/or demonstrate possession of required licenses and certificates within (10) ten calendar days after receiving a Notice of Award.	[ ]
11.	BID submitted intact with the volume entitled “Bidding Requirements” and “Contract Forms”, 1 original, and 2 flash drives as stated in the invitation to bid.	[ ]
12.	Bid Documents submitted in sealed envelope and addressed and labeled in conformance with the instructions in the Invitation to Bid.	[ ]

PART 2

CONTRACT FORMS

CONTRACT

This Contract, made and entered into this _____ day of _____ 2023,

by and between the CITY OF KEY WEST, hereinafter called the "Owner", and _____

_____

hereinafter called the "Contractor";

WITNESSETH:

The Contractor, in consideration of the sum to be paid him by the Owner and of the covenants and agreements herein contained, hereby agrees at his own proper cost and expense to do all the work and furnish all the materials, tools, labor, and all appliances, machinery, and appurtenances for ITB # 23-007 RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY RAS AND WAS PUMP SYSTEM REPLACEMENT Key West, Florida to the extent of the Bid made by the Contractor, dated the _____ day of_____2023, all in full compliance with the Contract Documents referred to herein.

The CONTRACT DOCUMENTS, including the signed copy of the BID, BID BOND, CONTRACT FORM, SUMMARY OF WORK, SPECIFICATIONS, DRAWINGS, GENERAL & SUPPLEMENTARY CONDITIONS OF THE CONTRACT.

In consideration of the performance of the work as set forth in these Contract Documents, the Owner agrees to pay to the Contractor the amount bid in the Bid as adjusted in accordance with the Contract Documents, or as otherwise herein provided, and to make such payments in the manner and at the times provided in the Contract Documents.

The Contractor agrees to complete the work within 270 days and to accept as full payment hereunder the amounts computed as determined by the Contract Documents and based on the said BID.

The Contractor agrees to remedy all defects appearing in the work or developing in the materials furnished and the workmanship performed under this Contract during the warranty period after the date of final acceptance of the work by the Owner, and further agrees to indemnify and save the Owner harmless from any costs encountered in remedying such defects.

It is agreed that the Contract, based upon the BID, shall be fully complete within the stated number of consecutive calendar days from the date the Notice to Proceed is issued.

In the event the Contractor fails to complete the work within the time limit or extended time limit agreed upon, as more particularly set forth in the Contract Documents, liquidated damages shall be paid at a rate of $1,000.00 per day. Sundays and legal holidays shall be included in determining days in default.

This contract will automatically expire upon completion of the project. Contractors warranty obligations remain in effect.

IN WITNESS WHEREOF, we, the parties hereto, each herewith subscribe the same this

_____ Day of _____, A.D., 2023.

CITY OF KEY WEST

_____ _____

By Attest

City Manager
Title

CONTRACTOR

_____ _____

By Attest

_____

Title

FLORIDA PERFORMANCE BOND

BOND NO._____

AMOUNT: $_____

KNOW ALL MEN BY THESE PRESENTS, that in accordance with Florida Statutes Section 255.05, _____

with offices, at _____

hereinafter called the CONTRACTOR, (Principal), and _____

with offices, at _____

a corporation duly organized and existing under and by virtue of the laws of the State of _____ , hereinafter called the SURETY, and authorized to transact business within the State of Florida, as SURETY, are held and firmly bound CITY OF KEY WEST**,**

represented by its _____, hereinafter called the City (Obligee), in the sum of:

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

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT:

WHEREAS, the CONTRACTOR has executed and entered into a certain Contract hereto attached, with the CITY, dated _____,2023, to furnish at his own cost, charges, and expense all the necessary materials, equipment, and/or labor in strict and express accordance with said Contract and the Contract Documents as defined therein, all of which is made a part of said Contract by certain terms and conditions in said Contract more particularly mentioned, which Contract, consisting of the various Contract Documents is made a part of this Bond as fully and completely as if said Contract Documents were set forth herein;

NOW THEREFORE, the conditions of this obligation are such that if the above bounden CONTRACTOR:

1. Shall in all respects comply with the terms and conditions of said Contract and his obligation there under, including the Contract Documents (which include the permit form, coral relocation plan, specifications, and conditions as prepared by the CITY, invitation to bid, instructions to bidders, the CONTRACTOR'S bid as accepted by the above CITY, the bid and contract performance and payment bonds, and all addenda, if any, issued prior to the opening of bids),

being made a part of this bond by reference, at the times and in the manner prescribed in the contract; and

2. Promptly makes payments to all claimants, as defined in Section 255.05(1), Florida Statutes, supplying PRINCIPAL with labor, materials, or supplies, used directly or indirectly by PRINCIPAL in the prosecution of the work provided for in the contract; and

3. Pays CITY all losses, costs, expenses, damages, attorney's fees, including appellate proceedings, injury or loss of whatever kind and however arising including, without limitation, delay damages to which said CITY may be subject by reason of any wrongdoing, misconduct, want of care or skill, negligence, failure of performance, breach, failure to petition within the prescribed time, or default, including patent infringements, on the part of said CONTRACTOR, his agents or employees, in the execution or performance of said Contract; and

4. Performs the guarantee of all work and materials furnished under the contract for the time specified in the contract, then this obligation shall be void; otherwise, to remain in full force and effect for the term of said Contract.

AND, the said Surety for value received, hereby stipulates and agrees that no change involving any extension of time, or addition to the terms of the Contract Documents, or to the work to be performed, or materials to be furnished there under shall affect said obligation of said Surety on this Bond, and the said Surety does hereby waive notice of any such changes, extension of time, alterations, or additions of the terms of the Contract Documents, or to the work.

Any action instituted by a claimant under this bond for payment must be in accordance with the notice and time limitation provisions in Section 255.05(2), Florida Statutes.

IN WITNESS WHEREOF, the above parties bonded together have executed this instrument this day of _____,2023, the name and corporate seal of each corporate party being hereto affixed and those presents duly signed by its undersigned representative, pursuant to authority of its governing body.

CONTRACTOR

_____

By:_____(Seal)

_____ Attest

SURETY

By _____(Seal)

_____ Attest

FLORIDA PAYMENT BOND

BOND NO_____

AMOUNT: $_____

KNOW ALL MEN BY THESE PRESENTS, that in accordance with Florida Statutes Section 255.05, _____

with offices at _____

hereinafter called the CONTRACTOR, (Principal), and

_____

with offices at _____

a corporation duly organized and existing under and by virtue of the laws of the State of _____ , hereinafter called the SURETY, and authorized to transact business within the State of Florida, as SURETY, are held and firmly bound CITY OF KEY WEST**,**

represented by its _____, hereinafter called the City (Obligee), in the sum of:

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

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH THAT:

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

RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY AERATION, RAS AND WAS PUMP SYSTEM REPLACEMENT ITB 23-007
attached hereto, with the CITY, dated _____, 2023, to furnish at his own cost, charges, and expense the necessary materials, equipment, and/or labor in strict and express accordance with said Contract and the plans, drawings (if any), and specifications prepared by the CITY, all of which is made a part of said Contract by certain terms and conditions in said Contract more particularly mentioned, which Contract, consisting of the various Contract Documents specifically mentioned herein and relative hereto, is made a part of this Bond as fully and completely as if said Contract Documents were set forth herein.

NOW THEREFORE, the conditions of this obligation are such that if the above bounden CONTRACTOR shall in all respects comply with the terms and conditions of said Contract and his obligation thereunder, including the Contract Documents (which include the permit form, coral

relocation plan, the specifications, and conditions prepared by the CITY, invitation to bid, instructions to bidders, the CONTRACTOR'S bid as accepted by the CITY, the bid and contract and payment bonds, and all addenda, if any, issued prior to the opening of bids), and further that if said CONTRACTOR shall promptly make payments to all persons supplying materials, equipment, and/or labor, used directly or indirectly by said CONTRACTOR or SUBCONTRACTORs in the prosecution of the work for said contract is accordance with Florida Statutes, Section 255.05 or Section 713.23, then this obligation shall be void; otherwise to remain in full force and effect for the term of said contract, including and all guarantee periods as specifically mentioned in said Contract Documents.

AND, the said SURETY for value received, hereby stipulates and agrees that no change involving any extension of time, or addition to the terms of the Contract or to the work to be performed, or materials to be furnished thereunder, or in the Contract Documents and specifications accompanying the said contract shall affect said obligation of said SURETY on this Bond, and the said SURETY does hereby waive notice of any such changes, extension of time, alternations, or additions of the terms of the Contract, or to the work, to the Contract Documents, or to the specifications.

Claimant shall give written notice to the CONTRACTOR and the SURETY as required by Section 255.05 or Section 713.23, Florida Statutes. Any action instituted against the CONTRACTOR or SURETY under this bond for payment must be in accordance with the notice and time limitation provisions in Section 255.05(2) or Section 713.23, Florida Statutes.

IN WITNESS WHEREOF, the above parties bounded together have executed this instrument this _____ day of _____,2023, the name and corporate seal of each corporate party being hereto affixed and those presents duly signed by its undersigned representative, pursuant to authority of its governing body.

_____
Contractor

_____ (Seal)
By

_____
Attest

SURETY

_____ (Seal)
By

_____
Attest

PART 3

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DEFINITIONS

Whenever in the Contract Documents the following terms are used, the intent and meaning shall be interpreted as follows:

1. AS APPROVED

The words "as approved", unless otherwise qualified, shall be understood to be followed by the words "by the ENGINEER for conformance with the Contract Document".

2. AS SHOWN, AND AS INDICATED

The words "as shown" and "as Indicated" shall be understood to be followed by the words "on the Drawings".

3. BIDDER

The person or persons, partnership, firm, or corporation submitting a Bid for the work contemplated.

4. CONTRACT DOCUMENTS

The "Contract Documents" consist of the Bidding Requirements, Contract Forms, Conditions of the Contact, Specifications, Drawings, all modifications thereof incorporated into the Documents before their execution, Change Orders, and all other requirements incorporated by specific reference thereto. These form the Contract.

5. CONTRACTOR

The person or persons, partnership, firm, or corporation who enters into the Contract awarded him by the OWNER.

6. CONTRACT COMPLETION

The "Contract Completion" is the date the OWNER accepts the entire work as being in compliance with the Contract Documents, or formally waives nonconforming work to extent of nonconformity, and issues the final payment in accordance with the requirements set forth in Article, "Final Payment" of these General Conditions.

7. DAYS

Unless otherwise specifically stated, the term "days" will be understood to mean calendar days. Business day or working day means any day other than Saturday, Sunday, or legal holiday.

8. DRAWINGS

The term "Drawings" refers to the official Drawings, Profiles, cross sections, elevations, details, and other working drawings and supplementary drawings, or reproductions thereof, signed by the ENGINEER, which shows the location, character, dimensions, and details of the work to be performed. Drawings may either be bound in the same book as the balance of the Contract Documents, or bound in separate sets, and are a part of the Contract Documents, regardless of the method of binding.

9. ENGINEER

The person or organization identified as such in the Contract Documents. The Term "ENGINEER" means ENGINEER or his authorized representative.

10. NOTICE

The term "notice" or the requirement to notify, as used in the Contract Documents or applicable state or federal statutes, shall signify a written communication delivered in person or by registered mail to the individual, or to a member of the firm, or to an officer of the corporation for whom it is intended. Certified or registered mail shall be addressed to the last business address known to him who gives the notice.

11. OR EQUAL

The term "or equal" shall be understood to indicate that the "equal" Product is equivalent to or better than the Product named in function, performance, reliability, quality, and general configuration. Determination of equality in reference to the Project design requirements will be made by the ENGINEER. Such equal Products shall not be purchased or installed by the CONTRACTOR without written authorization.

12. OWNER

The person, organization, or public body identified as such in the Contract Documents.

13. PLANS (See Drawings)

14. SPECIFICATIONS

The term "Specifications" refers to those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards, and workmanship as applied to the work and certain administrative details applicable thereto. Where standard specifications, such as those of ASTM, AASHTO, etc., have been referred to, the applicable portions of such standard specifications shall become a part of these Contract Documents. If referenced specifications conflict with specifications contained herein, the requirements contained herein shall prevail.

15. NOTICE TO PROCEED

A written notice given by the OWNER to the CONTRACTOR (with a copy to the ENGINEER) fixing the date on which the Contract time will commence to run and on which the CONTRACTOR shall start to perform his obligation under the Contract Documents. The Notice to Proceed will be given within 30 days following the execution of the Contract by the OWNER.

16. SUBSTANTIAL COMPLETION

"Substantial Completion" shall be that degree of completion of the Project or a defined portion of the Project, as evidenced by the ENGINEER's written notice of Substantial Completion, sufficient to Provide the OWNER, at his discretion, the full-time use of the Project or defined portion of the Project for the purposes for which it was intended. "Substantial Completion" of an operating facility shall be that degree of completion that has Provided a minimum of 7 continuous days of successful, trouble-free, operation, which period shall begin after all performance and acceptance testing has been successfully demonstrated to the ENGINEER. All equipment contained in the work, plus all other components necessary to enable the OWNER to operate the facility in a manner that was intended, shall be complete on the substantial completion date.

17. WORK

The word "work" within these Contract Documents shall include all material, labor, tools, and all appliances, machinery, transportation, and appurtenances necessary to perform and complete the Contract, and such additional items not specifically indicated or described which can be reasonably inferred as belonging to the item described or indicated and as required by good Practice to Provide a complete and satisfactory system or structure. As used herein, "Provide" shall be understood to mean "furnish and install, complete in-place ".

CONTRACT DOCUMENTS

18. INTENT OF CONTRACT DOCUMENTS

The Contract Documents are complementary, and what is called for by one shall be as binding as if called for by all. The intent of the Documents is to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents. Any work, materials, or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe work, materials, or equipment, such words shall be interpreted in accordance with that meaning.

Reference to standard specifications, manuals, or codes of any technical society, organization or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code or laws or regulations in effect on the first published date of the Invitation to Bid, except as may be otherwise specifically stated. However, no Provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR, or ENGINEER, or any of their consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to ENGINEER, or any ENGINEER's consultants, agents, or employees, any duty or authority to supervise or direct the furnishing or performance of the work or any duty or authority to undertake responsibility contrary to the Provisions of Article LIMITATIONS ON ENGINEER'S RESPONSIBILITIES.

19. DISCREPANCIES AND OMISSIONS

Any discrepancies or omissions found in the Contract Documents shall be reported to the ENGINEER immediately. The ENGINEER will clarify discrepancies or omissions, in writing, within a reasonable time.

In resolving inconsistencies among two or more sections of the Contract Documents, Precedence shall be given in the following order:

A. CONTRACT
B. BID
C. SUPPLEMENTARY CONDITIONS
D. INVITATION TO BID
E. INSTRUCTIONS TO BIDDERS
F. GENERAL CONDITIONS
G. SPECIFICATIONS
H. DRAWINGS

Addenda shall take Precedence over all sections referenced therein. Figure dimensions on Drawings shall take precedence over scale dimensions. Detailed Drawings shall take precedence over general Drawings.

20. CHANGES IN THE WORK

The OWNER, without notice to the Sureties and without invalidating the Contract, may order changes in the work within the general scope of the Contract by altering, adding to, or deducting from the work, the Contract being adjusted accordingly. All such work shall be executed under the conditions of the original Contract, except as specifically adjusted at the time of ordering such change.

In giving instructions, the ENGINEER may order minor changes in the work not involving extra cost and not inconsistent with the purposes of the Project, but otherwise, except in an emergency endangering life and Property, additions or deductions from the work shall be performed only in pursuance of an approved Change Order from the OWNER, countersigned by the ENGINEER.

If the work is reduced by alterations, such action shall not constitute a claim for damages based on loss of anticipated Profits.

21. EXAMINATION AND VERIFICATION OF CONTRACT DOCUMENTS

The CONTRACTOR shall thoroughly examine and become familiar with all of the various parts of these Contract Documents and determine the nature and location of the work, the general and local conditions, and all other matters, which can in any way affect the work under this Contract. Failure to make an examination necessary for this determination shall not release the CONTRACTOR from the obligations of this Contract. No verbal agreement or conversation with any officer, agent, or employee of the OWNER or with the ENGINEER either before or after the execution of this Contract shall affect or modify any of the terms or obligations herein contained.

22. DOCUMENTS TO BE KEPT ON THE JOBSITE

The CONTRACTOR shall keep one copy of the Contract Documents on the job- site, in good order, available to the ENGINEER and to his representatives.

The CONTRACTOR shall maintain on a daily basis at the jobsite, and make available to the ENGINEER on request, one current

record set of the Drawings which have been accurately marked to indicate all modifications in the completed work that differ from the design information shown on the Drawings. Upon Substantial completion of the work, the CONTRACTOR shall give the ENGINEER one complete set of these marked up record Drawings.

23. ADDITIONAL CONTRACT DOCUMENTS

Copies of Contract Documents or Drawings may be obtained on request from the ENGINEER and by paying the actual cost of reproducing the Contract Documents or Drawings.

24. OWNERSHIP OF CONTRACT DOCUMENTS

All portions of the Contract Documents, and copies thereof furnished by the ENGINEER are instruments of service for this Project. They are not to be used on other work and are to be returned to the ENGINEER on request at the completion of the work. Any reuse of these materials without specific written verification or adaptation by the ENGINEER will be at the risk of the user and without liability or legal expense to the ENGINEER. Such user shall hold the ENGINEER harmless from any and all damages, including reasonable attorneys' fees, from any and all claims arising from any such reuse. Any such verification and adaptation shall entitle the ENGINEER to further compensation at rates to be agreed upon by the user and the ENGINEER.

THE ENGINEER

25. AUTHORITY OF THE ENGINEER

The ENGINEER will be the OWNER's representative during the construction period. His authority and responsibility will be limited to the Provisions set forth in these Contract Documents. The ENGINEER will have the Authority to reject work that does not conform to the Contract Documents. However, neither the ENGINEER's authority to act under this Provision, nor any decision made by him in good faith either to exercise or not to exercise such authority, shall give rise to any duty or responsibility of the ENGINEER to the CONTRACTOR, any SUBCONTRACTOR, their respective Sureties, any of their agents or employees, or any other person performing any of the work.

26. DUTIES AND RESPONSIBILITIES OF THE ENGINEER

The ENGINEER will make visits to the site at intervals appropriate to the various stages of construction to observe the Progress and quality of the work and to determine, in general, if the work is proceeding in accordance with the intent of the Contract Documents. He will not make comprehensive or continuous review or observation to check quality or quantity of the work, and he will not be responsible for construction means, methods, techniques, sequences, or Procedures, or for safety Precautions and Programs in connection with the work. Visits and observations made by the ENGINEER shall not relieve the CONTRACTOR of his obligation to conduct comprehensive inspections of the work and to furnish materials and perform acceptable work, and to provide adequate safety Precautions, in conformance with the intent of the Contract.

The ENGINEER will make recommendations to the OWNER, in writing, on all claims of the OWNER or the CONTRACTOR arising from interpretation or execution of the Contract Documents. Such recommendations will be of factual and/or technical nature, and will not include the legal interpretation of the Contract Documents. Any necessary legal interpretation of the Contract Document will be made by the OWNER. Such recommendation shall be necessary before the CONTRACTOR can receive additional money under the terms of the Contract. Changes in work ordered by the ENGINEER shall be made in compliance with Article CHANGES IN THE WORK.
One or more Project representatives may be assigned to observe the work. It is understood that such Project representatives shall have the authority to issue notice of nonconformance and make decisions within the limitations of the authority of the ENGINEER. The CONTRACTOR shall furnish all reasonable assistance required by the ENGINEER or Project representatives for Proper observation of the work. The above-mentioned Project representatives shall not relieve the CONTRACTOR of his obligations to conduct comprehensive inspections of the work and to furnish materials and perform acceptable work, and to provide adequate safety Precautions, in conformance with the intent of the Contract.

27. LIMITATIONS ON ENGINEER'S RESPONSIBILITIES

ENGINEER will not be responsible for CONTRACTOR's means, methods, techniques, sequences, or Procedures of construction, or the safety Precautions and Programs incident thereto, and ENGINEER will not be responsible for CONTRACTOR's failure to

perform or furnish the work in accordance with the Contract Documents.

ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any SUBCONTRACTOR, any supplier, or of any other person or organization performing or furnishing any of the work.

Whenever in the Contract Documents the terms "as ordered", "as directed", "as required", "as allowed", "as approved", or terms of like effect or import are used, or the adjectives "reasonable", "suitable", "acceptable", "Proper", or "satisfactory", or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the work, it is intended that such requirement, direction, review or judgment will be solely to evaluate the work for compliance with the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the work or any duty or authority to undertake responsibility contrary to the Provisions of this Article.

28. REJECTED WORK

Any defective work or nonconforming materials or equipment that may be discovered at any time prior to expiration of the warranty period shall be removed and replaced by work which shall conform to the Provisions of the Contract Documents. Any material condemned or rejected shall be removed at once from the Project site.

Failure on the part of the ENGINEER to condemn or reject bad or inferior work or to note nonconforming materials or equipment on CONTRACTOR submittals shall not be construed to imply acceptance of such work. The OWNER shall reserve and retain all of its rights and remedies at law against the CONTRACTOR and its Surety for correction of any and all latent defects discovered after the guarantee period.

29. LINES AND GRADES

Lines and grades shall be established as provided in the supplementary conditions. All stakes, marks, and other reference information shall be carefully preserved by the CONTRACTOR, and in case of their careless or unnecessary destruction or removal by him or his employees, such stakes, marks, and other information shall be replaced at the CONTRACTOR's expense.

30. SUBMITTALS

After checking and verifying all field measurements and after complying with applicable Procedures specified in Division I, GENERAL REQUIREMENTS, CONTRACTOR shall submit to ENGINEER, in accordance with the schedule for submittals for review, shop drawings, electrical diagrams, and catalog cuts for fabricated items and manufactured items (including mechanical and electrical equipment), which shall bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's responsibilities under the Contract Documents with respect to the review of the submittal. All submittals shall be identified as ENGINEER may require. The data shown shall be complete with respect to quantities, dimensions specified, performance and design criteria, materials, and similar data to enable ENGINEER to review the information. CONTRACTOR shall also submit to ENGINEER for review, with such promptness as to cause no delay in work, all samples required by the Contract Documents. All samples shall have been checked by and accompanied by a specific written indication that CONTRACTOR has satisfied CONTRACTOR's responsibilities under the Contract Documents with respect to the review of the submission and shall be identified clearly as to material, supplier, pertinent data such as catalog numbers and the use for which intended.

Before submission of each submittal, CONTRACTOR shall have determined and verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar data with respect thereto and reviewed or coordinated each submittal with other submittals and with the requirements of the work and the Contract Documents.

At the time of each submission, CONTRACTOR shall give ENGINEER specific written notice of each variation that the submittal may have from the requirements of the Contract Documents, and, in addition, shall cause a specific notation to be made on each shop drawing submitted to ENGINEER for review and approval of each variation.

ENGINEER will review submittals with reasonable Promptness, but ENGINEER's review will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, techniques, sequences, or Procedures of construction (except where a specific means, method, technique, sequence, or Procedure of construction is indicated in or required by the Contract Documents) or to safety Precautions or Programs incident thereto. The review of a separate item as such will not indicate review of the assembly in which the item functions. CONTRACTOR

shall make corrections required by ENGINEER, and shall return the required number of corrected copies of shop drawings and submit as required new samples for review. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on Previous submittals.

ENGINEER's review of submittals shall not relieve CONTRACTOR from the responsibility for any variation from the requirements of the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to each such variation at the time of submission and ENGINEER has given written approval of each such variation by a specific written notation thereof incorporated therein or accompanying the shop drawing or sample approval; nor will any approval by ENGINEER relieve CONTRACTOR from responsibility for errors or omissions in the shop drawings or from responsibility for having complied with the Provisions herein. Where a shop drawing or sample is required by the specifications, any related work performed prior to ENGINEER's review and approval of the pertinent submission shall be at the sole expense and responsibility of the CONTRACTOR.

31. DETAIL DRAWINGS AND INSTRUCTIONS

The ENGINEER will furnish, with reasonable Promptness, additional instructions by means of Drawings or otherwise, if, in the ENGINEER's opinion, such are required for the Proper execution of the work. All such Drawings and instructions will be consistent with the Contract Documents, true developments thereof, and reasonably inferable there from.

THE CONTRACTOR AND HIS EMPLOYEES

32. CONTRACTOR, AN INDEPENDENT AGENT

The CONTRACTOR shall independently perform all work under this Contract and shall not be considered as an agent of the OWNER or of the ENGINEER, nor shall the CONTRACTOR's SUBCONTRACTORS or employees be subagents of the OWNER or of the ENGINEER.

33. SUBCONTRACTING

Unless modified in the Supplementary Conditions, within 10 days after the execution of the Contract, the CONTRACTOR shall submit to the ENGINEER the names of all SUBCONTRACTORS Proposed for the work, including the names of any SUBCONTRACTORS that were submitted with the Bid. The CONTRACTOR shall not employ any SUBCONTRACTORS to which the OWNER may object to as lacking capability to properly perform work of the type and scope anticipated.

The CONTRACTOR is as fully responsible to the OWNER for the acts and omissions of his SUBCONTRACTORS and of persons either directly or indirectly employed by them as he is for the acts and omissions of persons directly employed by him.

Nothing contained in the Contract Documents shall create any contractual relationship between any SUBCONTRACTOR and the OWNER or ENGINEER.

34. INSURANCE AND LIABILITY

A. GENERAL

The CONTRACTOR shall provide (from insurance companies acceptable to the OWNER) the insurance coverage designated hereinafter and pay all costs before commencing work under this Contract. The CONTRACTOR shall furnish the OWNER with certificates of insurance specified herein showing the type, amount class of operations covered, effective dates, and date of expiration of policies, and containing substantially the following statement:
"The insurance covered by this certificate shall not be canceled or materially altered, except after 30 days' written notice has been received by the OWNER."

In case of the breach of any Provision of this Article, the OWNER, at his option, may take out and maintain, at the expense of the CONTRACTOR, such insurance as the OWNER may deem Proper and may deduct the cost of such insurance from any monies which may be due or become due the CONTRACTOR under this Contract.

B. CONTRACTOR AND SUBCONTRACTOR INSURANCE

The CONTRACTOR shall not commence work under this Contract until he has obtained all the insurance required hereunder and

such insurance has been reviewed by the OWNER, nor shall the CONTRACTOR allow any SUBCONTRACTOR to commence work on his subcontract until insurance specified below has been obtained. Review of the insurance by the OWNER shall not relieve or decrease the liability of the CONTRACTOR hereunder.

C. COMPENSATION AND EMPLOYER'S LIABILITY INSURANCE

The CONTRACTOR shall maintain during the life of this Contract the statutory amount of Workmen's Compensation Insurance, in addition, Employer's Liability Insurance in an amount as specified in the Supplementary Conditions, for each occurrence, for all of his employees to be engaged in work on the Project under this Contract. In case any such work is subcontracted, the CONTRACTOR shall require the SUBCONTRACTOR to provide similar Workmen's Compensation and Employer's Liability Insurance for all of the SUBCONTRACTOR's employees to be engaged in such work.

D. GENERAL LIABILITY INSURANCE (INCLUDING AUTOMOBILE)

The CONTRACTOR shall maintain during the life of this Contract such general liability, completed operations and Products liability, and automobile liability insurance as will Provide coverage for claims for damages for personal injury, including accidental death, as well as for claims for Property damage, which may arise directly or indirectly from performance of the work under this Contract. The general liability policy shall include contractual liability assumed by the CONTRACTOR under Article **INDEMNITY.** Coverage for Property damage shall be on a "broad form" basis with no exclusions for "X, C & U". The amount of insurance to be provided shall be as specified in the Supplementary Conditions.

In the event any work under this Contract is performed by a SUBCONTRACTOR, the CONTRACTOR shall be responsible for any liability directly or indirectly arising out of the work performed by the SUBCONTRACTOR; to the extent such liability is not covered by the SUBCONTRACTOR's insurance.

The OWNER and ENGINEER, their officers, agents, and employees shall be named as Additional Insured's on the CONTRACTOR's and any SUBCONTRACTOR's general liability and automobile liability insurance policies for any claims arising out of work performed under this Contract.

E. BUILDERS RISK ALL RISK INSURANCE

Unless otherwise modified in the Supplementary Conditions, the CONTRACTOR shall secure and maintain during the life of this Contract, Builders Risk All Risk Insurance coverage in an amount equal to the full value of the facilities under construction. Such insurance shall include coverage for earthquake, landslide, flood, collapse, loss due to the results of faulty workmanship or design, and all other normally covered risks, and shall provide for losses to be paid to the CONTRACTOR, OWNER, and ENGINEER as their interests may appear.

The OWNER and ENGINEER, their officers, agents, and employees shall be named as additional insured's on the CONTRACTOR's and any SUBCONTRACTOR's Builders Risk All Risk insurance policies for any claims arising out of work performed under this Contract.

This insurance shall include a waiver of subrogation as to the ENGINEER, the OWNER, the CONTRACTOR, and their respective officers, agents, employees and SUBCONTRACTORS.

F. NO PERSONAL LIABILITY OF PUBLIC OFFICIALS

In carrying out any of the Provisions hereof in exercising any authority granted by the Contract, there will be no personal liability upon any public official.

35. INDEMNITY

To the maximum extent permitted by law, the CONTRACTOR shall indemnify and defend the OWNER and the ENGINEER, and their officers, employees, agents, and sub-consultants, from all claims and losses, including attorney's fees and litigation costs arising out of Property losses or health, safety, personal injury, or death claims by the CONTRACTOR, its SUBCONTRACTORS of any tier, and their employees, agents, or invitees regardless of the fault, breach of Contract, or negligence of the OWNER or ENGINEER, excepting only such claims or losses that have been adjudicated to have been caused solely by the negligence of the OWNER or the

ENGINEER and regardless of whether or not the CONTRACTOR is or can be named a party in a litigation.

36. EXCLUSION OF CONTRACTOR CLAIMS

In performing its obligations, the ENGINEER and its consultants may cause expense for the CONTRACTOR or its SUBCONTRACTORS and equipment or material suppliers. However, those parties and their sureties shall maintain no direct action against the ENGINEER, its officers, employees, agents, and consultants for any claim arising out of, in connection with, or resulting from the engineering services performed or required to be performed.

37. TAXES AND CHARGES

The CONTRACTOR shall withhold and pay any and all sales and use taxes and all withholding taxes, whether State or Federal, and pay all Social Security charges and also all State Unemployment Compensation charges, and pay or cause to be withheld, as the case may be, any and all taxes, charges, or fees or sums whatsoever, which are now or may hereafter be required to be paid or withheld under any laws.

38. REQUIREMENTS OF STATE LAW FOR PUBLIC WORKS PROJECTS

When the Contract Documents concern public works of the state or any county, municipality, or political subdivision created by its laws, the applicable statutes shall apply. All parties to this Contract shall determine the contents of all applicable statutes and comply with their Provisions throughout the performance of the Contract.

39. CODES, ORDINANCES, PERMITS AND LICENSES

The CONTRACTOR shall keep himself fully informed of all local codes and ordinances, as well as state and federal laws, which in any manner affect the work herein specified. The CONTRACTOR shall at all times comply with said codes and ordinances, laws, and regulations, and Protect and indemnify the OWNER, the ENGINEER and their respective employees, and its officers and agents against any claim or liability arising from or based on the violation of any such laws, ordinances, or regulations. All permits, licenses and inspection fees necessary for Prosecution and completion of the work shall be secured and paid for by the CONTRACTOR, unless otherwise specified.

40. SUPERINTENDENCE

The CONTRACTOR shall keep at the project site, competent supervisory personnel. The CONTRACTOR shall designate, in writing, before starting work, a Project superintendent who shall be an employee of the CONTRACTOR and shall have complete authority to represent and to act for the CONTRACTOR. ENGINEER shall be notified in writing prior to any change in superintendent assignment. The CONTRACTOR shall give efficient supervision to the work, using his best skill and attention. The CONTRACTOR shall be solely responsible for all construction means, methods, techniques, and Procedures, and for providing adequate safety Precautions and coordinating all portions of the work under the Contract. It is specifically understood and agreed that the ENGINEER, its employees and agents, shall not have control or charge of and shall not be responsible for the construction means, methods, techniques, procedures, or for providing adequate safety precautions in connection with the work under Contract.

41. RECEPTION OF ENGINEER'S COMMUNICATIONS

The superintendent shall receive for the CONTRACTOR all communications from the ENGINEER. Communications of major importance will be confirmed in writing upon request from the CONTRACTOR.

The ENGINEER may schedule Project meetings for the purposes of discussing and resolving matters concerning the various elements of the work. Time and place for these meetings and the names of persons required to be Present shall be as determined by the ENGINEER. CONTRACTOR shall comply with these attendance requirements and shall also require his SUBCONTRACTORS to comply.

42. SAFETY

The CONTRACTOR shall be solely and completely responsible for conditions of the jobsite, including safety of all persons (including employees) and Property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. Safety Provisions shall conform to U.S. Department of Labor (OSHA), and all other applicable federal,

state, county, and local laws, ordinances, codes, and regulations. Where any of these are in conflict, the more stringent requirement shall be followed. The CONTRACTOR's failure to thoroughly familiarize himself with the aforementioned safety Provisions shall not relieve him from compliance with the obligations and penalties set forth therein.

The CONTRACTOR shall develop and maintain for the duration of this Contract, a safety Program that will effectively incorporate and implement all required safety Provisions. The CONTRACTOR shall appoint an employee who is qualified and authorized to supervise and enforce compliance with the safety Program. The duty of the ENGINEER to conduct construction review of the work does not include review or approval of the adequacy of the CONTRACTOR's safety Program, safety supervisor, or any safety measures taken in, on, or near the construction site. The CONTRACTOR, as a part of his safety Program, shall maintain at his office or other well-known place at the jobsite, safety equipment applicable to the work as Prescribed by the aforementioned authorities, all articles necessary for giving first-aid to the injured, and shall establish the Procedure for the immediate removal to a hospital or a doctor's care of persons (including employees) who may be injured on the jobsite.

If death or serious injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to both the ENGINEER and the OWNER. In addition, the CONTRACTOR must promptly report in writing to the ENGINEER all accidents whatsoever arising out of, or in connection with, the performance of the work whether on, or adjacent to, the site, giving full details and statements of witnesses.

If a claim is made by anyone against the CONTRACTOR or any SUBCONTRACTOR on account of any accident, the CONTRACTOR shall promptly report the facts in writing to the ENGINEER, giving full details of the claim.

43. PROTECTION OF WORK AND PROPERTY

The CONTRACTOR shall at all times safely guard and Protect from damage the OWNER's Property, adjacent Property, and his own work from injury or loss in connection with this Contract. All facilities required for Protection by federal, state, or municipal laws and regulations and local conditions must be provided and maintained. The CONTRACTOR shall Protect his work and materials from damage due to the nature of the work, the elements, carelessness of other CONTRACTORs, or from any cause whatever until the completion and acceptance of the work. All loss or damages arising out of the nature of the work to be done under these Contract Documents, or from any unforeseen obstruction or defects which may be encountered in the Prosecution of the work, or from the action of the elements, shall be sustained by the CONTRACTOR.

44. RESPONSIBILITY OF CONTRACTOR TO ACT IN AN EMERGENCY

In case of an emergency which threatens loss or injury of Property, and/or safety of life, the CONTRACTOR shall act, without previous instructions from the OWNER or ENGINEER, as the situation may warrant. The CONTRACTOR shall notify the ENGINEER thereof immediately thereafter. Any claim for compensation by the CONTRACTOR, together with substantiating documents in regard to expense, shall be submitted to the OWNER through the ENGINEER and the amount of compensation shall be determined by agreement.

45. MATERIALS AND APPLIANCES

Unless otherwise stipulated, the CONTRACTOR shall Provide and pay for all materials, labor, water, tools, equipment, heat, light, fuel, power, transportation, construction equipment and machinery, appliances, telephone, sanitary facilities, temporary facilities and other facilities and incidentals necessary for the execution and completion of the work.

Unless otherwise specified, all materials shall be new, and both workmanship and materials shall be of good quality. The CONTRACTOR shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

In selecting and/or approving equipment for installation in the Project, the OWNER and ENGINEER assume no responsibility for injury or claims resulting from failure of the equipment to comply with applicable federal, state, and local safety codes or requirements, or the safety requirements of a recognized agency, or failure due to faulty design concepts, or defective workmanship and materials.

46. CONTRACTORS' AND MANUFACTURERS' COMPLIANCE WITH STATE SAFETY, OSHA, AND OTHER CODE REQUIREMENTS

The completed work shall include all necessary permanent safety devices, such as machinery guards and similar ordinary safety items required by the state and federal (OSHA) industrial authorities and applicable local and national codes. Further, any features of the work subject to such safety regulations shall be fabricated, furnished, and installed (including OWNER-furnished equipment) in compliance with these requirements. CONTRACTORs and manufacturers of equipment shall be held responsible for compliance with the requirements included herein. CONTRACTORs shall notify all equipment suppliers and SUBCONTRACTORS of the Provisions of this Article.

47. SUBSTITUTION OF MATERIALS

Except for OWNER-selected equipment items, and items where no substitution is clearly specified, whenever any material, article, device, Product, fixture, form, type of construction, or Process is indicated or specified by patent or Proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the material or Process desired. This Procedure is not to be construed as eliminating from competition other Products of equal or better quality by other manufacturers where fully suitable in design, and shall be deemed to be followed by the words "or equal". The CONTRACTOR may, in such cases, submit complete data to the ENGINEER for consideration of another material, type, or Process that shall be substantially equal in every respect to that so indicated or specified. Substitute materials shall not be used unless approved in writing. The ENGINEER will be the sole judge of the substituted article or material.

48. TESTS, SAMPLES, AND OBSERVATIONS

The CONTRACTOR shall furnish, without extra charge, the necessary test pieces and samples, including facilities and labor for obtaining the same, as requested by the ENGINEER. When required, the CONTRACTOR shall furnish certificates of tests of materials and equipment made at the point of manufacture by a recognized testing laboratory.

The OWNER, ENGINEER, and authorized government agents, and their representatives shall at all times be Provided safe access to the work wherever it is in Preparation or Progress, and the CONTRACTOR shall Provide facilities for such access and for observations, including maintenance of temporary and permanent access.

If the Specifications, laws, ordinances, or any public authority require any work, to be specially tested or approved, the CONTRACTOR shall give timely notice of its readiness for observations. If any work should be covered up without approval or consent of the ENGINEER, it shall, if required by the ENGINEER, be uncovered for examination at the CONTRACTOR's expense. Reexamination of questioned work may be ordered by the ENGINEER, and, if so ordered, the work shall be uncovered by the CONTRACTOR. If such work is found to be in accordance with the Contract Documents, the OWNER will pay the cost of uncovering, exposure, observation, inspection, testing and reconstruction. If such work is found to be not in accordance with the Contract Documents, the CONTRACTOR shall correct the defective work, and the cost of reexamination and correction of the defective work shall be paid by the CONTRACTOR.

49. ROYALTIES AND PATENTS

The CONTRACTOR shall pay all royalty and licenses fees, unless otherwise specified. The CONTRACTOR shall defend all suits or claims for infringement of any patent rights and shall save the OWNER and the ENGINEER harmless from any and all loss, including reasonable attorneys' fees, on account thereof.

50. CONTRACTOR'S RIGHT TO TERMINATE CONTRACT

If the work should be stopped under an order of any court or other public authority for a period of more than 3 months, through no act or fault of the CONTRACTOR, its SUBCONTRACTORS, or respective employees or if the ENGINEER should fail to make recommendation for payment to the OWNER or return payment request to CONTRACTOR for revision within 30 days after it is due, or if the OWNER should fail to pay the CONTRACTOR within 30 days after time specified in Article PARTIAL PAYMENTS, any sum recommended by the ENGINEER, then the CONTRACTOR may, upon 15 days' written notice to the OWNER and the ENGINEER, stop work or terminate this Contract and recover from the OWNER payment for all acceptable work performed and reasonable termination expenses, unless said default has been remedied.

51. CORRECTION OF DEFECTIVE WORK DURING WARRANTY PERIOD

The CONTRACTOR hereby agrees to make, at his own expense, all repairs or replacements necessitated by defects in materials or workmanship, Provided under terms of this Contract, and pay for any damage to other works resulting from such defects, which become evident within 2 years after the date of final acceptance of the work or within 2 years after the date of substantial completion established by the ENGINEER for specified items of equipment, or within such longer period as may be Prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents. Un-remedied defects identified for correction during the warranty period but remaining after its expiration shall be considered as part of the obligations of the warranty. Defects in material, workmanship, or equipment which are remedied as a result of obligations of the warranty shall subject the remedied portion of the work to an extended warranty period of 2 years after the defect has been remedied.

The CONTRACTOR further assumes responsibility for a similar guarantee for all work and materials provided by SUBCONTRACTORS or manufacturers of packaged equipment components. The effective date for the start of the guarantee or warranty period for equipment qualifying as substantially complete is defined in Article SUBSTANTIAL COMPLETION, AND Article SUBSTANTIAL COMPLETION DATE, in these General Conditions.

The CONTRACTOR also agrees to hold the OWNER and the ENGINEER harmless from liability of any kind arising from damage due to said defects. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order for same from the OWNER. If the CONTRACTOR fails to make the repairs and replacements promptly, or in an emergency where delay would cause serious risk, or loss, or damage, the OWNER may have the defective work corrected or the rejected work removed and replaced, and the CONTRACTOR and his Surety shall be liable for the cost thereof.

PROGRESS OF THE WORK

52. BEGINNING OF THE WORK

Following execution of the Contract, the CONTRACTOR shall meet with the OWNER and ENGINEER relative to his arrangements for prosecuting the work.

53. SCHEDULES AND PROGRESS REPORTS

Prior to starting the construction, the CONTRACTOR shall Prepare and submit to the ENGINEER, a Progress schedule showing the dates on which each part or division of the work is expected to be started and finished, and a Preliminary schedule for submittals. The Progress schedule for submittals shall be brought up to date and submitted to the ENGINEER at the end of each month or at such other times the ENGINEER may request.

The CONTRACTOR shall forward to the ENGINEER, at the end of each month, an itemized report of the delivery status of major and critical items of purchased equipment and material, including shop drawings and the status of shop and field fabricated work. These Progress reports shall indicate the date of the purchase order, the current percentage of completion, estimated delivery, and cause of delay, if any.

If the completion of any part of the work or the delivery of materials is behind the submitted Progress schedule, the CONTRACTOR shall submit in writing a plan acceptable to the OWNER and ENGINEER for bringing the work up to schedule.

The OWNER shall have the right to withhold Progress payments for the work if the CONTRACTOR fails to update and submit the Progress schedule and reports as specified.

54. PROSECUTION OF THE WORK

It is expressly understood and agreed that the time of beginning, rate of Progress, and time of completion of the work are the essence of this Contract. The work shall be prosecuted at such time, and in or on such part or parts of the Project as may be required, to complete the Project as contemplated in the Contract Documents and the Progress schedule.

If the CONTRACTOR desires to carry on work at night or outside the regular hours, he shall give timely notice to the ENGINEER to allow satisfactory arrangements to be made for observing the work in Progress.

55. OWNER'S RIGHT TO RETAIN IMPERFECT WORK

If any part or portion of the work completed under this Contract shall Prove defective and not in accordance with the Drawings and Specifications, and if the imperfection in the same shall not be of sufficient magnitude or importance as to make the work dangerous or unsuitable, or if the removal of such work will create conditions which are dangerous or undesirable, the OWNER shall have the right and authority to retain such work but will make such deductions in the final payment therefore as may be just and reasonable.

56. OWNER'S RIGHT TO DO WORK

Should the CONTRACTOR neglect to Prosecute the work in conformance with the Contract Documents or neglect or refuse at his own cost to remove and replace work rejected by the ENGINEER, then the OWNER may notify the Surety of the condition, and after 10 days' written notice to the CONTRACTOR and the Surety, or without notice if an emergency or danger to the work or public exists, and without Prejudice to any other right which the OWNER may have under Contract, or otherwise, take over that portion of the work which has been improperly or non-timely executed, and make good the deficiencies and deduct the cost thereof from the payments then or thereafter due the CONTRACTOR.

57. OWNER'S RIGHT TO TRANSFER EMPLOYMENT

If the CONTRACTOR should abandon the work or if he should persistently or repeatedly refuse or should fail to make prompt payment to SUBCONTRACTORS for material or labor, or to persistently disregard laws, ordinances, or to prosecute the work in conformance with the Contract Documents, or otherwise be guilty of a substantial violation of any Provision of the Contract or any laws or ordinance, then the OWNER may, without Prejudice to any other right or remedy, and after giving the CONTRACTOR and Surety 10 days' written notice, transfer the employment for said work from the CONTRACTOR to the Surety. Upon receipt of such notice, such Surety shall enter upon the Premises and take possession of all materials, tools, and appliances thereon for the purpose of completing the work included under this contract and employ by Contract or otherwise, any qualified person or persons to finish the work and Provide the materials therefore, in accordance with the Contract Documents, without termination of the continuing full force and effect of this contract. In case of such transfer of employment to such Surety, the Surety shall be paid in its own name on estimates according to the terms hereof without any right of the CONTRACTOR to make any claim for the same or any part thereof.

If, after the furnishing of said written notice to the Surety, the CONTRACTOR and the Surety still fail to make reasonable Progress on the performance of the work, the OWNER may terminate the employment of the CONTRACTOR and take possession of the Premises and of all materials, tools, and appliances thereon and finish the work by whatever method he may deem expedient and charge the cost thereof to the CONTRACTOR and the Surety. In such case, the CONTRACTOR shall not be entitled to receive any further payment until the work is finished. If the expense of completing the Contract, including compensation for additional managerial and administrative services, shall exceed such unpaid balance, the CONTRACTOR and the Surety shall pay the difference to the OWNER.

58. DELAYS AND EXTENSION OF TIME

If the CONTRACTOR is delayed in the Progress of the work by any act or neglect of the OWNER or the ENGINEER, or by any separate CONTRACTOR employed by the OWNER, or by strikes, lockouts, fire, adverse weather conditions not reasonably anticipated, or acts of Nature, and if the CONTRACTOR, within 48 hours of the start of the occurrence, gives written notice to the OWNER of the cause of the potential delay and estimate of the possible time extension involved, and within 10 days after the cause of the delay has been remedied, the CONTRACTOR gives written notice to the OWNER of any actual time extension requested as a result of the aforementioned occurrence, then the Contract time may be extended by change order for such reasonable time as the ENGINEER determines. It is agreed that no claim shall be made or allowed for any damages, loss, or expense which may arise out of any delay caused by the above referenced acts or occurrences other than claims for the appropriate extension of time. No extension of time will be granted to the CONTRACTOR for delays occurring to parts of the work that have no measurable impact on the completion of the total work under this Contract. No extension of time will be considered for weather conditions reasonably anticipated for the area in which the work is being performed. Reasonably anticipated weather conditions will be based on official records of monthly Precipitation and other historical data. Adverse weather conditions, if determined to be of a severity that would impact Progress of the work, may be considered as cause for an extension of Contract completion time.

Delays in delivery of equipment or material purchased by the CONTRACTOR or his SUBCONTRACTORS, including OWNER-selected equipment shall not be considered as a just cause for delay, unless the OWNER determines that for good cause the delay is

beyond the control of the CONTRACTOR. The CONTRACTOR shall be fully responsible for the timely ordering, scheduling, complete the work is the per-diem rate, as stipulated in the Bid. The said amount is hereby agreed upon as a reasonable estimate of the costs, which may be accrued by the OWNER after the expiration of the time of completion. It is expressly under- stood and agreed that this amount is not to be considered in the nature of a penalty, but as liquidated damages which have accrued against the CONTRACTOR. The OWNER shall have the right to deduct such damages from any amount due, or that may become due the CONTRACTOR, or the amount of such damages shall be due and collectible from the CONTRACTOR or Surety.

59. DIFFERING SITE CONDITIONS

The CONTRACTOR shall promptly, and before the conditions are disturbed, give a written notice to the OWNER and ENGINEER of:

A. subsurface or latent physical conditions at the site which differ materially from those indicated in this contract,
B. unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract.

The ENGINEER will investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the CONTRACTOR's cost of, or the time required for, performing any part of the work under this Contract, whether or not changed as a result of the conditions, and equitable adjustment shall be made under this Article and the Contract modified in writing accordingly.

No request by the CONTRACTOR for an equitable adjustment to the Contract under this Article will be allowed, unless the CONTRACTOR has given the written notice required; provided that the time prescribed above for giving written notice may be extended by the OWNER.

No request by the CONTRACTOR for an equitable adjustment to the Contract for differing site conditions will be allowed if made after final payment under this Contract.

60. LIQUIDATED DAMAGES

Should the CONTRACTOR fail to complete the work, or any part thereof, in the time agreed upon in the Contract or within such extra time as may have been allowed for delays by extensions granted as Provided in the Contract, the CONTRACTOR shall reimburse the OWNER for the additional expense and damage for each calendar day, Sundays and legal holidays included, that the Contract remains uncompleted after the Contract completion date. It is agreed that the amount of such additional expense and damage incurred by reason of failure to complete the work is the per-diem rate, as stipulated in the Bid. The said amount is hereby agreed upon as a reasonable estimate of the costs which may be accrued by the OWNER after the expiration of the time of completion. It is expressly under- stood and agreed that this amount is not to be considered in the nature of a penalty, but as liquidated damages which have accrued against the CONTRACTOR. The OWNER shall have the right to deduct such damages from any amount due, or that may become due the CONTRACTOR, or the amount of such damages shall be due and collectible from the CONTRACTOR or Surety.

61. OTHER CONTRACTS

The OWNER reserves the right to let other Contracts in connection with the work. The CONTRACTOR shall afford other CONTRACTORs reasonable opportunity for the introduction and storage of their materials and the execution of their work and shall properly connect and coordinate his work with theirs.
If any part of the work under this Contract depends for Proper execution or results upon the work of any other CONTRACTOR, utility service company or OWNER, the CONTRACTOR shall inspect and Promptly report to the ENGINEER in writing any patent or apparent defects to deficiencies in such work that render it unsuitable for such Proper execution and results. The CONTRACTOR's failure to so report shall constitute and acceptance of the work by others as being fit and Proper for integration with work under this Contract, except for latent or non-apparent defects and deficiencies in the work.

62. USE OF PREMISES

The CONTRACTOR shall confine his equipment, the storage of materials and the operation of his workers to limits shown on the Drawings or indicated by law, ordinances, permits, or directions of the ENGINEER, and shall not unreasonably encumber the Premises with his materials. The CONTRACTOR shall provide, at his own expense, the necessary rights-of-way and access to the

work, which may be required outside the limits of the OWNER's Property and shall furnish the ENGINEER copies of permits and agreements for use of the Property outside that provided by the OWNER.

The CONTRACTOR shall not load nor permit any part of the structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the work or adjacent Property to stresses or Pressures that will endanger it.

63. SUBSTANTIAL COMPLETION DATE

The ENGINEER may issue a written notice of substantial completion for the purpose of establishing the starting date for specific equipment guarantees, and to establish the date that the OWNER will assume the responsibility for the cost of operating such equipment. Said notice shall not be considered as final acceptance of any portion of the work or relieve the CONTRACTOR from completing the remaining work within the specified time and in full compliance with the Contract Documents. See SUBSTANTIAL COMPLETION under DEFINITIONS of these General Conditions.

64. PERFORMANCE TESTING

Operating equipment and systems shall be performance tested in the Presence of the ENGINEER to demonstrate compliance with the specified requirements. Performance testing shall be conducted under the specified design operating conditions or under such simulated operating conditions as recommended or approved by the ENGINEER. Schedule such testing with the ENGINEER at least one week in advance of the planned date for testing.

65. OWNER'S USE OF PORTIONS OF THE WORK

Following issuance of the written notice of Substantial Completion, the OWNER may initiate operation of the facility. Such use shall not be considered as final acceptance of any portion of the work, nor shall such use be considered as cause for an extension of the Contract completion time, unless authorized by a Change Order issued by the OWNER.

66. CUTTING AND PATCHING

The CONTRACTOR shall do all cutting, fitting, or patching of his work that may be required to make its several parts come together Properly and fit it to receive or be received by work of other CONTRACTORs shown upon or reasonably implied by the Drawings.

67. CLEANING UP

The CONTRACTOR shall, at all times, keep Property on which work is in Progress and the adjacent Property free from accumulations of waste material or rubbish caused by employees or by the work. Upon completion of the construction, the CONTRACTOR shall remove all temporary structures, rubbish, and waste materials resulting from his operations.

PAYMENT

68. PAYMENT FOR CHANGE ORDERS

The OWNER's request for quotations on alterations to the work shall not be considered authorization to proceed with the work expediting, delivery, and installation of all equipment and materials. Within a reasonable period after the CONTRACTOR submits to the OWNER a written request for an extension of time, the ENGINEER will Present his written opinion to the OWNER as to whether an extension of time is justified, and, if so, his recommendation as to the number of days for time extension. The OWNER will make the final decision on all requests for extension of time.

Prior to the issuance of a formal Change Order, nor shall such request justify any delay in existing work. Quotations for alterations to the work shall include substantiating documentation with an itemized breakdown of CONTRACTOR and SUBCONTRACTOR costs, including labor, material, rentals, approved services, overhead, and profit. OWNER may require detailed cost data in order to substantiate the reasonableness of the proposed costs.

Any compensation paid in conjunction with the terms of a Change Order shall comprise total compensation due the CONTRACTOR for the work or alteration defined in the Change Order. By signing the Change Order, the CONTRACTOR

acknowledges that the stipulated compensation includes payment for the work or alteration plus all payment for the interruption of schedules, extended overhead, delay, or any other impact claim or ripple effect, and by such signing specifically waives any reservation or claim for additional compensation in respect to the subject Change Order.

At the OWNER's option, payment or credit for any alterations covered by a Change Order shall be determined by one or a combination of the methods set forth in A, B, or C below, as applicable:

A. UNIT PRICES

Those unit Prices stipulated in the Bid shall be utilized where they are applicable. In the event the Change Order results in a change in the original quantity that is materially and significantly different from the original bid quantity, a new unit Price shall be negotiated upon demand of either party. Unit Prices for new items included in the Change Order shall be negotiated and mutually agreed upon.

B. LUMP SUM

A total lump sum for the work negotiated and mutually acceptable to the CONTRACTOR and the OWNER. Lump sum quotations for modifications to the work shall include substantiating documentation with an itemized breakdown of CONTRACTOR and SUBCONTRACTOR costs, including labor, material, rentals, approved services, overhead, and Profit, all calculated as specified under "C" below.

C. COST REIMBURSEMENT WORK

The term "cost reimbursement" shall be understood to mean that payment for the work will be made on a time and expense basis, that is, on an accounting of the CONTRACTOR's forces, materials, equipment, and other items of cost as required and used to do the work.

If the method of payment cannot be agreed upon Prior to the beginning of the work, and the OWNER directs by written Change Order that the work be done on a cost reimbursement basis, then the CONTRACTOR shall furnish labor, and furnish and install equipment and materials necessary to complete the work in a satisfactory manner and within a reasonable period of time. For the work performed, payment will be made for the documented actual cost of the following:

1. Labor including foremen for those hours they are assigned and participating in the cost reimbursement work (actual payroll cost, including wages, fringe benefits as established by negotiated labor agreements, labor insurance, and labor taxes as established by law). No other fixed labor burdens will be considered, unless approved in writing by the OWNER.
2. Material delivered and used on the designated work, including sales tax, if paid by the CONTRACTOR or his SUBCONTRACTOR.
3. Rental or equivalent rental cost of equipment, including necessary transportation for items having a value in excess of $100. Rental or equivalent rental cost will be allowed for only those days or hours during which the equipment is in actual use. Rental and transportation allowances shall not exceed the current rental rates prevailing in the locality. The rentals allowed for equipment will, in all cases, be understood to cover all fuel, supplies, repairs, and renewals, and no further allowances will be made for those items, unless specific agreement to that effect is made.
4. Additional bond, as required and approved by the OWNER.
5. Additional insurance (other than labor insurance) as required and approved by the OWNER.

In addition to items 1 through 5 above, an added fixed fee for general overhead and Profit shall be negotiated and allowed for the CONTRACTOR (or approved SUBCONTRACTOR) actually executing the Cost Reimbursement work.

An additional fixed fee shall be 5% and allowed the CONTRACTOR for the administrative handling of portions of the work that are executed by an approved SUBCONTRACTOR. No additional fixed fee will be allowed for the administrative handling of work executed by a SUBCONTRACTOR of a SUBCONTRACTOR, unless by written permission from the OWNER.

The added fixed fees shall be considered to be full compensation, covering the cost of general supervision, overhead, Profit, and any other general expense. The CONTRACTOR's records shall make clear distinction between the direct costs of work paid for on a cost reimbursement basis and the costs of other work. The CONTRACTOR shall furnish the ENGINEER report sheets in duplicate of each day's cost reimbursement work no later than the working day following the performance of said work. The daily report sheets shall itemize the materials used, and shall cover the direct cost of labor and the charges for equipment rental, whether furnished by the CONTRACTOR, SUBCONTRACTOR or other forces. The daily report sheets shall provide names or identifications and

classifications of workers, the hourly rate of pay and hours worked, and also the size, type, and identification number of equipment and hours operated.

Material charges shall be substantiated by valid copies of vendors' invoices. Such invoices shall be submitted with the daily report sheets, or, if not available, they shall be submitted with subsequent daily report sheets. Said daily report sheets shall be signed by the CONTRACTOR or his authorized agent.

The OWNER reserves the right to furnish such materials and equipment as he deems expedient and the CONTRACTOR shall have no claim for profit or added fees on the cost of such materials and equipment. To receive partial payments and final payment for cost reimbursement work, the CONTRACTOR shall submit to the ENGINEER, detailed and complete documented verification of the CONTRACTOR's and any of his SUBCONTRACTORS' actual costs involved in the cost reimbursement work. Such costs shall be submitted within 30 days after said work has been performed.

69. PARTIAL PAYMENTS

A. GENERAL

Nothing in this Article shall be construed to affect the right, hereby reserved, to reject the whole or any part of the aforesaid work, should such work be later found not to comply with the Provisions of the Contract Documents. All estimated quantities of work for which partial payments have been made are subject to review and correction on the final estimate. Payment by the OWNER and acceptance by the CONTRACTOR of partial payments based on periodic estimates of quantities of work performed shall not, in any way, constitute acceptance of the estimated quantities used as a basis for computing the amounts of the partial payments.

B. ESTIMATE

At least 30 days before each Progress payment falls due, as specified in the Supplementary Conditions, the CONTRACTOR shall submit to the ENGINEER a detailed estimate of the amount earned during the Preceding month for the separate portions of the work, and request payment. As used in this Article, the words "amount earned" means the value, on the date of the estimate for partial payment, of the work completed in accordance with the Contract Documents, and the value of approved materials delivered to the Project site suitable stored and Protected Prior to incorporation into the work.

ENGINEER will, within 7 days after receipt of each request for payment, either indicate in writing a recommendation of payment and present the request to OWNER, or return the request to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may, within 7 days, make the necessary corrections and resubmit the request.

ENGINEER may refuse to recommend the whole or any part of any payment if, in his opinion, it would be incorrect to make such representations to OWNER. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended to such an extent as may be necessary in ENGINEER's opinion to protect the OWNER from loss because:

1. The work is defective, or completed work has been damaged requiring correction or replacement;

2. Written claims have been made against OWNER or Liens have been filed in connection with the work;
3. The Contract Price has been reduced because of Change Orders;

4. OWNER has been required to correct defective work or complete the work in accordance with Article OWNER'S RIGHT TO DO WORK;

5. Of CONTRACTOR's unsatisfactory Prosecution of the work in accordance with the Contract Documents; or

6. CONTRACTOR's failure to make payment to SUBCONTRACTORS or for labor, materials, or equipment.

C. DEDUCTION FROM ESTIMATE

Unless modified in the Supplementary Conditions, deductions from the estimate will be as described below:

1. The OWNER will deduct from the estimate, and retain as part security, 10 percent of the amount earned for work satisfactorily completed. A deduction and retainage of 10 percent will be made on the estimated amount earned for approved items of material delivered to and properly stored at the jobsite but not incorporated into the work. When the work is 50 percent complete, the OWNER may reduce the retainage to 5 percent of the dollar value of all work satisfactorily completed to date provided the CONTRACTOR is making satisfactory progress and there is no specific cause for a greater retainage. The OWNER may reinstate the retainage up to 10 percent if the OWNER determines, at his discretion, that the CONTRACTOR is not making satisfactory progress or where there is other specific cause for such withholding.

D. QUALIFICATION FOR PARTIAL PAYMENT FOR MATERIALS DELIVERED

Unless modified in the Supplementary Conditions, qualification for partial payment for materials delivered but not yet incorporated into the work shall be as described below:

1. Materials, as used herein, shall be considered to be those items which are fabricated and manufactured material and equipment. No consideration shall be given to individual purchases of less than $200 for any one item.

2. To receive partial payment for materials delivered to the site, but not incorporated in the work, it shall be necessary for the CONTRACTOR to include a list of such materials on the Partial Payment Request. At his sole discretion, the ENGINEER may approve items for which partial payment is to be made. Partial payment shall be based on the CONTRACTOR's actual cost for the materials as evidenced by invoices from the supplier. Proper storage and Protection shall be provided by the CONTRACTOR, and as approved by the ENGINEER. Final payment shall be made only for materials actually incorporated in the work and, upon acceptance of the work, all materials remaining for which advance payments had been made shall revert to the CONTRACTOR, unless otherwise agreed, and partial payments made for these items shall be deducted from the final payment for the work.

3. CONTRACTOR warrants and guarantees that title to all work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER at the time of payment free and clear of all liens, claims, security interests, and encumbrances.
4. If requested by the ENGINEER, the CONTRACTOR shall provide, with subsequent pay requests, invoices receipted by the supplier showing payment in full has been made.

E. PAYMENT

After deducting the retainage and the amount of all previous partial payments made to the CONTRACTOR from the amount earned, the amount due will be made payable to the CONTRACTOR. Recommendations for payment received by the OWNER less than 9 days Prior to the scheduled day for payment will not be Processed or paid until the following month.

70. CLAIMS FOR EXTRA WORK

In any case where the CONTRACTOR deems additional time or compensation will become due him under this Contract for circumstances other than those defined in Article DELAYS AND EXTENSION OF TIME, the CONTRACTOR shall notify the ENGINEER, in writing, of his intention to make claim for such time or compensation before he begins the work on which he bases the claim, in order that such matters may be settled, if possible, or other appropriate action taken. The notice of claim shall be in duplicate, in writing, and shall state the circumstances and the reasons for the claim, but need not state the amount. If such notification is not given or if the ENGINEER is not afforded proper facilities by the CONTRACTOR for keeping strict account of actual cost, then the CONTRACTOR hereby agrees to waive the claim for such additional time or compensation. Such notice by the CONTRACTOR, and fact that the ENGINEER has kept account of the cost as aforesaid, shall not in any way be construed as proving the validity of the claim.

No extension of time will be granted to the CONTRACTOR for delays resulting from extra work that have no measurable impact on the completion of the total work under this Contract. Claims for additional time or compensation shall be made in itemized detail and submitted, in writing, to the OWNER and ENGINEER within 10 days following completion of that portion of the work for which the CONTRACTOR bases his claim. Failure to make the claim for additional compensation in the manner and within the time specified above shall constitute waiver of that claim. In case the claim is found to be just, it shall be allowed and paid for as provided in Article PAYMENT FOR CHANGE ORDERS.

71. RELEASE OF LIENS OR CLAIMS

The CONTRACTOR shall indemnify and hold harmless the OWNER from all claims for labor and materials furnished under this Contract. Prior to the final payment, the CONTRACTOR shall furnish to the OWNER, as part of his final payment request, a certification that all of the CONTRACTOR's obligations on the project have been satisfied and that all monetary claims and indebtedness have been paid. The CONTRACTOR shall furnish complete and legal effective releases or waivers, satisfactory to the OWNER, of all liens arising out of or filed in connection with the work.

72. FINAL PAYMENT

Upon completion of all the work under this Contract, the CONTRACTOR shall notify the ENGINEER, in writing, that he has completed his part of the Contract and shall request final payment. Upon receipt of such notice the ENGINEER will inspect and, if acceptable, submit to the OWNER his recommendation as to acceptance of the completed work and as to the final estimate of the amount due the CONTRACTOR. Upon approval of this final estimate by the OWNER and compliance by the CONTRACTOR with Provisions in Article **RELEASE OF LIENS OR CLAIMS,** and other Provisions as may be applicable, the OWNER shall pay to the CONTRACTOR all monies due him under the Provisions of these Contract Documents.

73. NO WAIVER OF RIGHTS

Neither the inspection by the OWNER, through the ENGINEER or any of his employees, nor any order by the OWNER for payment of money, nor any payment for, or acceptance of, the whole or any part of the work by the OWNER or ENGINEER, nor any extension of time, nor any possession taken by the OWNER or its employees, shall operate as a waiver of any Provision of this Contract, or any power herein reserved to the OWNER, or any right to damages herein Provided, nor shall any waiver of any breach in this Contract be held to be a waiver of any other or subsequent breach. Acceptance or final payment shall not be final and conclusive with regards to latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the OWNER's rights under the warranty.

74. ACCEPTANCE OF FINAL PAYMENT CONSTITUTES RELEASE

The acceptance by the CONTRACTOR of the final payment shall release the OWNER and the ENGINEER, as representatives of the OWNER, from all claims and all liability to the CONTRACTOR for all things done or furnished in connection with the work, and every act of the OWNER and others relating to or arising out of the work except claims Previously made in writing and still unsettled. No payment, however, final or otherwise, shall operate to release the CONTRACTOR or his Sureties from obligations under this Contract and the Performance Bond, Payment Bond, and other bonds and warranties, as herein provided.

SUPPLEMENTARY CONDITIONS

The General Conditions are hereby revised as follows:

ARTICLE 9 “ENGINEER”

Delete Article “ENGINEER” in its entirety and substitute the following:

The person or organization identified as such in the Contract Documents. The Term “ENGINEER” means authorized OWNER’s representative.

ARTICLE 32 “CONTRACTOR, AN INDEPENDENT AGENT”

Add the following:

A. ASSIGNMENT OF CONTRACT

Assignment of any part or the whole of this Contract shall be subject to review and approval of the City Commission

ARTICLE 34 "INSURANCE & LIABILITY”

Delete Articles 34 A, B,C, D & E and substitute the following:

Contractor shall maintain limits no less than those stated below:

GENERAL INSURANCE REQUIREMENTS:

1.01 During the Term of the Agreement, the Contractor shall provide, pay for, and maintain with insurance companies satisfactory to the City of Key West, Florida (“City”), the types of insurance described herein.

1.02 All insurance shall be from responsible insurance companies eligible to do business in the State of Florida. The required policies of insurance shall be performable in Monroe County, Florida, and shall be construed in accordance with the laws of the State of Florida.

1.03 The City shall be specifically included as an additional insured on the Contractor’s Liability policies with the exception of the Contractor’s Professional Liability policies (if required) and shall also provide the "Severability of Interest" provision (a/k/a "Separation of Insured’s" provision). The City’s additional insured status should be extended to all Completed Operations coverages.

1.04 The Contractor shall deliver to the City, prior to commencing work/activities under the Agreement, properly executed "Certificate(s) of Insurance" setting forth the insurance coverage and limits required herein. The Certificates must be signed by the authorized representative of the insurance company(s) shown on the Certificate of Insurance. In addition, certified, true, and exact copies of the insurance policies required herein shall be provided to the City, on a timely basis, if requested by the City.

1.05 If the Contractor fails to provide or maintain the insurance coverages required in this Agreement at any time during the Term of the Agreement and if the Contractor refuses or otherwise neglects to deliver the required Certificate(s) of Insurance signed by the authorized representative of the insurance company(s) to the City, the City may, at the City’s sole discretion, terminate or

suspend this Agreement and seize the amount of Contractor's performance bond, letter of credit, or other security acceptable to the City).

1.06 The Contractor shall take immediate steps to make up any impairment to any Aggregate Policy Limit upon notification of the impairment. If at any time the City requests a written statement from the insurance company(s) as to any impairment to the Aggregate Limit, the Contractor shall promptly authorize and have delivered such statement to the City.

1.07 The Contractor authorizes the City and/or its insurance consultant to confirm all information furnished to the City, as to its compliance with its Bonds and Insurance Requirements, with the Contractor's insurance agents, brokers, surety, and insurance carriers.

1.08 All insurance coverage of the Contractor shall be primary to any insurance or self-insurance program carried by the City. The City's insurance or self-insurance programs or coverage shall not be contributory with any insurance required of the Contractor in this Agreement.

1.09 The acceptance of delivery to the City of any Certificate of Insurance evidencing the insurance coverage and limits required in the Agreement does not constitute approval or agreement by the City that the insurance requirements in the Agreement have been met or that the insurance policies shown in the Certificates of Insurance are in compliance with the Agreement requirements.

1.10 No work/activity under this Agreement shall commence or continue unless and until the required Certificate(s) of Insurance are in effect and the written Notice to Proceed is issued by the City.

1.11 The insurance coverage and limits required of the Contractor under this Agreement are designed to meet the minimum requirements of the City. They are not designed as a recommended insurance program for the Contractor. The Contractor alone shall be responsible for the sufficiency of its own insurance program. Should the Contractor have any question concerning its exposures to loss under this Agreement or the possible insurance coverage needed therefore, it should seek professional assistance.

1.12 During the Term of this Agreement, the City and its agents and contractors may continue to engage in necessary business activities during the operations of the Contractor. No personal property owned by City used in connection with these business activities shall be considered by the Contractor's insurance company as being in the care, custody, or control of the Contractor.

1.13 Should any of the required insurances specified in this Agreement provide for a deductible, self-insured retention, self-insured amount, or any scheme other than a fully insured program, the Contractor shall be responsible for all deductibles and self-insured retentions.

1.14 All of the required insurance coverages shall be issued as required by law and shall be endorsed, where necessary, to comply with the minimum requirements contained herein.

1.15 All policies of insurance required herein shall require that the insurer give the City thirty (30) days advance written notice of any cancellation, intent not to renew any policy and/or any change that will reduce the insurance coverage required in this Agreement, except for the application of the Aggregate Limits Provisions.

1.16 Renewal Certificate(s) of Insurance shall be provided to the City at least twenty (20) days prior to expiration of current coverage so that there shall be no termination of the Agreement due to lack of proof of the insurance coverage required of the Contractor.

1.17 If the Contractor utilizes contractors or sub-contractors to perform any operations or activities governed by this Agreement, the Contractor will ensure all contractors and sub-contractors to maintain the same types and amounts of insurance required of the Contractor. In addition, the Contractor will ensure that the contractor and sub-contractor insurances comply with all of the Insurance Requirements specified for the Contractor contained within this Agreement. The Contractor shall obtain Certificates of Insurance comparable to those required of the Contractor from all contractors and sub-contractors.

Such Certificates of Insurances shall be presented to the City upon request. Contractor's obligation to ensure that all contractor's and sub-contractor's insurance as provided herein shall not exculpate Contractor from the direct primary responsibility Contractor has to the City hereunder. The City will look directly to Contractor for any such liability hereunder and shall not be obligated to seek recovery from any contractor or subcontract or under such contractor's or sub-contractor's insurance coverages.

2.0 **SPECIFIC INSURANCE COVERAGES AND LIMITS:**

2.01 All requirements in this Insurance Section shall be complied with in full by the Contractor unless excused from compliance in writing by the City.

2.02 The amounts and types of insurance must conform to the following minimum requirements. Current Insurance Service Office (ISO) or National Council on Compensation Insurance (NCCI) policies, forms, and endorsements or broader shall be used where applicable. Notwithstanding the foregoing, the wording of all policies, forms, and endorsements must be acceptable to the City.

Workers' Compensation and Employers' Liability Insurance shall be maintained in force during the Term of this Agreement for all employees engaged in this work under this Agreement, in accordance with the laws of the State of Florida. The minimum acceptable limits shall be:

Workers' Compensation	Florida Statutory Requirements
Employer's Liability	$1,000,000.00 Limit Each Accident
	$1,000,000.00 Limit Disease Aggregate
	$1,000,000.00 Limit Disease Each
Employee	

If the Contractor has less than four (4) employees and has elected not to purchase Workers' Compensation/Employers Liability coverage as permitted by *Florida Statutes*, the Contractor will be required to issue a formal letter (on the Contractor's letterhead) stating that it has less than four (4) employees and has elected not to purchase Workers' Compensation/Employers Liability coverage as permitted by *Florida Statutes*. This exception does **not** apply to firms engaged in construction activities.

Commercial General Liability Insurance shall be maintained by the Contractor on a Full Occurrence Form. Coverage shall include, but not be limited to, Premises and Operations, Personal Injury, Contractual for this Agreement, Independent Contractors, and Products & Completed Operations Coverage. The limits of such coverage shall not be less than:

Bodily Injury &	$1,000,000.00 Combined Single Limit each
Property Damage Liability	Occurrence and Aggregate

Completed Operations Liability Coverage shall be maintained by the Contractor for a period of not less than four (4) years following expiration or termination of this Agreement.

The use of an Excess, Umbrella and/or Bumbershoot policy shall be acceptable if the level of protection provided by the Excess, Umbrella and/or Bumbershoot policy is equal to or more comprehensive than the Primary Commercial General Liability policy.

Business Automobile Liability Insurance shall be maintained by the Contractor as to ownership, maintenance, use, loading and unloading of all owned, non-owned, leased, or hired vehicles with limits of such coverage of not less than:

Bodily Injury	$1,000,000.00 Limit Each Accident
Property Damage Liability	$1,000,000.00 Limit Each Accident
	or
Bodily Injury & Property Damage Liability	$1,000,000.00 Combined Single Limit Each Accident

If the Contractor does not own any vehicles, this requirement can be satisfied by having the Contractor's Commercial General Liability policy endorsed with "Non-Owned and Hired Automobile" Liability coverage.

Pollution/Environmental Liability Insurance shall be maintained by the Contractor that will respond to the impairment of land, water, or air resulting from activities governed by this Agreement. The minimum acceptable limits of liability shall be $1,000,000. If the policy is structured on a "Claims Made" basis, the policy must contain a "Retroactive Date" of no later than the commencement date of the Agreement and will have an extended reporting period of four (4) years following expiration or termination of the Agreement.

Installation Floater Insurance shall be maintained by the Contractor that will provide coverage for machinery and equipment while being transported, installed, and tested. The minimum acceptable limits of such coverage shall be not be less than the value of the machinery or equipment being installed. **City shall be designated as the "Loss Payee" on the policy.**

Add the following Article:

G. SURETY AND INSURER QUALIFICATIONS

All bonds, insurance contracts, and certificates of insurance shall be either executed by or countersigned by a licensed resident agent of the Surety or insurance company, having his place of business in the State of Florida, and in all ways complying with the insurance laws of the State of Florida. Further, the said Surety or Insurance Company shall be duly licensed and qualified to do business in the State of Florida. If requested, Contractor shall Provide Proof of Florida Licensure for all insurance companies. The City of Key West shall be named as Additional Insured on the insurance certificates.

ARTICLE 35 "INDEMNITY"

Delete Article "INDEMNITY" in its entirety and substitute the following:

INDEMNITY

To the fullest extent permitted by law, the CONTRACTOR expressly agrees to indemnify and hold harmless the City of Key West, their officers, directors, agents, and employees (herein called the "indemnitees") from liabilities, damages, losses and costs, including, but not limited to, reasonable attorney's fees and court costs, such legal expenses to include costs incurred in establishing the indemnification and other rights agreed to in this Paragraph, to persons or property, to the extent caused by the negligence, recklessness, or intentional wrongful misconduct of the CONTRACTOR, its Subcontractors or persons employed or utilized by them in the performance of the Contract. Claims by indemnitees for indemnification shall be limited to the amount of CONTRACTOR's insurance or $1 million per occurrence, whichever is greater. The parties acknowledge that the amount of the indemnity required hereunder bears a reasonable commercial relationship to the Contract and it is part of the project specifications or the bid documents, if any. The indemnification obligations under the Contract shall not be restricted in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for the CONTRACTOR under workers' compensation acts, disability benefits acts, or other employee benefits acts, and shall extend to and include any actions brought by or in the name of any employee of the CONTRACTOR or of any third party to whom CONTRACTOR may subcontract a part or all the Work. This indemnification shall continue beyond the date of completion of the work.

ARTICLE 39 "CODES, ORDINANCES, PERMITS, AND LICENSES"

Add the following:

A. NOISE ORDINANCE

City of Key West has a noise ordinance that allows working hours between 8:00 AM to 7:00 PM, Monday through Friday. No work should be performed during weekends or City Holidays, State Holidays and National Holidays. Any construction operations outside these hours and these days will require a variance from the City of Key West Commission.

B. "LICENSES"

THE BIDDER MUST BE A LICENSED CONTRACTOR BY THE STATE OF FLORIDA AND SUBMIT PROOF OF SUCH WITH THE BID.

1. Within 10 days of Notice of Award, the successful Bidder must represent that he holds all applicable, county, and City of Key West licenses and permits required to do business as a contractor with respect to the work described in the Contract Documents.

2. Further, the successful Bidder must, within 10 days of Notice of Award, furnish documentation showing that, as a minimum, he has complied with the provisions of

Chapter 18 of the Code of Ordinances of the City of Key West to enter the Agreement contained in the Contract Documents.

3. Specifically, within 10 days after Notice of Award, the successful Bidder must demonstrate that he holds, as a minimum, the following licenses and certificates:

   a.) City of Key West Tax License Receipt;
   b.) A valid Certificate of Competency issued by the Chief Building Official of Key West, Florida
   c.) A valid occupational license issued by the City of Key West, Florida.

ARTICLE 40 “SUPERINTENDENCE”

Add the following sub article:

The CONTRACTOR shall keep at the project site, competent supervisory personnel, able to read, write and speak English to effectively communicate with City staff.

ARTICLE 42 "SAFETY"

Add the following sub article:

OCCUPATIONAL SAFETY AND HEALTH

The Contractor shall observe and comply with all applicable local, state, and federal occupational safety and health regulations during the prosecution of work under this Contract. In addition, full compliance by the Contractor with the U.S. Department of Labor's Occupational Safety and Health Standards, as established in Public Law 91-596, will be required under the terms of this Contract.

ARTICLE 43 "PROTECTION OF WORK AND PROPERTY"

Add the following Article:

HISTORIC PRESERVATION

The Contractor shall comply with Florida's Archives and Historic Act (Florida Statutes, Chapter 267) and the regulations of the local historic preservation board as applicable and protect against the potential loss or destruction of significant historical or archaeological data, sites, and properties in connection with the project.

ARTICLE 57 “OWNERS RIGHT TO TRANSFER EMPLOYMENT”

Add the following Article:

TERMINATION FOR CONVENIENCE AND RIGHT OF SUSPENSION

A. Owner shall have the right to terminate this Contract without cause by written notice of Termination to the Contractor. In the event of such termination for convenience, the Contractor's recovery against the Owner shall be limited to that portion of the Contract amount earned through the date of termination, together with any retainage withheld and reasonable termination expenses incurred. Contractor shall not be entitled to any other or further recovery against the Owner, including, but not limited to, damages or any anticipated profit on portions of the Work not performed.

B. The Owner shall have the right to suspend all or any portions of the Work upon giving the Contractor prior written notice of such suspension. If all or any portion of the Work is so suspended, the Contractor shall be entitled to reasonable costs, expenses and time extension associated with the suspension.

ARTICLE 60 "LIQUIDATED DAMAGES"

Delete Article "LIQUIDATED DAMAGES" in its entirety and substitute the following:
LIQUIDATED DAMAGES

Should the Contractor fail to complete the work or any part thereof in the time agreed upon in the Contract Documents or within such extra time as may have been allowed for delays by extensions granted as provided in the Contract, the Contractor shall reimburse the Owner for the additional expense and damage for each calendar day that project outlined in Contract Documents remains uncompleted after the completion date. Liquidated damages shall be assessed. It is agreed that the amount of such additional expense and damage incurred by reason of failure to complete the work is the per diem rate as stipulated in the Bid. The said amount is hereby agreed upon as a reasonable estimate of the costs which may be accrued by the Owner after the expiration of the time of completion. It is expressly understood and agreed that this amount is not to be considered in the nature of a penalty but as liquidated damages, which have accrued against the Contractor. The Owner shall have the right to deduct such damages from any amount due or that may become due the Contractor or the amount of such damages shall be due and collectible from the Contractor.

ARTICLE 68 "PAYMENT"

Sub article C. "COST REIMBURSEMENT WORK"

Delete the third & fourth paragraph in its entirety & substitute the following;

In addition to 1 through 5 above, an added fixed fee of 15 percent (%) for general overhead & profit shall be allowed for the CONTRACTOR (or approved SUBCONTRACTOR) executing the Cost Reimbursement work.
An additional fixed fee of 5 % will be allowed the CONTRACTOR for the administrative handling of portions of the work that are executed by an approved SUBCONTRACTOR. No additional fixed fee will be allowed for the administrative handling of work executed by the SUBCONTRACTOR of a SUBCONTRACTOR.

ARTICLE 69 "PARTIAL PAYMENTS"

Delete the first paragraph of Sub Article B. "ESTIMATE" and substitute the following:

No more than once each month the Contractor shall submit to the ENGINEER a detailed estimate of the amount earned during the preceding month for the separate portions of the work and request payment. As used in this Article the words "amount earned" means the value, on the date of the estimate, for partial payment of the work completed in accordance with the Contract Documents and the value of approved materials delivered to the project site suitably stored and protected prior to incorporation into the work. Payment will be made by the Owner to the Contractor within 40 days receipt of the written recommendation of payment from the ENGINEER.

Sub Article C. "DEDUCTION FROM ESTIMATE

Delete third sentence in its entirety and substitute add the following;

1. When the work is 90 per cent complete, the OWNER may reduce the retainage to 5 percent of the dollar value of all work satisfactorily completed to date provided the CONTRACTOR is making satisfactory progress and there is no specific cause for greater retainage.

Delete Sub article E. "PAYMENT" in its entirety and substitute the following:

After deducting the retainage and the amount of all previous partial payments made to the Contractor from the amount earned the amount due will be made payable to the Contractor. Recommendations for payment received by the Owner less than 40 days prior to the scheduled day for payment will not be processed or paid until the following month.

ARTICLE 72 "FINAL PAYMENT"
Delete Article "FINAL PAYMENT" in its entirety and substitute the following:

FINAL PAYMENT

Upon completion of the work the Contractor shall notify the ENGINEER, in writing, that he has completed it and shall request final payment. The Contractor shall be responsible for keeping an accurate and detailed record of his actual construction. Upon completion of construction and before final acceptance and payment the Contractor shall furnish the ENGINEER as-built drawings of his construction. Upon receipt of a request for final payment and the as-built drawings the ENGINEER will inspect and, if acceptable, submit to the Owner his recommendation as to acceptance of the completed work and as to the final estimate of the amount due the Contractor. Upon approval of this final estimate by the Owner and compliance by the Contractor with provisions in Article RELEASE OF LIENS OR CLAIMS, and other provisions as may be applicable, the Owner shall pay to the Contractor all monies due him under the provisions of these Contract Documents.

A. Acceptance and Final Payment

Whenever the Contractor has completely performed the work provided for under the Contract and the ENGINEER has performed a final inspection and made final acceptance and subject to the terms of the ENGINEER will prepare a final estimate showing the value of the work as soon as the ENGINEER makes the necessary measurements and computations. The ENGINEER will correct all prior estimates and payments in the final estimate and payment. The OWNER will pay the estimate, less any sums that the OWNER may have deducted or retained under the provisions of the Contract, as soon as practicable after final acceptance of the work, provided the Contractor has met the requirements of (1) through (4) below.

1. The Contractor has agreed in writing to accept the balance due or refund the overpayment, as determined by the OWNER, as full settlement of his account under the Contract and of all claims in connection therewith, or the Contractor, accepted the balance due or refunded the overpayment, as determined by the OWNER, with the stipulation that his acceptance of such payment or the making of such refund does not constitute any bar, admission, or estoppel, or have any effect as to those payments in dispute or the subject of a pending claim between the Contractor and the OWNER. To receive payment based on a FINAL PAYMENT CERTIFCATE, The Contractor further agrees, by submitting a FINAL PAYMENT CERTIFICATE that any pending or future arbitration claim or suit is limited to those particulars, including the itemized amounts, defined in the original FINAL PAYMENT CERTIFICATE , and that he will commence with any such arbitration claim or suit within 15 calendar days from and after the time of final PAYMENT of the work and that his failure to file a formal claim within this period constitutes his full acceptance of the ENGINEER's final estimate and payment. The overpayment refund check from the Contractor, if required, will be considered a part of any Acceptance Letter executed.

2. The Contractor has properly maintained the project, as specified hereinbefore.

3. The Contractor has furnished a sworn affidavit to the effect that the Contractor has paid all bills and no suits are pending (other than those exceptions listed, if any) in connection with work performed under the Contract and that the Contractor has not offered or made any gift or gratuity to, or made any financial transaction of any nature with, any employee of the OWNER in the performance of the Contract.

4. Final payment will not be released until the City receives Certified As-built drawings in Auto Cad & Adobe format as well as:

As-Built Drawing Standards:

All supplied data collections, as-builts, drawings and files to be compatible with esri ArcGIS 10.7.1 Software. The current computing environment consists of:

- Microsoft SQL Server - Windows 7/Server 2008 - ESRI GIS Platform

Interfaces and Integrations:

The City of Key West uses a number of software applications critical to its core operation and mission. The proposed mobile asset data collection solution will need to interface or integrate with these existing platforms. - Arc Collector-ArcGIS Online - ArcMap 10.2

END OF SECTION

PART 4

GENERAL REQUIREMENTS & SCOPE OF WORK

SECTION 01001

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 MOBILIZATION AND DEMOBILIZATION

A. Contractor shall be responsible for mobilization and demobilization of labor, materials and equipment. Payment for mobilization and demobilization will be included in the lump sum price indicated in the BID. Parking for vehicles used on site will be determined by the ENGINEER prior to mobilization.

B. DAILY REPORTS
   1) The CONTRACTOR shall submit daily reports of construction activities for each site, including non-work days. The report shall include:
      a) Manpower, number of workers by craft
      b) Quality Control
      c) Equipment on the Project
      d) Major deliveries
      e) Activities worked
      f) New problems
      g) Other pertinent information
   2) A similar report shall be submitted for/by each Subcontractor.
   3) The reports shall be submitted to the ENGINEER upon request.

1.2 SCHEDULING

A. Prior to starting the work, confer with the ENGINEER and Owner's representative to develop an approved work schedule. Which will permit the surrounding facilities to function as normally as practical. It may be necessary to do certain parts of the work outside normal working hours to avoid undesirable conditions. The Contractor shall do this work at such times and at no additional cost to the Owner.

B. SPECIAL EVENTS: Contractor may be asked to stop work during special events.

C. NIGHT WORK: Work which may require the temporary shutdown of facilities will be performed at night when Jacobs staff and flowrates allow.

D. CONTRACTOR shall notify all residents and proprietors adjacent to construction site of work to be performed, more specifically the notice shall state the day and time construction will begin, the name and phone number of the Contractor’s representative responsible for the completion of the proposed improvements. Notice shall also include the Owner’s representative for the project.

1.3 SITE INVESTIGATION AND REPRESENTATION

A. The Contractor acknowledges satisfaction as to the nature and location of the work, the general and local conditions, particularly those bearing upon availability of transportation, access to the site, disposal, handling and storage of materials, availability of labor, water, electric power, roads, and uncertainties of weather, or similar physical conditions at the

site, the conformation and conditions at the site, the character of equipment and facilities needed preliminary to and during the prosecution of the work, and all other matters which can any way affect the work or the cost thereof under this Contract.

B. The Contractor further acknowledges satisfaction as to character, quality, and quantity of surface and subsurface materials to be encountered from his inspection of the site and from reviewing any available records of exploratory work furnished by the Owner or included in these Documents. Failure by the Contractor to become acquainted with the physical conditions of the site and all available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of successfully performing the work.

C. The Contractor warrants that as a result of examination and investigation of all the aforesaid data, the contractor can perform the work in a good and workmanlike manner and to the satisfaction of the Owner.

D. The Owner assumes no responsibility for any representations made by any of its officers or agents during or prior to the execution of this Contract, unless (1) such representations are expressly stated in the Contract, and (2) the Contract expressly provides that the responsibility therefore is assumed by the Owner.

1.4 INFORMATION ON SITE CONDITIONS

A. General: Any information obtained by the ENGINEER regarding site conditions, subsurface information, water level, existing construction of site facilities as applicable, and similar data will be available for inspection at the office of the ENGINEER upon request. Such information is offered as supplementary information only. Neither the ENGINEER nor the Owner assumes any responsibility for the completeness or interpretation of such supplementary information.

1.5 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE

A. Where the Contractor's operations could cause damage or inconvenience to telephone, television, gas, water, sewer, or irrigation systems, the operations shall be suspended until all arrangements necessary for the protection of these utilities and services have been made by the Contractor.

B. The Contractor shall be solely and directly responsible to the Owner and operators of such properties for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage which may result from the construction operations under this Contract.

C. Neither the Owner nor its Officers or agents shall be responsible to the Contractor for damages as a result of the Contractor's failure to protect utilities encountered in the work.

D. In the event of interruption to domestic water, sewer, storm drain, or other utility services as a result of accidental breakage due to construction operations, promptly notify the proper authority. Cooperate with said authority in restoration of service as promptly as possible and bear all costs of repair. In no case shall interruption of any water or utility service be

allowed to exist outside working hours unless prior approval is granted.

E. The Contractor shall replace, at his own expense, all existing utilities or structures removed or damaged during construction, unless otherwise provided for in these Contract Documents or ordered by the ENGINEER.

1.6 TEMPORARY WATER

A. The Contractor shall make his own arrangements to obtain suitable water for any need and shall pay all costs.

1.7 TEMPORARY ELECTRIC POWER

A. The Contractor shall make his own arrangements to obtain and pay for electrical power used until final acceptance by the Owner.

1.8 SAFETY REQUIREMENTS FOR TEMPORARY ELECTRIC POWER

A. Temporary electric power installation shall meet the construction Safety requirements of OSHA, State, and other governing agencies.

1.9 SANITARY FACILITIES

A. The Contractor shall provide and maintain sanitary facilities for his employees and his subcontractor's employees that will comply with the regulations of the local and State Departments of Health and as directed by the Owner.

1.10 STORAGE OF MATERIALS

A. Materials shall be so stored as to ensure the preservation of their quality and fitness for the work. When considered necessary, they shall be placed on wooden platforms or other clean hard surfaces and not on the ground. Stored materials shall be located to facilitate prompt inspection. Stored materials on city property must be safe and secured from the general public and if necessary, they must be fitted with lights at night. Private property shall not be used for storage purposes without the written permission of the owner or lessee. Materials shall not be stored where access to any structure, plot, or road is blocked. Location of stored materials approved by the ENGINEER or his designee.

B. Delicate instruments and materials subject to vandalism shall be placed under lock cover and, if necessary, provided with temperature control as recommended by the manufacturer.

1.11 CONSTRUCTION SAFETY PROGRAM

A. The Contractor shall develop and maintain for the duration of this Contract, a safety program that will effectively incorporate and implement all required safety provisions. The Contractor shall appoint an employee who is qualified and authorized to supervise and enforce compliance with the safety program.

B. The duty of the ENGINEER to conduct construction review of the Contractor's performance is not intended to include a review or approval of the adequacy of the Contractor's safety supervisor, the safety program or any safety measures taken in, on, or near the construction site.

C. The Contractor shall do all work necessary to protect the public from hazards, including, but not limited to, surface irregularities, or unramped grade changes on pedestrian walkways and docks. Barricades, lights, and proper signs shall be furnished in sufficient amounts to safeguard the public and the work.

D. The performance of all work shall be in accordance with the applicable governing safety authorities.

1.12 ACCIDENT REPORTS

A. If death or serious injuries or serious damages are caused; the Contractor must promptly report by telephone or messenger to the ENGINEER. In addition to all federal, state, and local requirements,, the Contractor must promptly report in writing to the ENGINEER all accidents whatsoever arising out of or in connection with, the performance of the work whether on, or adjacent, to the site, giving full details and statements of witnesses.

B. If a claim is made against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the ENGINEER, giving full details of the claim.

1.13 FIRE PREVENTION AND PROTECTION

A. The Contractor shall perform all work in a fire-safe manner and shall supply and maintain on the site adequate fire-fighting equipment capable of extinguishing incipient fires. The Contractor shall comply with applicable federal, state, and local fire-prevention regulations. Where these regulations do not apply, applicable parts of the National Fire Prevention Standard for Safeguarding Building Construction Operations (NFPA No. 241) shall be followed.

1.14 SITE RESTORATION AND CLEANUP:

A. At all times during the work keep the premises clean and orderly and upon completion of daily work repair all damage caused by equipment and leave the project free of rubbish or excess materials of any kind.

B. Stockpile excavated materials in a manner that will cause the least damage to adjacent lawns, grassed areas, gardens, shrubbery, or fences regardless of whether these are on private property, or State, County, or City rights-of-way. Remove all excavated materials from grassed and planted areas and leave these surfaces in a condition equivalent to their original condition.

C. Thoroughly clean all spilled dirt, gavel, sand, and other foreign materials caused by the construction operations from all streets and roads, grass, pathways, docks, or concrete walkways and from adjacent areas at the conclusion of each day’s operation. Truck or equipment wash down is not to be performed on city or government property.

1.15 FINISHING OF SITE AND STORAGE AREAS

A. Upon completion of the project, all areas used by the Contractor shall be properly cleared of

all temporary structures, rubbish and waste materials and properly graded to drain and bled in with in with the abutting property. Areas used for the deposit of waste materials shall be finished to properly drain and blend in with the surrounding terrain.

1.16 PREVENTION

A. Applicable environmental regulations shall be strictly adhered to.

1.17 PAYMENT

A. The cost of the work in this section is considered incidental to the contract.

END OF SECTION

SCOPE OF WORK

GENERAL DESCRIPTION:

The proposed project consists of providing all site work, materials, equipment, and labor necessary for the removal and replacements of the RAS and WAS system pumps, valves, plumbing, instrumentation, structural supports, variable frequency drives, meters, and appurtenances as shown in the construction drawings, except the valves and materials provided by the owner as listed.

CITY OF KEY WEST CONTACT:

CITY PROJECT MANAGER (PM): Ian McDowell
Phone No: 305-809-3753
E-mail: cimcdowell@cityofkeywest-fl.gov

DRAWINGS / SKETCHES / PHOTOS:

The following drawings, sketches and photos accompany this project description and are a part thereof. Drawings, Sketches and Photos are the property of the City and shall not be used for any purpose other than that contemplated by this project:

ATTACHMENTS:

1) Employment Elegibility Form I-9
2) Department of the Navy Base Access Pass Registration Form 5512

PROJECT SCHEDULE:

Project shall be completed in **270** calendar days from date of Notice to Proceed.

SPECIFIC PROJECT REQUIREMENTS:

Note: All measurements given in this document are approximate and are in no way to be construed by the contractor as absolute. The contractor shall be responsible for his own field investigation and measurements. The City will assume no responsibility for the contractor failing to make his or her own measurements. All discrepancies at the site found by the contractor shall be brought to the attention of the City prior to commencing.

ACCESS REQUIREMENTS:

1. Access to Site: The Contractor shall be responsible for obtaining permission to enter each site and perform all required fieldwork. The contractor shall gain access through the COKW project manager responsible for the project.
2. Licenses and Permits: The Contractor shall be responsible for obtaining any necessary licenses and permits, and for complying with all applicable laws, codes and regulations in connection with prosecution of the work.
3. Ownership. Deliverable shall become City property and shall be part of the facilities library and may be used in whole or in part by the City in any way.
4. Contractor shall expect delays when accessing restricted areas and include time into this proposal. All areas are within NASKW and within the controlled perimeter. NASKW will provide a Government escort, as required, while the Contractor is on site.

EXAMINATION OF PREMISES:
Prior to submitting proposals, Contractors are expected to inspect the project site and satisfy themselves as to the general and local conditions that may affect the cost of performance of the work to the extent that such information is reasonably obtainable.

The project manager will announce a specific date and time when contractors will be allowed to visit the project site.

PRE-PERFORMANCE MEETING:
Prior to beginning any work, the Contractor shall meet with the project manager in order that an approved schedule and sequence of work may be arranged. This meeting shall be held within 14 calendar days after issue date of the Notice to Proceed.

The Contractor agrees to prosecute the work with sufficient diligence to ensure completion within the time specified.

All work shall be accomplished between the hours of 7:30 a.m. and 5:00 p.m., Monday through Friday (excluding Federal Holidays) unless other times are specifically pre-arranged with the Project manager's representative.

Invoice forms and processing will be distributed and discussed during this Pre-Construction Meeting.

STATION REGULATIONS:
The Contractor, employees and Sub-contractor(s) shall become familiar with any and obey all Station Regulations, including fire, traffic and security regulations. All Contractor personnel shall keep within the limits of the work (and avenues of ingress egress) and shall not enter any restricted areas unless required to do so and are cleared for such entry. The Contractors and Sub-contractor's equipment shall be conspicuously marked for identification.

SECURITY REQUIREMENTS:
All individuals working at the Naval Air Station Complex and associated Annexes shall obtain an individual Identification Card issued by the Naval Air Station Pass and ID Office. (This does not apply to individuals making deliveries.) Each individual shall present two original forms of identification: photo ID, such as State Driver's License, or passport; and Original Social Security

Card. The firm shall provide Employment Eligibility Verification in accordance with Homeland Security requirements. Pass and ID Forms and additional instructions will be issued to the Contractor upon award of the Contract.

In addition to individual Identifications, vehicle permits shall be obtained for non-rental vehicles. Vehicle Permits require documentary proof of liability insurance coverage and all pertinent identification/description such as manufacture's Model, Body type and engine number.

IDENTIFICATION BADGE AND INSTALLATION ACCESS:
All contractors, suppliers and vendors must have a Defense Biometric Identification System (DBIDS) credential for base access. Obtain access to the installation by participating in the DBIDS. Costs for obtaining passes through the DBIDS are the responsibility of the Contractor. One-day passes, issued through the Base Pass and Identification Office will be furnished without charge. Furnish a completed EMPLOYMENT ELIGIBILITY VERIFICATION (DHS FORM I-9) form for all personnel requesting badges.

This form is available at http://www.uscis.gov/portal/site/uscis by searching or selecting Employment Verification (Form I-9). Immediately report instances of lost or stolen badges to the Project manager.

a. DBIDS Program: Defense Biometric Identification System (DBIDS) increases installation security and communications by receiving frequent database updates on changes to personnel/credential status, law enforcement warrants, lost/stolen cards, and force protection conditions. The system provides a continuous vetting anytime the DBIDS card is scanned at an installation entry point. If you currently have a Navy Commercial Access Control System (NCACS) card, the following is required to get a DBIDS credential:

1. Present your NCACS Card and a completed copy of the SECNAV FORM 5512/1 to the base Visitor Control Center representative.
2. The VCC will pull up your information in the computer, ensuring all information is current and correct.
3. Once your information is validated, a temporary DBIDS credential is provided.
4. Your temporary credential will have an expiration date, prior to which you will need to obtain your permanent DBIDS credential (~ 180 days).
5. For each additional U.S. Navy installation to which you need access, the first time you visit you only need to bring your DBIDS credential and statement of purpose for base access when arriving at the Visitor Control Center.
6. The representative will enter base access authorization and then you may proceed to work.
7. All other information can be found on the website: https://cnic.navy.mil/om/dbids.html

One-Day Passes: The City will not be responsible for any cost or lost time associated with obtaining daily passes or added vehicle inspections incurred by non-participants in the DBIDS.

THE CONTRACTOR MUST COMPLY WITH ALL NAS KEY WEST CONTRACTOR COVID REQUIREMENTS. BEFORE WORK START, CONTRACTOR SHOULD REQUEST THE LATEST UPDATE ON BASE ACCESS.

CLEANUP:
The Contractor shall at all times keep the work area free from accumulations of waste materials. Combustibles and waste materials, rubbish and other items shall be removed from the work site each

workday. Before completing the work, the Contractor shall remove from the work area and premises any tools, equipment, and materials that are not the property of the City, etc.
Upon completing all work, the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Project manager.

DISPOSAL:
All generated/construction waste shall be removed off Government property and disposed of in accordance with all local, State and Federal regulations at the Contractor's expense.

COOPERATION WITH OTHER CONTRACTORS:
Attention is invited to the fact that other Contractors may be engaged in similar and supporting work requiring close cooperation. The Contractor shall cooperate and schedule his work to avoid conflict with and interruption of the work of others insofar as practical. In the case of conflicts with other Contractors that cannot be resolved satisfactorily, the matter shall be referred to the Project manager for decision, and such decision shall be final, subject to right of appeal in accordance with the terms of this contract.

UNFORESEEN MAJOR REPAIRS:
Should deteriorated material of a major nature be uncovered in the course of the work, it shall be brought to the attention of the Project manager. All repairs shall be made only as directed in writing, by the Project manager.

Any additional work that may increase the original cost of this contract must be approved and funded prior to executing of same.

EXISTING WORK:
Operations affecting existing work shall be executed with care so as not to damage work in place; and all work damaged by such operations shall be rectified or be replaced without additional cost to the City and be satisfactory to the Project manager. Care shall be taken when removing all existing equipment, fasteners and be protected with the intention to Re-use existing services.

AVAILABILITY OF UTILITIES:
All reasonable amounts of electric and water service will be made available to the Contractor by the City from the nearest suitable and available connection. The contractor is fully responsible for all material and labor costs associated with the utility connection.

INTERRUPTION OF UTILITIES SERVICES:
Permission to interrupt any Activity roads and/or utility services such as water, sanitary sewer, telephone and electric shall be requested in writing a minimum of fourteen (14) calendar days prior to the desired date of interruption.

Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays.

DRUG ABUSE BY CONTRACT EMPLOYEES:
It has been determined that the illegal possession and use of drugs and paraphernalia by civilian and contract employees in the Military setting contributes directly to widespread military drug abuse and undermines command efforts to eliminate drug abuse among military personnel. Every effort will be made to deter and detect drug offenses by civilian and contract employees on military installations.

Measures to be taken to identify drug offenses and paraphernalia include routine, random inspection of vehicles on entry and exit, with drug detection dog teams, when available; and random inspection of personal possessions on entry or exit.

Where there is probable cause to believe that civilian or contract personnel on a military installation has been engaged in use, possession or trafficking of drugs, that employee may be restricted or detained for the period necessary until the employee can be removed from the installation or can be turned over to local Law Enforcement authorities having jurisdiction, when appropriate. In any event, civilian or contract employees suspected of committing a drug offense on the Military installation may be removed there from at the earliest opportunity.

When illegal drugs are discovered in the course of an inspection or search of a vehicle operated by a civilian or contract employee, the employee and the vehicle may be detained for a reasonable period of time necessary to turn the employee and the vehicle over to appropriate civil law enforcement officials, and action may be taken to suspend, revoke or deny installation driving privileges.

Implicit with the acceptance of this Contract is the Contractor's agreement to comply with all Federal statues, laws and regulations, including those regulations issued by the Commanding Officer of Naval Air Station, Key West, Florida.

STORM PROTECTION:
In an effort to ensure all contractors are prepared for hurricane conditions, the City requests that each contractor provide a hurricane plan to the Project manager if any construction work under this contract falls within the hurricane season which starts 01 June and ends 30 November. This plan shall address the following:

1. What your company and associated subcontractors will do during each Hurricane Condition.
2. Key personnel contact information (home, work, cell, and pager numbers).
3. List of equipment essential to hurricane recovery and associated operator.

MINIMUM INSURANCE REQUIREMENTS: Refer to General Conditions of the Contract

SUPERVISION:
The Contractor shall have a Superintendent fluent in English on the job site during working hours. Approval of on-site Superintendent is required prior to start of construction. Provide resumes describing their experience with references and qualifications to the Project manager for approval.

Minimum SSHO Requirements are 3 years work on similar projects, completion of the 30-hour OSHA construction safety class within the last 3 years and competent person training for work of this project.

The Superintendent may also be the Site Safety and Health Officer (SSHO).
The Quality Control (QC) Manager may serve in any other position.
Superintendent shall also be responsible for updating the project schedule.

- End SOW –

ATTACHMENT 1
EMPLOYMENT ELIGIBILITY VERIFICATION
FORM I-9

Employment Eligibility Verification

Department of Homeland Security
U.S. Citizenship and Immigration Services

USCIS
Form I-9
OMB No. 1615-0047
Expires 10/31/2022

▶START HERE: Read instructions carefully before completing this form. The instructions must be available, either in paper or electronically, during completion of this form. Employers are liable for errors in the completion of this form.

ANTI-DISCRIMINATION NOTICE: It is illegal to discriminate against work-authorized individuals. Employers **CANNOT** specify which document(s) an employee may present to establish employment authorization and identity. The refusal to hire or continue to employ an individual because the documentation presented has a future expiration date may also constitute illegal discrimination.

Section 1. Employee Information and Attestation *(Employees must complete and sign Section 1 of Form I-9 no later than the **first day of employment**, but not before accepting a job offer.)*

Last Name *(Family Name)*	First Name *(Given Name)*	Middle Initial	Other Last Names Used *(if any)*

Address *(Street Number and Name)*	Apt. Number	City or Town	State	ZIP Code

Date of Birth *(mm/dd/yyyy)*	U.S. Social Security Number	Employee's E-mail Address	Employee's Telephone Number
	☐☐☐ - ☐☐ - ☐☐☐☐		

I am aware that federal law provides for imprisonment and/or fines for false statements or use of false documents in connection with the completion of this form.

I attest, under penalty of perjury, that I am (check one of the following boxes):

☐ 1. A citizen of the United States

☐ 2. A noncitizen national of the United States *(See instructions)*

☐ 3. A lawful permanent resident (Alien Registration Number/USCIS Number): _____

☐ 4. An alien authorized to work until (expiration date, if applicable, mm/dd/yyyy): _____
Some aliens may write "N/A" in the expiration date field. *(See instructions)*

Aliens authorized to work must provide only one of the following document numbers to complete Form I-9: An Alien Registration Number/USCIS Number OR Form I-94 Admission Number OR Foreign Passport Number.

1. Alien Registration Number/USCIS Number: _____
OR
2. Form I-94 Admission Number: _____
OR
3. Foreign Passport Number: _____
Country of Issuance: _____

QR Code - Section 1
Do Not Write In This Space

Signature of Employee	Today's Date *(mm/dd/yyyy)*

Preparer and/or Translator Certification (check one):

☐ I did not use a preparer or translator. ☐ A preparer(s) and/or translator(s) assisted the employee in completing Section 1.

(Fields below must be completed and signed when preparers and/or translators assist an employee in completing Section 1.)

I attest, under penalty of perjury, that I have assisted in the completion of Section 1 of this form and that to the best of my knowledge the information is true and correct.

Signature of Preparer or Translator	Today's Date *(mm/dd/yyyy)*

Last Name *(Family Name)*	First Name *(Given Name)*

Address *(Street Number and Name)*	City or Town	State	ZIP Code

STOP *Employer Completes Next Page* STOP

Employment Eligibility Verification

Department of Homeland Security
U.S. Citizenship and Immigration Services

USCIS
Form I-9
OMB No. 1615-0047
Expires 10/31/2022

Section 2. Employer or Authorized Representative Review and Verification

(Employers or their authorized representative must complete and sign Section 2 within 3 business days of the employee's first day of employment. You must physically examine one document from List A OR a combination of one document from List B and one document from List C as listed on the "Lists of Acceptable Documents.")

Employee Info from Section 1	Last Name *(Family Name)*	First Name *(Given Name)*	M.I.	Citizenship/Immigration Status

List A Identity and Employment Authorization	OR	List B Identity	AND	List C Employment Authorization
Document Title		Document Title		Document Title
Issuing Authority		Issuing Authority		Issuing Authority
Document Number		Document Number		Document Number
Expiration Date *(if any) (mm/dd/yyyy)*		Expiration Date *(if any) (mm/dd/yyyy)*		Expiration Date *(if any) (mm/dd/yyyy)*
Document Title				
Issuing Authority				
Document Number				
Expiration Date *(if any) (mm/dd/yyyy)*				
Document Title				
Issuing Authority				
Document Number				
Expiration Date *(if any) (mm/dd/yyyy)*				

Additional Information

QR Code - Sections 2 & 3
Do Not Write In This Space

Certification: I attest, under penalty of perjury, that (1) I have examined the document(s) presented by the above-named employee, (2) the above-listed document(s) appear to be genuine and to relate to the employee named, and (3) to the best of my knowledge the employee is authorized to work in the United States.

The employee's first day of employment *(mm/dd/yyyy)*: _____ ***(See instructions for exemptions)***

Signature of Employer or Authorized Representative	Today's Date *(mm/dd/yyyy)*	Title of Employer or Authorized Representative

Last Name of Employer or Authorized Representative	First Name of Employer or Authorized Representative	Employer's Business or Organization Name

Employer's Business or Organization Address (*Street Number and Name*)	City or Town	State	ZIP Code

Section 3. Reverification and Rehires *(To be completed and signed by employer or authorized representative.)*

A. New Name *(if applicable)*			B. Date of Rehire *(if applicable)*
Last Name *(Family Name)*	First Name *(Given Name)*	Middle Initial	Date *(mm/dd/yyyy)*

C. If the employee's previous grant of employment authorization has expired, provide the information for the document or receipt that establishes continuing employment authorization in the space provided below.

Document Title	Document Number	Expiration Date *(if any) (mm/dd/yyyy)*

I attest, under penalty of perjury, that to the best of my knowledge, this employee is authorized to work in the United States, and if the employee presented document(s), the document(s) I have examined appear to be genuine and to relate to the individual.

Signature of Employer or Authorized Representative	Today's Date *(mm/dd/yyyy)*	Name of Employer or Authorized Representative

LISTS OF ACCEPTABLE DOCUMENTS
All documents must be UNEXPIRED

Employees may present one selection from List A
or a combination of one selection from List B and one selection from List C.

LIST A Documents that Establish Both Identity and Employment Authorization	OR	LIST B Documents that Establish Identity	AND	LIST C Documents that Establish Employment Authorization
1. U.S. Passport or U.S. Passport Card		**1.** Driver's license or ID card issued by a State or outlying possession of the United States provided it contains a photograph or information such as name, date of birth, gender, height, eye color, and address		**1.** A Social Security Account Number card, unless the card includes one of the following restrictions: (1) NOT VALID FOR EMPLOYMENT (2) VALID FOR WORK ONLY WITH INS AUTHORIZATION (3) VALID FOR WORK ONLY WITH DHS AUTHORIZATION
2. Permanent Resident Card or Alien Registration Receipt Card (Form I-551)		**2.** ID card issued by federal, state or local government agencies or entities, provided it contains a photograph or information such as name, date of birth, gender, height, eye color, and address		**2.** Certification of report of birth issued by the Department of State (Forms DS-1350, FS-545, FS-240)
3. Foreign passport that contains a temporary I-551 stamp or temporary I-551 printed notation on a machine-readable immigrant visa		**3.** School ID card with a photograph		**3.** Original or certified copy of birth certificate issued by a State, county, municipal authority, or territory of the United States bearing an official seal
4. Employment Authorization Document that contains a photograph (Form I-766)		**4.** Voter's registration card		**4.** Native American tribal document
5. For a nonimmigrant alien authorized to work for a specific employer because of his or her status: **a.** Foreign passport; and **b.** Form I-94 or Form I-94A that has the following: (1) The same name as the passport; and (2) An endorsement of the alien's nonimmigrant status as long as that period of endorsement has not yet expired and the proposed employment is not in conflict with any restrictions or limitations identified on the form.		**5.** U.S. Military card or draft record		**5.** U.S. Citizen ID Card (Form I-197)
		6. Military dependent's ID card		**6.** Identification Card for Use of Resident Citizen in the United States (Form I-179)
		7. U.S. Coast Guard Merchant Mariner Card		**7.** Employment authorization document issued by the Department of Homeland Security
		8. Native American tribal document		
		9. Driver's license issued by a Canadian government authority		
		For persons under age 18 who are unable to present a document listed above:		
		10. School record or report card		
		11. Clinic, doctor, or hospital record		
		12. Day-care or nursery school record		
6. Passport from the Federated States of Micronesia (FSM) or the Republic of the Marshall Islands (RMI) with Form I-94 or Form I-94A indicating nonimmigrant admission under the Compact of Free Association Between the United States and the FSM or RMI				

Examples of many of these documents appear in the Handbook for Employers (M-274).

Refer to the instructions for more information about acceptable receipts.

ATTACHMENT 2
DEPARTMENT OF THE NAVY BASE ACCESS PASS REGISTRATION FORM 5512

DEPARTMENT OF THE NAVY LOCAL POPULATION ID CARD/BASE ACCESS PASS REGISTRATION

PRIVACY ACT STATEMENT:

AUTHORITY: 10 U.S.C. 5013, Secretary of the Navy; 10 U.S.C. 5041, Headquarters, Marine Corps; OPNAVINST 5530.14E, Navy Physical Security; Marine Corps Order 5530.14A, Marine Corps Physical Security Program Manual; and E.O. 9397 (SSN), as amended, SORN NM05512-2 .
PURPOSE(S): To control physical access to Department of Defense (DoD), Department of the Navy (DON) or U.S. Marine Corps Installations/Units controlled information, installations, facilities, or areas over which DoD, DON, or U.S. Marine Corps has security responsibilities by identifying or verifying an individual through the use of biometric databases and associated data processing/information services for designated populations for purposes of protecting U.S./Coalition/allied government/national security areas of responsibility and information; to issue badges, replace lost badges, and retrieve passes upon separation; to maintain visitor statistics; collect information to adjudicate access to facility; and track the entry/exit times of personnel.
ROUTINE USE(S): To designated contractors, Federal agencies, and foreign governments for the purpose of granting Navy officials access to their facility.
DISCLOSURE: Providing registration information is voluntary. Failure to provide requested information may result in denial of access to benefits, privileges, and DoD installations, facilities and buildings.

IDENTITY PROOFING AND APPLICANT INFORMATION

1. LAST NAME:	2. FIRST NAME:	3. MIDDLE NAME:	4. NAME SUFFIX: ☐ Jr. ☐ Sr. ☐ I ☐ II ☐ III ☐ IV

5. HISPANIC OR LATINO *(Check one)*: ☐ YES ☐ NO	6. RACE *(Check one or more)*: ☐ WHITE ☐ AFRICAN AMERICAN OR BLACK ☐ ASIAN ☐ AMERICAN INDIAN OR ALASKIN NATIVE ☐ NATIVE HAWAIIAN OR OTHER PACIFIC ISLANDER

7. GENDER *(Check one)*: ☐ MALE ☐ FEMALE	8. DATE OF BIRTH:	9. CITY OF BIRTH:	10. STATE OF BIRTH:	11. BIRTH COUNTRY:

12. US CITIZEN *(Check)*: ☐ YES ☐ NO	13. DUAL CITIZENSHIP: ☐ YES ☐ NO CITIZENSHIP IF OTHER THAN US *(Country)* :

U.S. Citizen Minimum Documentation Required:
By Birth - Social Security No and/or State ID/Drivers License.
Naturalized - Certification Number, Petition Number, Date, Place and Court, United States passport number, Social Security No and/or State ID/Drivers License.
Derived - Parent's certification number, Social Security No and/or State ID/Drivers License.

Alien Minimum Documentation Required:
Registration Number, Expiration date, Date of entry, Port of entry.

14. IDENTITY SOURCE DOCUMENTS PRESENTED:	15. DOCUMENT NUMBER:	16. ISSUED BY STATE/COURT:	17. ISSUED BY COUNTRY:	18. ISSUED:	19. EXPIRES:
☐ Social Security No.			United States		
☐ State ID/Drivers License			United States		
☐ Passport No.					
☐ Certification Number and Petition Number					
☐ Derived - Parent's Certification Number:			United States		
☐ Alien Registration No.			United States		
		Date of Entry:	Port of Entry:		
OTHER APPROVED IDENTITY SOURCE DOCUMENTS:					
☐					
☐					

20. WEIGHT *(Pounds)*:	21. HEIGHT *(Inches)*:	22. HAIR COLOR *(Check one)*: ☐ Blond ☐ Brown ☐ Black ☐ Gray ☐ Red ☐ White ☐ Silver ☐ Auburn ☐ Bald	23. EYE COLOR *(Check one)*: ☐ Brown ☐ Green ☐ Blue ☐ Hazel ☐ Black ☐ Gray ☐ Violet ☐ Unknown

24. HOME ADDRESS *(Include city, state, zip code)*:	HOME PHONE *(Include Area Code)*:
25. BASE SPONSOR'S NAME:	SPONSOR PHONE *(Include Area Code)*:

EMPLOYMENT ACTIVITY INFORMATON

26. EMPLOYER NAME AND ADDRESS *(Include city/state/zip code)*:	EMPLOYER PHONE *(Include Area Code)*:
ENTER YOUR EMPLOYER NAME, STREET, CITY, STATE, ZIP CODE	ENTER EMPLOYER WORK #
27. SUPERVISOR NAME AND ADDRESS *(Include city/state/zip code)*:	SUPERVISOR PHONE *(Include Area Code)*:
ENTER YOUR SUPERVISOR'S NAME, WORK STREET, CITY, STATE, ZIP CODE	ENTER SUPERVISOR WORK #

FOR OFFICIAL USE ONLY WHEN FILLED - PRIVACY SENSITIVE:
Any misuse or unauthorized disclosure of this information may result in both criminal and civil penalties.

28. Check the applicable box for WORK HOURS box or check the OTHER box and enter the work hours, then check the applicable for WORK DAYS:

WORK HOURS: ☐ 0600-1800 ☐ 0800-1700 ☐ OTHER _____ WORK DAYS: ☐ SN ☐ M ☐ T ☐ W ☐ TH ☐ F ☐ ST

PRIOR FELONY CONVICTIONS

29. Have you ever been convicted of a Felony? ☐ YES ☐ NO _____ *Initial*

REQUIREMENT TO RETURN LOCAL POPULATION ID CARD

30. I understand that I am required to return my Local Population Identification Card to the Base Pass Office when it expires or if my employment is terminated for any reason. _____ *(initial)*

AUTHORIZATION AND RELEASE AND CERTIFICATION

31. I hereby authorize the DOD/DON and other authorized Federal agencies to obtain any information required from the Federal government and/or state agencies, including but not limited to, the Federal Bureau of Investigation (FBI), the Defense Security Service (DSS), the U.S. Department of Homeland Security (DHS).

I have been notified of DON right to perform minimal vetting and fitness determination as a condition of access to DON installation/facilities. I understand that I may request a record identifier; the source of the record and that I may obtain records from the State Law Enforcement Office as may be available to me under the law. I also understand that this information will be treated as privileged and confidential information.

I release any individual, including records custodians, any component of the U.S. Government or the individual State Criminal History Repository supplying information, from all liability for damages that may result on account of compliance, or any attempts to comply with this authorization. This release is binding, now and in the future, on my heirs, assigns, associates, and personal representative(s) of any nature. Copies of this authorization that show my signature are as valid as the original release signed by me.

FALSE STATEMENTS ARE PUNISHABLE BY LAW AND COULD RESULT IN FINES AND/OR IMPRISONMENT UP TO FIVE YEARS.

BEFORE SIGNING THIS FORM, REVIEW IT CAREFULLY TO MAKE SURE YOU HAVE ANSWERED ALL QUESTIONS FULLY AND CORRECTLY.

I DECLARE UNDER PENALTY OF PERJURY THAT THE STATEMENTS MADE BY ME ON THIS FORM ARE TRUE, COMPLETE AND CORRECT

DATE _____ SIGNATURE _____

FINAL DETERMINATION ON YOUR ACCESS: The Base Commanding Officer has final authority for determination on granting physical access to DON controlled installations/facilities under his/her jurisdiction.

BELOW COMPLETED BY BASE REGISTRAR PERSON CONDUCTING IDENTY PROOFING and NCIC CHECK

32. INFORMATION VERIFIED BY:	33. ENTERED IN C/S SYSTEM BY:	34. PASS ISSUE DATE:	35. PASS EXPIRATION DATE:

36. NCIC CHECK PERFORMED BY:	37. RESULTS OF NCIC CHECK: ☐ NO RECORDS ☐ RECORD IDENTIFIER RECORD NUMBER:	38. RESULTS OF LOCAL RECORDS CHECK: ☐ NO RECORDS ☐ RECORD IDENTIFIER RECORD NUMBER:

Office of Under Secretary of Defense Directive-Type Memorandum (DTM) 09-012, "Interim Policy Guidance for DoD Physical Access Control," December 8, 2009. DTM 09-012 requires that DoD installation government representatives query the National Crime Information Center (NCIC) and Terrorist Screening Database to vet the claimed identity and to determine the fitness of non-federal government and non-DoD-issued card holders (i.e. visitors) who are requesting unescorted access to a DoD installation. The minimum criteria to determine the fitness of a visitor is: 1) not on a terrorist watch list; 2) not on an DoD installation debarment list; and 3) not on a FBI National Criminal Information Center (NCIC) felony wants and warrants list. Additionally, SECNAV Memo, Policy for Sex Offender Tracking and Assignment and Access Restrictions within the Department of the Navy, of 7 Oct 08 and OPNAVINST 1752.3 established the Navy's policy on sex offenders, requiring Region Commanders (REGCOMs) and Installation Commanding Officers (COs) to prohibit sex offender access to DoN facilities and Navy owned, leased or PPV housing. This form describes the authority and purpose to collect and share the required information; and identifies the applicant/visitor and sponsor; and authorizes the DoD to perform the minimum vetting and fitness determination criteria. A favorable response on the vetting and fitness determination is required to receive access to DOD-controlled installation/facilities.

Instruction for completing the Local Population Access Registration Form

INSTRUCTIONS: Please complete all information in black ink (printed) or by typing. By voluntarily providing your Personal Information, you agree to the following terms and restrictions:
RESTRICTIONS: Local Population Identification Card/Base Access Pass may only be used by person to whom they are issued and for the specific business/purpose issued. Applicants are reminded that soliciting (i.e., door-to-door sales) is prohibited on the base, and that such activity is grounds for cancellation of the Pass. Additionally, such action may result in debarment from the base and legal action. The Base Commanding Officer has discretion over specifying the period of validity for any Local Population ID Cards/Base Access Passes that are issued under his/her jurisdiction.
Review the Privacy At Statement that is printed at the top of the form

Block 1: Enter the Last Name.
Block 2: Enter the First Name.
Block 3: Enter the Middle Name.
Block 4: If applicable, check the box for Name Suffix.
Block 5: Check the applicable box for Hispanic or Latino.
Block 6: Check the applicable box for Race.
Block 7: Check the applicable box for Gender.
Block 8: Enter Date of Birth.
Block 9: Enter City of Birth.
Block 10: Enter State of Birth.
Block 11: Enter Country of Birth.
Block 12: Check the applicable box for US Citizenship.
Block 13: If not a US Citizen, enter the name of the Country of Citizenship.
Block 14: Two forms of identity source documents from the list of acceptable documents listed below must be presented to the base registrar with this completed form. Check the box for the type of Documents that will be presented for identity proofing. If the document type is not listed, use the two rows under Other Approved Identity Source Documents to enter the type of document(s) that you will present.
Block 15: Enter the Document Number located on the Identity Proofing Source document that was checked in Block 14.
Block 16: Enter the State that issued the Identity Source Document.
Block 17: Enter the Country that issued the Identity Source Document.
Block 18: Enter the Date that the Identity Source Document was issued.
Block 19: Enter the Date that the Identity Source Document will expire.
Block 20: Enter Weight in pounds.
Block 21: Enter Height in inches.
Block 22: Check the applicable box for Hair Color.
Block 23: Check the applicable box for Eye Color.
Block 24: Enter Home Address Including City, State, Zip Code, and Home Telephone Number.
Block 25: Enter Name of Registrant's Base Sponsor and Base Sponsor's Telephone Number.
Block 26: Enter Employer Name and address including City, State, Zip Code, and Employer's Telephone Number.
Block 27: Enter Supervisor's Name including City, State, Zip Code, and Supervisor's Telephone Number.
Block 28: Check the applicable box for Work Hours box or check the OTHER box and enter the work hours, then check applicable boxes for Work Days. Block 28: Check the applicable answer if you have been convicted of Felony and enter initials.
Block 29: Check the applicable box for felony conviction.
Block 30: Enter initials to accept terms for returning Local Population Identification Card.
Block 31: Sign and date the form to attest that the foregoing information is true and complete to best of your knowledge.

LIST OF ACCEPTABLE DOCUMENTS - All documents must not be expired.

Must present one selection from List A or a combination of one selection from List B and one selection from List C.

List A - Documents that Establish Identity and Employment Authorization

1. U.S. Passport or U.S. Passport Card.
2. Permanent Resident Card or Alien Registration Receipt Card (Form I-551).
3. Foreign passport that contains a temporary I-551 stamp or temporary I-551 printed notation on a machine-readable immigrant visa.
4. Employment Authorization Document that contains a photograph (Form I-766).
5. For a nonimmigrant alien authorized to work for a specific employer because of his or her status:
   a. Foreign Passport; and
   b. Form I-94 or Form I-94A that has the following:
      (1) The same name as the passport; and
      (2) An endorsement of the alien's nonimmigrant status as long as that period of endorsement has not yet expired and the proposed employment is not in conflict with and restrictions or limitations identified on form.
6. Passport from the Federal States of Micronesia (FSM) or the Republic of the Marshal Islands (RM) with Form I-94 or Form I-94A indicating nonimmigrant admission under the Compact of Free Association Between the United Stated and FSM or RM.

OR

List B - Documents that Establish Identity

1. Driver's license or ID card issued by a State or outlying possession of the United States provided it contains a photograph or information such as name, date of birth, gender, height, eye color, and address.
2. ID card issued by federal, state or local government agencies or entities, provided it contains a photograph or information such as name, date of birth, gender, height, eye color, and address.
3. School ID card with a photograph
4. Voter's registration card.
5. U.S. Military card or draft record.
6. Military dependent's ID card.
7. U.S. Coast Guard Merchant Mariner Card.
8. Native American tribal document.
9. Driver's license issued by a Canadian government authority.

For persons under age 18 who are unable to present a document listed above:

10. School record or report card.
11. Clinic, doctor, or hospital record.
12 Day-care or nursery school record.

AND

List C - Documents that Establish Employment Authorization

1. A Social Security Account Number card, unless the card includes one of the following restrictions:
   (1) NOT VALID FOR EMPLOYMEMT
   (2) VALID FOR WORK ONY WITH INS AUTHORIZATION.
   (3) VALID FOR WORK ONLY WITH DHS AUTHORIZATION.
2. Certification of Birth Abroad issued by the Department of State (Form FS-545).
3. Certification of Birth issued by the Department of State (Form DS-1360).
4. Original or certified copy of birth certificate issued by a State, county, municipal authority or territory of the United States bearing an official seal.
5. Native American tribal document.
6. U.S. Citizen ID Card (Form I-197).
7. Identification Card for Use of Resident Citizen in the United States (Form I-179).
8. Employment authorization document issued by the Department of Homeland Security.

The remainder of the form will be completed by the Base Registrar Person conducting Identify Proofing process and NCIC check.

AGENCY DISCLOSURE STATEMENT:

The public reporting burden for this collection of information is estimated to average 10 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to the Department of Defense, Washington Headquarters Services, Executive Services Directorate, Information Management Division, 4800 Mark Center Drive, East Tower, Suite 02G09, Alexandria, VA 22350-3100 OMB 0703-0061. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN COMPLETED FORM TO THE ABOVE ADDRESS.
Completed form should be submitted to the Base Registrar.

FOR OFFICIAL USE ONLY WHEN FILLED - PRIVACY SENSITIVE:
Any misuse or unauthorized disclosure of this information may result in both criminal and civil penalties.

PART 5
CONSTRUCTION DRAWINGS & SPECIFICATIONS

CITY OF KEY WEST

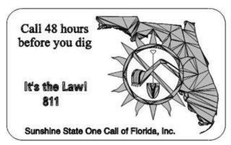
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

CITY OF KEY WEST PROJECT NO : SE35042002

CITY OF KEY WEST ITB NO :

FEBRUARY 2023

100% SUBMITTAL



BLACK & VEATCH

Black & Veatch Corporation

2121 Ponce de Leon Boulevard suite 305

Coral Gables, FL 33134 Certificate No. 8132

OWNER CONTACT INFORMATION:

Project Engineer:
Ian McDowell, E.I. - CIMcDowell@cityofkeywest-fl.gov.
PH (305) 809-3753

Maintenance Manager:
Danny Caraballo - Danny.Caraballo@jacobs.com.
PH (305) 292-5100

FD7000
D9000

GENERAL ANNOTATION, SYMBOL, AND CALLOUT LEGENDS

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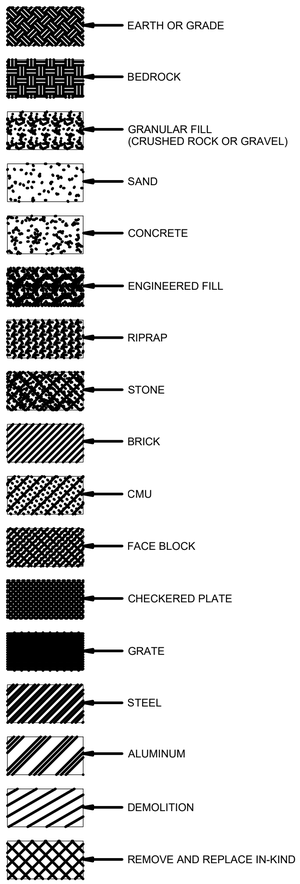
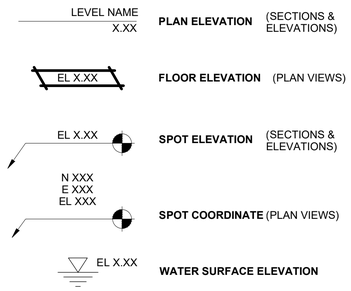
28 I-10-602 P&ID WAS PUMPING STATION

FILL PATTERNS

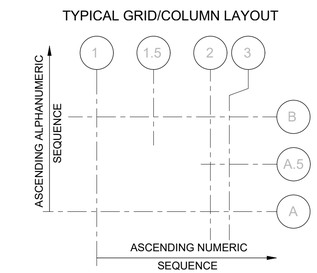


ELEVATION & GRID CALLOUTS

ELEVATION CALLOUTS

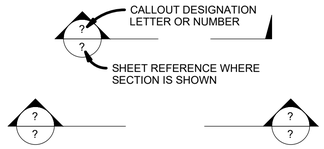


GRID/COLUMN CALLOUTS

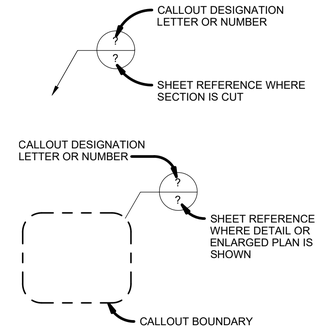


VIEW CALLOUTS

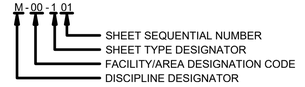
SECTION CALLOUTS



DETAIL/ENLARGED PLAN AREA CALLOUTS



DRAWING NUMBERING SYSTEM



DISCIPLINE DESIGNATORS

A ARCHITECTURAL
C CIVIL
D DEMOLITION
E ELECTRICAL
F FIRE PROTECTION
G GENERAL
H HVAC/BUILDING MECHANICAL
I INSTRUMENTATION AND CONTROLS
L LANDSCAPE
M PROCESS MECHANICAL
P PLUMBING
S STRUCTURAL

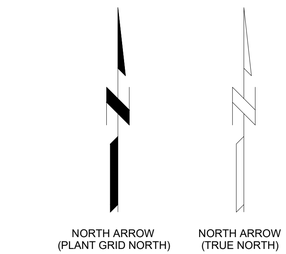
AREA/FACILITY DESIGNATION CODES

FACILITY / AREA CODE	FACILITY / AREA CODE
00	GENERAL (APPLIES TO ALL)
10	OPERATIONS BUILDING
20	AERATION BASINS WALKWAY
99	DETAILS

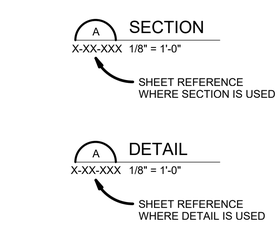
SHEET TYPE DESIGNATORS

0 GENERAL (SYMBOLS, LEGENDS, NOTES, ETC.)
1 PLANS (ARRANGEMENT PLANS, PARTIAL PLANS)
2 ELEVATIONS
3 SECTIONS
4 LARGE SCALE VIEWS (ENLARGED PLANS, STAIR SECTIONS OR SECTIONS THAT ARE NOT DETAILS)
5 DETAILS
6 SCHEDULES & DIAGRAMS
7 SCHEMATICS (ONE-LINES, BLOCK DIAGRAMS)
8 USER DEFINED
9 3D MODEL (PERSPECTIVES, ISOMETRICS, PHOTOGRAPHS)

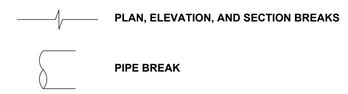
NORTH ARROW



SECTION & DETAIL VIEW TITLES

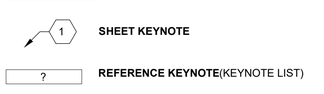


BREAKS

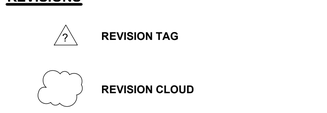


ANNOTATION

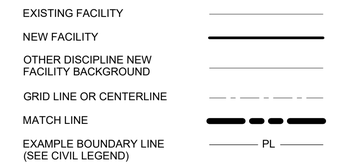
SHEET NOTES



REVISIONS



LINE STYLES



100% SUBMITTAL

NO.	BY	CHK	APP	DATE	REVISIONS AND RECORD OF USE
2	AD	PG	IB	02/01/2023	100% SUBMITTAL
1	AD	PG	IB	10/10/2022	90% SUBMITTAL
				09/28/2021	ISSUED FOR 60% SUBMITTAL

Date:
Engineer of Record:
Florida License No.:

BLACK & VEATCH
Black & Veatch Corporation
2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

GENERAL
LIST OF DRAWINGS, ANNOTATIONS & SYMBOL LEGENDS

DESIGNED:	MG
DETAILED:	HT , AD
CHECKED:	PG
APPROVED:	IB
DATE:	02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

G-00-001
SHEET
2 OF 28

FD:160522
D:409283

GENERAL, CIVIL, AND PROCESS MECHANICAL ABBREVIATIONS

A

AB	AGGREGATE BASE
ABV	ABOVE
AC	ASPHALT CONCRETE
ACP	ASBESTOS CEMENT PIPE
AD	AREA DRAIN, ANODE
ADD	ADDITIONAL
ADJ	ADJUSTABLE, ADJACENT
ADMIN	ADMINISTRATION
ADWF	AVERAGE DRY-WEATHER FLOW
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AH	AHEAD
ALT	ALTERNATE, ALTERNATIVE
ANC	ANCHOR
AP	ACCESS PANEL, ANGLE POINT
APPR	APPROACH
APPROX	APPROXIMATE, APPROXIMATELY
AR	ANCHOR ROD
ARCH	ARCHITECTURAL
ASSY	ASSEMBLY
ATM	ATMOSPHERE, ATMOSPHERIC
AUTO	AUTOMATIC
AUX	AUXILIARY
AVG	AVERAGE
AWG	AMERICAN WIRE GAUGE
AWWA	AMERICAN WATER WORKS ASSOCIATION
AWWF	AVERAGE WET-WEATHER FLOW

B

B	BORE HOLE
B TO B	BACK TO BACK
BAL	BALANCE
BC	BACK OF CURB
BET	BETWEEN
BF	BLIND FLANGE
BHP	BRAKE HORSEPOWER
BITUM	BITUMINOUS
BLDG	BUILDING
BLK	BLOCK
BM	BENCHMARK
BNR	BIOLOGICAL NUTRIENT REMOVAL
BOD	BIOLOGICAL/BIOCHEMICAL OXYGEN DEMAND
BOF	BOTTOM OF FOOTING
BOP	BOTTOM OF PIPE
BOT	BOTTOM
BP	BACK PRESSURE
BRG	BEARING
BS	BOTH SIDES
BU	BELL-UP
BVC	BEGINNING OF VERTICAL CURVE

C

C	CURVE
C TO C	CENTER TO CENTER
CB	CATCH BASIN
CF	CUBIC FEET
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
C&G	CURB AND GUTTER
CIP	CAST IRON PIPE
CISP	CAST IRON SOIL PIPE
CL	CLASS
C/L	CENTERLINE
CLG	CEILING
CLR	CLEAR, CLEARANCE
CLSM	CONTROLLED LOW STRENGTH MATERIAL
CMC	CEMENT MORTAR COATED
CML	CEMENT MORTAR LINED
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT, COMPANY
COD	CHEMICAL OXYGEN DEMAND
COL	COLUMN
COMB	COMBINATION
COMB SWR	COMBINED SEWER
CONC	CONCRETE
CONN	CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUED, CONTINUOUS, CONTINUATION, CONTROL
CONTR	CONTRACTOR
COR	CORNER
CORR	CORRIDOR, CORRUGATED
CP	CONTROL POINT, CATHODIC PROTECTION, CATCH POINT
CPLG	COUPLING
CPVC	CHLORINATED POLYVINYL CHLORIDE
CSP	CORRUGATED STEEL PIPE
CTR(S)	CENTER(S)
CTS	CORROSION/CATHODIC TEST STATION
CU	CUBIC, COPPER
CY	CUBIC YARD

D

D	DOOR
DB	DUCT BANK
DBL	DOUBLE
DEG	DEGREE
DEPT	DEPARTMENT
DET	DETAIL
DI	DROP INLET, DUCTILE IRON
DIA	DIAMETER
DIFF	DIFFUSER
DIM	DIMENSION
DIP	DUCTILE IRON PIPE
DISCH	DISCHARGE
DIST	DISTRIBUTION
DIV	DIVISION
DMJ	DISMANTLING JOINT
DN	DOWN
DR	DRAIN
DW	DRY WELL
DWG(S)	DRAWING(S)

E

E	EAST, EASTING
EA	EACH
ECC	ECCENTRIC
ECC RED	ECCENTRIC REDUCER
EFF	EFFLUENT, EFFICIENCY
EG	EXISTING GRADE
EJ	EXPANSION JOINT
EL	ELEVATION
ELB	ELBOW
ELL	ELBOW
ELEC	ELECTRIC, ELECTRICAL
EMER	EMERGENCY
ENC	ENCASEMENT
ENCL	ENCLOSURE
EOL	END OF LINE
EOP	EDGE OF PAVEMENT
EOS	EDGE OF SLAB
EQ	EQUAL
EQUIP	EQUIPMENT
EVC	END OF VERTICAL CURVE
EW	EACH WAY
EXH	EXHAUST
EXIST	EXISTING
EXP	EXPANSION, EXPOSED
EXT	EXTENSION, EXTERIOR, EXTERNAL

F

F	FAHRENHEIT, FACE
F TO F	FACE TO FACE
FAB	FABRICATE(D)(TION)
FC	FACE OF CONCRETE, FAIL CLOSED
FCA	FLANGED COUPLING ADAPTER
FD	FLOOR DRAIN
FF	FINISHED FLOOR
FG	FINISHED GRADE
FH	FIRE HYDRANT
FIG	FIGURE
FL	FLOOR, FLOW LINE
FLEX	FLEXIBLE
FLG	FLANGE(D)
FM	FORCE MAIN
FMH	FLEXIBLE METAL HOSE
FO	FAIL OPEN
FOB	FLAT ON BOTTOM
FOM	FACE OF MASONRY
FOT	FLAT ON TOP
FPS	FEET PER SECOND
FRP	FIBERGLASS REINFORCED PLASTIC
FS	FAR SIDE, FLOOR SLEEVE
FT	FOOT, FEET
FTG	FOOTING
FURN	FURNISH, FURNISHED
FWD	FORWARD

G

G	GAS
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GB	GRADE BREAK
GC	GROOVED COUPLING
GEN	GENERAL, GENERATOR
GL	GLASS
GM	GAS METER
GPD	GALLONS PER DAY
GPM	GALLONS PER MINUTE
GR	GRADE

H

H	HIGH, HOUR
HDG	HOT-DIPPED GALVANIZED
HDPE	HIGH DENSITY POLYETHYLENE
HEX	HEAT EXCHANGER
HGT	HEIGHT
HH	HANDHOLE
HMC	HARNESSED MECHANICAL COUPLING
HMJ	HARNESSED MECHANICAL JOINT
HORIZ	HORIZONTAL
HP	HIGH POINT, HIGH PRESSURE, HORSEPOWER
HR	HOUR, HANDRAIL
HS	HIGH STRENGTH
HVAC	HEATING, VENTILATING AND AIR CONDITIONING
HWY	HIGHWAY
HYDRO	HYDROPNEUMATIC, HYDROGENERATION

I

ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IF	INSIDE FACE
IN	INCH(ES)
INCL	INCLUDING
INCR	INCREASE
INST	INSTRUMENT, INSTRUMENTATION
INSUL	INSULATE, INSULATED, INSULATING
INT	INTERIOR, INTERNAL
INV	INVERT
IPS	IRON PIPE SIZE

J

JB	JUNCTION BOX
JT	JOINT

K

KVA	KILOVOLT AMPERE

L

L	LENGTH, LONG, LOW
LAT	LATERAL, LATITUDE
LB(S)	POUND(S)
LC	LENGTH OF CURVE
LF	LINEAR FEET
LH	LEFT HAND
LIN	LINEAL, LINEAR
LONG	LONGITUDE
LP LOW	POINT, LOW PRESSURE
LT	LEFT

M

MAINT	MAINTENANCE
MAN	MANUAL(LY)
MAX	MAXIMUM
MBR	MEMBRANE BIOREACTOR
MC	MECHANICAL COUPLING
MECH	MECHANICAL
MED	MEDIUM
MF	MICROFILTRATION
MFR	MANUFACTURER
MG	MILLION GALLONS
MG/L	MILLIGRAMS PER LITER
MGD	MILLION GALLONS PER DAY
MH	MAINTENANCE HOLE, MANHOLE
MIN	MINIMUM, MINUTE
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
MJRG	MECHANICAL JOINT RETAINER GLAND
MJTR	MECHANICAL JOINT WITH TIE ROD
MO	MOTOR OPERATED
MSL	MEAN SEA LEVEL
MTD	MOUNTED
MTL	MATERIAL
MTR	MOTOR
MW	MONITORING WELL

N

N	NORTH, NORTHING, NITROGEN (TOTAL AS N)
N/A	NOT APPLICABLE
NAD	NORTH AMERICAN DATUM (HORIZONTAL)
NAVD	NORTH AMERICAN VERTICAL DATUM
NC	NORMALLY CLOSED
NF	NEAR FACE
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
NO.	NUMBER(S)
NOM	NOMINAL
NPSH	NET POSITIVE SUCTION HEAD
NPSHR	NET POSITIVE SUCTION HEAD REQUIRED
NPT	NATIONAL PIPE THREAD
NRS	NON-RISING STEM
NS	NEAR SIDE
NTS	NOT TO SCALE

O

OC	ON CENTER, ODOR CONTROL
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE, OVERFLOW
OH	OVERHEAD
OPER	OPERATING
OPNG	OPENING
OPP	OPPOSITE
OZ	OUNCE

P

P&ID	PIPING/PROCESS AND INSTRUMENTATION DIAGRAM
P	PHOSPHORUS (TOTAL AS P)
PPM	PARTS PER MILLION
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
PCCP	PRESTRESSED CONCRETE CYLINDER PIPE
PE	PLAIN END
PG	PRESSURE GAUGE
PH	PIPE HANGER
PI	POINT OF INTERSECTION
PNL(S)	PANEL(S), PANELBOARD(S)
POC	POINT ON CIRCULAR CURVE, POINT OF CONNECTION
POT	POINT ON TANGENT
PP	POWER POLE
PROJ	PROJECTION
PRS	PRESSURE REDUCING STATION
PS	PIPE SUPPORT
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAUGE
PT	POINT OF TANGENCY, POINT
PVC	POLYVINYL CHLORIDE, POINT OF VERTICAL CURVATURE
PVT	POINT OF VERTICAL TANGENCY
PVCP	POLYVINYL CHLORIDE PIPE
PVI	POINT OF VERTICAL INTERSECTION
PVMT	PAVEMENT

Q

Q	RATE OF FLOW
QCPLG	QUICK COUPLING

R

R	RADIUS, RISER
R/W	RIGHT OF WAY
RCP	REINFORCED CONCRETE PIPE
RCCP	REINFORCED CONCRETE CYLINDER PIPE
RECIRC	RECIRCULATING
RED	REDUCER, REDUCING
REF	REFERENCE
REINF	REINFORCED, REINFORCING
REM	REMOVABLE, REMOVE
REQD	REQUIRED
RET	RETURN
REV	REVISION, REVISED, REVERSED
RH	RIGHT HAND
RO	REVERSE OSMOSIS
RPM	REVOLUTIONS PER MINUTE
RR	RAILROAD
RS	RISING STEM
RT	RIGHT
ROW	RIGHT OF WAY

S

S	SECOND, SLOPE, SOUTH
SCHED	SCHEDULE
SCFM	STANDARD CUBIC FEET PER MINUTE
SD	STORM DRAIN
SEC	SECOND
SECT	SECTION
SF	SQUARE FEET
SH	SHEET
SIM	SIMILAR
SP	STEEL PIPE
SPA	SPACING, SPACES
SPEC(S)	SPECIFICATION(S)
SPL	SPECIAL
SPLY	SUPPLY
SQ	SQUARE
SS	STAINLESS STEEL
SS	SANITARY SEWER
ST SWR	STORM SEWER
STA	STATION
STD	STANDARD
STL	STEEL
STOR	STORAGE
STR	STRUCTURAL
SUSP	SUSPENDED
SYM	SYMMETRICAL
SYS	SYSTEM

T

T	TELEPHONE, TOP
TAN	TANGENT
TBC	TOP BACK OF CURB
TBD	TO BE DETERMINED
TBM	TEMPORARY BENCHMARK
TC	TOP OF CURB
TDS	TOTAL DISSOLVED SOLIDS
TEMP	TEMPERATURE, TEMPORARY
TH	TEST HOLE
THD	THREADED
THK	THICK, THICKNESS
TOC	TOP OF CONCRETE, TABLE OF CONTENTS, TOTAL ORGANIC CARBON
TOF	TOP OF FOOTING
TOM	TOP OF MASONRY
TOP	TOP OF PIPE
TOW	TOP OF WALL
TP	TEST PIT
TRANS	TRANSFORMER
TS	TOTAL SOLIDS
TSS	TOTAL SUSPENDED SOLIDS
TYP	TYPICAL

U

UB	UTILITY BOX
UF	ULTRAFILTRATION
UG	UNDERGROUND
UNO	UNLESS NOTED OTHERWISE
UP	UTILITY POLE
USGS	UNITED STATES GEOLOGICAL SURVEY
UV	ULTRAVIOLET

V

V	VALVE (SEE P&ID ABBREVIATIONS), VERTICAL, VOLT, VENT
VAC	VACUUM
VB	VALVE BOX
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE
VERT	VERTICAL
VIF	VERIFY IN FIELD
VOCs	VOLATILE ORGANIC COMPOUNDS
VP	VAPOR PRESSURE

W

W	WEST, WIDE, WATER
W/	WITH
WC	WATER COLUMN
WEF	WATER ENVIRONMENT FEDERATION
W	WATER LEVEL
WM	WATER METER
W/O	WITHOUT
WP	WATERPROOF
WS	WATERSTOP
WS	WATER SURFACE
WSL	WATER SURFACE LEVEL
WT	WEIGHT
WW	WETWELL

X

x	BY, TIMES

Y

YH	YARD HYDRANT

NOTES:

1. FOR EQUIPMENT ABBREVIATIONS, INCLUDING FOR VALVES, REFER TO P&ID LEGEND AND ABBREVIATIONS DRAWINGS FUNCTION CODE ABBREVIATIONS.
2. FOR SYSTEM AND PROCESS STREAM ABBREVIATIONS, REFER TO P&ID LEGEND AND ABBREVIATIONS DRAWINGS SYSTEM CODE AND PROCESS CODE ABBREVIATIONS.
3. FOR PIPE MATERIAL AND INSULATION MATERIAL ABBREVIATIONS REFER TO P&ID LEGEND AND ABBREVIATIONS DRAWINGS PIPELINE MATERIAL CODE AND INSULATION MATERIAL CODE ABBREVIATIONS.

NO.	DATE	REVISIONS AND RECORD OF USE	BY	CHK	APP
	02/01/2023	100% SUBMITTAL			
2	10/10/2022	95% SUBMITTAL	AD	PG	IB
1	09/29/2021	ISSUED FOR 90% SUBMITTAL	AD	PG	IB

Date:
Engineer of Record:
Florida License No.:

BLACK & VEATCH
Black & Veatch Corporation
2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

GENERAL
GENERAL, CIVIL, AND PROCESS MECHANICAL ABBREVIATIONS

DESIGNED: MG
DETAILED: HT , AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

G-00-002
SHEET
3 OF 28

100% SUBMITTAL

F01060222
D409283

GENERAL NOTES

1. ALL CONSTRUCTION MATERIALS AND TESTING SHALL CONFORM TO THE APPLICABLE SPECIFICATIONS OF THE CITY OF KEY WEST, LOCAL, MONROE COUNTY, STATE OF FLORIDA, AND NATIONAL CODES.

2. IF SPECIFICATIONS OR DRAWINGS CONFLICT, CONTRACTOR SHALL NOTIFY THE CITY OF KEY WEST FOR MORE INFORMATION PRIOR TO PROCEEDING WITH THE WORK.

3. REVIEW OF THE SHOP DRAWINGS BY THE CITY OF KEY WEST OR AUTHORIZED REPRESENTATIVE IS ONLY FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PROJECT AND COMPLIANCE WITH THE INFORMATION GIVEN IN THE CONTRACT DOCUMENTS. THE CONTRACTOR IS RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT THE SITE FOR INFORMATION THAT PERTAINS SOLELY TO THE FABRICATION, PROCESSES, OR TO THE MEANS, METHODS, TECHNIQUES, SEQUENCES AND PROCEDURES OF CONSTRUCTION AND FOR COORDINATION OF THE WORK OF ALL TRADES.

4. "SCREENED" (LIGHT) DELINEATION INDICATED ON THE DRAWINGS DENOTES EXISTING FACILITIES. "SCREENED" INFORMATION IS FOR REFERENCE ONLY, AND SHALL BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO THE ORDERING OF MATERIALS AND BEGINNING OF CONSTRUCTION. "BOLD" DELINEATION IS NEW WORK TO BE CONSTRUCTED UNDER THIS CONTRACT.

5. EXISTING UTILITIES AND STRUCTURES (UNDERGROUND, SURFACE, OR OVERHEAD) ARE INDICATED ONLY TO THE EXTENT THAT SUCH INFORMATION WAS KNOWN, OR MADE AVAILABLE TO, OR DISCOVERED BY THE ENGINEER IN PREPARING THE DRAWINGS. THE LOCATIONS, CONFIGURATIONS, AND ELEVATIONS OF SUBSURFACE FACILITIES AND UTILITIES ARE APPROXIMATE, AND NOT ALL UTILITIES AND FACILITIES MAY BE INDICATED.

UTILITY NOTES

1. CALL BEFORE YOU DIG. CONTRACTOR SHALL VERIFY PRECISE LOCATIONS AND ELEVATIONS OF ALL UTILITIES AND STRUCTURES, WHETHER INDICATED ON THE DRAWINGS OR NOT, IN THE FIELD IN ADVANCE OF EXCAVATING. THE CONTRACTOR SHALL CONTACT FLORIDA SUNSHINE ONE TO VERIFY UNDER GROUND UTILITIES WITHIN THE PROJECT SITE. THE FLORIDA SUNSHINE ONE TELEPHONE NUMBER IS 811.

2. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL, DEMOLITION, RECONSTRUCTION, AND RECONNECTION OF EXISTING FACILITIES AS REQUIRED TO COMPLETE THE WORK. IF REQUIRED AFTER FIELD VERIFICATION, CONTRACTOR SHALL COORDINATE WITH THE ENGINEER TO DETERMINE ANY NECESSARY MODIFICATIONS TO THE PROPOSED NEW WORK.

3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE COST OF REPAIRING ALL DAMAGED UTILITIES.

4. BEFORE CONSTRUCTION IS STARTED, CONTRACTOR SHALL COORDINATE WITH THE OWNER OF EACH UTILITY AND DEFINE THE REQUIREMENTS AND METHODS TO ACCOMMODATE THE PROTECTION, TEMPORARY SUPPORT, ADJUSTMENT, OR RELOCATION OF ANY UTILITIES AFFECTED BY THE PROPOSED NEW WORK.

CIVIL NOTES

1. ALL EXISTING FEATURES TO REMAIN UNLESS OTHERWISE NOTED ON THE DRAWINGS.

2. CONTRACTOR SHALL COMPLY WITH THE GOVERNING AGENCY NPDES CONSTRUCTION REQUIREMENTS, AND SHALL PROVIDE APPROPRIATE MITIGATION MEASURES OR PROTECTION AND RESTORATION AT ALL LOCATIONS AS REQUIRED BY THEIR OPERATIONS, AND AS DIRECTED BY THE ENGINEER. CONTRACTOR SHALL BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION. CONTRACTOR SHALL MAINTAIN AND REPAIR EROSION AND SEDIMENT CONTROL DEVICES THROUGHOUT THE DURATION OF CONSTRUCTION.

3. CLEAR THE SITE USING STANDARD CLEARING AND GRUBBING PROCEDURES.

4. SOD ALL DISTURBED AREAS.

5. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL AND DISPOSAL OF ANY CONSTRUCTION DEBRIS TO AN APPROVED FACILITY.

6. CONTRACTOR SHALL USE CAUTION WHEN WORKING NEAR OVERHEAD OR UNDER GROUND UTILITIES.

7. CONTRACTOR SHALL PROTECT AND MAINTAIN ALL EXISTING TREES, SHRUBS, AND PLANTS UNLESS OTHERWISE NOTED.

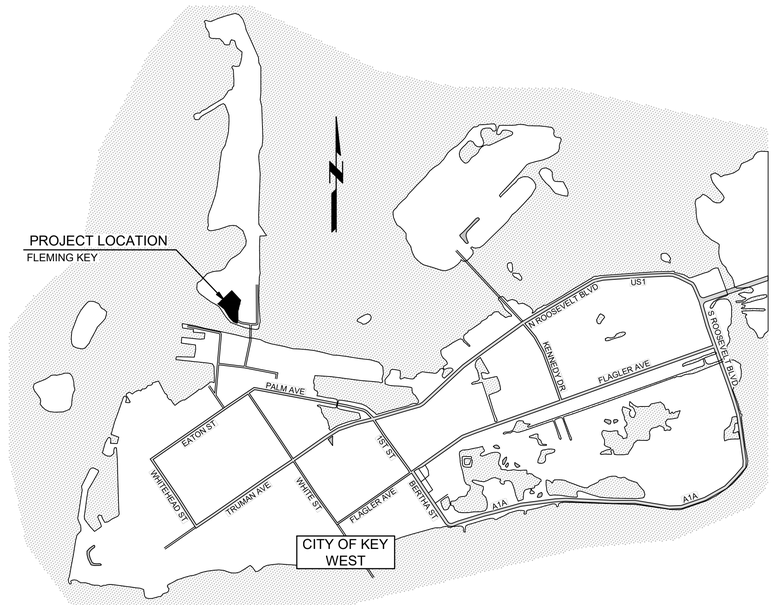
8. FINISHED GRADE ELEVATION AT ANY STRUCTURE, WHERE NOT ADJACENT TO PAVEMENT, SHALL BE APPROXIMATELY 6 INCHES BELOW FINISHED FLOOR ELEVATION UNLESS OTHERWISE NOTED.

9. THE CONTRACTOR'S OPERATIONS SHALL CONFORM TO THE RULES AND REGULATIONS OF THE STATE CONSTRUCTION SAFETY ORDERS PERTAINING TO EXCAVATION AND TRENCHING.

10. IF ANY SIGNAGE IS DEMOLISHED OR DAMAGED DURING CONSTRUCTION THE CONTRACTOR WILL REPLACE IT IN KIND PER CITY OF KEY WEST SPECIFICATIONS.

ABBREVIATIONS

@	AT
ABDN	ABANDON
BOT	BOTTOM
CB	CATCH BASIN
CLDIP	CEMENT LINED DUCTILE IRON PIPE
CONC	CONCRETE
CPE	CORRUGATED POLYETHYLENE
DF	DRAINAGE FORCE MAIN
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
DR	DRIVE, DIMENSION RATIO
DRN	DRAIN
E	EAST
EL	ELEVATION
EW	EACH WAY
EX, EXST	EXISTING
FL	FLANGE
FM	FORCE MAIN
GLDIP	GLASS LINED DUCTILE IRON PIPE
HORIZ	HORIZONTAL
INV	INVERT
IP	IRON POST
LT	LEFT
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
N	NORTH
NO.	NUMBER
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
PL	PROPERTY LINE
PP	POWER POLE
PVC	POLYVINYLCHLORIDE
RCP	REINFORCED CONCRETE PIPE
REQD	REQUIRED
RJ	RESTRAINED JOINT
RT	RIGHT
R/W	RIGHT OF WAY
S	SOUTH, SANITARY
SD	STORM DRAIN
SDR	STANDARD DIMENSION RATIO
SPECD	SPECIFIED
SS	STORM SEWER
SS, SST	STAINLESS STEEL
STA	STATION
STW	STORMWATER
T, TEL	TELEPHONE
TYP	TYPICAL
W	WEST, WATER
WT	WEIGHT



LOCATION MAP
NO SCALE

100% SUBMITTAL

F01/06/2022
D409283

NO.	DATE	REVISIONS AND RECORD OF USE	BY	CHK	APP
	02/01/2023	100% SUBMITTAL			
2	10/10/2022	95% SUBMITTAL	AD	PG	IB
1	09/28/2021	ISSUED FOR 60% SUBMITTAL	AD	PG	IB

Date:
Engineer of Record:
Florida License No.:

BLACK & VEATCH
Black & Veatch Corporation
2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

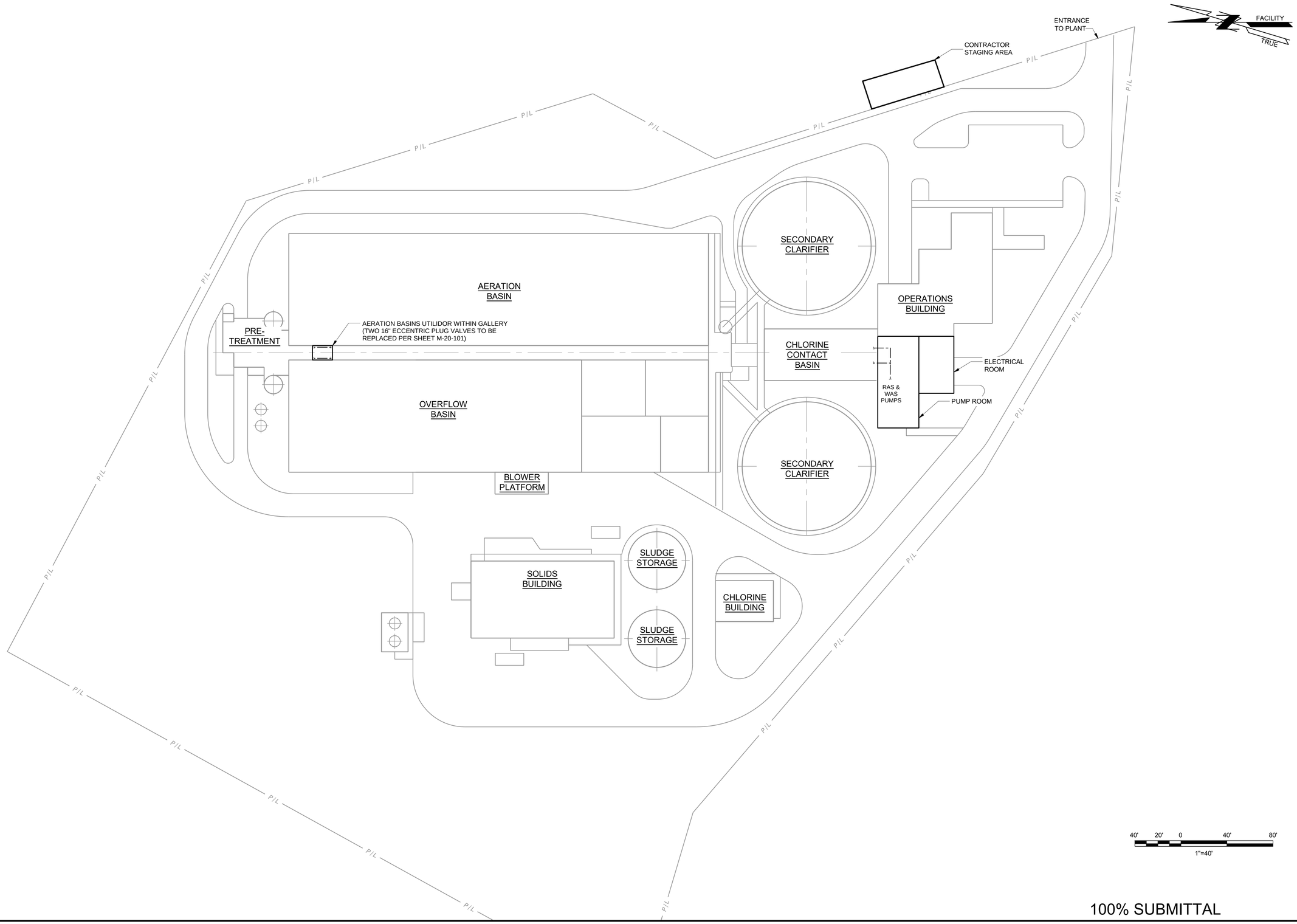
GENERAL
NOTES, LEGEND, ABBREVIATIONS
AND LOCATION MAP

DESIGNED: MG
DETAILED: HT , AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

G-00-003
SHEET
4 OF 28



100% SUBMITTAL

NO.	BY	CHK	DATE	REVISIONS AND RECORD OF USE
			02/01/2023	100% SUBMITTAL
2	AD	PG	10/10/2022	95% SUBMITTAL
1	AD	PG	09/28/2021	ISSUED FOR 60% SUBMITTAL

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Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

CIVIL
OVERALL SITE PLAN

DESIGNED:	MG
DETAILED:	HT, AD
CHECKED:	PG
APPROVED:	IB
DATE:	02/01/2023

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IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

C-00-102
SHEET
5 OF 28

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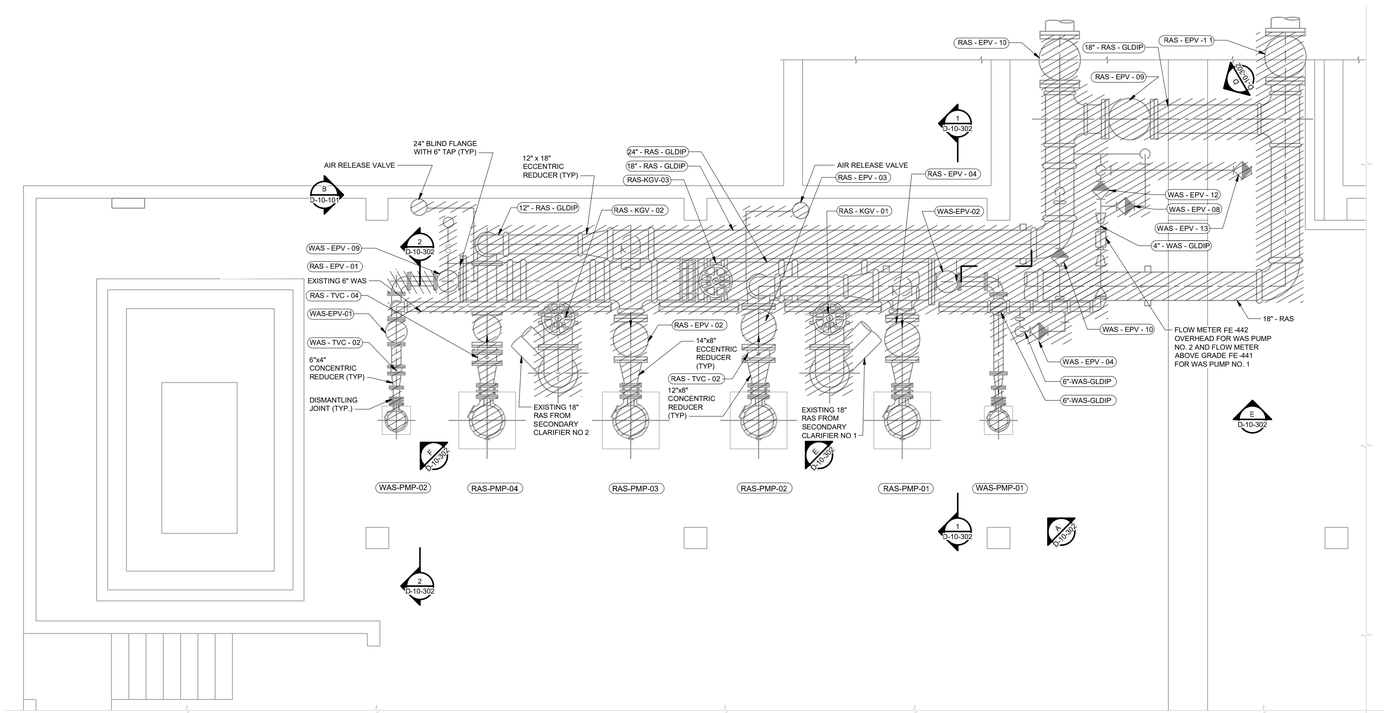
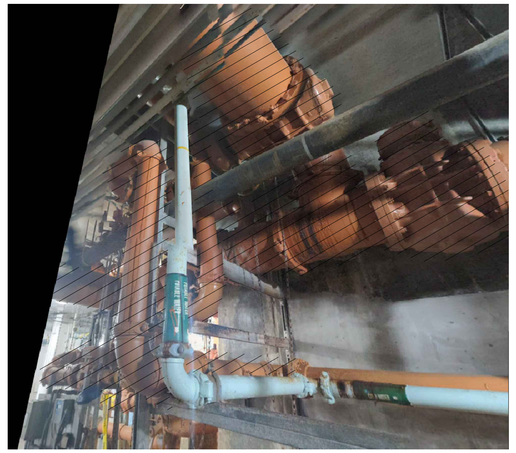


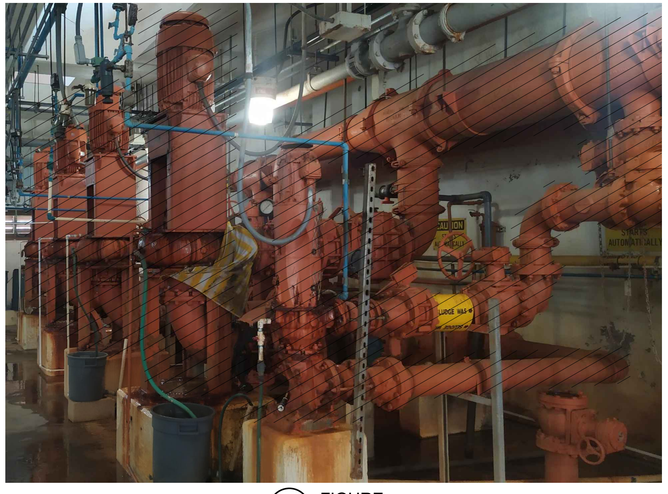
PUMP ROOM DEMOLITION PLAN
1/4" = 1'-0"

NOTES:

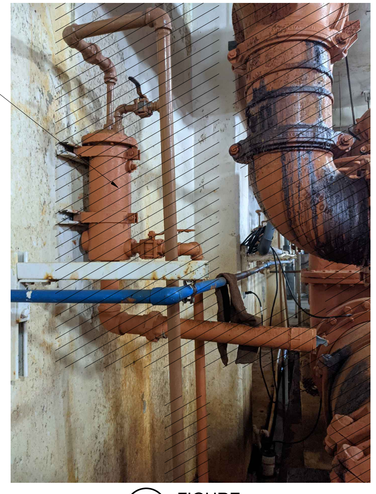
1. PLANS DO NOT NECESSARILY REPRESENT THE ACTUAL SYSTEM CONFIGURATION AND ALL ITEMS REQUIRING DEMOLITION, REMOVAL, OR PATCHING. ALL DEMOLITION, REMOVAL, CUTTING, PATCHING, AND OTHER WORK NECESSARY TO ACCOMMODATE NEW CONSTRUCTION SHALL BE INCLUDED IN THE CONTRACT AT NO ADDITIONAL COST TO OWNER.
2. CONTRACTOR TO FIELD CHECK EXISTING DIMENSIONS AND PIPING SYSTEM COMPONENTS INCLUDING PIPING, VALVES, SUPPORTS AND FITTINGS REQUIRED PRIOR TO DEMOLITION AND REPLACEMENT.
3. EXISTING PUMP BASES AND CONCRETE PEDESTALS TO REMAIN.
4. EXISTING METAL PIPE SUPPORTS TO BE REPLACED AT EXISTING LOCATIONS EXCEPT WHERE SUPPORT IS SUPPORTING OTHER STRUCTURES NOT INCLUDED IN THIS PROJECT.
5. EXISTING SEAL WATER AND CHLORINE PIPING SHALL BE DEMOLISHED AND CAPPED AT SOURCE HEADER PIPE.
6. ALL WORK ASSOCIATED WITH OTHER UTILITIES AND ELECTRICAL CONDUITS AND REQUIRED FOR THE DEMOLITION AND REPLACEMENT OF THE PIPING SYSTEM WILL BE PROVIDED BY CONTRACTOR AT NO ADDITIONAL COST TO OWNER. SUCH WORK MAY INCLUDE TEMPORARY SUPPORT, RELOCATION, DISCONNECT, BY-PASS SYSTEMS, ETC. AND IS NOT SHOWN ON THESE DRAWINGS OR SPECIFIED.



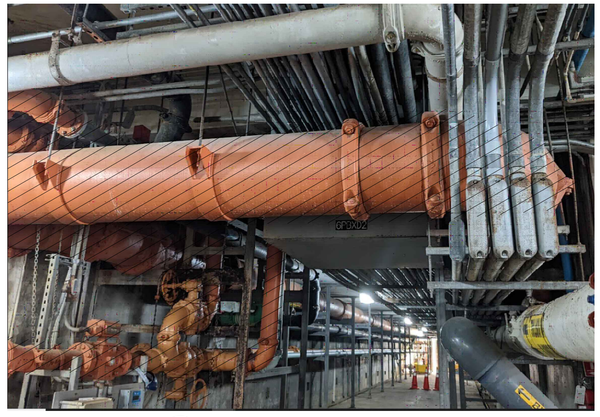
D FIGURE
NTS



A FIGURE
NTS



B FIGURE
NTS



C FIGURE
NTS

4' 2' 0 4' 8'
1/4"=1'-0"

100% SUBMITTAL

NO.	DATE	BY	CHK	APP
	REVISIONS AND RECORD OF USE			
	02/01/2023 100% SUBMITTAL	PG	IB	IB
2	10/10/2022 95% SUBMITTAL	AD	PG	
1	09/28/2021 ISSUED FOR 60% SUBMITTAL	AD	PG	

Date:
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Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

DEMOLITION
OPERATIONS BUILDING PUMP ROOM PLAN - EL 3.00

DESIGNED: MG
DETAILED: HT, AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

D-10-101
SHEET
6 OF 28

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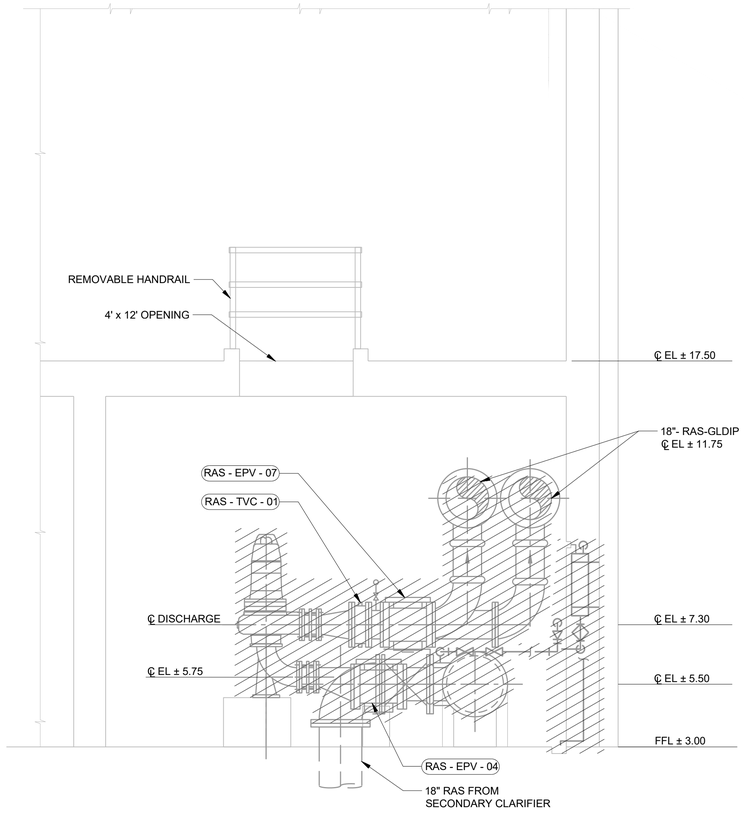
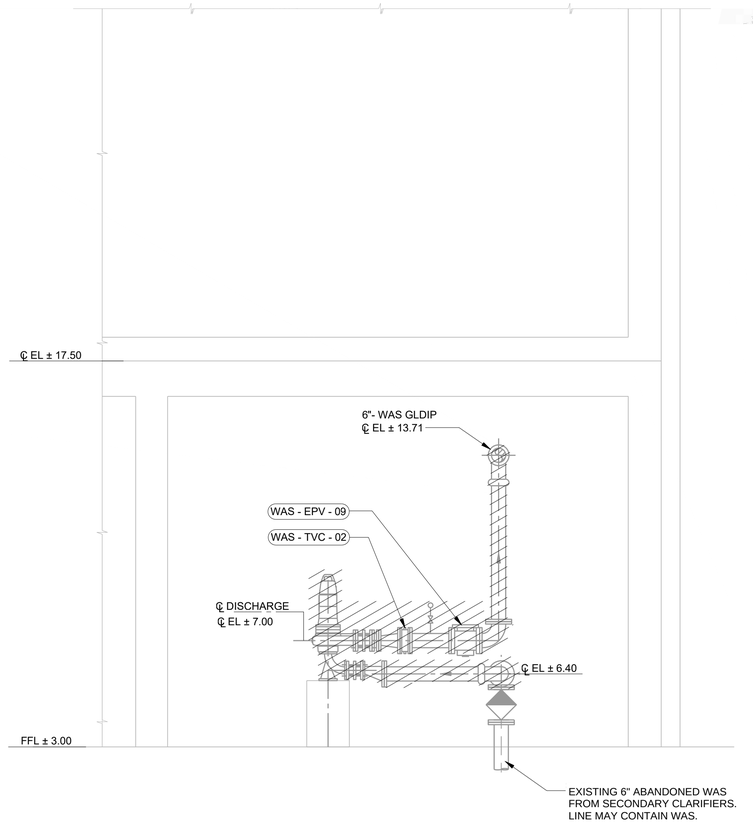
D409283



1 SECTION
D-10-101 3/8" = 1'-0"



2 SECTION
D-10-101 3/8" = 1'-0"

E PHOTO RAS PUMP
(TYPICAL)

F PHOTO WAS PUMP
(TYPICAL)

NOTES:

1. PLANS DO NOT NECESSARILY REPRESENT THE ACTUAL SYSTEM CONFIGURATION AND ALL ITEMS REQUIRING DEMOLITION, REMOVAL, OR PATCHING. ALL DEMOLITION, REMOVAL, CUTTING, PATCHING, AND OTHER WORK NECESSARY TO ACCOMMODATE NEW CONSTRUCTION SHALL BE INCLUDED IN THE CONTRACT AT NO ADDITIONAL COST TO OWNER.
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3. EXISTING PUMP BASES AND CONCRETE PEDESTALS TO REMAIN.
4. EXISTING METAL PIPE SUPPORTS TO BE REPLACED AT EXISTING LOCATIONS EXCEPT WHERE SUPPORT IS SUPPORTING OTHER STRUCTURES NOT INCLUDED IN THIS PROJECT.
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6"1'2" 1' 2' 3' 4' 5' 6' 7'
3/8"=1'-0"

100% SUBMITTAL

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D409283

NO.	BY	CHK'APP	DATE	REVISIONS AND RECORD OF USE
2	AD	PG	02/01/2023	100% SUBMITTAL
1	AD	PG	10/10/2022	95% SUBMITTAL
		IB	09/28/2021	ISSUED FOR 60% SUBMITTAL

Date:
Engineer of Record:
Florida License No.:

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Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

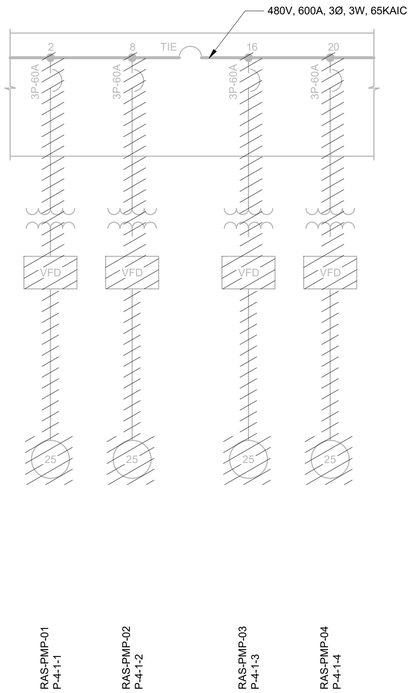
DEMOLITION
OPERATIONS BUILDING
SECTIONS

DESIGNED: MG
DETAILED: HT, AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

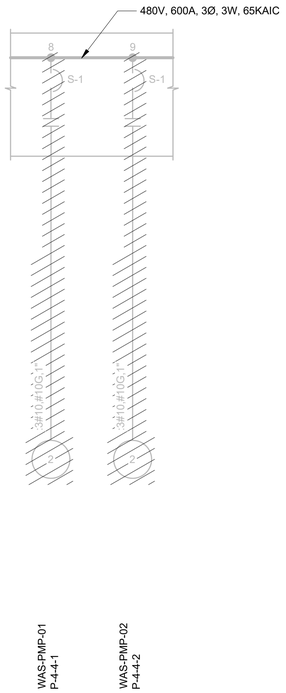
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

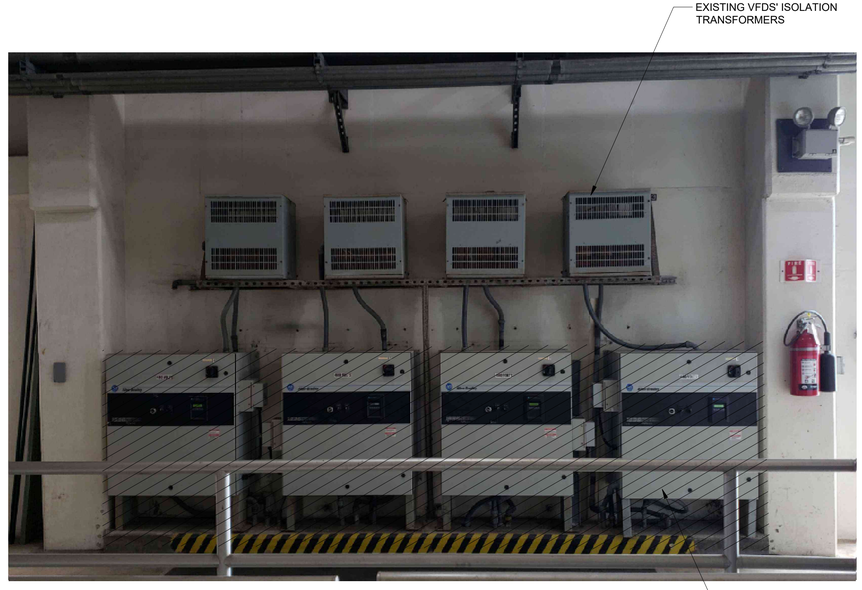
D-10-301
SHEET
7 OF 28



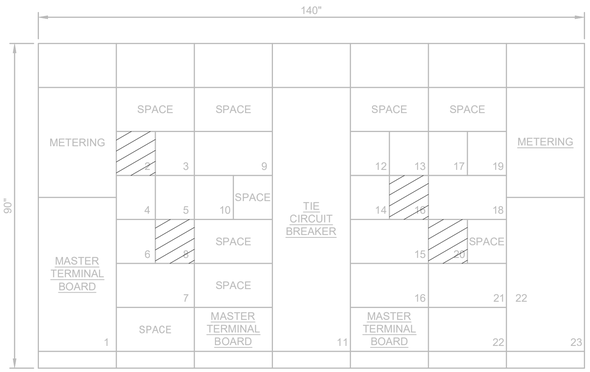
6MCC4A / 4B PARTIAL ONE-LINE DEMOLITION DIAGRAM
(ELECTRICAL ROOM)
NO SCALE



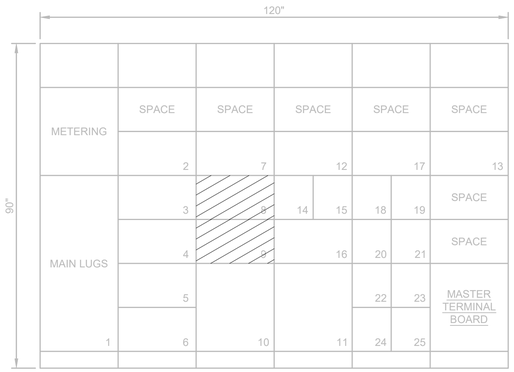
6MCC7 PARTIAL ONE-LINE DEMOLITION DIAGRAM
(ELECTRICAL ROOM)
NO SCALE



EXISTING VFD DEMOLITION
(PUMP ROOM)
NO SCALE



6MCC4A / 4B DEMOLITION FRONT ELEVATION
(ELECTRICAL ROOM)
NO SCALE



6MCC7 DEMOLITION FRONT ELEVATION
(ELECTRICAL ROOM)
NO SCALE

NOTES:

1. SEE DRAWINGS E-01 AND E-02 FOR ELECTRICAL LEGEND AND ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. EXISTING VARIABLE FREQUENCY DRIVES ARE ALLEN-BRADLEY MODEL 1336 PLUS II.
3. CONTRACTOR SHALL SALVAGE EXISTING VFD ENCLOSURES AND EVALUATE IF THEY CAN BE USED TO HOUSE NEW VFDS. CONTRACTOR SHALL PROVIDE CREDIT TO ONWER IF EXISTING VFD ENCLOSURES CAN BE UTILIZED.

100% SUBMITTAL

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D409283

NO.	DATE	REVISIONS AND RECORD OF USE	BY	CHK/APP
	02/01/2023	100% SUBMITTAL		
	10/10/2022	95% SUBMITTAL		
1	11/26/2021	ISSUED FOR 65% SUBMITTAL	AD	PG IB

Date:
Engineer of Record:
Florida License No.:

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Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

DEMOLITION
ONE-LINE DEMOLITION DIAGRAMS

DESIGNED: DG
DETAILED: HT, AD
CHECKED: RRB
APPROVED: RRB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

D-10-302
SHEET
8 OF 28

GENERAL

1. THE APPLICABLE BUILDING CODE IS AS INDICATED IN THE BASIC LOADING CRITERIA LISTED ON THIS DRAWING.
2. THE REQUIREMENTS INDICATED ON THIS SHEET ARE INTENDED AS A BASIC SUMMARY OF THE MATERIAL AND CONSTRUCTION REQUIREMENTS FOR THE PROJECT. ADDITIONAL, MORE STRINGENT REQUIREMENTS ARE GIVEN IN THE PROJECT DETAIL DRAWINGS AND SPECIFICATIONS.
3. ALL STRUCTURAL RELATED SHOP DRAWINGS SHALL BE REVIEWED BY THE ENGINEER PRIOR TO CONSTRUCTION.
4. STRUCTURES MAY BE BUOYANT WHEN EMPTY DURING CONSTRUCTION. CONTRACTOR SHALL PROTECT STRUCTURES AGAINST FLOTATION UNTIL CONSTRUCTION IS COMPLETE. .
5. STRUCTURES MAY BE UNSTABLE UNTIL THEY ARE CONSTRUCTED IN THIER ENTIRETY. CONTRACTOR IS RESPONSIBLE FOR DESIGNING TEMPORARY STRUCTURAL SUPPORTS TO RESIST WIND LOADS, CONSTRUCTION LOADS, AND ANY OTHER TEMPORARY CONDITIONS THAT MAY OCCUR DURING CONSTRUCTION, IN ORDER TO MAINTAIN STABILITY OF THE CONSTRUCTION WORK. ANCHORS FOR CONTRACTOR'S TEMPORARY SUPPORT SYSTEMS THAT ATTACH TO CONCRETE OR MASONRY SHALL BE LOCATED TO AVOID DAMAGING EMBEDDED REINFORCEMENT OR UTILITIES.

CAST-IN-PLACE CONCRETE

1. A MINIMUM 28 DAY COMPRESSIVE STRENGTH (f'c) OF 4,000 PSI WAS UTILIZED IN THE DESIGN OF STRUCTURAL REINFORCED CONCRETE. SEE SPECIFICATIONS FOR CONSTRUCTION STRENGTH REQUIREMENTS.
2. THE LOCATION OF ALL CONSTRUCTION JOINTS AND OTHER TYPES OF JOINTS, OTHER THAN THOSE SPECIFIED OR SHOWN ON THE PLANS, SHALL BE ACCEPTABLE TO THE ENGINEER PRIOR TO PLACING CONCRETE.
3. PROVIDE 3/4" CHAMFER ON ALL EXPOSED CORNERS.

REINFORCING STEEL

1. ALL REINFORCING BAR SHALL BE GRADE 60, DEFORMED, ASTM A615, UNLESS NOTED OTHERWISE.
2. DIMENSIONS TO REINFORCING BARS ARE TO BAR CENTERLINES, UNLESS NOTED OTHERWISE. BAR COVER IS THE CLEAR DISTANCE BETWEEN THE BAR AND THE CONCRETE SURFACE.
3. NO WELDING OF REINFORCING BARS SHALL BE PERMITTED UNLESS APPROVAL IS OBTAINED FROM THE ENGINEER PRIOR TO CONSTRUCTION.
4. FOR CONCRETE SLABS THAT HAVE A SLOPING TOP FACE, THE TOP LAYERS OF REINFORCEMENT SHALL BE PLACED ON A SIMILAR SLOPE SO THAT SPECIFIED COVER IS MAINTAINED.

POST-INSTALLED ANCHORS

1. POST-INSTALLED ANCHORS SHALL INCLUDE ADHESIVE ANCHORS (THREADED RODS, BOLTS OR REINFORCING BARS), EXPANSION ANCHORS, AND UNDERCUT ANCHORS INSTALLED INTO HARDENED CONCRETE OR MASONRY. SEE THE ANCHORAGE IN CONCRETE AND MASONRY SPECIFICATION SECTION FOR ADDITIONAL REQUIREMENTS.
2. POST-INSTALLED ANCHORS SHALL ONLY BE USED WHERE INDICATED ON THE DRAWINGS. CONTRACTOR SHALL OBTAIN APPROVAL FROM ENGINEER PRIOR TO USING POST-INSTALLED ANCHORS FOR MISSING OR MISPLACED CAST-IN-PLACE ANCHORS.
3. CARE SHALL BE TAKEN TO AVOID CONFLICTS WITH EXISTING REINFORCING STEEL AND OTHER EMBEDDED ITEMS WHEN DRILLING HOLES. REINFORCING BARS SHALL NOT BE DAMAGED DURING DRILLING OR ANCHOR INSTALLATION. HOLES SHALL BE DRILLED AND CLEANED PER THE PRODUCT MANUFACTURER'S INSTRUCTIONS. ANCHORS SHALL BE INSTALLED PER THE PRODUCT MANUFACTURER'S INSTRUCTIONS AT NOT LESS THAN MINIMUM EDGE DISTANCES AND/OR SPACING INDICATED IN THE MANUFACTURER'S LITERATURE.
4. SUBSTITUTION REQUESTS FOR PRODUCTS OTHER THAN THOSE LISTED IN THE SPECIFICATION OR INDICATED ON THE DRAWINGS SHALL BE SUBMITTED TO ENGINEER FOR REVIEW AND APPROVAL. PRODUCT ICC-ESR EVALUATION REPORTS SHALL BE INCLUDED WITH THE SUBMITTAL PACKAGE. IF REQUESTED, CALCULATIONS PREPARED BY A REGISTERED PROFESSIONAL ENGINEER USING METHODS AND PROCEDURES REQUIRED BY THE BUILDING CODE MAY BE REQUIRED AS PART OF THE SUBMITTAL PACKAGE.
5. UNLESS NOTED OTHERWISE, THE MINIMUM EMBEDMENT PROVIDED FOR ADHESIVE ANCHORED REINFORCING BARS SHALL DEVELOP THE FULL TENSILE STRENGTH OF THE BAR.
6. SPECIAL INSPECTION WILL BE PROVIDED FOR ALL POST-INSTALLED ANCHORS.

STRUCTURAL STEEL

1. ROLLED WIDE FLANGE SHAPES SHALL HAVE A MINIMUM YIELD STRENGTH OF 50 KSI;
   CHANNELS, PLATES, AND ANGLES A MINIMUM OF 36 KSI;
   STRUCTURAL PIPES A MINIMUM OF 35 KSI;
   ROUND STRUCTURAL TUBES A MINIMUM OF 46 KSI;
   RECTANGULAR STRUCTURAL TUBES A MINIMUM OF 50 KSI.
2. WELDING SHALL BE DONE WITH A FILLER MATERIAL HAVING A MINIMUM TENSILE STRENGTH OF 70 KSI.
3. BOLTED CONNECTIONS SHALL USE 3/4" DIA ASTM F3125, GRADE A325 BOLTS OR GRADE F1852 TWIST-OFF BOLTS, WITH THE THREADS EXCLUDED FROM THE SHEAR PLANE, UNLESS NOTED OTHERWISE.
4. HOLES FOR ANCHOR RODS AND ANCHOR BOLTS IN COLUMN BASE PLATES USING ASTM F844 OR F436 FLAT CIRCULAR WASHERS SHALL BE AS FOLLOWS:

   BOLTS/RODS 3/4" TO 1" - 5/16" OVERSIZE
   BOLTS/RODS 1" TO 2" - 1/2" OVERSIZE
   BOLTS/RODS OVER 2" - 1" OVERSIZE

   AT THE CONTRACTORS OPTION, OVERSIZE HOLES LARGER THAN THOSE LISTED ABOVE MAY BE USED, PROVIDED THAT 3/8" PLATE WASHERS ARE USED WITH STANDARD HOLES AND FIELD WELDED WITH A 5/16" FILLET WELD TO THE BASE PLATE ALONG A MIN OF 3 SIDES.

EXISTING STRUCTURES

1. THE DRAWINGS DEPICT WORK AT EXISTING STRUCTURES. ALL DIMENSIONS AND ALL DEPICTIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO ORDERING MATERIALS, STARTING FABRICATION, OR STARTING CONSTRUCTION.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE, REPAIRS OR STRUCTURAL MODIFICATIONS THAT ARE REQUIRED DUE TO DEMOLITION BEYOND THE LIMITS IDENTIFIED IN THE DRAWINGS.
3. REINFORCEMENT FOR ANY EXISTING CONCRETE OR MASONRY ELEMENT SHALL NOT BE DAMAGED UNLESS THE ELEMENT IS TO BE DEMOLISHED. WHEN LOCATING EXISTING REINFORCEMENT IS REQUIRED, IT SHALL BE LOCATED USING NON-DESTRUCTIVE METHODS. REINFORCING STRANDS IN EXISTING PRESTRESSED CONCRETE SHALL NOT BE CUT UNLESS INDICATED ON THE DRAWINGS OR OTHERWISE AUTHORIZED BY THE ENGINEER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ANY DAMAGE, REPAIRS OR STRUCTURAL MODIFICATIONS THAT ARE REQUIRED DUE TO DAMAGE OF CONCRETE, MASONRY OR REINFORCEMENT THAT HAS BEEN IDENTIFIED ON THE DRAWINGS TO REQUIRE FIELD VERIFICATION.
4. CORE DRILLING AND SAW CUTTING SHALL NOT BE PERFORMED UNLESS INDICATED ON THE DRAWINGS OR APPROVED BY ENGINEER.
5. EXPOSED CONCRETE SURFACES THAT REMAIN AFTER DEMOLITION SHALL BE REPAIRED TO MATCH ADJACENT CONCRETE SURFACES.
6. UNLESS OTHERWISE INDICATED ON THE DRAWINGS, EXPOSED CONCRETE SURFACES WITH REINFORCEMENT, ANCHOR BOLTS, HANGER RODS, OR OTHER EXPOSED METAL EMBEDMENTS SHALL BE REPAIRED BY CUTTING OFF THE METAL AT THE FACE OF THE CONCRETE, GRINDING SMOOTH, AND COATING. COATING SHALL EXTEND A MINIMUM OF 1" BEYOND THE EDGE OF ANY EXPOSED METAL.

DELEGATED DESIGN

1. THE FOLLOWING ITEMS ARE IDENTIFIED IN THE DRAWINGS AND SPECIFICATIONS AS BEING DESIGNED AND SEALED BY OTHERS. SUBMITTALS FOR THESE ITEMS SHALL BE PREPARED BY THE SUPPLIERS AND SUBMITTED TO ENGINEER AND CODE OFFICIAL FOR REVIEW.

   SECTION 15140 - PIPE SUPPORTS

PIPE SUPPORTS

1. PIPE SUPPORTS FOR PIPES 12 INCHES IN DIAMETER OR SMALLER SHALL BE PER SPECIFICATION SECTION 15140 FOR PIPES LARGER THAN 12 INCHES IN DIAMETER, THE NOTES AND DETAILS SHOWN ON THE DRAWINGS SHALL PRECEDE THE SPECIFICATIONS ALTHOUGH SPECIFICATION SECTION 15140 MAY USED FOR INFORMATION NOT FOUND ON THE DRAWINGS.
2. ALL NON-HANGER TYPE SUPPORTS SHALL HAVE A CONCRETE PAD INSTALLED AT EACH LEG BASE FOR PREFABRICATED CHANNELS/UNISTRUT SUPPORTS OR AT EACH STEEL COLUMN PIPE SUPPORT BASE. REFER TO DRAWING S-00-003 FOR TYPICAL PIPE SUPPORT BASE DETAIL.
3. THE CONTRACTOR SHALL REMOVE THE EXISTING HANGER RODS AND SADDLE AT THE EXISTING HANGER SUPPORTS AND REPLACE PER DETAILS AND NOTES ON DRAWING S-00-002. DURING REPLACEMENT OF THE HANGER RODS THE CONTRACTOR SHALL ALSO INSPECT THE EXISTING EMBEDDED CEILING HANGER BRACKETS. EXISTING BRACKETS FOUND TO BE IN SUFFICIENT SUITABLE CONDITION MAY BE REUSED. IF THE EXISTING BRACKET IS FOUND TO NOT BE IN SUFFICIENT CONDITION FOR REUSE NEW ANCHORS SHALL BE INSTALLED AS CLOSE TO THE EXISTING AS POSSIBLE ALONG WITH THE NEW HANGER RODS AND SADDLE. REFER THE DETAILS ON DRAWING S-00-002 AND ANCHOR MANUFACTURER LITERATURE FOR ANCHOR INSTALLATION REQUIREMENTS.

BASIC LOADING CRITERIA

THE APPLICABLE BUILDING CODE IS THE 2020 FLORIDA BUILDING CODE.

1. DEAD LOAD ..... AS CALCULATED
2. LIVE LOADS ..... AS CALCULATED
3. SNOW LOAD:
   GROUND SNOW LOAD (P_g) ..... 0 PSF
   SNOW EXPOSURE FACTOR (C_e) ..... N/A
4. SEISMIC LOAD:
   MAPPED MCE SHORT PERIOD SPECTRAL RESPONSE ACCELERATION (S_S) 0.021g
   MAPPED MCE ONE SECOND PERIOD SPECTRAL RESPONSE ACCELERATION (S_1) 0.013g
   DESIGN SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (S_{DS}) 0.022g
   DESIGN SPECTRAL RESPONSE ACCELERATION AT ONE SECOND PERIOD (S_{D1}) 0.021g
   SITE CLASS ..... D
   RISK CATEGORY III
   SEISMIC DESIGN CATEGORY ..... A
5. WIND LOAD:
   BASIC (ULTIMATE) DESIGN WIND SPEED ..... 200 MPH
   ALLOWABLE STRESS (NOMINAL) DESIGN WIND SPEED ..... 150 MPH
   GROUND ELEVATION FACTOR (K_e) 1.0
   EXPOSURE ..... D
   RISK CATEGORY III

100% SUBMITTAL

NO.	DATE	REVISIONS AND RECORD OF USE	BY	CHK	APP
	02/01/2023	100% SUBMITTAL			
2	09/30/2022	60% SUBMITTAL	AIP	DLD	IB
1	09/28/2021	ISSUED FOR 60% SUBMITTAL	AIP	DLD	IB

Date:
Engineer of Record:
Florida License No.:

BLACK & VEATCH
Black & Veatch Corporation
2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

STRUCTURAL
STRUCTURAL NOTES

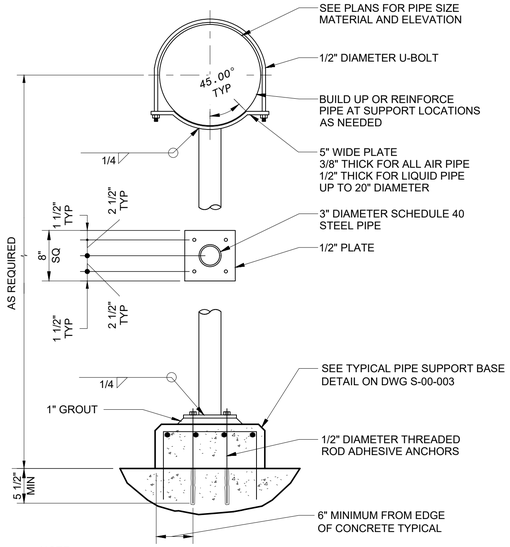
DESIGNED: MFS
DETAILED: AIP
CHECKED: DLD
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

S-00-001
SHEET
9 OF 28

FD9000
D409283

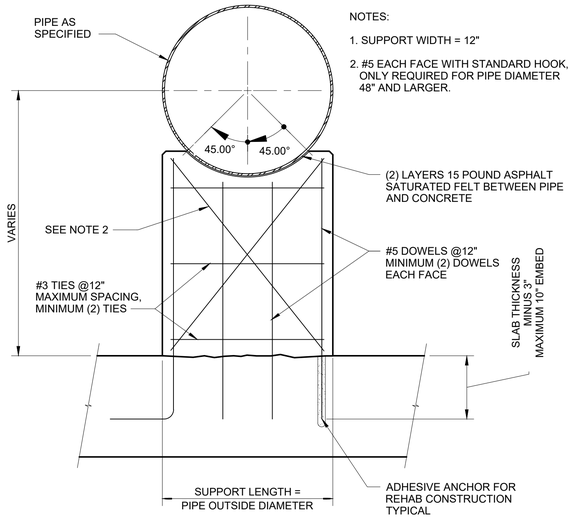


NOTE:

ALL STEEL MATERIALS SHALL BE HOT-DIP GALVANIZED FOR EXTERIOR LOCATIONS. VENT HOLES FOR GALVANIZING SHALL BE THE MINIMUM SIZE NECESSARY. HOLES SHALL BE LOCATED IN THE BOTTOM BASEPLATE AND ALSO LOCATED IN THE TOP OF THE PIPE, ADJACENT TO THE CURVED PLATE.

3 INCH DIAMETER STEEL COLUMN PIPE SUPPORT

1" = 1'-0"

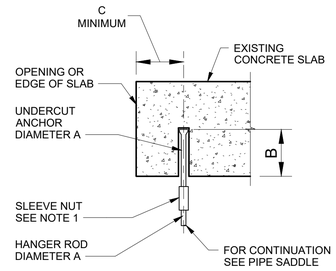


NOTES:

1. SUPPORT WIDTH = 12"
2. #5 EACH FACE WITH STANDARD HOOK, ONLY REQUIRED FOR PIPE DIAMETER 48" AND LARGER.

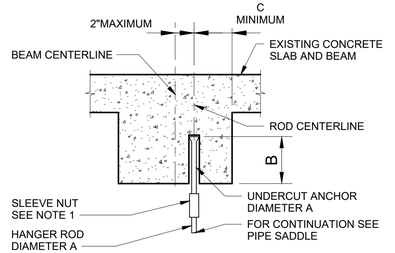
CONCRETE SADDLE PIPE SUPPORT

1" = 1'-0"



TYPE C - UNDERCUT ANCHOR IN SLAB

TYPE C SUPPORTS			
ID#	A	B	C
C-50	1/2"	5"	5"
C-75	3/4"	10"	9"



TYPE D - UNDERCUT ANCHOR IN BEAM

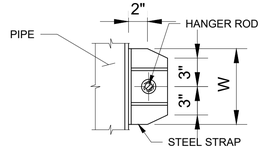
TYPE D SUPPORTS			
ID#	A	B	C
D-50	1/2"	5"	4"
D-75	3/4"	10"	8"

NOTES:

1. SLEEVE NUTS SHALL HAVE THE FOLLOWING MINIMUM ULTIMATE CAPACITIES:

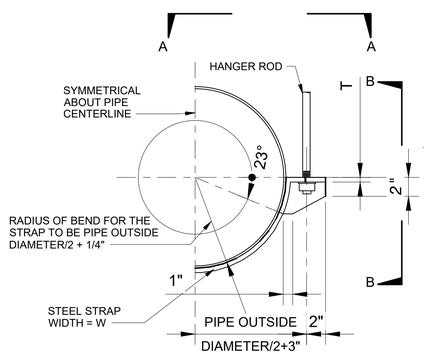
ROD DIAMETER	SLEEVE NUT CAPACITY
1/2"	7,100 LB
3/4"	15,900 LB
1"	28,300 LB

2. ALL PRODUCTS SHALL BE STAINLESS STEEL IN LOCATIONS WHERE EXPOSED WATER IS PRESENT. OTHERWISE ALL PRODUCTS SHALL BE GALVANIZED STEEL.
3. ALL MATERIALS ON THIS DRAWING SHALL BE AS SPECIFIED IN THE STRUCTURAL METALS SECTION AND THE ANCHORAGE IN CONCRETE AND MASONRY SECTION.



SECTION A-A

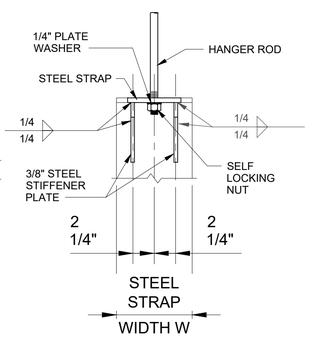
PIPE SADDLE	
PIPE SIZE	STRAP SIZE T x W
14"-16"	1/2"x6"
18"-20"	5/8"x6"
24"-30"	3/4"x6"
36"	3/4"x8"
42"-48"	3/4"x11"
54"	7/8"x11"
60"	7/8"x11"
66"	7/8"x11"



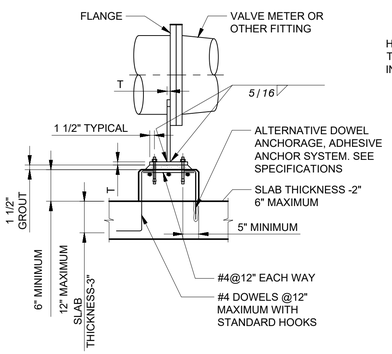
ELEVATION

PIPE SADDLE

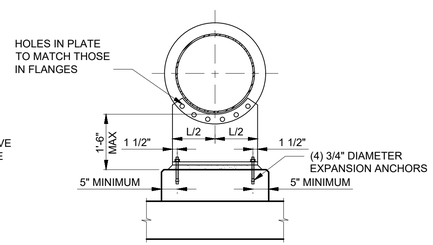
1 1/2" = 1'-0"



SECTION B-B



ELEVATION



SECTION

PIPE SIZE	T	L
14"-18"	5/8"	PIPE OD
20"	3/4"	18"
24"	3/4"	21"
30"	3/4"	27"
36"	3/4"	33"
42"	3/4"	36"
48"	3/4"	42"
54"	3/4"	44"
60"	3/4"	50"

NOTES:
OD = OUTSIDE DIAMETER

FLANGE PIPE SUPPORT

1/2" = 1'-0"

100% SUBMITTAL

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

STRUCTURAL
MISCELLANEOUS STRUCTURAL DETAILS

DESIGNED: MFS
DETAILED: AIP
CHECKED: DLD
APPROVED: IB
DATE: 02/01/2023

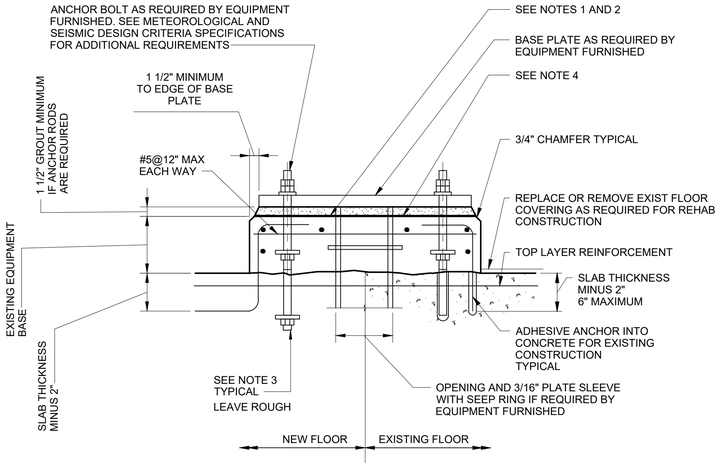
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

S-00-002
SHEET
10 OF 28

100% SUBMITTAL

FD9000
D409283

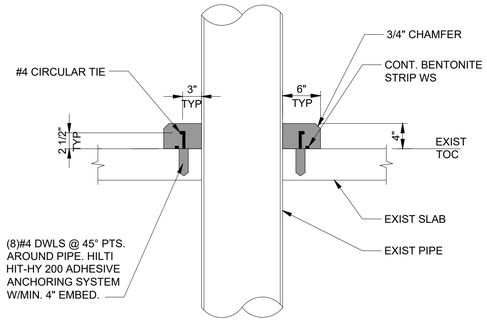


NOTES:

1. EQUIPMENT MANUFACTURER TO INDICATE REQUIRED FLATNESS WHERE NO GROUT IS SPECIFIED. TOLERANCES SHALL BE IN CONFORMANCE WITH ACI PRC-117 GUIDE FOR TOLERANCE COMPATIBILITY IN CONCRETE CONSTRUCTION.
2. CONTRACTOR AND SUPPLIER SHALL COORDINATE FINAL LOCATION AND SIZE OF PADS WITH EQUIPMENT FURNISHED. COORDINATE ANCHOR BOLT REQUIREMENTS FOR REQUIRED EMBEDMENT DEPTHS AND CONCRETE EDGE DISTANCES.
3. WHERE THE DESIGN ANCHOR BOLT EMBEDMENT IS GREATER THAN THE CONCRETE EQUIPMENT BASE THICKNESS, THEN THE REQUIRED DEPTH OF EMBEDMENT SHALL BE MEASURED FROM THE TOP OF STRUCTURAL SLAB AND NOT THE TOP OF THE EQUIPMENT BASE.
4. EQUIPMENT BASE SHALL USE STRUCTURAL CONCRETE AS INDICATED IN THE CAST-IN-PLACE CONCRETE SPECIFICATION. 5. ANCHOR BOLTS AND REINFORCING WILL BE INSPECTED IN ACCORDANCE WITH THE CODE REQUIRED SPECIAL INSPECTIONS AND PROCEDURES SPECIFICATION.

EQUIPMENT ANCHORAGE DETAIL

1" = 1'-0"

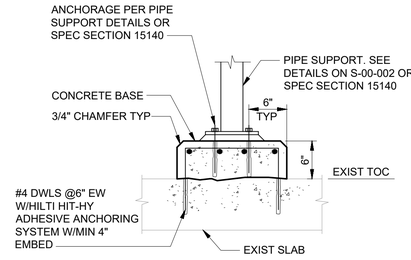


NOTE:

1. EXISTING PIPE SHALL BE RECOATED PRIOR TO INSTALLATION OF CONCRETE COLLAR. SURFACE PREP SHALL CONSIST OF ABRASIVE BLAST CLEANING TO NAPF 500-03-04 AND COATING SHALL BE COATING SYSTEM DATA SHEET 13S2 AS SPECIFIED IN SECTION 09940.

TYPICAL EXISTING PIPE PENETRATION COLLAR DETAIL

1" = 1'-0"



TYPICAL PIPE SUPPORT BASE DETAIL

1" = 1'-0"

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

STRUCTURAL
MISCELLANEOUS STRUCTURAL DETAILS

DESIGNED: MFS
DETAILED: AIP
CHECKED: DLD
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
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S-00-003
SHEET
11 OF 28

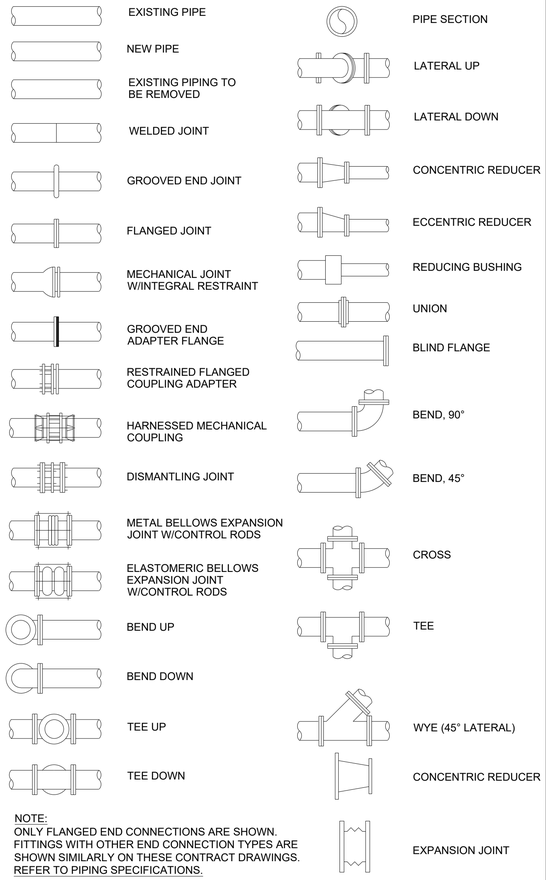
FD9000
D409283

PIPE, EQUIPMENT & VALVE TAG LEGEND

NOTE:
REFER TO PIPING SPECIFICATIONS AND P&ID'S.

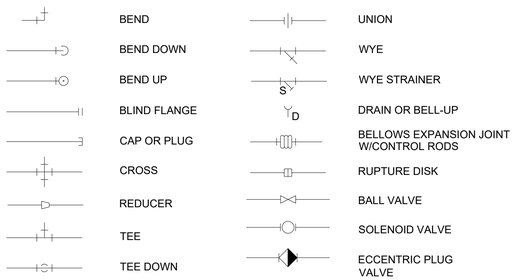
PIPE & FITTINGS SYMBOL LEGEND

DOUBLE LINE

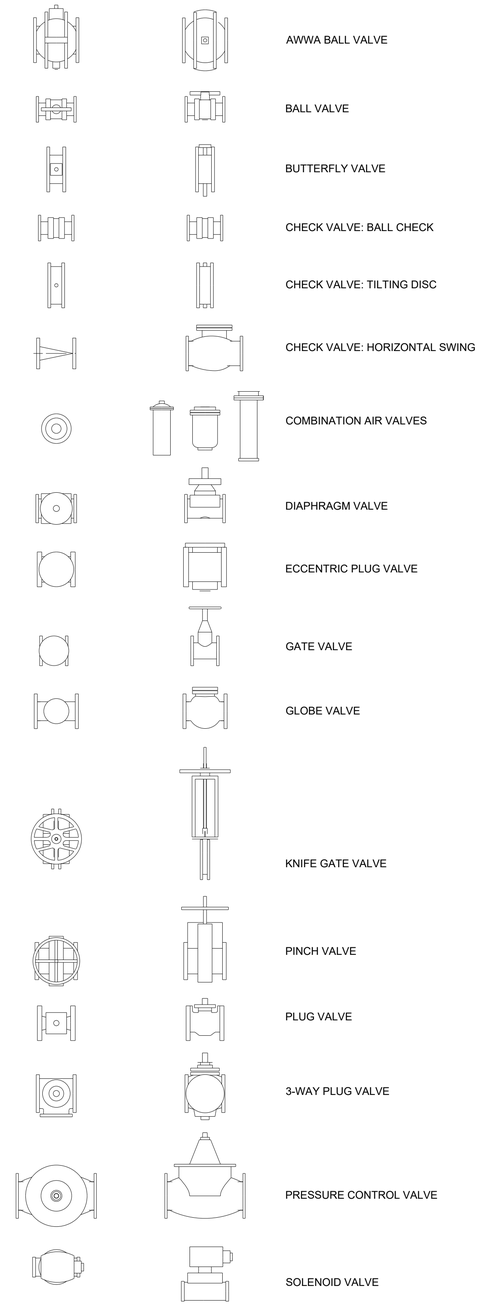


NOTE:
ONLY FLANGED END CONNECTIONS ARE SHOWN.
FITTINGS WITH OTHER END CONNECTION TYPES ARE SHOWN SIMILARLY ON THESE CONTRACT DRAWINGS.
REFER TO PIPING SPECIFICATIONS.

SINGLE LINE



VALVE SYMBOL LEGEND



NOTE:
VALVES SHOWN ARE REPRESENTATIVE ONLY. SEE SPECIFICATIONS FOR APPROVED MANUFACTURE LIST.

GENERAL PROCESS MECHANCAL NOTES

1. LEGENDS SHOWN IN THIS DRAWING ARE BASED ON A TEMPLATE THAT IS NOT PROJECT SPECIFIC. SOME LEGEND SYMBOLS ARE NOT USED ON THIS PROJECT, BUT ARE SHOWN TO PROVIDE A DICTIONARY FOR SYMBOLS THAT MAY ALSO BE USED DURING THE PROJECT CONSTRUCTION PHASE.
2. LAY PIPE TO UNIFORM GRADE BETWEEN INDICATED ELEVATION POINTS.
3. SIZE OF FITTINGS SHOWN ON DRAWINGS SHALL CORRESPOND TO ADJACENT STRAIGHT RUN OF PIPE, UNLESS OTHERWISE INDICATED. TYPE OF JOINT AND FITTING MATERIAL SHALL BE THE SAME AS SHOWN FOR ADJACENT STRAIGHT RUN OF PIPE.
4. ALL REQUIRED HANGERS, SUPPORTS, BRACES, INSERTS, AND ACCESSORIES ARE NOT SHOWN ON THE DRAWINGS. PIPE SUPPORTS FOR 12-INCH DIAMETER AND SMALLER PIPES SHALL BE DESIGNED AND FURNISHED BY THE CONTRACTOR IN ACCORDANCE WITH THE SPECIFICATIONS AND UTILIZING CONTRACTOR SELECTED SUPPORTS FROM THE SUPPORT DETAILS, OR THE SPECIFIC DETAIL CALLED FOR BY THE DRAWINGS.
5. ALL JOINTS SHALL BE WATERTIGHT
6. ALL BURIED PIPING SPECIFIED TO BE PRESSURE TESTED, EXCEPT FLANGED, WELDED, OR SCREWED PIPING, SHALL BE PROVIDED WITH THRUST PROTECTION AS SPECIFIED, UNLESS OTHERWISE NOTED.
7. NUMBER AND LOCATION OF UNIONS AND COUPLINGS SHOWN ON DRAWINGS IS ONLY APPROXIMATE. CONTRACTOR SHALL PROVIDE ALL UNIONS AND COUPLINGS REQUIRED BY THE SPECIFICATIONS AND AS NECESSARY TO FACILITATE CONVENIENT REMOVAL OF VALVES AND MECHANICAL EQUIPMENT.
8. WHERE A GROOVED END JOINT IS SHOWN,IT SHALL BE THE RIGID JOINT TYPE,UNLESS OTHERWISE SPECIFIED. WHERE A FLANGED COUPLING ADAPTER IS SHOWN, A STANDARD FLANGE SHALL BE JOINED TO THE COUPLING ADAPTER.
9. CONTRACTOR SHALL ORIENT VALVES AS SPECIFIED SHOWN ON DRAWINGS AND IN ACCORDANCE WITH VALVE SPECIFICATIONS.

100% SUBMITTAL

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

MECHANICAL
LEGENDS AND NOTES

DESIGNED: MG
DETAILED: HT, AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

M-00-001
SHEET
12 OF 27

FD9000
D409283

PROCESS MECHANICAL ABBREVIATIONS

GENERAL ABBREVIATIONS

A	
ABV	ABOVE
ACC	AREA CONTROL CENTER
ACP	ASBESTOS CEMENT PIPE
AD	ACCESS DOOR
ADWF	AVERAGE DRY-WEATHER FLOW
AFC	ABOVE FINISHED CONCRETE
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AL	ALUMINUM
ALT	ALTERNATE
AN	ANAEROBIC
APPROX	APPROXIMATE, APPROXIMATELY
ASSY	ASSEMBLY
AUTO	AUTOMATIC
AUX	AUXILIARY
AVG	AVERAGE
AX	ANOXIC
B	
BET	BETWEEN
BF	BLIND FLANGE
BFP	BELT FILTER PRESS
BFF	BELOW FINISH FLOOR
BL	BOTTOM LEVEL
BLDG	BUILDING
BLW	BELOW
BNR	BIOLOGICAL NUTRIENT REMOVAL
BOD	BOTTOM OF DUCT ELEVATION, BIOCHEMICAL OXYGEN DEMAND
BOF	BOTTOM OF FOOTING
BOT	BOTTOM
C	
C-C	CENTER TO CENTER
C/C	CENTER TO CENTER
C/L	CENTERLINE
CAP	CAPACITY
CB	CATCH BASIN
CCP	CONCRETE CYLINDER PIPE
CCSP	CONCRETE LINED AND COATED STEEL PIPE
CCT	CHLORINE CONTACT TANKS
CF	CUBIC FEET
CI	CAST IRON
CIP	CAST IRON PIPE
CIRC	CIRCUMFERENCE
CL2	CHLORINE
CLR	CHLORINATOR
CMC	CEMENT MORTAR COATED
CML	CEMENT MORTAR LINED
CMP	CORRUGATED METAL PIPE
CNTL	CONTROL
CO	CLEAN OUT
CO2	CARBON DIOXIDE
COD	CHEMICAL OXYGEN DEMAND
CONT	CONTINUED, CONTINUOUS
CP	COMPRESSOR
CPLG	COUPLING
CPVC	CHLORINATED POLYVINYL CHLORIDE
CRN	CRANE
CSP	CORRUGATED STEEL PIPE
CTF	CENTRIFUGE
CTR	CENTER
CTS	CORROSION/CATHODIC TEST STATION
CU	CUBIC
CY	CUBIC YARD
D	
D	DRAIN
DET	DETAIL
DI	DUCTILE IRON
DIA	DIAMETER
DIAG	DIAGRAM
DIFF	DIFFERENTIAL
DMJ	DISMANTLING JOINT
DN	DOWN
DO	DISSOLVED OXYGEN
DWG	DRAWING
E	
E	EAST, EASTING
EA	EACH
ECC	ECCENTRIC
EE	EACH END
EFF	EFFLUENT, EFFICIENCY
EJ	EXPANSION JOINT
EL	ELEVATION
ELEC	ELECTRICAL
ELL	ELBOW
EO	ELECTRICALLY OPERATED
EPWWF	EQUALIZED PEAK WET WEATHER FLOW
EQ	EQUAL
EQUIP	EQUIPMENT
EXIST	EXISTING
F	
FAB	FABRICATE(D)(TION)
FL	FLOW LINE
FLEX	FLEXIBLE
FLG	FLANGE(D)
FM	FORCE MAIN
FPC	FLEXIBLE PIPE COUPLING
FR	FLOW RATE
FRP	FIBERGLASS REINFORCED PIPE
FSL	FACULTATIVE SLUDGE LAGOON
FT	FOOT, FEET
FUT	FUTURE
G	
GA	GAGE, GAUGE
GALV	GALVANIZED
GEN	GENERAL, GENERATOR
GPD	GALLONS PER DAY
GPM	GALLONS PER MINUTE
GR	GRADE
H	
HDPE	HIGH DENSITY POLYETHYLENE
HDR	HEADER
HOR	HORIZONTAL
HP	HIGH POINT, HIGH PRESSURE
HR	HEAT RESERVOIR
HT	HEIGHT
HWTR	HIGH WATER
I	
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IJS	INFLUENT JUNCTION STRUCTURE
IN	INCH(ES)
INF	INFLUENT
INS	INSULATE(D)(ION)
INV	INVERT
IW	INJECTION WELL
IWI	INJECTION WELL INFLUENT
IWL	INJECTION WELL LOOP
L	
L	LENGTH
LB	POUND
LDLD	LINED DEDICATED LAND DISPOSAL
LEV	LEVEL
LF	LINEAR FEET
LG	LONG
LP	LOW POINT, LOW PRESSURE
LT	LEFT
LWR	LOWER
M	
MAN	MANUAL(LY)
MAX	MAXIMUM
MECH	MECHANICAL
MFR	MANUFACTURE(R)
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MI	MALLEABLE IRON
MIN	MINIMUM, MINUTE
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
ML	MILLILITER
MW	MONITORING WELL
MO	MOTORIZED
N	
N	NORTH, NORTHING
N/A	NOT APPLICABLE
NAOH	SODIUM HYDROXIDE
NIC	NOT IN CONTRACT
NO./#	NUMBER
NOX	NITRATES AND NITRITES
NPSH	NET POSITIVE SUCTION HEAD
NPSHR	NET POSITIVE SUCTION HEAD REQUIRED
NRS	NON-RISING STEM
NTS	NOT TO SCALE
O	
OD	OUTSIDE DIAMETER
OPNG	OPENING
OPP	OPPOSITE
ORP	OXIDATION REDUCTION POTENTIAL
P	
P	PROCESS, PNEUMATIC
P&ID	PIPING/PROCESS AND INSTRUMENTATION DIAGRAM
PC	PIPE COUPLING
PCP	PLAIN CONCRETE PIPE
PE	PLAIN END
PEPS	PRIMARY EFFLUENT PUMPING STATION
PERC	PERCOLATION
PF	PRESSURIZED FLOW
PL	PROPERTY LINE, PIPELINE
PMO	PROJECT MANAGEMENT OFFICE
POP	PNEUMATIC OPERATOR
PPM	PARTS PER MILLION
PRES	PRESSURE
PROP	PROPELLER
PSI	POUNDS PER SQUARE INCH
PSL	PIPE SLEEVE
R	
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
RCCP	REINFORCED CONCRETE CYLINDER PIPE
RED	REDUCE(R)
REG	REGULATOR
REQD	REQUIRED
RH	RIGHT HAND
RL	REDUCED LEVEL
RT	RIGHT
S	
S	SOUTH, SILENCER, SLOPE
SCH	SCHEDULE
SECT	SECTION
SHT	SHEET
SIM	SIMILAR
SL	SLOPE
SO2	SULFER DIOXIDE
SPEC(S)	SPECIFICATION(S)
SPG	SPACING
SQ	SQUARE
STD	STANDARD
SST	STAINLESS STEEL
ST	STEEL
T	
TBD	TO BE DETERMINED
TD	TANK DRAIN
TDS	TOTAL DISSOLVED SOLIDS
THD	THREADED
TO	TOP OF
TOG	TOP OF GRADE
TYP	TYPICAL
U	
UG	UNDERGROUND
UN	UNION
UON	UNLESS OTHERWISE NOTED
V	
VAR	VARIES, VARIABLE
VCP	VITRIFIED CLAY PIPE
VERT	VERTICAL
W	
W	WEST, WIDTH
W/	WITH
W/O	WITHOUT
WF	WIDE FLANGE
WM	WALL MOUNTED
WS	WATER SURFACE
WSL	WATER SURFACE LEVEL
WSTP	WATERSTOP
WT	WATERTIGHT, WEIGHT
Y	
YCO	YARD CLEANOUT
MISC	
Ø	ROUND, DIAMETER

PIPING SYSTEM ABBREVIATIONS

A	
A	AERATION AIR
AA	AGITATION AIR
ACH	AFTER COOLER WATER
ASH	ASH PNEUMATIC
B	
BD	BOILER BLOWDOWN
BF	BOILER FEEDWATER
BSC	BIOLOGICAL SCUM
C	
CA	COMPRESSED AIR
CAA	CHANNEL AERATION AIR
CC	CENTRIFUGE CAKE
CD	CHEMICAL DRAIN
CEN	CENTRATE
CF	CENTRIFUGE FEED
CFA	CONDENSATE FOUL AIR
CFE	CHLORINATED FINAL EFFLUENT
CL	LOW PRESSURE CONDENSATE
CLG	CHLORINE GAS
CLL	CHLORINE LIQUID
CLS	CHLORINE SOLUTION
CLV	CHLORINE VACUUM
CM	MEDIUM PRESSURE CONDENSATE
CPA	CHEMICAL PADDING AIR
CS	CIRCULATING SLUDGE
CSO	CAUSTIC SODA
CV	CHEMICAL VENT
D	
DR	DRAIN
DFE	DECHLORINATED FINAL EFFLUENT
DIZ	DEIONIZED WATER
DS	DIGESTED SLUDGE
DSSG	DIGESTED SLUDGE/SLUDGE GAS
DRS	DRAIN, SANITARY
E	
EA	EMISSION AIR
ED	EQUIPMENT DRAIN
EWS	ESB WASHDOWN SYSTEM
EV	EMERGENCY VENT
EXH	EXHAUST
F	
FAE	FOUL AIR EXHAUST
FBW	FILTER BACKWASH WATER
FC	FERRIC CHLORIDE
FCA	FLANGEL COUPLING ADAPTER
FE	FILTER EFFLUENT
FILT	FILTRATE
FMSC	FOAM SUPRESSING CHEMICAL
FOG	FATS, OILS, AND GREASE
FO	FUEL OIL
FOF	FUEL OIL FILL
FOM	FUEL OIL MAINTENANCE
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
FOT	FUEL OIL TRANSFER
FI	FILTER INFLUENT
FR	FILTER RECIRCULATION
G	
GC	GAS CIRCULATION
GLY	GLYCOL/WATER COOLANT
GR	GRIT
GRC	GAS RECIRCULATION COMPRESSOR
GRO	GRIT OVERFLOW
H	
HCL	HYDROCHLORIC ACID
HLD	HIGH LEVEL DISINFECTION
HNG	HIGH PRESSURE NATURAL GAS
HOH	HIGH PRESSURE HYDRAULIC OIL
HOL	LOW PRESSURE HYDRAULIC OIL
HRR	HEAT RESERVOIR RETURN
HRS	HEAT RESERVOIR SUPPLY
HS	HARVESTED SLUDGE
HSO	SULFURIC ACID
HTV	HIGH TEMPERATURE VENT
I	
IA	INSTRUMENT AIR
J	
JCW	JACKET COOLING WATER
L	
LOD	LUBE OIL DRAIN
M	
MG	MIXED GAS
ML	MIXED LIQUOR
MLF	MIXED LIQUOR FERMENTER
MLR	MIXED LIQUOR RECYCLE
MS	MIXED SLUDGE
MSCS	MIXED SLUDGE/CIRCULATING SLUDGE
MSDS	MIXED SLUDGE/DIGESTER SLUDGE
MSG	MEDIUM PRESSURE SLUDGE GAS
O	
OCA	ODOR CONTROL AIR
ODG	OXYGEN DRY GAS
OF	OVERFLOW
OFSG	OVERFLOW/SLUDGE GAS
OHP	OXYGEN HIGH PRESSURE
OLPD	OXYGEN LOW PRESSURE DISCHARGE
OLPS	OXYGEN LOW PRESSURE SUCTION
P	
PA	PRE-AERATION AIR
PAS	PRIMARY AND ACTIVATED SLUDGE
PCH	HIGH PRESSURE PROCESS CONDENSATE
PCL	LOW PRESSURE PROCESS CONDENSATE
PCR	PROCESS CONDENSATE RETURN
PD	PUMPED DRAINAGE
PE	PRIMARY EFFLUENT
PEJ	PRIMARY EFFLUENT JETTING
PERM	PERMEATE
PF	PRESSURIZED FLOW
POL	POLYELECTROLYTE
PRS	PROCESS SAMPLING
PS	PRIMARY SLUDGE
PSC	PRIMARY SCUM
PSCS	PRIMARY SLUDGE/CIRCULATING SLUDGE
PSG	PRIMARY SLUDGE AND GRIT
PSO	POLYMER SOLUTION
PSR	PRIMARY SLUDGE RECIRCULATION
PSS	PROCESS STEAM SUPPLY
R	
RAS	RETURN ACTIVATED SLUDGE
RG	REFRIGERANT GAS
RL	REFRIGERANT LIQUID
RS	RAW SEWAGE
RWL	RAIN WATER LEADER
RWP	RAIN WATER PIPE
S	
S	STEAM
IE	STARTER AIR
SBIS	SODIUM BISULFITE
SC	SCUM DECANT
SCL	SODIUM HYPOCHLORITE SOLUTION
SHC	SODIUM HYPOCHLORITE CONTAINMENT
SCR	STEAM CLEAN RINSE
SCS	STEAM CLEAN SUPPLY
SD	SANITARY DRAIN
SE	SECONDARY EFFLUENT
SG	SLUDGE GAS
SHS	SODIUM HYDROXIDE SOLUTION
SME	SAMPLE-EFFLUENT
SMI	SAMPLE-INFLUENT
SMML	SAMPLE MIXED LIQUOR
SMO	SAMPLE OXYGEN
SMP	SAMPLE-PRIMARY EFFLUENT
SMS	SLUDGE SAMPLE-SLUDGE
SN	SUPERNATANT
SOG	SULFER DIOXIDE GAS
SOL	SULFER DIOXIDE LIQUID
SOS	SULFER DIOXIDE SOLUTION
SOV	SULFER DIOXIDE VACUUM
SPC	SUPPLEMENTAL CARBON
SPD	SUMP PUMP DISCHARGE
SR	SCREENINGS
SRA	SCUM REMOVAL AIR
SRF	SCREENINGS FEED
SRO	SCREENINGS OVERFLOW
SSC	SECONDARY SCUM
SSE	SIDESTREAM EFFLUENT
STD	STORM DRAIN
SWAS	SAMPLE-WASTE ACTIVATED SLUDGE
SW	SOLIDS WASTE
T	
TA	TOOL AIR
TD	TANK DRAIN
TE	THICKENING EFFLUENT
THS	THICKENING SIDESTREAM
TO	THICKENED OVERFLOW
TS	TRANSFER SLUDGE
TSC	THICKENED SCUM
TWAS	THICKENED WASTE ACTIVATED SLUDGE
U	
UA	UTILITY AIR
UD	UNDER DRAIN
V	
V	VENT
VA	VACUUM
VS	STEAM VENT
W	
W1	TBD
W3	TBD
WAS	WASTE ACTIVATED SLUDGE
WFP	WATER FIRE PROTECTION
WFSW	FILTERED SURFACE WASH WATER
WHWC	WASTE HEAT COOLING WATER RETURN-COGEN
WHWR	WASTE HEAT COOLING WATER RETURN
WHWS	WASTE HEAT COOLING WATER SUPPLY
WI	WETLANDS INFLUENT
WIJ	WELL, INJECTION
WML	WASTE MIXED LIQUOR
WNP	NON-POTABLE WATER
WNM	NON-POTABLE WATER, MONITORING
WNS	NON-POTABLE WATER SOFT
WP	POTABLE WATER
WPS	POTABLE WATER SOFT
WR	RECLAIMED WATER
WRF	RECLAMATION WATER, FILTERED
WRH	RECLAIMED WATER HIGH PRESSURE
WRL	RECLAIMED WATER LOW PRESSURE
WRS	FOAM SUPPRESSING SPRAY WATER
WS	SERVICE WATER
WIJ	WELL, INJECTION

EQUIPMENT ABBREVIATIONS

A	
AA	ATOMIC ABSORPTION UNIT
ACC	AREA CONTROL CENTER
AE	ANALYZER ELEMENT
AHF	ACTIVE HARMONIC FILTER
AMD	AIR MONITORING DEVICE
ARV	AIR RELEASE VALVE
AV	ANGLE VALVE
B	
B	BLOWER
BFP	BACKFLOW PREVENTER, BELT FILTER PRESS
BKHD	BULKHEAD
BKR	BREAKER
BSN	BAR SCREEN
C	
C	CRANE
CAV	COMBINATION AIR VALVE
CFR	CHEMICAL FEEDER
COM	COMMINUTOR
COB	CONVEYOR BELT
CP	COMPRESSOR
CPNL	CONTROL PANEL
CSN	COMMINUTING SCREEN
CENT	CENTRIFUGE
CTS	CATHODIC PROTECTION TEST STATION
CYL	CYLINDER
E	
EPV	ECCENTRIC PLUG VALVE
D	
DE	DENSITY METER
DF	DISK FILTER
DPR	DAMPER
DU	DRIVE UNIT
F	
FDK	FILTER, DISK
FE	FILTER EFFLUENT
FG	FLAP GATE
FI	FILTER INFLUENT
FLC	FLOCCULATOR
FLP	FLUID POWER UNIT
FLT	FILTRATE
FM	FLOW METER
FMX	FLASH MIXER
FN	FAN
FP	FILTER PRESS
G	
GBV	GLOBE VALVE
GDR	GRINDER
GEN	GENERATOR
GV	GATE VALVE
H	
H	HOIST
HEX	HEAT EXCHANGER
I	
ICN	INCINERATOR
IR	INLET RELIEF
K	
KGV	KNIFE GATE VALVE
M	
MC	MAGNETIC CLUTCH
MD	MOTORIZED DAMPER
MBR	MEMBRANE BIO REACTOR
MME	MISCELLANEOUS MECHANICAL EQUIPMENT
MW	MONITORING WELL
MV	MUD VALVE
MVU	MOBILE VENTILATION UNIT
MX	MIXER
N	
NOCL	SODIUM HYPOCHLORITE
NT	NEUTRALIZATION TANK
O	
OCU	ODOR CONTROL UNIT
ORF	ORFICE (PIPING), ODOR REMOVAL FILTER
ORP	OXIDATION REDUCTION POTENTIAL
ORU	ODOR REDUCTION UNIT
P	
PMP	PUMP
PCHV	PINCH VALVE
PDIT	PRESSURE DIFFERENTIAL INDICATOR TRANSMITTER
PG	PRESSURE GAUGE
PMH	PROCESS MANHOLE
POP	PNEUMATIC OPERATOR
PRS	PRESSURE REDUCING STATION
PRV	PRESSURE REGULATING (REDUCING) VALVE, PRESSURE RELIEF VALVE
PSV	POP SAFETY VALVE
PVL	PRESSURE VESSEL
S	
S	SILENCER
SBR	SCRUBBER
SCRN	SCREEN
SEP	SEPARATOR
SG	SLUICE GATE
SI	SPEED INDICATOR
SLG	SLIDE GATE
SMX	SLURRY MIXER
SRV	SAFETY RELIEF VALVE
STN	STRAINER
SV	SOLENOID VALVE
T	
TNK	TANK
TBN	TURBINE
TVC	TILTING DISK CHECK VALVE
V	
VB	VALVE BOX
VBF	BUTTERFLY VALVE
VBM	BALL VALVE
VC	CHECK VALVE
VFT	VACUUM FILTER
VP	VACUUM PUMP
VRV	VACUUM RELEASE VALVE
VS	VACUUM SYSTEM
VSC	VARIABLE SPEED COUPLING (ECC)
W	
W	WEIR
WG	WEIR GATE
WM	WATER MAIN
WRP	WEIR, ROTATING PIPE

INTERIOR PIPING ABBREVIATIONS

ALP	AIR LOW PRESSURE
CMS	COMPRESSED AIR
FSC	FERMENTER SCUM
G	NATURAL GAS
PD	SUMP PUMP DISCHARGE
PS	PRIMARY SLUDGE
RAS	RETURN ACTIVATED SLUDGE
RCS	RECIRCULATED SLUDGE
SAN	SANITARY
TFS	THICKENED FERMENTED SLUDGE
V	VENT
WAS	WASTE ACTIVATED SLUDGE
W2	NON-POTABLE WATER

PIPE MATERIAL ABBREVIATIONS

D	
DIP	DUCTILE IRON PIPE
P	
PCCP	PRESTRESSED CONCRETE CYLINDER PIPE
PVC	POLYVINYL CHLORIDE

NOTES:

1. FOR EQUIPMENT ABBREVIATIONS, INCLUDING FOR VALVES, REFER TO P&ID LEGEND AND ABBREVIATIONS DRAWINGS FUNCTION CODE ABBREVIATIONS.
2. FOR SYSTEM AND PROCESS STREAM ABBREVIATIONS, REFER TO P&ID LEGEND AND ABBREVIATIONS DRAWINGS SYSTEM CODE AND PROCESS CODE ABBREVIATIONS.
3. FOR PIPE MATERIAL AND INSULATION MATERIAL ABBREVIATIONS REFER TO P&ID LEGEND AND ABBREVIATIONS DRAWINGS PIPELINE MATERIAL CODE AND INSULATION MATERIAL CODE ABBREVIATIONS.

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1	AD	PS	IB	09/28/2021	ISSUED FOR 60% SUBMITTAL

Date:
Engineer of Record:
Florida License No.:

BLACK & VEATCH
Black & Veatch Corporation
2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

MECHANICAL ABREVIATIONS

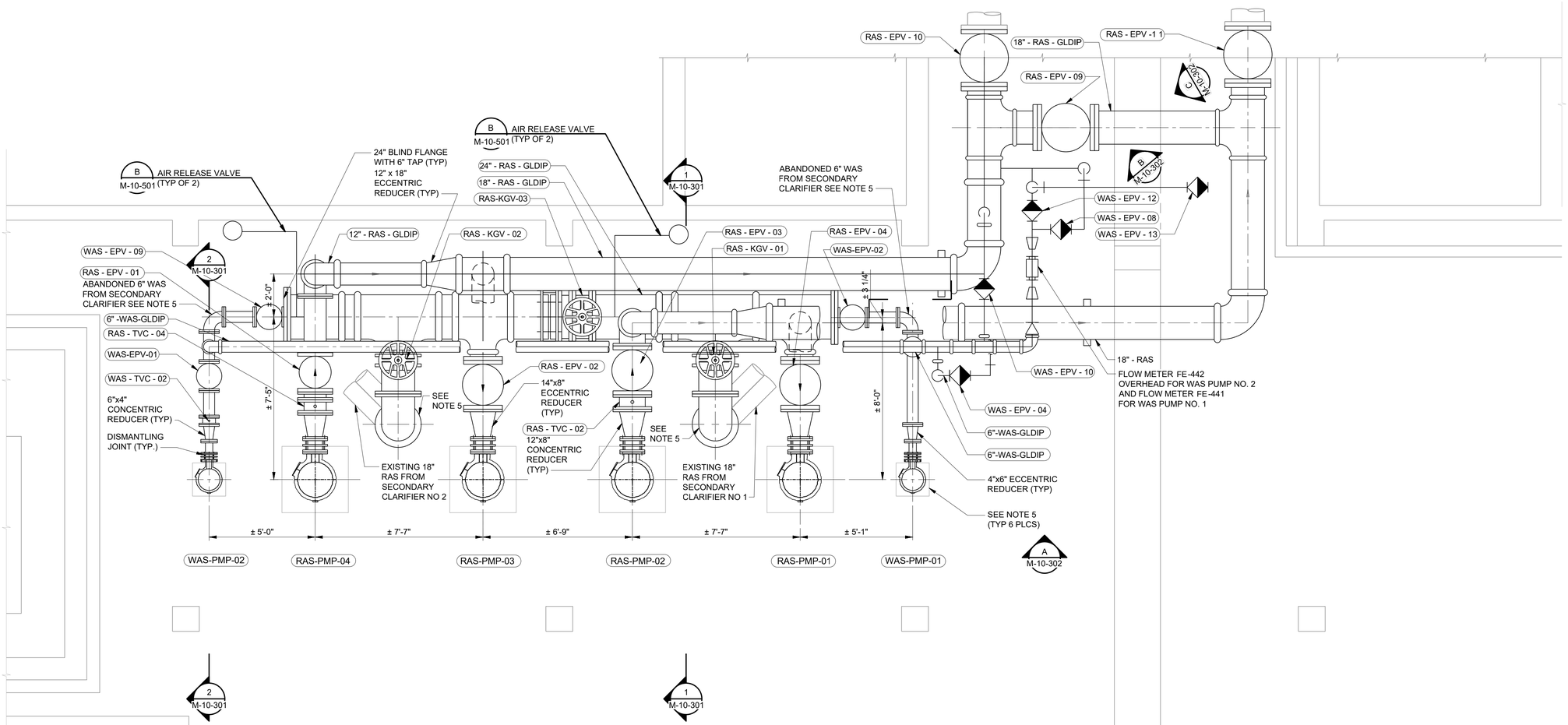
DESIGNED: MG
DETAILED: HT, AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

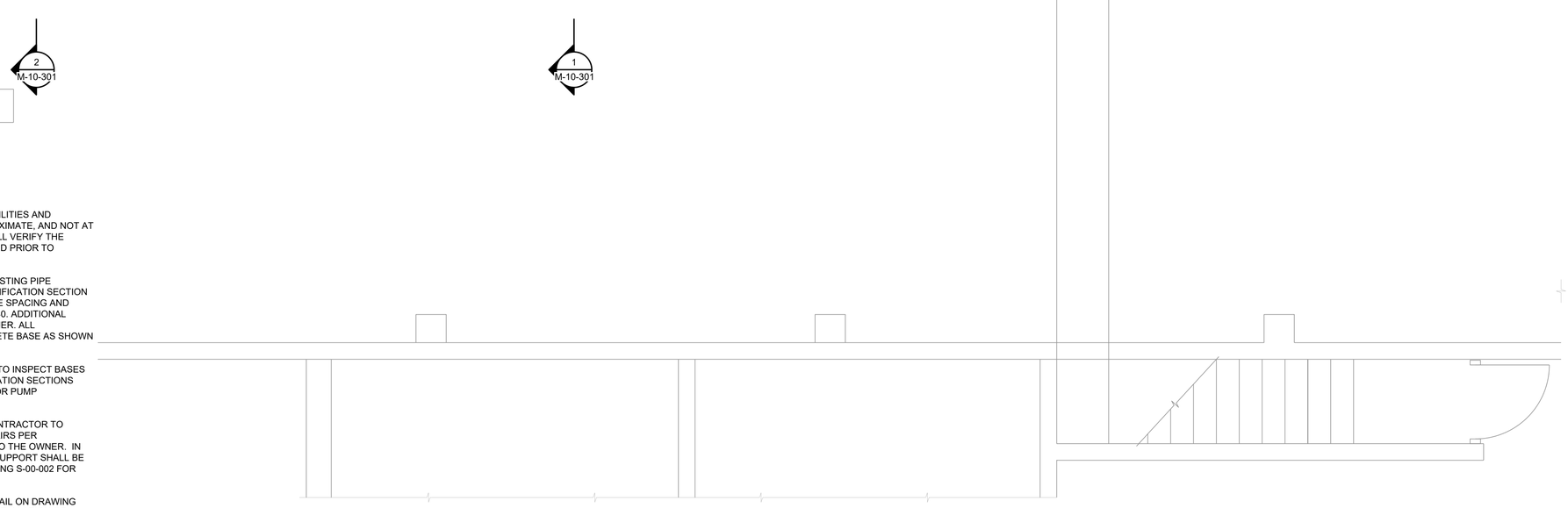
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

M-00-002
SHEET
13 OF 27

FD9000
D409283





NOTES:

1. THE LOCATIONS, CONFIGURATIONS, AND ELEVATIONS OF EXISTING UTILITIES AND STRUCTURES (UNDERGROUND, SURFACE, OR OVERHEAD) ARE APPROXIMATE, AND NOT AT ALL UTILITIES AND FACILITIES ARE INDICATED. THE CONTRACTOR SHALL VERIFY THE EXACT LOCATION AND CONFIGURATION OF THE ITEMS BEING REPLACED PRIOR TO PROCEEDING WITH THE WORK.
2. PIPE SUPPORTS SHALL BE REPLACED AT THE SAME LOCATIONS AS EXISTING PIPE SUPPORTS. REFER TO TYPICAL DETAILS ON SHEET S-00-002 AND SPECIFICATION SECTION 15140.ADDITIONAL SUPPORTS MAY BE REQUIRED TO COMPLY WITH THE SPACING AND SUPPORT LOCATION REQUIREMENTS OF SPECIFICATION SECTION 15140. ADDITIONAL SUPPORTS SHALL BE PROVIDED AT NO ADDITIONAL COST TO THE OWNER. ALL NON-HANGING METAL SUPPORTS SHALL BE PROVIDED WITH A CONCRETE BASE AS SHOWN IN THE TYPICAL PIPE SUPPORT BASE DETAIL ON SHEET S-00-003.
3. EXISTING CONCRETE PUMP BASES SHALL BE REUSED. CONTRACTOR TO INSPECT BASES PRIOR TO REUSE AND MAKE ANY NECESSARY REPAIRS PER SPECIFICATION SECTIONS 03920 AND 03930. REFER TO TYPICAL DETAIL ON DRAWING S-00-003 FOR PUMP ANCHORAGE.
4. EXISTING CONCRETE PIPE SADDLE SUPPORTS SHALL BE REUSED. CONTRACTOR TO INSPECT SADDLES PRIOR TO REUSE AND MAKE ANY NECESSARY REPAIRS PER SPECIFICATION SECTIONS 03920 AND 03930 AT NO ADDITIONAL COST TO THE OWNER. IN THE EVENT A SADDLE SUPPORT CANNOT BE REPAIRED, THE SADDLE SUPPORT SHALL BE REPLACED AT NO ADDITIONAL COST TO THE OWNER. REFER TO DRAWING S-00-002 FOR TYPICAL REPLACEMENT DETAILS.
5. PROVIDE CONCRETE COLLAR AT PIPE PENETRATION PER TYPICAL DETAIL ON DRAWING S-00-003.EXISTING PIPE TO REMAIN SHALL BE RECOATED PRIOR TO INSTALLATION OF CONCRETE COLLAR. SURFACE PREPARATION SHALL BE ABRASIVE BLAST CLEANING TO NAPF 500-03-04 AND COATING SYSTEM PER DATA SHEET 13S2 AS SPECIFIED IN SECTION 09940.
6. EXISTING WAFER CHECK VALVES SHALL BE REPLACED WITH HORIZONTAL SWING CHECK VALVES WHERE INSTALLATION IS FEASIBLE BASED ON LAYING LENGTH AND PENDING ENGINEER'S APPROVAL PER SPECIFICATION 15093. WHERE LAYING LENGTH IS NOT SUFFICIENT, WAFER CHECK VALVES SHALL BE REPLACED IN-KIND.

PUMP ROOM PLAN
3/8"=1'-0"

12" 6" 0 1' 2' 3' 4' 5' 6' 7'
3/8"=1'-0"

100% SUBMITTAL

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

MECHANICAL
PUMP ROOM - PLAN

DESIGNED: MG
DETAILED: HT, AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

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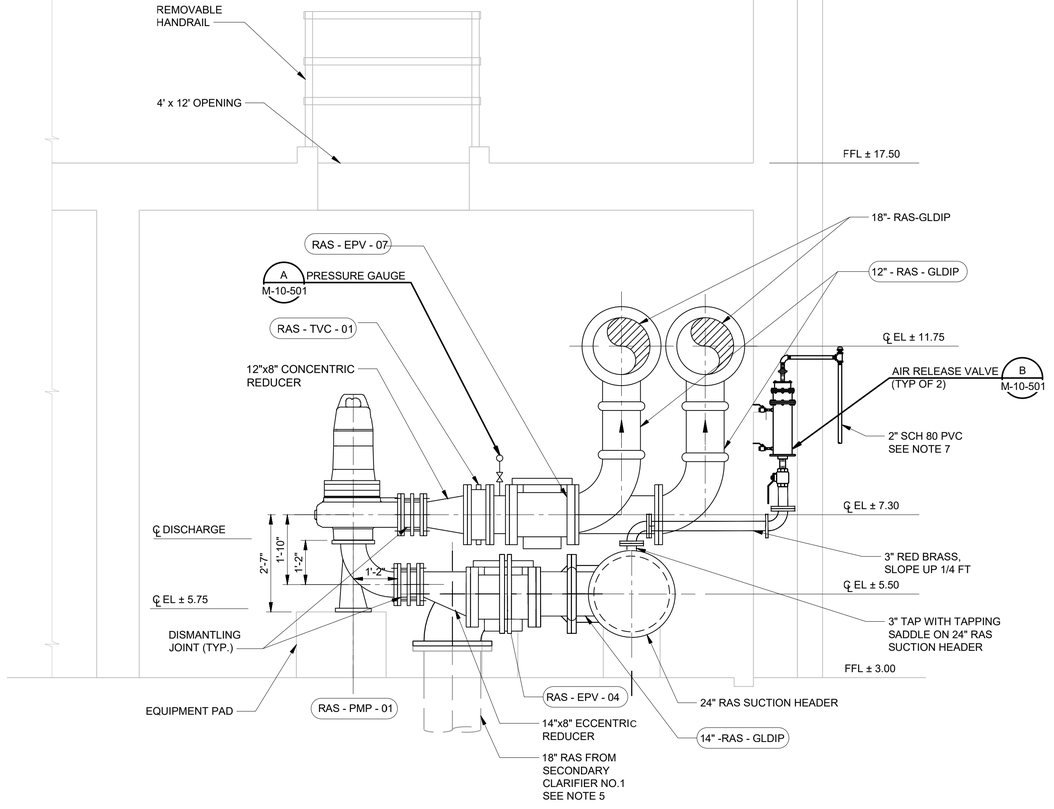
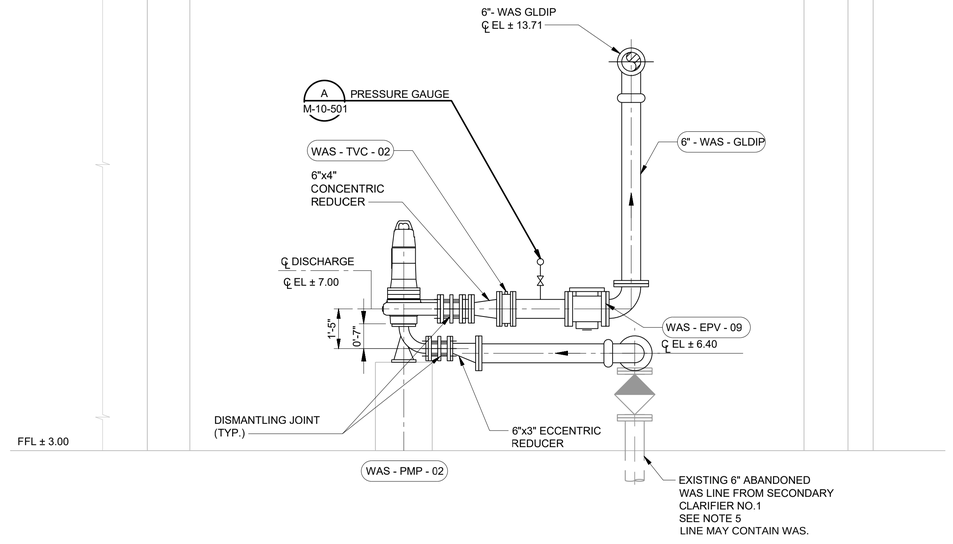
PROJECT NO.
409283

M-10-101
SHEET
14 OF 28

FB9000
D-409283



1 RAS PUMP SECTION (TYP 4)
M-10-101 1/2" = 1'-0"



2 WAS PUMP SECTION (TYP 2)
M-10-101 1/2" = 1'-0"

NOTES:

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2. PIPE SUPPORTS SHALL BE REPLACED AT THE SAME LOCATIONS AS EXISTING PIPE SUPPORTS. REFER TO TYPICAL DETAILS ON SHEET S-00-002 AND SPECIFICATION SECTION 15140. ADDITIONAL SUPPORTS MAY BE REQUIRED TO COMPLY WITH THE SPACING AND SUPPORT LOCATION REQUIREMENTS OF SPECIFICATION SECTION 15140. ADDITIONAL SUPPORTS SHALL BE PROVIDED AT NO ADDITIONAL COST TO THE OWNER. ALL NON-HANGING METAL SUPPORTS SHALL BE PROVIDED WITH A CONCRETE BASE AS SHOWN IN THE TYPICAL PIPE SUPPORT BASE DETAIL ON SHEET S-00-003.
3. EXISTING CONCRETE PUMP BASES SHALL BE REUSED. CONTRACTOR TO INSPECT BASES PRIOR TO REUSE AND MAKE ANY NECESSARY REPAIRS PER SPECIFICATION SECTIONS 03920 AND 03930. REFER TO TYPICAL DETAIL ON DRAWING S-00-003 FOR PUMP ANCHORAGE.
4. EXISTING CONCRETE PIPE SADDLE SUPPORTS SHALL BE REUSED. CONTRACTOR TO INSPECT SADDLES PRIOR TO REUSE AND MAKE ANY NECESSARY REPAIRS PER SPECIFICATION SECTIONS 03920 AND 03930 AT NO ADDITIONAL COST TO THE OWNER. IN THE EVENT A SADDLE SUPPORT CANNOT BE REPAIRED, THE SADDLE SUPPORT SHALL BE REPLACED AT NO ADDITIONAL COST TO THE OWNER. REFER TO DRAWING S-00-002 FOR TYPICAL REPLACEMENT DETAILS.
5. PROVIDE CONCRETE COLLAR AT PIPE PENETRATION PER TYPICAL DETAIL ON DRAWING S-00-003. EXISTING PIPE TO REMAIN SHALL BE RECOATED PRIOR TO INSTALLATION OF CONCRETE COLLAR. SURFACE PREPARATION SHALL BE ABRASIVE BLAST CLEANING TO NAPF 500-03-04 AND COATING SYSTEM PER DATA SHEET 13S2 AS SPECIFIED IN SECTION 09940.
6. EXISTING WAFER CHECK VALVES SHALL BE REPLACED WITH HORIZONTAL SWING CHECK VALVES WHERE INSTALLATION IS FEASIBLE BASED ON LAYING LENGTH AND PENDING ENGINEER'S APPROVAL PER SPECIFICATION 15093. WHERE LAYING LENGTH IS NOT SUFFICIENT, WAFER CHECK VALVES SHALL BE REPLACED IN-KIND.
7. FIELD ROUTE AIR RELEASE VALVE VENT PIPE TO THE SOUTH WEST WALL OF THE PUMP ROOM AND ROUTE OUTSIDE THE BUILDING. ROUTING SHALL AVOID TRIPPING HAZARDS AND SHALL PROVIDE ADEQUATE PIPE SUPPORTS. THE ENGINEER SHALL APPROVE FINAL ROUTING PRIOR TO INSTALLATION. SEE DETAIL C ON SHEET M-10-301 FOR VENT DISCHARGE PIPE ARRANGEMENT.

12" 6" 0 1' 2' 3' 4' 5'
1/2"=1'-0"

100% SUBMITTAL

F090000
D409283

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

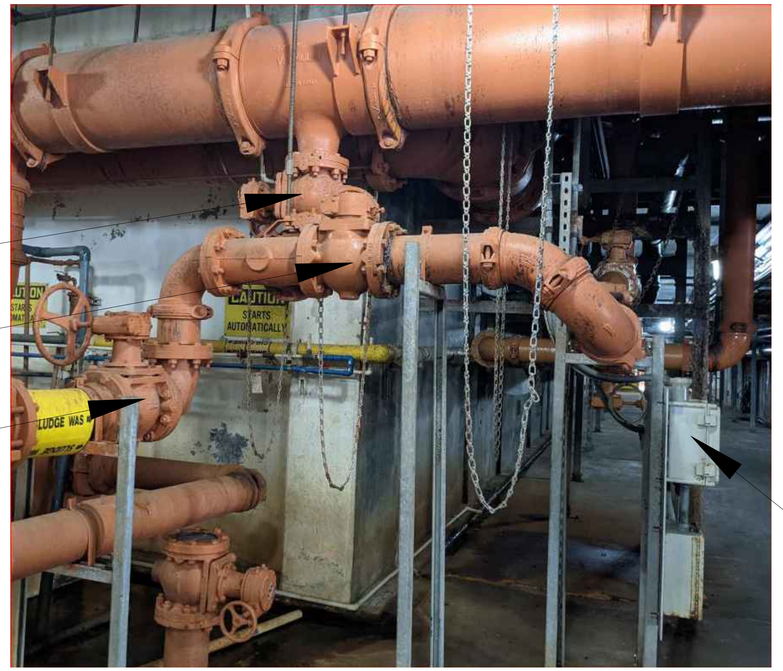
MECHANICAL
PUMP ROOM - SECTIONS

DESIGNED: MG
DETAILED: HT, AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

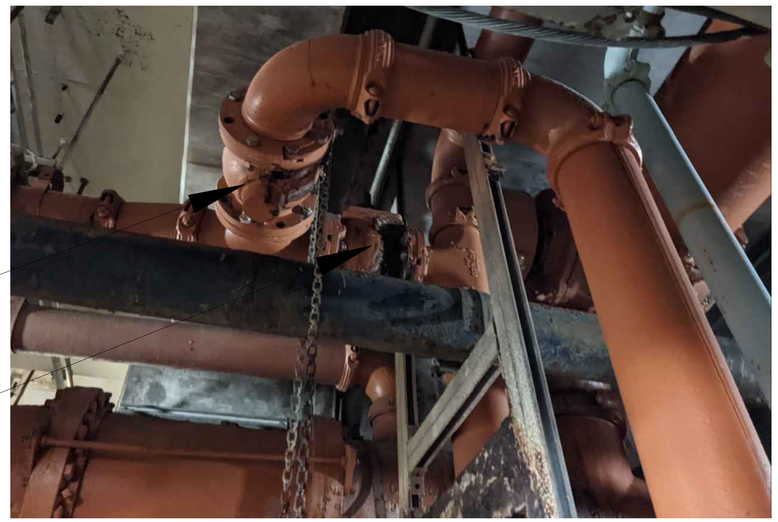
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

M-10-301
SHEET
15 OF 28



A FIGURE
(NTS)



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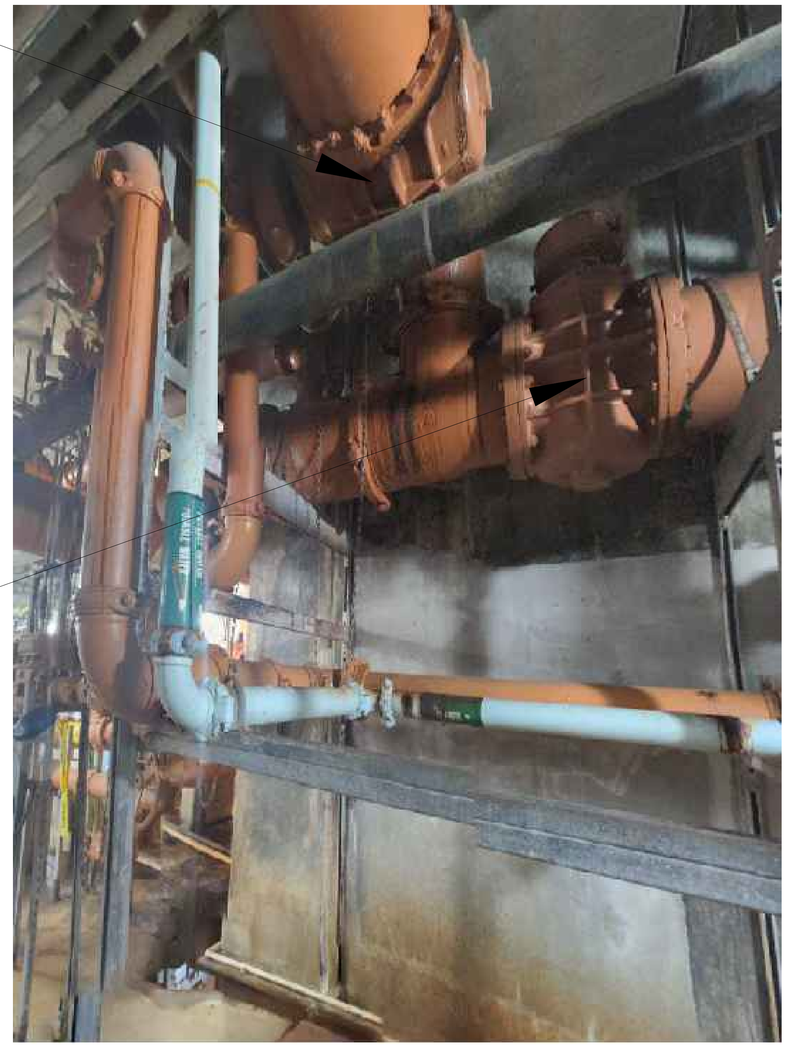
(NTS)



C FIGURE
(NTS)

100% SUBMITTAL

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CITY OF KEY WEST
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ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

MECHANICAL
PUMP ROOM - SECTIONS

DESIGNED:	MG
DETAILED:	HT, AD
CHECKED:	PG
APPROVED:	IB
DATE:	02/01/2023

0 1/2 1
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PROJECT NO.
409283

M-10-302
SHEET
16 OF 28

F09000
D409283

TABLE 1- VALVE SCHEDULE

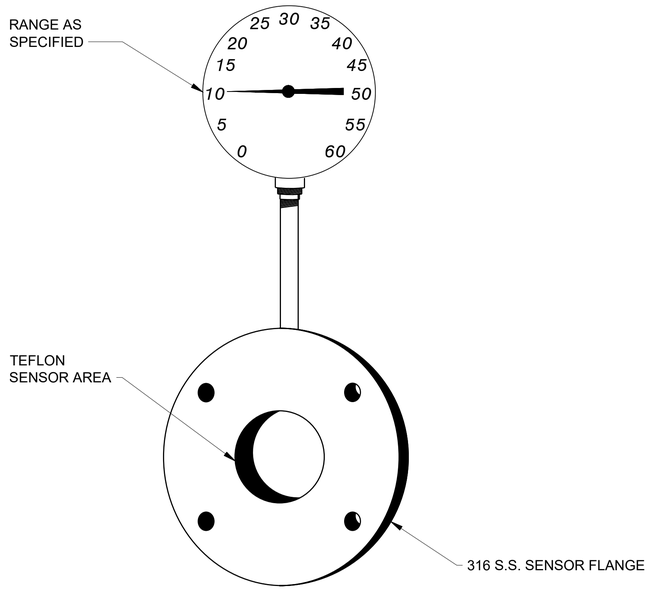
TAG NO.	SIZE (IN)	TYPE OF VALVE	SERVICE	DESIGN CAPACITY2 (gpm)	ENDS
WAS-TVC-01	6	Horizontal Swing Check1	RAS	260	Flange
WAS-TVC-02	6	Horizontal Swing Check1	RAS	260	Flange
RAS-TVC-01	12	Horizontal Swing Check1	RAS	1,580	Flange
RAS-TVC-02	12	Horizontal Swing Check1	RAS	1,580	Flange
RAS-TVC-03	12	Horizontal Swing Check1	RAS	1,580	Flange
RAS-TVC-04	12	Horizontal Swing Check1	RAS	1,580	Flange
RAS-KGV-01	18	Knife Gate	RAS	6,320	Flange
RAS-KGV-02	18	Knife Gate	RAS	6,320	Flange
RAS-KGV-03	24	Knife Gate	RAS	6,320	Flange
RAS-EPV-01	12	Eccentric Plug	RAS	1,580	Flange
RAS-EPV-02	14	Eccentric Plug	RAS	1,580	Flange
RAS-EPV-03	12	Eccentric Plug	RAS	1,580	Flange
RAS-EPV-04	14	Eccentric Plug	RAS	1,580	Flange
RAS-EPV-05	14	Eccentric Plug	RAS	1,580	Flange
RAS-EPV-06	14	Eccentric Plug	RAS	1,580	Flange
RAS-EPV-07	12	Eccentric Plug	RAS	1,580	Flange
RAS-EPV-08	12	Eccentric Plug	RAS	1,580	Flange
RAS-EPV-09	18	Eccentric Plug	RAS	6,320	Flange
RAS-EPV-10	18	Eccentric Plug	RAS	6,320	Flange
RAS-EPV-11	18	Eccentric Plug	RAS	6,320	Flange
WAS-EPV-01	6	Eccentric Plug	RAS	260	Flange
WAS-EPV-02	6	Eccentric Plug	RAS	260	Flange
WAS-EPV-03	6	Eccentric Plug	RAS	260	Flange
WAS-EPV-04	6	Eccentric Plug	RAS	520	Flange
WAS-EPV-05	6	Eccentric Plug	RAS	520	Flange
WAS-EPV-06	6	Eccentric Plug	RAS	520	Flange
WAS-EPV-07	6	Eccentric Plug	RAS	520	Flange
WAS-EPV-08	6	Eccentric Plug	RAS	520	Flange
WAS-EPV-09	6	Eccentric Plug	RAS	260	Flange
WAS-EPV-10	6	Eccentric Plug	RAS	520	Flange
WAS-EPV-11	6	Eccentric Plug	RAS	520	Flange
WAS-EPV-12	6	Eccentric Plug	RAS	520	Flange
WAS-EPV-13	6	Eccentric Plug	RAS	520	Flange

NOTES:

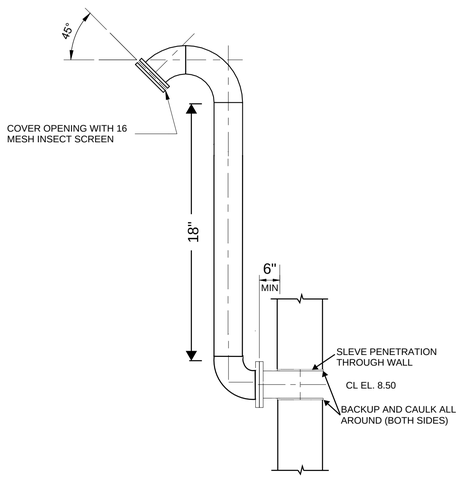
1. EXISTING WAFER CHECK VALVES SHALL BE REPLACED WITH HORIZONTAL SWING CHECK VALVES WHERE INSTALLATION IS FEASIBLE BASED ON LAYING LENGTH AND PENDING ENGINEER'S APPROVAL PER SPECIFICATION 15093. WHERE LAYING LENGTH IS NOT SUFFICIENT, WAFER CHECK VALVES SHALL BE REPLACED IN-KIND.
2. DESIGN CAPACITY IS BASED ON RATED CAPACITY OF RAS AND WAS PUMPS.

TABLE 2- HARNESS RODS FOR PUMP DISCHARGE PIPING

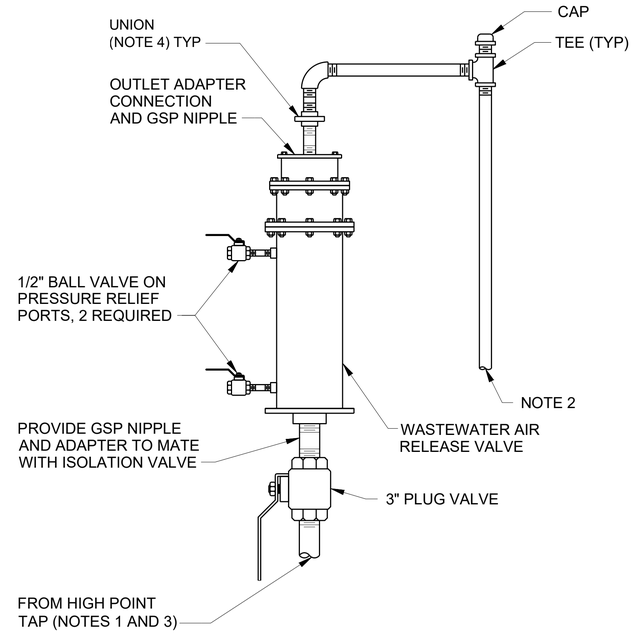
PIPE SIZE	NO. OF HARNESS RODS	DIA OF HARNESS RODS
3"	4	3/4"
8"	4	3/4"



A M-10-301 PRESSURE GAUGE WITH ANNULAR TYPE DIAPHRAGM SEAL INSTALLATION DETAIL
(NO SCALE)



C M-10-301 VENTILATION PIPE TERMINATION POINT
(NO SCALE)



B M-10-301 WASTEWATER AIR RELEASE VALVE DETAIL
(NO SCALE)

NOTES:

1. THE LINE BETWEEN THE TAP AND ARV SHALL CONTINUOUSLY SLOPE UPWARD TO TO ARV
2. FIELD ROUTE AIR RELEASE VALVE VENT PIPE TO THE SOUTH WEST WALL OF THE PUMP ROOM AND ROUTE OUTISDE THE BUILDING PER DETAIL C. ROUTING SHALL AVOID TRIPPING HAZARDS AND SHALL PROVIDE PIPE BRACING AND SUPPORTS. THE ENGINEER SHALL APPROVE FINAL ROUTING PRIOR TO INSTALLATION.
3. FOR ALLOWABLE PIPE AND VALVE MATERIALS, SEE SPECIFICAITON SECTION 15060. PROVIDE SYSTEM-SPECIFIC MATERIALS THROUGH UNION.
4. PROVIDE DIALETRIC UNION FOR DISSIMILAR METALS.

100% SUBMITTAL

NO.	BY	CHK	APP	DATE	REVISIONS AND RECORD OF USE
2	AD	PG	IB	02/01/2023	100% SUBMITTAL
1	AD	PS	IB	10/10/2022	95% SUBMITTAL
				09/28/2021	ISSUED FOR 60% SUBMITTAL

Date:
Engineer of Record:
Florida License No.:

BLACK & VEATCH
Black & Veatch Corporation
2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

MECHANICAL
MISCELLANEOUS MECHANICAL DETAILS

DESIGNED: MG
DETAILED: HT, AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

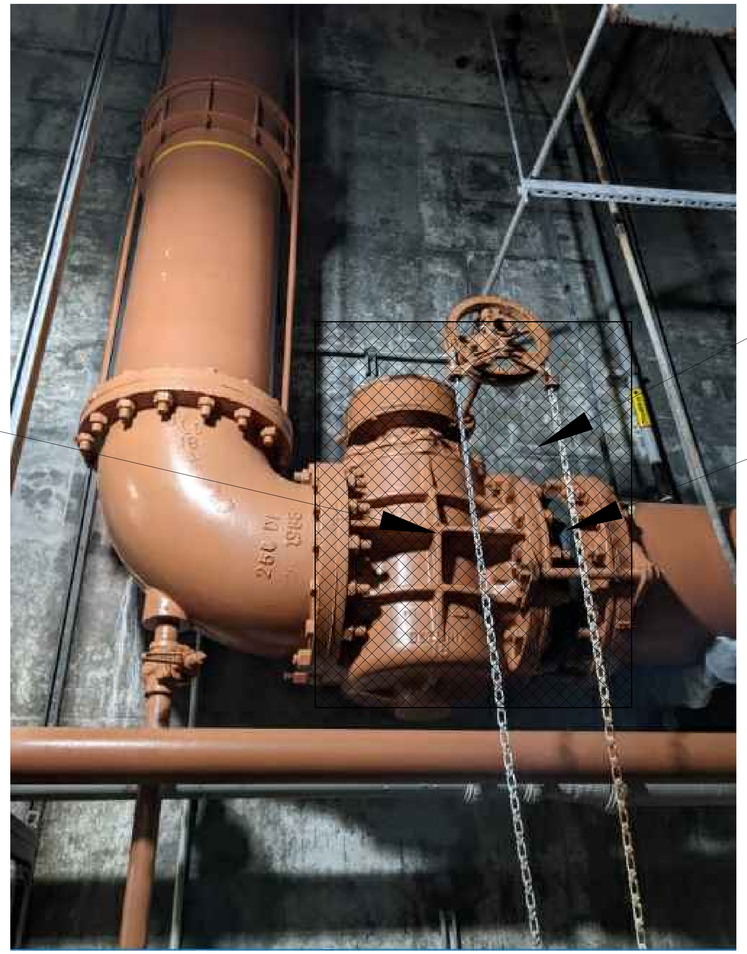
PROJECT NO.
409283

M-10-501
SHEET
17 OF 28

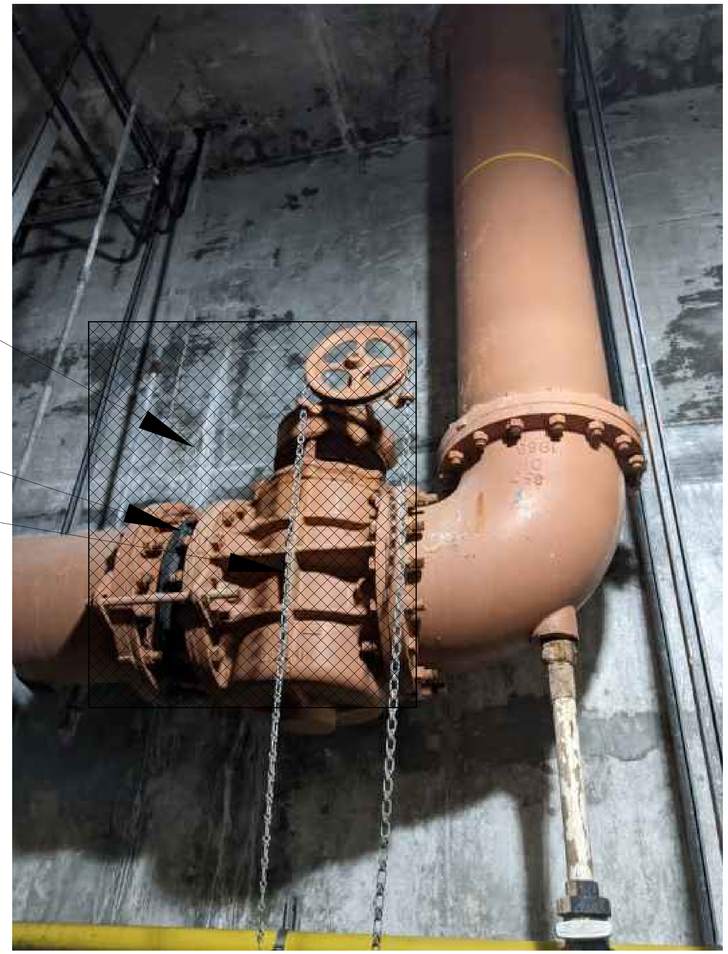
FD9000
D409283

NOTES :

1. REMOVE AND REPLACE EXISTING 18" DEZURIK PLUG VALVES AND DISMANTLING JOINTS IN-KIND.
2. REFER TO SHEET C-00-102 FOR LOCATION.
3. CONTRACTOR SHALL PROVIDE LINE ISOLATION VIA HOT TAP OR ANY OTHER MEANS AS DEEMED NECESSARY FOR THE REPLACEMENT OF THE VALVES.



EAST VALVE SECTION
NTS



WEST VALVE SECTION
NTS

100% SUBMITTAL

NO.	DATE	REVISIONS AND RECORD OF USE	BY	CHK	APP
	02/01/2023	100% SUBMITTAL			
2	10/10/2022	95% SUBMITTAL	AD	PG	IB
1	09/28/2021	ISSUED FOR 65% SUBMITTAL	AD	PG	IB

Date:
Engineer of Record:
Florida License No.:

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2121 Ponce de Leon Boulevard, Suite 305
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Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

MECHANICAL
AERATION BASINS UTILIDOR

DESIGNED: MG
DETAILED: HT, AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

M-20-101
SHEET
18 OF *28*

F09000
D409283

ELECTRICAL LEGENDS

ONE-LINE DIAGRAM LEGEND

1500KVA
2.4KV Δ - 480Y/277V
3-PH, 60HZ
TRANSFORMER WITH PRIMARY AND SECONDARY VOLTAGE, AND KVA RATING AS NOTED

CS 4#14,3/4"
20 3P-60 22:3#8,#10G, 4#14,2"
CIRCUIT NO.22 WITH 3#8 INSULATED CONDUCTORS AND 1#10 GROUND WIRE FOR A 20HP MOTOR WITH 3 POLE, 60A, MOTOR DISCONNECT SWITCH AND 4#14 INSULATED CONDUCTORS FOR AUXILIARY ITEM, AS FOR EXAMPLE A CONTROL STATION, ALL IN 2" CONDUIT.

AUXILIARY ITEMS MAY NOT BE COMPLETELY SHOWN
HS
20 3P-60 22:3#8,#10G 4#14,2"
CONDUCTORS FOR AUXILIARY ITEM SHALL NOT PASS THROUGH MOTOR DISCONNECT SWITCH.

AUXILIARY ITEMS MAY NOT BE COMPLETELY SHOWN
15
ONE-LINE SHOWING POWER AND CONTROL TO A PACKAGE UNIT, AS FOR EXAMPLE A STEAM GENERATOR OR AN AIR HANDLING UNIT, SHALL IMPLY THAT ANY AND ALL ASSOCIATED EQUIPMENT SHALL ALSO BE INSTALLED AND WIRED AS REQUIRED BY THE EQUIPMENT FURNISHED.

INDICATES THAT ALL OR PART OF CIRCUIT MAY BE ROUTED IN DUCT BANK OR UNDERGROUND. CONDUIT SIZE SHOWN ON ONE-LINE IS ABOVE GROUND AND/OR INSIDE OF STRUCTURE. SEE DUCT BANK SCHEDULE AND SECTIONS FOR CONDUIT SIZE OF UNDERGROUND PORTION OF CIRCUIT.

HIGH VOLTAGE DRAWOUT AIR OR VACUUM CIRCUIT BREAKER

3P-20
LOW VOLTAGE AIR CIRCUIT BREAKER, 3 POLE, 20 AMPERE

S4
SIZE 4 COMBINATION MAGNETIC MOTOR STARTER

LOW VOLTAGE DRAWOUT AIR CIRCUIT BREAKER

HIGH VOLTAGE DRAWOUT CONTACTOR

FUSE AND DISCONNECT SWITCH

S2
SIZE 2 COMBINATION MAGNETIC MOTOR STARTER, REVERSING OR 2 SPEED

S1
SIZE 1 COMBINATION REDUCED VOLTAGE AUTOTRANSFORMER

POTENTIAL TRANSFORMER

CURRENT TRANSFORMER

CURRENT OR POTENTIAL TEST SWITCH

G GENERATOR

K KIRK KEY INTERLOCK

E ELECTRICAL INTERLOCK

R RESISTOR

59G PROTECTION RELAY WITH IEEE DEVICE FUNCTION AS SHOWN

V SINGLE-FUNCTION METER

SURGE OR LIGHTNING ARRESTER

SURGE ARRESTER WITH SURGE CAPACITOR

GROUND CONNECTION

SCHEMATIC SYMBOLS

- WIRE CONNECTION POINT
- EXTERNAL CONNECTION POINT
- NORMALLY OPEN CONTACT
- NORMALLY CLOSED CONTACT
- STARTER, CONTACTOR OR RELAY COIL
- NORMALLY OPEN PUSH BUTTON
- NORMALLY CLOSED PUSH BUTTON
- MAINTAINED PUSH BUTTON
- NORMALLY CLOSED GEARED LIMIT SWITCH
- NORMALLY OPEN GEARED LIMIT SWITCH
- INDICATING LIGHT
- FUSE
- POTENTIOMETER
- CAPACITOR
- DIODE
- RESISTOR
- CONTROL POWER TRANSFORMER
- SWITCH
- MS MANUAL STARTER
- OL OVERLOAD
- OVERLOAD
- ELECTRODE
- FLOAT SWITCH (CLOSING ON RISING LEVEL)
- FLOAT SWITCH (OPENING ON RISING LEVEL)
- P PRESSURE SWITCH (CLOSING ON RISING PRESSURE)
- P PRESSURE SWITCH (OPENING ON RISING PRESSURE)
- V VACUUM SWITCH (CLOSING ON INCREASING VACUUM)
- V VACUUM SWITCH (OPENING ON INCREASING VACUUM)
- TEMPERATURE SWITCH (CLOSING ON RISING TEMPERATURE)
- TEMPERATURE SWITCH (OPENING ON RISING TEMPERATURE)
- FLOW ACTUATED SWITCH (CLOSING ON INCREASE IN FLOW)
- FLOW ACTUATED SWITCH (OPENING ON INCREASE IN FLOW)
- ON TIME DELAY CONTACT (NORMALLY OPEN, WHEN THE COIL IS ENERGIZED THE CONTACT WILL CLOSE AFTER A TIME DELAY)
- ON TIME DELAY CONTACT (NORMALLY CLOSED, WHEN THE COIL IS ENERGIZED THE CONTACT WILL OPEN AFTER A TIME DELAY)
- OFF TIME DELAY CONTACT (NORMALLY OPEN, WHEN THE COIL IS DE-ENERGIZED THE CONTACT WILL OPEN AFTER A TIME DELAY)
- OFF TIME DELAY CONTACT (NORMALLY CLOSED, WHEN THE COIL IS DE-ENERGIZED THE CONTACT WILL CLOSE AFTER A TIME DELAY)
- TORQUE SWITCH (NORMALLY OPEN)
- TORQUE SWITCH (NORMALLY CLOSED)
- LIMIT SWITCH (NORMALLY OPEN)
- LIMIT SWITCH (NORMALLY CLOSED)
- LIMIT SWITCH (NORMALLY CLOSED, HELD OPEN)
- DIFFERENTIAL PRESSURE SWITCH (NORMALLY OPEN, CLOSING ON INCREASING DIFF.)
- DIFFERENTIAL PRESSURE SWITCH (NORMALLY CLOSED, OPENING ON INCREASING DIFF.)

SWITCH & OUTLET SYMBOLS

- S SINGLE POLE SWITCH
- S_2 TWO POLE SWITCH
- S_{3A} THREE-WAY SWITCH CONTROLLING LIGHTS WITH "A" DESIGNATION
- S_4 FOUR-WAY SWITCH
- S^{C1}_{M} MOMENTARY SWITCH CONTROLLING CONTACTOR C1
- S^{DM}_{A} DIMMING WALL SWITCH CONTROLLING LIGHTS WITH "A" DESIGNATION
- S^{OS}_{A} WALL SWITCH OCCUPANCY SENSOR CONTROLLING LIGHTS WITH "A" DESIGNATION
- DUPLEX RECEPTACLE 120 VOLT
- SIMPLEX RECEPTACLE
- RANGE RECEPTACLE
- TWISTLOCK RECEPTACLE
- 30 240V, 1Ø RECEPTACLE, TYPICAL AMPERE RATING NOTED
- 60 480V, 3Ø WELDING RECEPTACLE, TYPICAL AMPERE RATING NOTED
- 120 VOLT DUPLEX RECEPTACLE (UPS)
- DUPLEX FLOOR OUTLET
- TELEPHONE OUTLET
- TELEPHONE FLOOR OUTLET
- CX COAXIAL CABLE OUTLET
- DATA NETWORK OUTLET

MISCELLANEOUS SYMBOLS

- STROBE
- HORN & STROBE
- HORN
- T THERMOSTAT
- J JUNCTION BOX
- GROUND ROD
- GROUND ROD WITH TEST WELL
- GROUND CONNECTION
- DISCONNECT SWITCH
- COMBINATION STARTER
- POWER PANEL
- LIGHTING PANEL
- MISCELLANEOUS PANEL
- LIGHTING CONTACTOR
- CAMERA
- PE PHOTOELECTRIC SENSOR, PHOTOCELL
- OS CEILING MOUNTED OCCUPANCY SENSOR
- OS WALL MOUNTED OCCUPANCY SENSOR

BREAKER DETAILS

DETAIL A

52
5KV
1200A
49KA
A 5KV CLASS MEDIUM-VOLTAGE, DRAWOUT, VACUUM OR AIR INSULATED CIRCUIT BREAKER WITH A 1,200 AMPERE FRAME. BREAKER HAS A 49,000 AMPERE MAXIMUM FAULT CURRENT INTERRUPTING RATING.

DETAIL B

3P-50
A LOW VOLTAGE FIXED MOUNTED MOLDED CASE CIRCUIT BREAKER WITH A 50 AMPERE TRIP RATING.
TRIP UNIT IS NON-ADJUSTABLE THERMAL-MAGNETIC TYPE.

1000AT
1200AF
SST
LSIG
AFRD
A LOW VOLTAGE FIXED MOUNTED MOLDED CASE CIRCUIT BREAKER WITH A 1200 AMPERE FRAME AND A 1000 AMPERE TRIP RATING.
TRIP UNIT IS ADJUSTABLE SOLID-STATE TYPE WITH LONG-TIME, SHORT-TIME, INSTANTANEOUS, GROUND FAULT AND ARC-FLASH REDUCTION PROTECTION FEATURES.

DETAIL C

800AT
1000AS
1600AF
AFRD
A LOW VOLTAGE, DRAWOUT, POWER OR INSULATED CASE CIRCUIT BREAKER WITH A 1600A FRAME AND SOLID-STATE TRIP UNIT.
TRIP UNIT HAS A SENSOR MODULE RATED FOR 1000 AMPERES AND WITH A TRIP RATING OF 800 AMPERES AND ARC-FLASH REDUCTION PROTECTION FEATURES.

CONDUIT & WIRING INSTALLATION LEGEND

- CONDUIT EXPOSED
- CONDUIT CONCEALED
- CONDUIT TURNING UP. CONDUIT TURNING DOWN.
- CONDUIT PLUGGED FLUSH. CONDUIT CAPPED.
- L2 - 5 TYPICAL FOR HOME RUN TO BE ROUTED TO LIGHTING PANEL L2 & CONNECTED TO CIRCUIT #5 (MINIMUM NO. 12 AWG CONDUCTORS AND 3/4" CONDUIT)
- 1 LP1-1 A POLE OR STANCHION MOUNTED LIGHTING FIXTURE. REFER TO NUMBER OR LETTER IN FIXTURE SCHEDULE. POWERED FROM LIGHTING PANEL LP1, CIRCUIT 1. CONTROLLED VIA FROM SWITCH A.
- 1 LP1-1 A WALL MOUNTED LIGHTING FIXTURE. REFER TO NUMBER OR LETTER IN FIXTURE SCHEDULE. POWERED FROM LIGHTING PANEL LP1, CIRCUIT 1. CONTROLLED VIA FROM SWITCH A.
- 1 LP1-1 A CEILING, PENDANT, OR RECESSED LIGHTING FIXTURE. REFER TO NUMBER OR LETTER IN FIXTURE SCHEDULE. POWERED FROM LIGHTING PANEL LP1, CIRCUIT 1. CONTROLLED VIA FROM SWITCH A.
- LP1-1 RECEPTACLE POWERED FROM LIGHTING PANEL LP1, CIRCUIT 1.
- LP1-1 A 1 LINEAR LIGHTING FIXTURE. REFER TO FIXTURE NUMBER IN FIXTURE SCHEDULE. POWERED FROM LIGHTING PANEL LP1, CIRCUIT 1, VIA SWITCH A.
- LP1-1 EX EXIT LIGHTING FIXTURE. REFER TO FIXTURE NUMBER OR LETTERS IN FIXTURE SCHEDULE. POWERED FROM LIGHTING PANEL 1, CIRCUIT 1.
- LP1-1 EM EMERGENCY LIGHTING FIXTURE. REFER TO FIXTURE NUMBER OR LETTERS IN FIXTURE SCHEDULE. POWERED FROM LIGHTING PANEL 1, CIRCUIT 1.
- E UNDERGROUND CONCRETE ENCASED ELECTRICAL DUCT BANK
- UNDERGROUND CONCRETE ENCASED ELECTRICAL BANK ROUTED BENEATH SLAB-ON-GRADE
- EE DIRECT BURIED CONDUIT
- GROUND CONDUCTOR
- UE UE UNDERGROUND ELECTRIC
- OH OH OVERHEAD CIRCUIT

COMMUNICATION SYMBOLS

- HORN SPEAKER
- DUAL HORN SPEAKER
- WALL MOUNTED CONE SPEAKER
- SK CEILING MOUNTED CONE SPEAKER

PROTECTION/RELAY DEVICE NUMBERS

25 - SYNCHRONIZING OR SYNCHRONISM-CHECK DEVICE
27 - UNDERVOLTAGE RELAY
32 - DIRECTIONAL POWER RELAY
37 - UNDERCURRENT OR UNDERPOWER RELAY
46 - REV. PHASE OR PHASE-BAL. CURRENT RELAY
47 - PHASE SEQ. OR PHASE BAL. VOLTAGE RELAY
49 - MACHINE OR TRANSFORMER THERMAL RELAY
50 - INSTANTANEOUS OVERCURRENT
51 - AC TIME OVERCURRENT RELAY
52 - AC CIRCUIT BREAKER
59 - OVERVOLTAGE RELAY
63 - PRESSURE SWITCH
64 - GROUND DETECTOR RELAY
67 - AC DIRECTIONAL OVERCURRENT RELAY
71 - LIQUID OR GAS LEVEL RELAY
81 - FREQUENCY RELAY
83 - AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY
86 - LOCKOUT RELAY
87 - DIFFERENTIAL PROTECTIVE RELAY

NO.	DATE	REVISIONS AND RECORD OF USE	BY	CHK	APP
	02/01/2023	100% SUBMITTAL			
	09/02/2022	95% SUBMITTAL			
1	09/28/2021	ISSUED FOR 60% SUBMITTAL	AD	PG	IB

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Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

ELECTRICAL LEGENDS

DESIGNED: DG
DETAILED: HT, AD
CHECKED: RRB
APPROVED: RRB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

E-00-001
SHEET
19 OF 27

100% SUBMITTAL

F0199222
D4409283

ELECTRICAL ABBREVIATIONS & NOTES

ELECTRICAL GENERAL NOTES

1. SOLID LINES (————————) INDICATE NEW WORK OR EQUIPMENT.
2. SCREENED LINES (————————) INDICATE EXISTING WORK OR EQUIPMENT.
3. DASHED LINES (– – – – – – – –) INDICATE FUTURE WORK OR EQUIPMENT.
4. REFER TO INDIVIDUAL DISCIPLINE CONTRACT DRAWINGS FOR ADDITIONAL ABBREVIATIONS, DETAILS, AND GENERAL DESIGN NOTES.
5. LEGEND SHEETS ARE GENERAL. SOME SYMBOLS AND ABBREVIATIONS MAY NOT BE UTILIZED ON THIS SPECIFIC PROJECT.
6. INFORMATION RELATED TO CIRCUIT IDENTIFICATION, WIRE & CONDUIT SIZES, AND ROUTING, IS ON THE FOLLOWING DRAWING TYPES.

   A. *ONE-LINE DIAGRAMS SHOW CIRCUIT IDENTIFICATION, WIRE QUANTITY AND SIZES, AND CONDUIT SIZE WITHIN STRUCTURES. ONE-LINE DIAGRAMS ALSO INDICATE ORIGIN AND DESTINATION OF CIRCUITS, AND IDENTIFY CIRCUITS ROUTED UNDERGROUND.*

   B. *FOR CIRCUITS WITHOUT UNDERGROUND PORTIONS, BUILDING FLOOR PLANS SHOW LOCATION OF EQUIPMENT FOR DETERMINING CIRCUIT LENGTH WITHIN THE STRUCTURE. FOR CIRCUITS WITH UNDERGROUND PORTIONS, ANTICIPATED PENETRATION OF UNDERGROUND CONDUITS ARE SHOWN ON STRUCTURE PLANS FOR DETERMINING THE LENGTH OF THE IN-STRUCTURE PORTIONS OF CIRCUITS. BUILDING FLOOR PLANS MAY ALSO SHOW HOME RUNS FOR LIGHTING, RECEPTACLE, AND OTHER MISCELLANEOUS EQUIPMENT CIRCUITS.*

   C. *SITE PLANS INDICATE THE GENERAL ROUTING OF UNDERGROUND CONDUITS AND DUCT BANKS. CIRCUITS ROUTED IN UNDERGROUND CONDUITS OR DUCT BANKS ARE INDICATED IN DUCT BANK SECTIONS REFERENCED ON THE SITE PLAN.*

   D. *DUCT BANK SECTIONS AND SCHEDULES IDENTIFY CONDUIT SIZE, CONDUIT MATERIAL, ARRANGEMENT OF THE UNDERGROUND CONDUITS, AND CIRCUITS ROUTED IN EACH UNDERGROUND CONDUIT.*

AREA DESIGNATIONS

THE SPECIAL AREA DESIGNATION BOXES, AS DEFINED BELOW, ARE LOCATED ON THE PLAN DRAWINGS TO DEFINE ELECTRICAL INSTALLATION REQUIREMENTS. DESIGNATION BOXES ARE LOCATED WITHIN ROOM OR BELOW ROOM NUMBER. ALL INDOOR AREAS NOT INDICATED OTHERWISE ARE AREA TYPE 1 AND MINIMUM NEMA TYPE 1 ENCLOSURES.

AREA TYPE 1A	CORROSIVE CHEMICAL FEED AND STORAGE ROOMS. CONDUIT SYSTEM SHALL BE EXPOSED SCHEDULE 80 PVC RIGID NON-METALLIC CONDUIT WITH PVC FITTINGS, BOXES AND ACCESSORIES.
AREA TYPE 4	INDOOR WET LOCATIONS SUCH AS VAULTS, HOSEDOWN AREAS, BASEMENTS, ETC. MINIMUM NEMA TYPE 4 ENCLOSURE FOR EQUIPMENT AND GASKETED FITTINGS IN A CONDUIT SYSTEM.
AREA TYPE 7A	CLASS I, DIVISION 1 AREA AS DEFINED BY NEC. ALL EQUIPMENT AND CONDUIT SYSTEMS SHALL BE RATED FOR USE IN THIS AREA.
AREA TYPE 7B	CLASS I, DIVISION 2, GROUP C AND D (METHANE, GASOLINE) AS DEFINED BY NEC. EQUIPMENT AND CONDUITS SYSTEMS SHALL BE RATED FOR USE IN THIS AREA.
AREA TYPE 12	INDOOR, DRY, DIRTY AREA. REQUIRES MINIMUM NEMA TYPE 12 GASKETED ENCLOSURES FOR ALL EQUIPMENT AND GASKETED FITTINGS IN CONDUIT SYSTEMS.

GENERAL REQUIREMENTS

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ROUTING ALL CONDUITS NOT SHOWN ON THE PLANS. THIS SHALL INCLUDE ALL CONDUITS SHOWN ON THE ONE-LINES AND HOME-RUNS SHOWN ON THE PLAN DRAWINGS. CONDUITS SHALL BE ROUTED AS DEFINED IN THE SPECIFICATION.
2. SPARE WIRES SHALL BE TAPED AND COILED AND LABELED TO INDICATE WHERE OTHER END OF SPARE WIRE IS LOCATED.
3. IF EQUIPMENT SUPPLIED BY MANUFACTURER HAS A LARGER LOAD THAN VALUE SHOWN, THE CABLE CONDUIT AND ELECTRICAL EQUIPMENT SHALL BE ENLARGED, AS REQUIRED, TO ACCOMMODATE THE HIGHER VALUE.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING PROPERLY SIZED STARTER OVERLOADS FOR EQUIPMENT FURNISHED.
5. LIGHTING AND RECEPTACLE CIRCUITS DESIGNATED ON THE FLOOR PLANS ARE NOT SHOWN ON THE ONE-LINES. CONDUCTORS FOR LIGHTING, RECEPTACLES, AND MISCELLANEOUS 120VAC CIRCUITS SHALL BE MINIMUM NO. 12AWG. CONDUIT FOR LIGHTING, RECEPTACLES, AND MISCELLANEOUS 120VAC CIRCUITS SHALL BE MINIMUM 3/4".
6. IN AREAS WHERE THERE ARE OVERHEAD BRIDGE CRANES, HOISTS, ETC. NO CONDUITS SHALL BE RUN OVERHEAD THAT WILL INTERFERE WITH THE OPERATION OF THE EQUIPMENT.

ELECTRICAL ABBREVIATIONS

A

A	AMBER, AMPERE, ALARM
AC	ALTERNATING CURRENT
ACB	AIR CIRCUIT BREAKER
ACR	ACCESS CARD READER
AF	AMPERE FRAME
AFD	ADJUSTABLE FREQUENCY DRIVE
AFRD	ARC-FLASH REDUCTION DEVICE
AM	AMMETER
ANN	ANNUNCIATOR
AR	ALARM RELAY
AS	AMMETER SWITCH, AMPERE SENSOR
AT	AMPERE TRIP
ATS	AUTOMATIC TRANSFER SWITCH
AUX	AUXILIARY
AWG	AMERICAN WIRE GAUGE

B

B	BUS
BC	BATTERY CHARGER
BKR	BREAKER
BR	BRAKE
BT	BEARING TEMPERATURE

C

C	CLOSE, COUNTER, CONTACTOR, CONTROL, CCTV CAMERA
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CB"A"	CIRCUIT BREAKER AUXILIARY CONTACT (OPEN WHEN BREAKER IS OPEN)
CB"B"	CIRCUIT BREAKER AUXILIARY CONTACT (CLOSED WHEN BREAKER IS OPEN)
CD	CONTROL DAMPER
CI	CELL INTERLOCK
CKT	CIRCUIT
CL2	CHLORINE
COS	CABLE OPERATED SWITCH
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CR	CURRENT OF CONTROL RELAY, CARD READER
CS	CONTROL STATION
CT	CYCLE TIMER OR CURRENT TRANSFORMER
CTC	CYCLE TIMER CLUTCH
CTM	CYCLE TIMER MONITOR
2/C	2 CONDUCTOR
4"C	4" CONDUIT

D

DC	DIRECT CURRENT, DOOR CONTACT
DI	DOOR INTERLOCK
DM	DAMPER MOTOR, DEMAND METER, DIMMER SWITCH
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DPR	DIFFERENTIAL PRESSURE REGULATOR
DPS	DIFFERENTIAL PRESSURE SWITCH
DS	DISCONNECT SWITCH, DOOR SWITCH, DESKTOP STATION
DVLS	DISCHARGE VALVE LIMIT SWITCH

E

E	ELECTRIC OPERATOR FOR CONTROL DAMPER OR VALVE
EC	EMPTY CONDUIT
EDS	ELECTRICAL DOOR STRIKE
EL	ELEVATION, EMERGENCY LIGHT
EMH	ELECTRICAL MANHOLE
ER	ELECTRODE RELAY
ES	END SWITCH, REQUEST TO EXIT SENSOR
E-STOP	EMERGENCY STOP
ETM	ELAPSED TIME METER
EX	EXISTING
EXP	EXPLOSION PROOF

F

F	FORWARD, FIELD
FO	FIBER OPTIC
FPR	FEEDER PROTECTION RELAY
FS	FLOW SWITCH

G

G	GREEN, GROUND, GENERATOR, GROUND FAULT
GD	GROUND DETECTOR
GEN	GENERATOR
GFCI,GFI	GROUND FAULT CURRENT INTERRUPTOR, GROUND FAULT INTERRUPTOR
GLS	GEARED LIMIT SWITCH
GPR	GENERATOR PROTECTION RELAY
GND	GROUND
#8G	#8 GROUND WIRE

H

H	HIGH, HUMIDISTAT
HH	HANDHOLE
HMT	HIGH MOTOR TEMPERATURE
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
HP	HORSEPOWER
HS	HAND STATION
HWCO	HIGH WATER CUTOFF
HZ	HERTZ (CYCLE)

I

I/O	INPUT/OUTPUT
I	INSTANTANEOUS
IJB	INTERCOM JUNCTION BOX

J

J,JB	JUNCTION BOX

K

K	KEY INTERLOCK
KAIC	THOUSAND AMPERES INTERRUPTING CURRENT
KCMIL	THOUSAND CIRCULAR MIL
KO	KEY OPERATED
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KVAR	KILOVAR
KW	KILOWATT
KWH	KILOWATT HOUR

L

L	LOW, LEVEL, LONG-TIME
LA	LIGHTNING ARRESTER
LAN	LOCAL AREA NETWORK
LC	LIGHTING CONTRACTOR
LCE	LIGHTING CONTACTOR ENCLOSURE
	LIGHTING CONTROL ENCLOSURE
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
LOA	LOCAL-OFF-AUTO
LOR	LOCAL-OFF-REMOTE
LOS	LOCK OUT STOP
LP	LIGHTING PANEL
LS	LIMIT OR LEVEL SWITCH
LTG	LIGHTING
LWCO	LOW WATER CUTOFF

M

M	MAGNETIC MOTOR STARTER
MA	MILLIAMPERE
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MCLU	MOTOR CONTROL LINEUP
MD	MOISTURE DETECTOR, MOTION DETECTOR
MDL	MAGNETIC DOOR LOCK
MFR	MANUFACTURER
MH	MANHOLE, MOUNTING HEIGHT
MOV	MOTOR OPERATED VALVE
MPR	MOTOR PROTECTION RELAY
MS	MANUAL MOTOR STARTER
MSH	MOTOR SPACE HEATER
MTS	MANUAL TRANSFER SWITCH
MV	MILLIVOLT, MEDIUM VOLTAGE
MVA	MEGAVOLT AMPERE

N

N	NEUTRAL
NGR	NEUTRAL GROUNDING RESISTOR
NGT	NEUTRAL GROUNDING TRANSFORMER
NC	NORMALLY CLOSED
NO	NORMALLY OPEN, NUMBER

O

O	OPEN
OL	OVERLOAD
OOA	ON-OFF-AUTO
OOR	ON-OFF-REMOTE
OS	OCCUPANCY SENSOR
O/U	OVER/UNDER

P

P	PRIMARY, POWER, POLE
PCS	PLANT CONTROL SYSTEM
PB	PUSH BUTTON, PULL BOX
PE	PHOTOELECTRIC SENSOR, PHOTOCELL
PF	POWER FACTOR
PFCC	POWER FACTOR CORRECTION CAPACITOR
PH	PHASE
PL	PILOT LIGHT
PLC	PROGRAMMABLE LOGIC CONTROLLER
PP	POWER PANEL
PR	PAIR
PRS	PROXIMITY SWITCH
PS	PRESSURE SWITCH
PT	POTENTIAL TRANSFORMER, PROGRAM TIMER

Q

	NOT USED

R

R	RED, RAISE, RELAY, REVERSE
RECP	RECEPTACLE
RES	RESISTOR
RH	REMOTE HANDSET
RT	REPEATING TIMER
RTD	RESISTANCE TEMPERATURE DETECTOR
RTU	REMOTE TERMINAL UNIT
RVSS	REDUCED VOLTAGE SOLID STATE STARTER

S

S	SHORT-TIME, SHIELDED, STARTER
SA	SURGE ARRESTER, SPEAKER AMPLIFIER
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
SF6	SULFUR HEXAFLOURIDE
SH	SPACE HEATER
SN	SOLID NEUTRAL
SO	SOLENOID OILER
SP	SINGLE POLE
SPD	SURGE PROTECTION DEVICE
SPDT	SINGLE POLE DOUBLE THROW
SPST	SINGLE POLE SINGLE THROW
SS	SELECTOR SWITCH, START/STOP, STAINLESS STEEL
SSM	SOLID-STATE METERING
SSS	SOLID STATE STARTER
SST	SOLID-STATE TRIP
SUPV	SUPERVISORY CONTROL
SV	SOLENOID VALVE
SWB,SWBD	SWITCHBOARD
SWG,SWGR	SWITCHGEAR

T

T	THERMOSTAT, TIMER, TOTALIZER, TRANSFORMER
TACH	TACHOMETER
TB	TERMINAL BLOCK
TC	TIMER CLUTCH
TD	TIME DELAY RELAY
TEMP	TEMPERATURE
TM	TIMER MOTOR
TQ	TORQUE
TR	TIMER RELAY, TRIAD
TS	TEMPERATURE SWITCH
TTB	TELEPHONE TERMINAL BOARD

U

UG	UNDERGROUND
UPS	UNINTERRUPTIBLE POWER SUPPLY

V

V	VOLTS, VOLTAGE RESTRAINED
VA	VOLT AMPERE
VAR	VARMETER
VFD	VARIABLE FREQUENCY DRIVE
VI	VACUUM INTERRUPTER
VLS	VALVE LIMIT SWITCH
VM	VOLTMETER
VPI	VALVE POSITION INDICATOR
VS	VOLTMETER SWITCH

W

W	WHITE, WATTS
WH	WATTHOUR METER
WM	WATT METER
WP	WEATHERPROOF
WPI	WEATHERPROOF IN-USE
WS	WALL STATION

X

X	AUXILIARY RELAY
XFMR	TRANSFORMER
XP	EXPLOSION PROOF

Y

Y	YELLOW

Z

Z	AUXILIARY RELAY, IMPEDANCE
ZS	POSITION SWITCH
ZSS	ZERO SPEED SWITCH

1-1PR#16S	ONE, SINGLE PAIR, TWISTED SHIELDED #16 CABLE
3-7/C#14	THREE, SINGLE, SEVEN CONDUCTOR #14 MULTICONDUCTOR CONTROL CABLES

100% SUBMITTAL

F0109222
D4592B3

NO.	BY	CHK	APP	DATE	REVISIONS AND RECORD OF USE
1	AD	PG	IB	02/01/2023	100% SUBMITTAL
				09/30/2022	90% SUBMITTAL
				09/28/2021	ISSUED FOR 60% SUBMITTAL

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2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

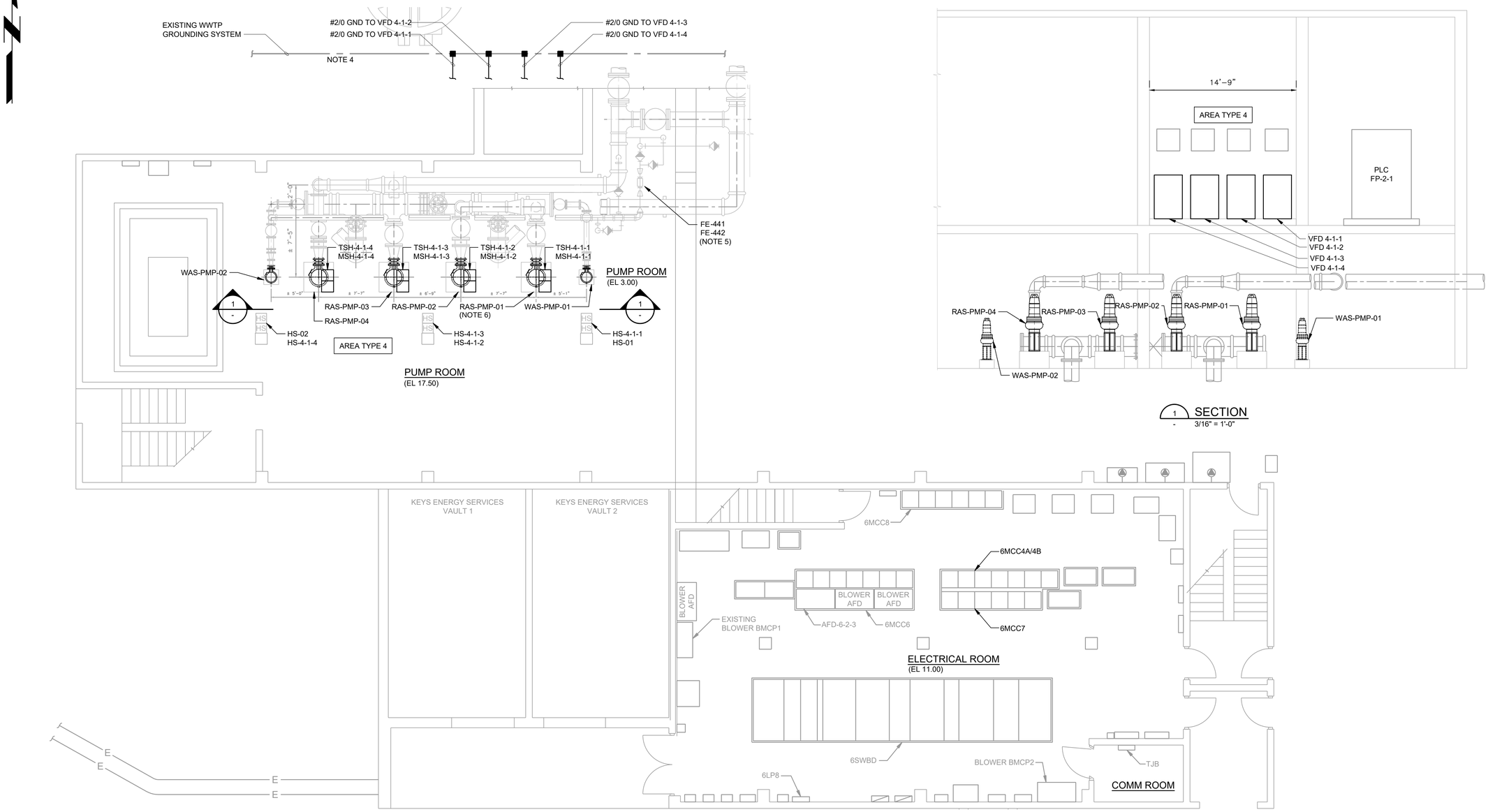
ELECTRICAL
ABBREVIATIONS AND NOTES

DESIGNED: DG
DETAILED: HT, AD
CHECKED: RRB
APPROVED: RRB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

E-00-002
SHEET
20 OF 27



1 SECTION
- 3/16" = 1'-0"

OPERATIONS BUILDING POWER PLAN
3/16" = 1'-0"

NOTES:

1. SEE DRAWINGS E-00-001 AND E-00-002 FOR ELECTRICAL LEGEND AND ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. DRIVES VFD 4-1-1 THROUGH VFD 4-1-4 ARE LOCATED ONE LEVEL ABOVE THE RAS AND WAS PUMPS, REFER TO SECTION VIEW 1. CONTRACTOR SHALL DEMOLISH THE FOUR EXISTING DRIVES ALONG WITH THE DRIVES' TRANSFORMERS, NEW DRIVES SHALL BE LOCATED IN SAME LOCATION AS EXISTING DRIVES.
3. PLC FP-2-1 IS LOCATED ONE LEVEL ABOVE THE RAS AND WAS PUMPS, ADJACENT TO THE VFDS, REFER TO SECTION VIEW 1.
4. CONTRACTOR SHALL UN-EARTH EXISTING GROUNDING SYSTEM BEFORE ADDING NEW EQUIPMENT TO THE GROUNDING SYSTEM.
5. WAS FLOW METERS FIT-441 AND FIT-442 SHALL BE REPLACED AT EXISTING LOCATION.
6. CONTRACTOR SHALL COIL AND STORE ALL PUMP'S POWER CABLE SLACK INSIDE A PULL BOX. THE PULL BOX SHALL BE LOCATED NEAR THE PUMP MOTORS AND SHALL HAVE A NEMA RATING SUITABLE FOR THE LOCATION BEING INSTALLED.

6' 4' 2' 0 5' 10'
3/16"=1'-0"

100% SUBMITTAL

NO.	BY	CHK	APP	DATE	REVISIONS AND RECORD OF USE
				02/01/2023	100% SUBMITTAL
				10/10/2022	95% SUBMITTAL
1	AD	PG	IB	11/26/2021	ISSUED FOR 60% SUBMITTAL

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

ELECTRICAL
OPERATIONS BUILDING POWER PLAN

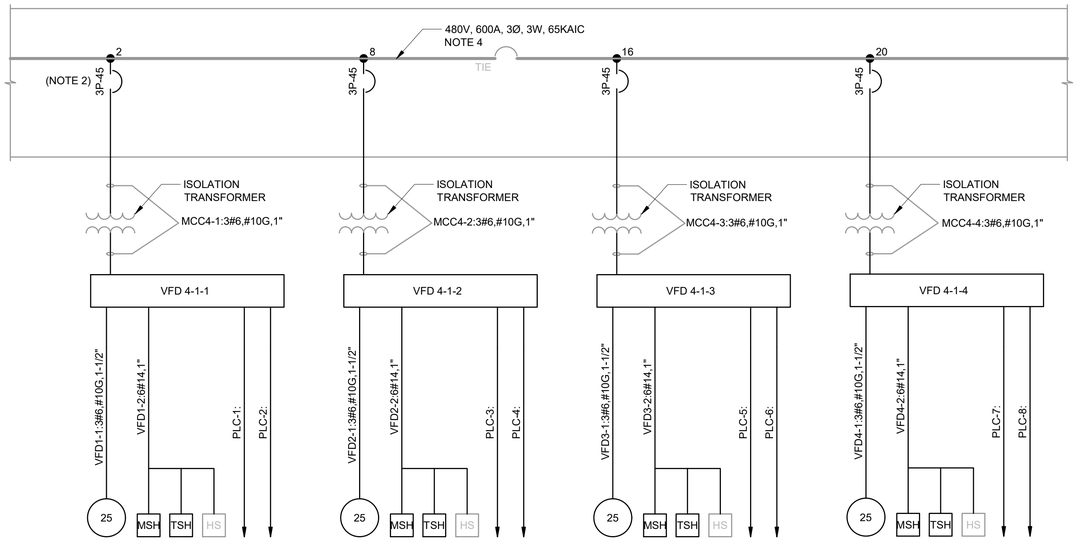
DESIGNED: DG
DETAILED: HT, AD
CHECKED: RRB
APPROVED: RRB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

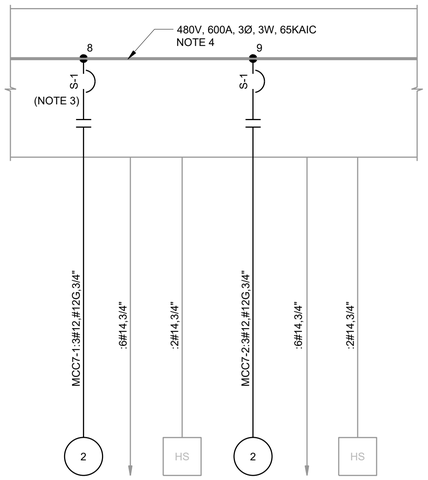
PROJECT NO.
409283

E-10-601
SHEET
21 OF 27

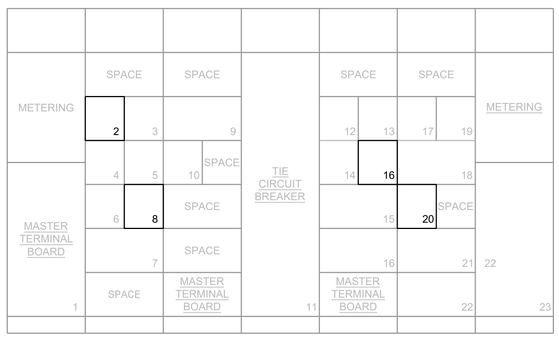
F0160322
D3409283



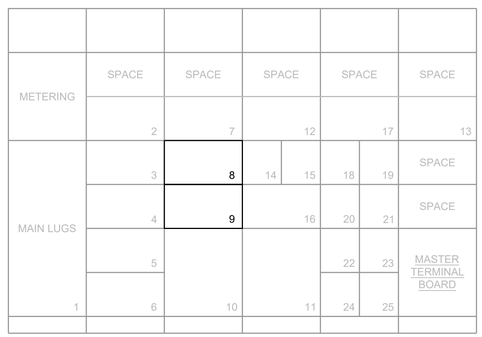
6MCC4A / 4B PARTIAL ONE-LINE DIAGRAM
(ELECTRICAL ROOM)
NO SCALE



6MCC7 PARTIAL ONE-LINE DIAGRAM
(ELECTRICAL ROOM)
NO SCALE



6MCC4A / 4B FRONT ELEVATION
(ELECTRICAL ROOM)
NO SCALE



6MCC7 FRONT ELEVATION
(ELECTRICAL ROOM)
NO SCALE

NOTES:

1. SEE DRAWINGS E-00-001 AND E-00-002 FOR ELECTRICAL LEGEND AND ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. CONTRACTOR SHALL REPLACE BREAKERS IN 6MCC4A / 4B BUCKETS 2, 8, 16 AND 20 AS SHOWN IN THE ONE-LINE DIAGRAM.
3. CONTRACTOR SHALL REPLACE MOTOR STARTERS IN 6MCC7 BUCKETS 8 AND 9 AS SHOWN IN THE ONE-LINE DIAGRAM.
4. EXISTING MOTOR CONTROL CENTERS 6MCC4A/4B AND 6MCC7 ARE WESTINGHOUSE SERIES 2100. NEW BREAKERS AND MOTOR STARTERS SHALL BE COMPATIBLE WITH EXISTING EQUIPMENT.

F0109822
D409283

100% SUBMITTAL

DATE	REVISIONS AND RECORD OF USE	NO.	BY	CHK APP
02/01/2023	100% SUBMITTAL			
10/10/2022	90% SUBMITTAL			
11/26/2021	ISSUED FOR 60% SUBMITTAL	1	AD	PG IB

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

ELECTRICAL
ONE-LINE DIAGRAMS

DESIGNED: DG
DETAILED: HT, AD
CHECKED: RRB
APPROVED: RRB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

E-10-602
SHEET
22 OF 27

PUMP ROOM PLC FP-2-1 ONE-LINE DIAGRAM
(PARTIAL)
NO SCALE

NOTES:

1. SEE DRAWINGS E-00-001 AND E-00-002 FOR ELECTRICAL LEGEND AND ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. RECONNECT EXISTING 120VAC SUPPLY TO NEW FLOW METERS.

100% SUBMITTAL

F0109822
D409283

DATE	REVISIONS AND RECORD OF USE	NO.	BY	CHK APP
02/01/2023	100% SUBMITTAL			
10/10/2022	95% SUBMITTAL			
11/29/2021	ISSUED FOR 60% SUBMITTAL	1	AD	PG IB

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

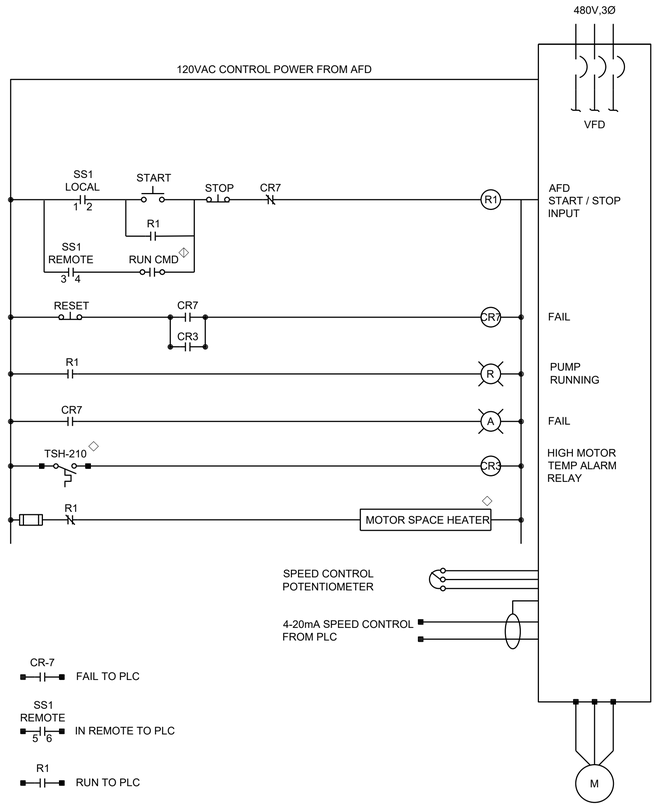
ELECTRICAL
PLC ONE-LINE DIAGRAM

DESIGNED:	DG
DETAILED:	HT, AD
CHECKED:	RRB
APPROVED:	RRB
DATE:	02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

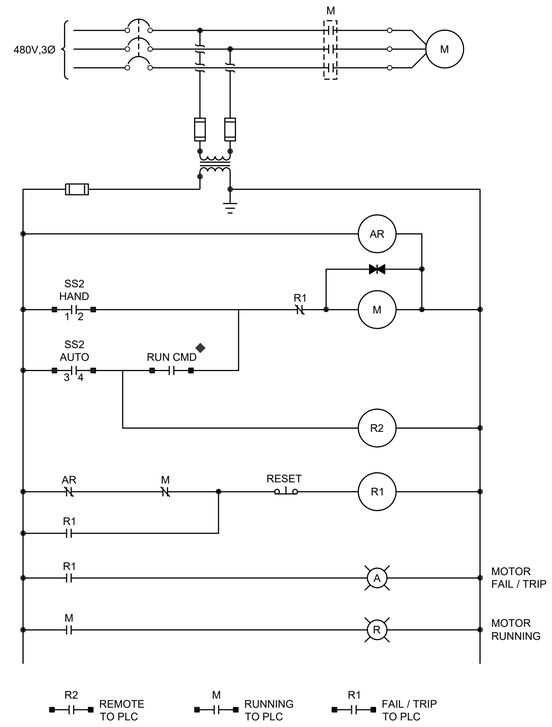
PROJECT NO.
409283

E-10-603
SHEET
23 OF 27



VFD 4-1-1

SIMILAR FOR VFD 4-1-2, VFD 4-1-3, AND VFD 4-1-4



WAS-PMP-01

SIMILAR FOR WAS-PMP-02

SWITCH DEVELOPMENTS:

SS1

CONTACTS	POSITION		
	LOCAL	OFF	REMOTE
1 - 2	X		
3 - 4			X
5 - 6			X

SS2

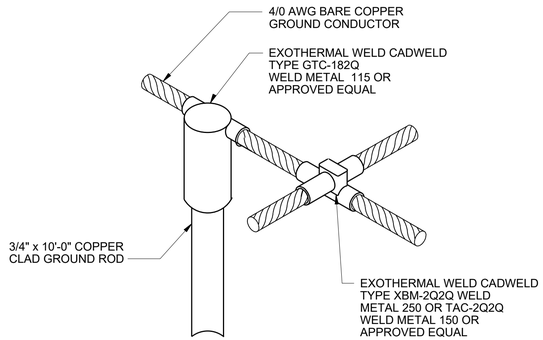
CONTACTS	POSITION		
	LOCAL	OFF	REMOTE
1 - 2	X		
3 - 4			X
5 - 6			X

SYMBOL LEGEND:

◇ AT OR NEAR DRIVEN EQUIPMENT

◆ REMOTE FROM STARTER

◇ AT PLC



EXOTHERMAL WELD

C GROUND ROD AT CROSS OR TEE CONNECTION

\- NO SCALE

NOTES:

1. SEE DRAWINGS E-00-001 AND E-00-002 FOR ELECTRICAL LEGEND AND ABBREVIATIONS AND GENERAL REQUIREMENTS.
2. CONTRACTOR SHALL FIELD VERIFY ALL EXISTING COMMUNICATION AND CONTROL WIRING BETWEEN THE EXISTING PLC FP-2-1 AND THE FOUR RAS PUMPS VFDS. THE CONFIGURATION AND FUNCTIONS OF THE NEW DRIVES SHOULD MATCH THAT OF THE EXISTING DRIVES. EXISTING VFDS ARE ALLEN-BRADLEY MODEL 1336 PLUS II. CONTRACTOR SHALL COORDINATE WITH OWNER AND THE DRIVES' MANUFACTURER TO FINISH THE DEVELOPMENT OF THE VFD SCHEMATIC TO MATCH THE EXISTING DRIVES.

NO.	DATE	REVISIONS AND RECORD OF USE	BY	CHK
1	11/26/2021	ISSUED FOR 60% SUBMITTAL	AD	PG
	10/10/2022	95% SUBMITTAL		IB
	02/01/2023	100% SUBMITTAL		

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CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

ELECTRICAL
SCEHMATICS AND DETAILS

DESIGNED: DG
DETAILED: HT, AD
CHECKED: RRB
APPROVED: RRB
DATE: 02/01/2023

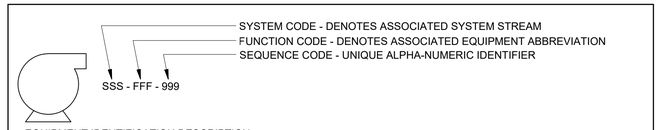
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

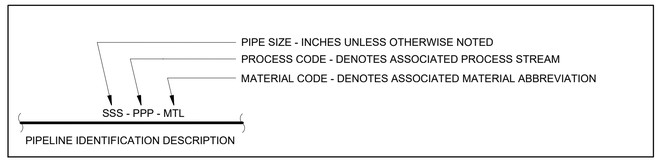
PROJECT NO.
409283

E-10-701
SHEET
24 OF 27

100% SUBMITTAL

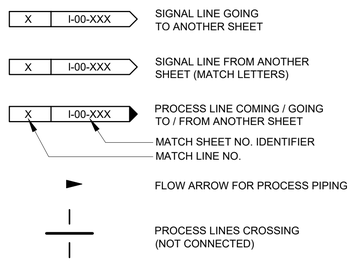
F01109222
D4169283





LINE SYMBOLS

- MAJOR PROCESS PIPING OR FLOW CHANNEL
- SECONDARY PROCESS PIPING
- MISCELLANEOUS PIPING
- SCREENED LINE DENOTES EXISTING PIPE OR EQUIPMENT
- DASHED LINE DENOTES FUTURE PIPE AND EQUIPMENT
- ELECTRIC SIGNAL



PRIMARY ELEMENT & FITTING SYMBOLS

- M — PRIMARY FLOW ELEMENT: ELECTROMAGNETIC
- ANNULAR TYPE DIAPHRAGM SEAL
- REDUCER - CONCENTRIC
- REDUCER - ECCENTRIC

PUMP & BLOWER SYMBOLS

- CENTRIFUGAL PUMP OR OTHER TYPE NOT SPECIFIED
- ELECTRIC MOTOR

PIPELINE MATERIAL CODE ABBREVIATIONS

GLDIP	SECTION 15061, DUCTILE IRON PIPE

VALVE & GATE SYMBOLS

- VALVE: GATE OR OTHER TWO-WAY TYPE NOT OTHERWISE IDENTIFIED
- VALVE: BALL
- VALVE: BUTTERFLY
- VALVE: ECCENTRIC PLUG
- VALVE: CHECK
- VALVE: AIR RELEASE

INSTRUMENT AND I/O ABBREVIATION DEFINITIONS

FA	FAIL ALARM
FI	FLOW INDICATOR
FE	PRIMARY FLOW ELEMENT / SENSOR
FIT	FLOW INDICATING TRANSMITTER
GA	GENERAL ALARM
HS	HAND SWITCH
PE	PRESSURE SENSOR
PI	PRESSURE INDICATOR
PIT	PRESSURE INDICATING TRANSMITTER
RES	RESET
SI	SPEED INDICATION
SK	SPEED COMMAND
TAH	TEMPERATURE ALARM HIGH
TSH	TEMPERATURE SWITCH HIGH
UA	MULTI-VARIABLE / COMMON ALARM / COMMON FAULT
UCR	RUN COMMAND
UCS	STOP COMMAND
YA	GENERAL ALARM EVENT
YI	EVENT INDICATION

FUNCTION DESIGNATIONS AND ABBREVIATIONS

HAND SWITCH DESIGNATIONS

HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
OOA	ON-OFF-AUTO
OO	ON-OFF
OO/R	ON-OFF/RESET
SS	START-STOP
AM	AUTO-MANUAL

POWER SUPPLY ABBREVIATIONS

24VDC	24 VOLT DC SUPPLY
120VAC	120 VOLT AC SUPPLY
480VAC	480 VOLT AC SUPPLY

120V — POWER SUPPLY SOURCE LABEL. USED ONLY WHERE NECESSARY TO HELP CLARIFY AN INSTRUMENT OR SYSTEM FUNCTION.

SYSTEM CODE ABBREVIATIONS

CL2	CHLORINE
RAS	RETURN ACTIVATED SLUDGE
WAS	WASTE ACTIVATED SLUDGE

PROCESS CODE ABBREVIATIONS

CL2	CHLORINE
RAS	RETURN ACTIVATED SLUDGE
WAS	WASTE ACTIVATED SLUDGE

FUNCTION CODE ABBREVIATIONS

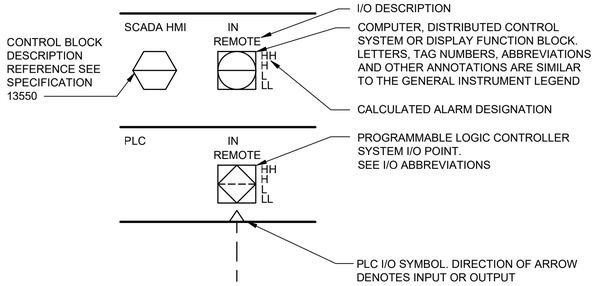
AVR	VALVE, AIR RELEASE
BFV	AWWA BUTTERFLY VALVE
BV	AWWA BALL VALVE
EPV	VALVE, ECCENTRIC PLUG
GV	GATE VALVE
M	MOTOR
PCL	PUMP, CENTRIFUGAL
PLC	PROGRAMMABLE LOGIC CONTROLLER
PV	NON-ECCENTRIC PLUG VALVE
VC	CHECK VALVE
TVC	TILTING DISK CHECK VALVE

GENERAL INSTRUMENT SYMBOLS

- FIELD MOUNTED DISCRETE INSTRUMENT
- PILOT LIGHT
- DISCRETE INSTRUMENT MOUNTED ON FACE PRIMARY OF PANEL
- DISCRETE INSTRUMENT MOUNTED BEHIND OR INSIDE OF PRIMARY PANEL
- DISCRETE INSTRUMENT MOUNTED ON FACE OF LOCAL PANEL
- DISCRETE INSTRUMENT MOUNTED BEHIND OR INSIDE OF LOCAL PANEL
- SINGLE INSTRUMENT HOUSING CONTAINING TWO (OR MORE) INSTRUMENTATION FUNCTIONS
- I — GENERAL CONTROL INTERLOCK FUNCTION, SEE SCHEMATICS AND SYSTEM SPECIFICATIONS FOR SPECIFIC FUNCTION

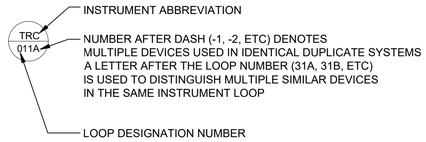
DIGITAL SYSTEMS INTERFACE SYMBOLS

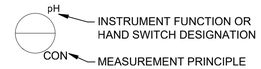
NOTE : REFER TO DETAILED SYSTEM SPECIFICATIONS FOR FUNCTIONAL DESCRIPTION. ALSO SEE I/O SCHEDULES FOR COMPLETE INPUT AND OUTPUT LISTINGS.



- DISCRETE INPUT
- DISCRETE OUTPUT
- ANALOG INPUT
- ANALOG OUTPUT
- PULSE INPUT

INSTRUMENTATION SYMBOLOGY AND DESIGNATIONS





GENERAL NOTES

1. IN GENERAL, THE P&ID SYMBOLS AND DEVICE IDENTIFICATIONS ARE BASED ON INTERNATIONAL SOCIETY OF AUTOMATION, STANDARD PRACTICE ANSI/ISA-5.1 (2009). SOME MODIFICATIONS, ADDITIONS AND ALTERATIONS HAVE BEEN MADE AS NEEDED TO ACCOMMODATE THE PROJECT REQUIREMENTS.
2. SOME CONTROL AND INTERLOCK REQUIREMENTS WHICH CAN BE MORE CLEARLY ILLUSTRATED ON SCHEMATIC DRAWINGS HAVE BEEN OMITTED FROM THE P&ID DRAWINGS.
3. THIS IS A GENERAL LEGEND SHEET. SOME SYMBOLS AND ABBREVIATIONS MAY NOT BE UTILIZED ON THIS SPECIFIC PROJECT.
4. PIPING AND EQUIPMENT LEGEND APPLIES TO P&ID SHEETS ONLY AND MAY DIFFER FROM LEGENDS FOR OTHER SHEETS.

100% SUBMITTAL

NO.	DATE	REVISIONS AND RECORD OF USE	BY	CHK	APP
2	02/01/2023	100% SUBMITTAL	AD	PG	IB
1	10/10/2022	ISSUED FOR 60% SUBMITTAL	AD	PG	IB
	09/28/2021				

Date:
Engineer of Record:
Florida License No.:

BLACK & VEATCH
Black & Veatch Corporation
2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

P&ID
LEGEND AND ABBREVIATIONS

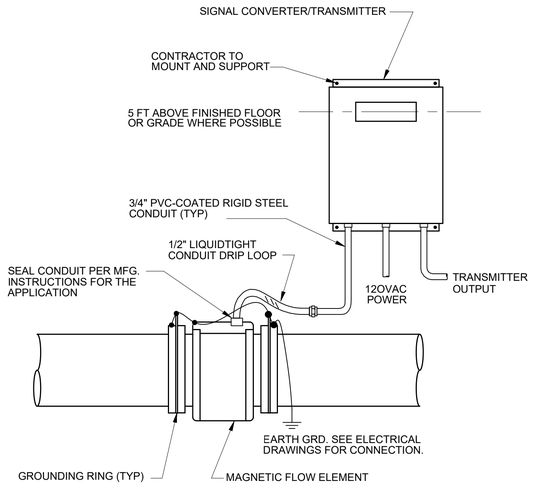
DESIGNED: LB
DETAILED: AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

I-00-001
SHEET
25 OF 28

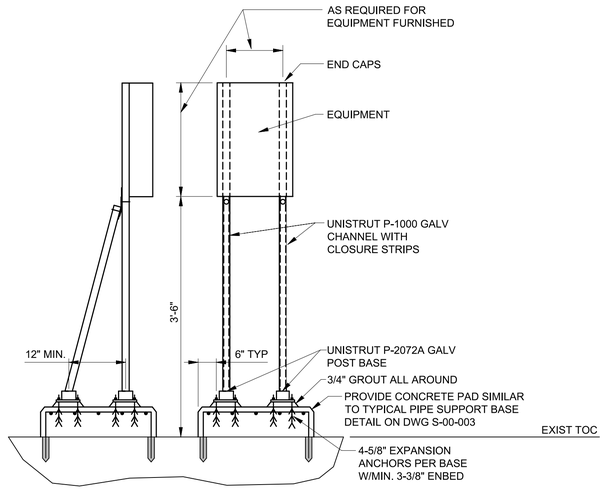
F0190622
D409283



A MAGNETIC FLOWMETER

NO SCALE

NOTES:
1. PIPE TO BE SUPPORTED ON BOTH SIDES OF METER.



B TYPICAL EQUIPMENT MOUNTING

NO SCALE

100% SUBMITTAL

NO.	BY	CHK	APP	DATE	REVISIONS AND RECORD OF USE
				02/01/2023	100% SUBMITTAL

Date:
Engineer of Record:
Florida License No.:

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Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

P&ID
INSTRUMENT INSTALLATION DETAILS

DESIGNED: DH
DETAILED: DH
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

I-00-501
SHEET
26 OF 28

F0106522
D409283

SCADA HMI

PLC FP-2-1

	FAIL	RUNNING	RUN CMD	SPEED SETPOINT
VFD 414	UA 414	YIR 414	UCR 414	SK 414
VFD 413	UA 413	YIR 413	UCR 413	SK 413
VFD 412	UA 412	YIR 412	UCR 412	SK 412
VFD 411	UA 411	YIR 411	UCR 411	SK 411

FLOW: FI

VFD 414: HOA HS 414; OO HS 414; HK 414; 480VAC
VFD 413: HOA HS 413; OO HS 413; HK 413; 480VAC
VFD 412: HOA HS 412; OO HS 412; HK 412; 480VAC
VFD 411: HOA HS 411; OO HS 411; HK 411; 480VAC

A | I-10-602 — TO WAS-PMP-02 SUCTION

I-10-602 | A — FROM WAS-PMP-02

6"-WAS-GLDIP

WAS-EPV-09

FROM CLARIFIER — 18"-RAS-GLDIP — RAS-KGV-02 — RAS-EPV-06 — 14"-RAS-GLDIP — 14" x 8" — RAS-PMP-04 — 8" x 12" — PI 414 — RAS-TVC-04 — RAS-EPV-01 — 12"-RAS-GLDIP — 18" x 12" x 12" TEE — 18"-RAS-GLDIP — RAS-EPV-10

TSH 414; OO HS 414

6"-RAS-GLDIP — WAS-EPV-10 — FIT — 120V — FE — M — RAS — TO AERATION BASIN

24"-RAS-GLDIP

RAS-KGV-03

14"-RAS-GLDIP — RAS-EPV-02 — 14" x 8" — RAS-PMP-03 — 8" x 12" — PI 413 — RAS-TVC-03 — RAS-EPV-08 — 12"-RAS-GLDIP

TSH 413; OO HS 413

RAS-EPV-09 — 18"-RAS-GLDIP

14"-RAS-GLDIP — RAS-EPV-05 — 14" x 8" — RAS-PMP-02 — 8" x 12" — PI 412 — RAS-TVC-02 — RAS-EPV-03 — 12"-RAS-GLDIP — 18" x 12" x 12" TEE — 18"-RAS-GLDIP

TSH 412; OO HS 412

FIT — 120V — FE — M — RAS — TO AERATION BASIN

RAS-EPV-11

24"-RAS-GLDIP

12"-RAS-GLDIP — WAS-EPV-05

I-10-602 | B — FROM WAS-PMP-01

FROM CLARIFIER — 18"-RAS-GLDIP — RAS-KGV-01 — RAS-EPV-04 — 14"-RAS-GLDIP — 14" x 8" — RAS-PMP-01 — PI 411 — RAS-TVC-01 — RAS-EPV-07

TSH 411; OO HS 411

WAS-EPV-02

6"-WAS-GLDIP

B | I-10-602 — TO WAS-PMP-02 SUCTION

NOTES:

1. SEE LEGEND AND ABBREVIATIONS ON DRAWINGS I-00-001.
2. SYSTEM CODE IS RAS UNLESS OTHERWISE NOTED.

100 % SUBMITTAL

NO.	BY	CHK	DATE	REVISIONS AND RECORD OF USE
			02/01/2023	100% SUBMITTAL
2	AD	PG	10/10/2022	ISSUED FOR 90% SUBMITTAL
1	AD	IB	09/28/2021	ISSUED FOR 60% SUBMITTAL

Date:
Engineer of Record:
Florida License No.:

BLACK & VEATCH
Black & Veatch Corporation
2121 Ponce de Leon Boulevard, Suite 305
Coral Springs, FL 33134
Certificate No. 8132

CITY OF KEY WEST
RICHARD A. HEYMAN
ENVIRONMENTAL PROTECTION FACILITY
RAS AND WAS PUMPS REPLACEMENT

P&ID
RAS PUMPING STATION

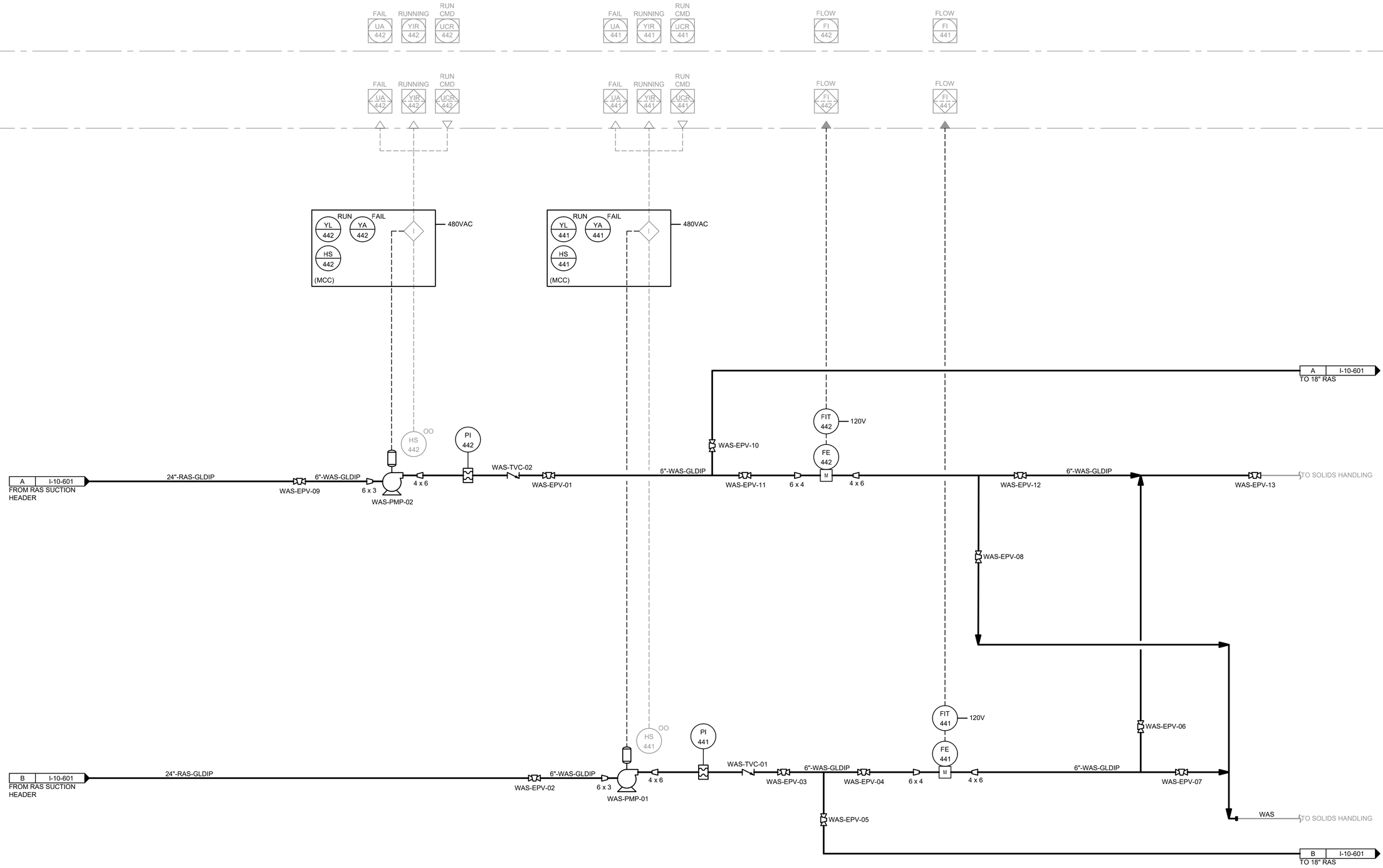
DESIGNED: LB
DETAILED: AD
CHECKED: PG
APPROVED: IB
DATE: 02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

I-10-601
SHEET
27 OF 28

F0106622
D409283



NOTES:

1. SEE LEGEND AND ABBREVIATIONS ON DRAWINGS I-00-001.
2. SYSTEM CODE IS WAS UNLESS OTHERWISE NOTED.

100% SUBMITTAL

NO.	BY	CHK	APP	DATE	REVISIONS AND RECORD OF USE
				02/01/2023	100% SUBMITTAL
2	AD	PG	IB	10/10/2022	ISSUED FOR 90% SUBMITTAL
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DESIGNED:	LB
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APPROVED:	IB
DATE:	02/01/2023

0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE

PROJECT NO.
409283

I-10-602
SHEET
28 OF 28

FB109522
D409283

Project: 409283 Key West RAS WAS Pumps
Design Consultant: Black & Veatch
Major Equipment List Costs

Equipment	Manufacturers	Estimated Value	Comments
RAS VFDs (25 hp each) (four drives) VFD-4-1-1, VFD-4-1-2 VFD-4-1-3, VFD-4-1-4	Schneider Electric per unit	$11,000	Total: 4 VFDs
RAS	WILO per unit	$22,608	WILO FA20.54T 18HP WILO Dry Pit Pumps CERAM Coated Wet Ends Total: 4 RAS Pumps
WAS	WILO per unit	$4,998	WILO FA10.33E 2.85hp WILO Dry Pit Pumps CERAM Coated Wet Ends Total: 4 WAS Pumps
RAS 12" Wafer Check Valve (TVC)	Dezuirk per unit	$3,733	Total: 4 valves
RAS 12" Eccentric Plug Valve (EPV)	Dezuirk per unit	$3,233	Total: 4 valves
RAS 14" Eccentric Plug Valve (EPV)	Dezuirk per unit	$5,586	Total: 4 valves
RAS 18" Eccentric Plug Valve (EPV)	Dezuirk per unit	$8,046	Total: 3 valves
RAS 18" Knife Gate Valve (KGV)	Dezuirk per unit	$9,230	Total: 2 valves
RAS 24" Knife Gate Valve (KGV)	Dezuirk per unit	$16,900	Total : 1 valve

Project:	RAS Replacement	Created on:	2021-07-27
Project number:	Key West WWTP	Created by:	PSI Technologies

wilo

Technical data with motor

Submersible sewage pump FA 20.54T FK 202-6/27

Pump							
Pump type		FA 20.54T		Installation type		Dry sump installation	
Impeller Ø	max. possible	320	mm				
	standard	270	mm	Free passage		78	mm
	designed	270	mm	Suction port	Pressure rating	PN10	
	min. possible	270	mm		Rated diameter	Size8	
Nominal speed		1140	1/min		Standard	ANSI B16.1 Class 125 Std.-S	
Frequency		60	Hz	Discharge port	Pressure rating	PN10	
Impeller type		Solid			Rated diameter	Size8	
Impeller construction		Closed			Standard	ANSI B16.1 Class 125 Std.-D	

Weights				
Weight of pump end	max. 297.6	lb	Weight of unit	max. 639.3 lb
Weight of motor	341.7	lb		

Materials	
Pump housing	EN-GJL-250
Stationary wear ring	1.4308
Impeller	EN-GJL-250
Mobile wear ring	1.4462/1.4470

Motor					
Motor name	FK 202-6/27		Number of poles	6	
Rated power	18.2	hp	Rated speed	1130	rpm
Power input with rated power				23	hp
Rated voltage				460 ~3	V
Current input with rated power				26	A
Efficiency with rated power				80	%
cos phi with rated power	0.83		Rated frequency	60	Hz
cos phi with starting	0.6		Operation type wet	S1	
Starting current, direct starting	104	A	Operation type dry	S1	
Starting current, star-delta	35	A	Max. fluid temperature	104	°F
Starting torque	153	lbf ft	Starts per hour max.	15	
Inertia moment	1.6967	lb ft²	Degree of protection	IP 68	
Sel. explosion protection	--		Ex-number	--	
Ex-designation	--				
Motor connection cable			4x4 + 2x1,5 NSSHÖU		

Duty point data						
Volume flow		1579.8	US g.p.m.	Fluid	Water, pure	
Head		24.4	ft	Required pump NPSH	10.7	ft
Shaft power	P_2	13.6	hp	Speed	1148	rpm
Pump efficiency		71.4	%	Total efficiency	$= \frac{P_2 * \text{Pump efficiency}}{P_1}$	
Power input	P_1	16.6	hp			

Item no.

Project:	RAS Replacement	Created on:	2021-07-27
Project number:	Key West WWTP	Created by:	PSI Technologies

Technical data — with motor

Submersible sewage pump — FA 20.54T — FK 202-6/27

Tender text

Submersible Sewage Pump as submersible, single-stage block unit in stationary, vertical installation to pump untreated sewage which doesn't attack the pump neither chemically nor mechanically. Pump with radially arranged discharge piece and axial pump intake. Service-friendly design by separated motor and pump casing. Pumping values to be guaranteed as per ISO 9906 Annex A

Submersible motor in pressure-resistant design, with internal, sealed, active circulation cooling and heat exchanger, double mechanical shaft seal in EMU block design as well as separate sealing chamber. The motor chamber and sealing chamber are filled with medical white oil.

Motor sealing at the shaft by a double, wear-resistant mechanical shaft seal independent of the direction on rotation entirely made of silicon-carbide as closed unit, in EMU sealing cartridge of stainless steel with intermediate separation chamber. Both seals are cooled and lubricated by medical white oil. The motor chamber is equipped with a terminal board. The motor is equipped with two maintenance-free ball bearings.

The upper bearing is filled with high-quality grease, the lower bearing is oil-lubricated. Possibility for retrofitting a moisture probe by means of a pencil electrode for protection against penetrading humidity. All casing parts are of cast iron.

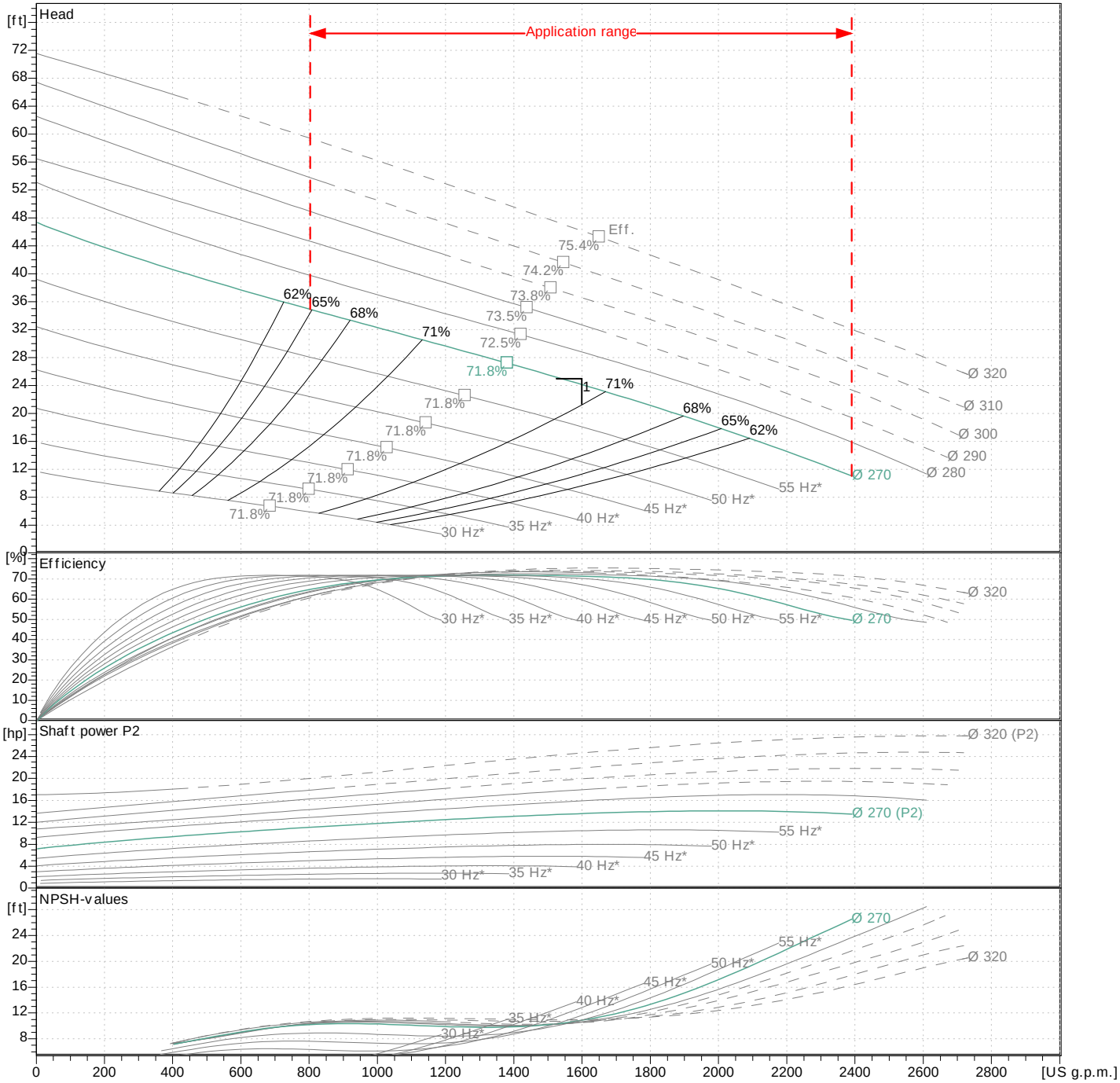
Shaft and connecting elements are of stainless steel. The motor is suitable for continuous operation (S1) under full load in immerged and completely emerged condition.

Project:	RAS Replacement	Created on:	2021-07-27
Project number:	Key West WWTP	Created by:	PSI Technologies

Performance curves — with motor

Submersible sewage pump — FA 20.54T — FK 202-6/27

Power data referred to: Water, pure [100%] ; 68°F; 62.315lb/ft³; 1.0768E-5ft²/s
Tolerance as per ISO 9906 / Annex A.2



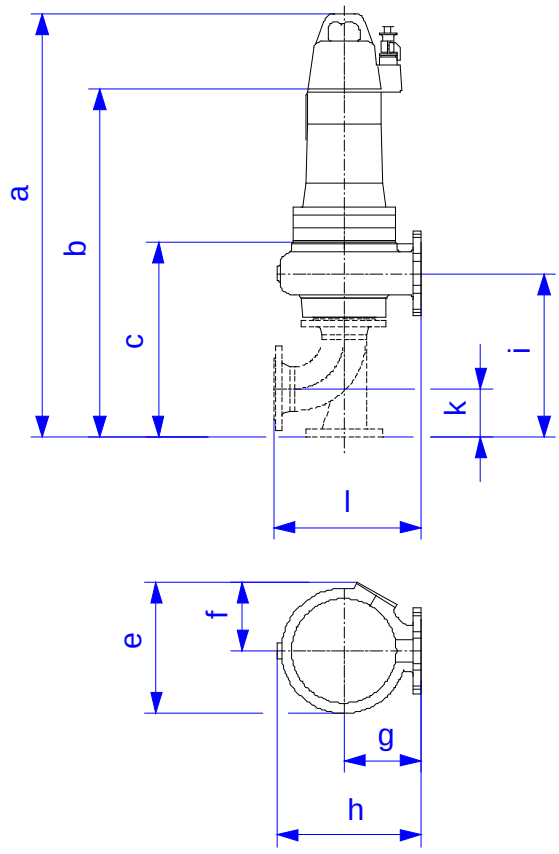
Pump				Duty point data			
Impeller Ø	designed	270	mm	Volume flow		1579.8	US g.p.m.
Nominal speed		1140	rpm	Head		24.4	ft
Frequency		60	Hz	Shaft power	P_2	13.6	hp
Impeller type		Solid		Pump efficiency		71.4	%
Motor				Power input	P_1	16.6	hp
Rated power		18.2	hp	Required pump NPSH		10.7	ft
Sel. explosion protection		--		Speed		1148	rpm

Project:	RAS Replacement	Created on:	2021-07-27
Project number:	Key West WWTP	Created by:	PSI Technologies

Technical data

with motor

Submersible sewage pump FA 20.54T FK 202-6/27



Dimensions in mm				Connections
a	1593			Suction port
b	1486			Size8
c	722			PN10
e	605			
f	358			Discharge port
g	400			Size8
h	693			PN10
i	625			
k	190			Dry sump installation
l	660			

Project:	WAS Pumps	Created on:	2021-07-16
Project number:	Key West WWTP	Created by:	PSI Technologies, Inc

wilo

Technical data — with motor

Submersible sewage pump — FA 10.33E — FK 17.1-6/8K

Pump							
Pump type		FA 10.33E		Installation type		Dry sump installation	
Impeller Ø	max. possible	249	mm				
	standard	194	mm	Free passage		80	mm
	designed	194	mm	Suction port	Pressure rating	PN10	
	min. possible	194	mm		Rated diameter	Size3	
Nominal speed		1140	1/min		Standard	ANSI B16.1 Class 125 Std.-S	
Frequency		60	Hz	Discharge port	Pressure rating	PN10	
Impeller type		Single-channel			Rated diameter	Size4	
Impeller construction		Closed			Standard	ANSI B16.1 Class 125 Std.-D	

Weights				
Weight of pump end	max. 68.3	lb	Weight of unit	max. 255.7 lb
Weight of motor	187.4	lb		

Materials			
Pump housing	EN-GJL-250		
Stationary wear ring	1.4308		
Impeller	EN-GJS-500-7		
Mobile wear ring	1.4462/1.4470		

Motor					
Motor name	FK 17.1-6/8K		Number of poles	6	
Rated power	2.85	hp	Rated speed	1090	rpm
Power input with rated power				4.15	hp
Rated voltage				460 ~3	V
Current input with rated power				4.75	A
Efficiency with rated power				68	%
cos phi with rated power	0.82		Rated frequency	60	Hz
cos phi with starting			Operation type wet	S1	
Starting current, direct starting	17.1	A	Operation type dry	S1	
Starting current, star-delta	6	A	Max. fluid temperature	104	°F
Starting torque	26	lbf ft	Starts per hour max.	15	
Inertia moment	0.2658	lb ft²	Degree of protection	IP 68	
Sel. explosion protection	--		Ex-number	--	
Ex-designation	--				
Motor connection cable			7G1,5 H07RN-F		

Duty point data					
Volume flow	258.9	US g.p.m.	Fluid	Water, pure	
Head	16.1	ft	Required pump NPSH	5	ft
Shaft power P_2	1.51	hp	Speed	1140	rpm
Pump efficiency	69.7	%	Total efficiency	$= \frac{P_2 * \text{Pump efficiency}}{P_1}$	
Power input P_1	2.5	hp			

Item no.

Project:	WAS Pumps	Created on:	2021-07-16
Project number:	Key West WWTP	Created by:	PSI Technologies, Inc

wilo

Technical data — with motor

Submersible sewage pump — FA 10.33E — FK 17.1-6/8K

Tender text

Submersible Sewage Pump as submersible, single-stage block unit in stationary, vertical installation to pump untreated sewage which doesn't attack the pump neither chemically nor mechanically. Pump with radially arranged discharge piece and axial pump intake. Service-friendly design by separated motor and pump casing. Pumping values to be guaranteed as per ISO 9906 Annex A

Submersible motor in pressure-resistant design, with internal, hermetically-tight active cooling with highly efficient heat exchanger, double mechanical shaft seal in EMU block design, as well as separate sealing chamber. The motor chamber and the sealing chamber are filled with medical white oil. Motor sealing at the shaft by a double, wear-resistant mechanical shaft seal independent of the direction of rotation entirely made of silicon-carbide as closed unit in EMU sealing cartridge of stainless steel with intermediate separation chamber and additional shaft sealing ring.

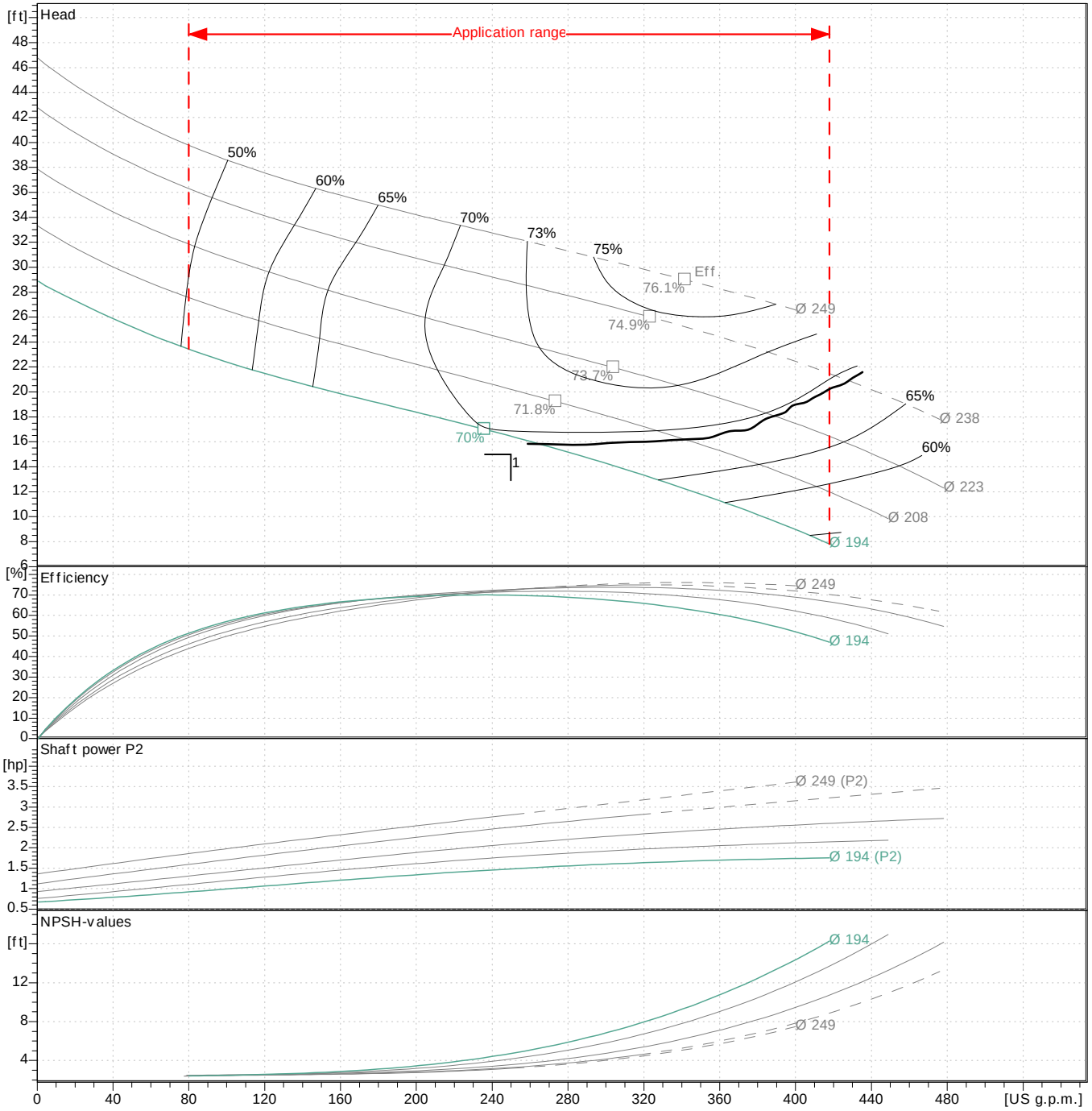
Both seals are cooled and lubricated. The motor chamber is equipped with connecting terminals. Protection of the motor winding by thermistors installed. Both closed ball bearings are maintenance-free and filled with high-quality grease. All casing parts are of cast iron. Shaft and connecting elements are of stainless steel. The motor is suitable for continuous operation (s1) under full load in immerged and completely emerged condition.

Project:	WAS Pumps	Created on:	2021-07-16
Project number:	Key West WWTP	Created by:	PSI Technologies, Inc

Performance curves with motor

Submersible sewage pump FA 10.33E FK 17.1-6/8K

Power data referred to: Water, pure [100%] ; 68°F; 62.315lb/ft³; 1.0768E-5ft²/s
Tolerance as per ISO 9906 / Annex A.2



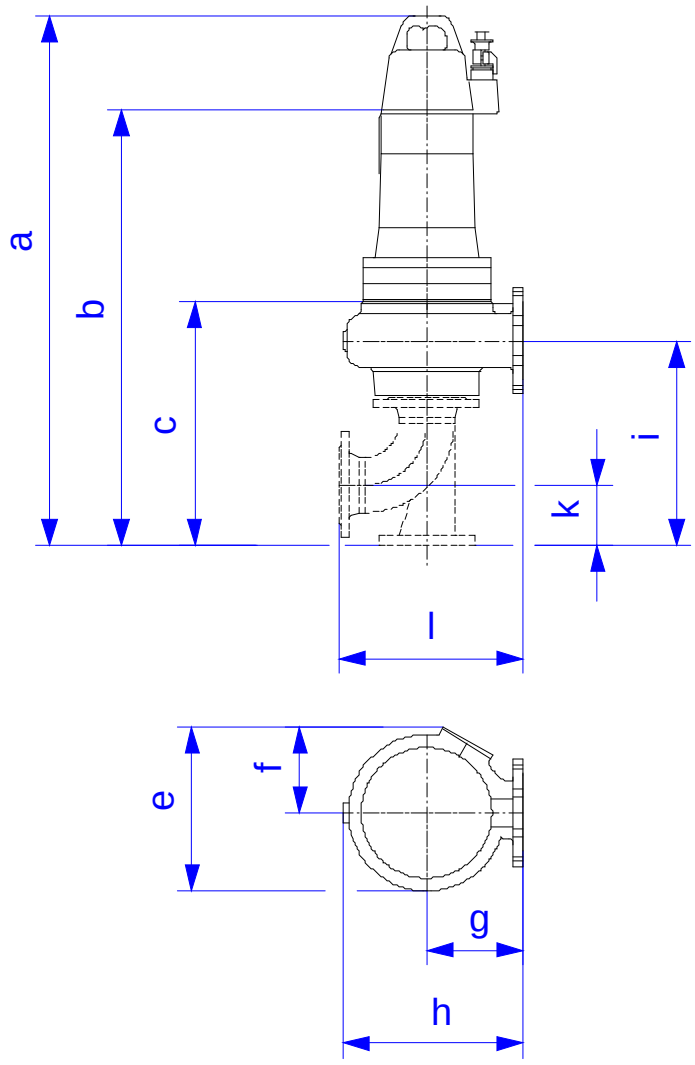
Pump				Duty point data			
Impeller Ø	designed	194	mm	Volume flow		258.9	US g.p.m.
Nominal speed		1140	rpm	Head		16.1	ft
Frequency		60	Hz	Shaft power	P_2	1.51	hp
Impeller type		Single-channel		Pump efficiency		69.7	%
Motor				Power input	P_1	2.5	hp
Rated power		2.85	hp	Required pump NPSH		5	ft
Sel. explosion protection		--		Speed		1140	rpm

Project:	WAS Pumps	Created on:	2021-07-16
Project number:	Key West WWTP	Created by:	PSI Technologies, Inc

Technical data

with motor

Submersible sewage pump FA 10.33E FK 17.1-6/8K



Dimensions in mm				Connections
a	1081			Suction port
b	871			Size3
c	441			PN10
e	374			
f	197			Discharge port
g	269			Size4
h	462			PN10
i	372			
k	110			Dry sump installation
l	434			

TECHNICAL SPECIFICATIONS

FOR

RICHARD A. HEYMAN ENVIRONMENTAL PROTECTION FACILITY

RAS AND WAS PUMPS REPLACEMENT

CITY OF KEY WEST

PROJECT No: SE35042002

BV PN: 409283

100% Submittal

December 2022

Black & Veatch
2121 Ponce de Leon, Suite 305
Coral Gables, FL 33134

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Section 01015

PROJECT REQUIREMENTS

1. GENERAL DESCRIPTION OF WORK. The Work to be performed under these Contract Documents is generally described as follows:

Replacement of four (4) Return Activated Sludge (RAS) and two (2) Waste Activated Sludge (WAS) Pumps and associated valves, piping, instruments, electrical components, and metal structural support components at the Pump Room as shown on the Drawings. Replacement in-kind of two (2) eccentric plug valves at the Aeration System Walkway as shown on the Drawings .

The work shall further consist of furnishing and installation of all tools, equipment, materials, supplies, manufactured articles, transportation and services, including fuel, power, water, and essential communications, for the performance of all labor, work, and/or other operations as required for the fulfillment of the Contract in strict conformance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly shown or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be performed, furnished, and installed by the Contractor as though originally so specified or shown, at no increase in cost to the Owner.

The Work shall be performed at the Richard A. Heyman Environmental Protection Facility (RAHEPF) on the island of Fleming Key, Florida.

All work shall be in compliance with all applicable federal, state and local laws and regulations, including those for materials that contain lead. All work shall meet Occupational Safety & Health Administration (OSHA) compliance.

2. UNITS OF MEASUREMENT. Not Used.

3. OTHER CONSTRUCTION CONTRACTS. Not Used.

4. COORDINATION. Contractor shall plan, schedule, and coordinate its operations in a manner which will facilitate the simultaneous progress of the Work under other sections of this Contract.

5. WORK BY PUBLIC UTILITIES. Not used.

6. WORK BY OWNER. Not Used.

7. PROCUREMENT CONTRACTS. Not Used.

8. ITEMS FURNISHED BY OWNER. Not used.

9. RESPONSIBILITY FOR MATERIALS AND EQUIPMENT.

9.01. Items Furnished by Owner. Not Used.

9.02. Items Furnished by Contractor. Contractor shall be fully responsible for all materials and equipment which it has furnished.

10. OFFSITE STORAGE. Offsite storage arrangements shall be approved by Owner for all materials and equipment not incorporated into the Work but included in the Applications for Payment. Such offsite storage arrangements shall be presented in writing and shall afford adequate and satisfactory security and protection. Offsite storage facilities shall be accessible to Owner and Engineer.

11. SUBSTITUTES AND "OR-EQUAL" ITEMS. Provisions for evaluation of proposed "or-equal" items of materials or equipment are covered in Paragraph 7.04 of the General Conditions. Provisions for evaluation of proposed substitute items of materials or equipment are covered in Paragraph 7.05 of the General Conditions. Requests for review of equivalency will not be accepted by Engineer from anyone except Contractor, and such requests will not be considered until after the Effective Date of the Agreement.

12. PREPARATION FOR SHIPMENT. All materials shall be suitably packaged to facilitate handling and protect against damage during transit and storage. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Each item, package, or bundle of material shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

13. SALVAGE OF MATERIALS AND EQUIPMENT. Existing materials and equipment removed and not reused as a part of the Work shall become Contractor's property.

Existing materials and equipment removed by Contractor shall not be reused in the Work, except where so specified or indicated.

14. LAND FOR CONSTRUCTION PURPOSES. Contractor will be permitted to use available land belonging to Owner, on or near the Site, for construction purposes and for storage of materials and equipment.

The locations and extent of the areas so used is indicated on the Drawings.

Contractor shall immediately move stored materials or equipment if any occasion arises, as determined by Owner, requiring access to the storage area. Materials or equipment shall not be placed on the property of Owner until Owner has agreed to the location to be used for storage.

15. OPERATION OF EXISTING FACILITIES. The existing facilities must be kept in continuous operation throughout the construction period. No interruption will be permitted which adversely affects the degree of service provided. Provided permission is obtained from Owner in advance, portions of the existing facilities may be taken out of service for short periods corresponding with periods of minimum service demands.

Contractor shallprovide temporary facilities and make temporary modifications as necessary to keep the existing facilities in operation during the construction period.

16. ACCESS TO PROJECT SITE. Not Used.

17. NOTICES TO OWNERS AND AUTHORITIES. Not Used.

18. LINES AND GRADES. All Work shall be done to the lines, grades, and elevations indicated on the Drawings.

All survey, layout, and measurement work, including horizontal and vertical control points, shall be established and performed by Contractor as a part of the Work.

Contractor shall provide an experienced instrument person, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement work. In addition, Contractor shall furnish, without charge, competent persons and such tools, stakes, and other materials as Engineer may require in establishing or designating control points or in checking survey, layout, and measurement work performed by Contractor.

Contractor shall keep Engineer informed, a reasonable time in advance, of the times and places at which it wishes to do Work, so that horizontal and vertical control points may be established and any checking deemed necessary by Engineer may be done with minimum inconvenience to Engineer and minimum delay to Contractor.

Contractor shall remove and reconstruct work which is improperly located.

19. ALLOWANCES. Not Used.

20. CONNECTIONS TO EXISTING FACILITIES. Unless otherwise specified or indicated, Contractor shall make all necessary connections to existing facilities, including structures, drain lines, and utilities such as water, sewer, gas, telephone, and electric. In each case, Contractor shall receive permission from Owner or the owning utility prior to undertaking connections. Contractor shall protect facilities against deleterious substances and damage.

Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock) if necessary to complete connections in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.

21. UNFAVORABLE CONSTRUCTION CONDITIONS. During unfavorable weather, wet ground, or other unsuitable construction conditions, Contractor shall confine its operations to work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the Work in a proper and satisfactory manner.

21.01 HURRICANE AND STORM WARNINGS. The Contractor shall take all precautions necessary to protect the job site during hurricane and storm watches and warnings.

22. DEMOLITION, CUTTING AND PATCHING. As provided in General Conditions, Contractor shall perform all cutting and patching required for the Work and as may be necessary in connection with uncovering Work for inspection or for the correction of defective Work.

Contractor shall perform all demolition, cutting and patching required for and in connection with the Work, including but not limited to the following:

Removal of existing structures.
Removal of improperly timed Work.
Removal of samples of installed materials for testing.
Installation of new Work in existing structures.

Contractor shall provide all shoring, bracing, supports, and protective devices necessary to safeguard all Work and existing facilities during cutting and patching operations. Contractor shall not undertake any cutting or demolition which may affect the structural stability of the Work or existing structures without Engineer's concurrence.

Materials shall be demolished, cut and removed to the extent indicated on the Drawings or as required to complete the Work. Materials shall be removed in a careful manner, with no damage to adjacent structures or materials. Materials which are not salvable shall be removed from the site by Contractor.

All Work and existing structures affected by cutting and demolition operations shall be restored with new materials, or with salvaged materials acceptable to Engineer, to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, entire surfaces shall be patched and refinished.

23. SITE CONDITIONS. The Contractor acknowledges that it has satisfied itself as to the conditions affecting the Work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads and uncertainties of weather, river stages, tides, water tables or similar physical conditions at the site, the conformation and conditions of the ground, the character of equipment and facilities needed preliminary to and during execution of the Work. The Contractor further acknowledges that it has satisfied itself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from information presented by the Drawings and Specifications made a part of this Contract, or any other information made available to it prior to receipt of Bids. Any failure by the Contractor to acquaint itself with the available information will not relieve the Contractor from responsibility for estimating properly the difficulty or cost of successfully performing the Work. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor on the basis of the information made available by the Owner.

24. HAZARDOUS ENVIRONMENTAL CONDITIONS AT SITE. No Hazardous Environmental Conditions at the Site in areas that will be affected by the Work are known to the Owner.

25. CLEANING UP. Contractor shall keep the premises free at all times from accumulations of waste materials and rubbish. Contractor shall provide adequate trash receptacles about the Site and shall promptly empty the containers when filled.

Construction materials, such as concrete forms and scaffolding, shall be neatly stacked by Contractor when not in use. Contractor shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

Volatile wastes shall be properly stored in covered metal containers and removed daily.

Wastes shall not be buried or burned on the Site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the Site and disposed of in a manner complying with local ordinances and antipollution laws.

Adequate cleanup will be a condition for recommendation of progress payment applications.

26. APPLICABLE CODES. References in the Contract Documents to local codes mean the following:

a. National Electrical Code (NEC-NFPA 70)

b. Florida Building Code (FBC), 7th Edition (2020)

c. International Fire Code (IFC), Florida Fire Prevention Code, and NFPA 820

d. Applicable local ordinances for Key West.

Other standard codes which apply to the Work are designated in the Specifications.

27. REFERENCE STANDARDS. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to the laws or regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or laws or regulations in effect at the time of opening of Bids (or on the effective date of the Contract or Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents. However, no provision of any referenced standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractor, consultants, agents, or employees from those set forth in the Contract Documents, nor shall any such provision or instruction be effective to assign to Owner, Engineer, or any of Engineer's Consultants, agents, or employees, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

28. BID ALTERNATIVES. Not Used.

29. PRECONSTRUCTION CONFERENCE. Prior to the commencement of Work at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by:

a. Contractor and its superintendent.
b. Principal Subcontractors.

c. Representatives of principal Suppliers and manufacturers as appropriate.
d. Engineer and its Resident Project Representative.
e. Representatives of Owner.
f. Government representatives as appropriate.
g. Others as requested by Contractor, Owner, or Engineer.

Unless previously submitted to Engineer, Contractor shall bring to the conference a preliminary schedule for each of the following:

a. Progress Schedule.
b. Procurement schedule.
c. Schedule of Values for progress payment purposes.
d. Schedule of Shop Drawings and other submittals.

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:

a. Contractor's preliminary schedules.
b. Transmittal, review, and distribution of Contractor's submittals.
c. Processing Applications for Payment.
d. Maintaining record documents.
e. Critical Work sequencing.
f. Field decisions and Change Orders.
g. Use of premises, office and storage areas, security, housekeeping, and Owner's needs.
h. Major equipment deliveries and priorities.
i. Contractor's assignments for safety and first aid.

Engineer will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

30. PROGRESS MEETINGS. Contractor shall schedule and hold regular progress meetings at least monthly and at other times as requested by Engineer or required by progress of the Work. Contractor, Engineer, and all Subcontractors active on the Site shall be represented at each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.

Contractor shall preside at the meetings. Meeting minutes shall be prepared and distributed by Contractor. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

31. SITE ADMINISTRATION. Contractor shall be responsible for all areas of the Site used by it, and by all Subcontractors in the performance of the Work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to Owner or others. Contractor shall have the right to exclude from the Site all persons who have no purpose related to the Work or its inspection, and may require all persons on the Site (except Owner's employees) to observe the same regulations as Contractor requires of its employees.

32. USE OF PREMISES. Contractor shall limit site disturbance within the area identified on the Drawings.

33. NONSMOKING BUILDING. Not used.

End of Section

Section 01300

SUBMITTAL PROCEDURES

1. SHOP DRAWINGS AND ENGINEERING DATA.

1.01. General. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.
Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

All submittals, regardless of origin, shall be approved by Contractor and clearly identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each copy of all submittals, regardless of origin, shall be stamped or affixed with an approval statement of Contractor. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor shall be solely responsible for the completeness of each submittal. Contractor's stamp or affixed approval statement of a submittal, per Figure 1-01300, is a representation to Owner, and Engineer that Contractor accepts sole responsibility for determining and verifying all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto, and that Contractor has reviewed and coordinated each submittal with other Shop Drawings and with the requirements of the Work and the Contract Documents.

All deviations from the requirements of the Contract Documents shall be identified as deviations on each submittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

Shop drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the Drawings.

When so specified, or if considered by the Engineer to be acceptable, the manufacturer's specifications, catalog data, descriptive matter, illustrations, etc. may be submitted for review in place of shop drawings. In such case, the requirements shall be as specified for shop drawings, insofar as applicable.

Contractor shall submit shop drawings electronically. Drawings and the necessary data shall be submitted electronically to Engineer as specified below. Submittal documents shall be in color to facilitate use of red line markups. All electronic files shall be in Portable Document Format (PDF). The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Use of higher resolution is acceptable with Owner and Engineer approval. Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file. The PDF documents shall have a bookmark created in the navigation frame for each major entry (“Section” or “Chapter”) in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.

PDF document properties shall include the submittal number for the document title and Contractor’s name for the author.

Electronic submittal file sizes shall be limited to 10 MB. When multiple files are required for a submittal the least number of files possible shall be created.

1.02. Requirements. All shop drawings shall be submitted to the Engineer through the Contractor. The Contractor is responsible for obtaining shop drawings from its subcontractors and returning reviewed Drawings to them. All shop drawings shall be prepared on standard size, 24-inch by 36-inch sheets. All Drawings shall be clearly marked with the name of the project, Owner, Contractor, and building, equipment, or structure to which the drawing applies. Drawings shall be suitably numbered and stamped by the Contractor. Each submittal shall include a letter of transmittal giving a list of the items included in the submittal.

1.03. Product Data. Where manufacturer's publications in the form of catalogs, brochures, illustrations, or other data sheets are submitted in lieu of prepared shop drawings, such submission shall specifically indicate the particular item offered with complete model number. Identification of such items and relative pertinent information shall be made with indelible ink. Submissions showing only general information will not be accepted

Product data shall include materials of construction, dimensions, performance characteristics, capacities, wiring diagrams, piping and controls, etc.

1.04. Warranties: When warranties are called for, a sample of the warranty shall be submitted with the shop drawings. The sample warranty shall be the same form that will be used for the actual warranty. Actual warranties shall be originals and notarized.

1.05. Work Prior to Review: No material or equipment shall be purchased, fabricated especially for this Contract, or delivered to the project site until the required shop drawings have been submitted, processed and marked either "FURNISH AS SUBMITTED" or "FURNISH AS CORRECTED". All materials and Work involved in the construction shall be as represented by said Drawings.

The Contractor shall not proceed with any portion of the Work (such as the construction of foundations) for which the design and details are dependent upon the design and details of equipment for which submittal review has not been completed.

1.06. Substitutions: Whenever a particular brand or make of material, equipment, or other item is specified, or is indicated on the Drawings, it is for the purpose of establishing a standard of quality, design, and type desired and to supplement the detailed specifications. Any other brand or make which is equivalent to that specified or indicated may be offered as a substitute subject to the following provisions:

a. The Contractor shall submit for each proposed substitution sufficient details, complete descriptive literature, and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed substitution is equal, in all respects including, but not limited to, quality, performance, ease of maintenance, availability of spare parts, and experience record.

b. The Contractor shall submit certified tests, where applicable, by an independent laboratory attesting that the proposed substitution is equal.

c. A list of installations where the proposed substitution is equal. Such listing shall cover a minimum of the previous five years and will furnish project names and contact phone numbers.

d. Where the acceptance of a substitution requires redesign of any part of the Work, all such additional redesign and all new Drawings and details required therefore shall be at the Contractor’s expense.

e. In all cases the Engineer shall be the sole judge as to whether a proposed substitution is to be accepted. The Contractor shall abide by the

Engineer's decision when proposed substitute items are judged to be unacceptable and shall in such instances furnish the item as specified. No substitute items shall be used in the Work without written acceptance of the Engineer.

f. Any substitution submitted by Contractor must meet the form, fit, function and life cycle criteria of the item proposed to be replaced and there must be a net dollar savings including Engineer review fees and charges.

g. Acceptance of any proposed substitution shall in no way release the Contractor from any of the provisions of the Contract Documents. Acceptance shall not result in any increase in the Contract Price or Contract time.

h. Owner may require, at Contractor's expense, a special performance guarantee or other surety with respect to any substitute.

1.07. Complete Submittals. Each submittal shall be complete in all aspects incorporating all information and data required to evaluate the products' compliance with the Contract Documents. Partial or incomplete submissions shall be returned to the Contractor without review.

1.08. Engineer's Review of Submittals. Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. Engineer's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

Engineer's submittal review period shall be 15 consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal in Engineer's office.

When the drawings and data are returned with review status "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION," the Contractor is required to resubmit the drawings and data in their entirety plus additional or corrected data specifically requested by the Engineer and responses to Engineer’s review comments.

When the drawings and data are returned with the review status “EXCEPTIONS NOTED, RESUBMITTAL REQUIRED”, the corrections shall be made as instructed by Engineer. The select corrected drawings and data as indicated by the Engineer shall be resubmitted, along with written responses to Engineer’s review comments. The Contractor is not required to resubmit the drawings and data in their entirety.

When the drawings and data are returned with review status "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless specifically requested by Engineer.

1.09. Resubmittal of Shop Drawings and Data. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by Engineer are provided on the resubmittal. Resubmittals shall be in an organized and consistent format.

When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal.

If more than one resubmittal is required because of failure of Contractor to provide all previously requested corrected data or additional information, Contractor shall reimburse Owner for the charges of Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

Resubmittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 14 days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.

The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

1.10. Product Samples. Contractor shall furnish for review all product samples as required by the Contract Documents or requested by the Engineer to determine compliance with the specifications.

Samples shall be of sufficient size or quantity to clearly illustrate the quality, type, range of color, finish or texture and shall be properly labeled to show complete project identification, the nature of the material, trade name of manufacturer and location of the Work where the material represented by the sample will be used.

Samples shall be checked by the Contractor for conformance to the Contract Documents before being submitted to the Engineer and shall bear the Contractor's stamp certifying that they have been so checked. Transportation charges on samples submitted to the Engineer shall be prepaid by the Contractor.

Engineer's review will be for compliance with the Contract Documents, and its comments will be transmitted to the Contractor by regular mail, posted no later than 15 days after receipt.

Acceptable samples will establish the standards by which the completed Work will be judged.

1.11. Color Selection. Contractor shall submit samples of colors and finishes for all accepted products before purchasing. Engineer will coordinate the selection of colors and finishes with Owner. Engineer will prepare a schedule of finishes that includes the colors and finishes selected for both manufactured products and for surfaces to be field painted or finished and will furnish this schedule to Contractor within 60 days after the date of acceptance of the last color or finish sample.

1.13. Record Drawings. The Contractor shall keep and maintain, at the job site, one record set of Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Drawings. Said record drawings shall be supplemented by detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed. These master record drawings of the Contractor's representation of as-built conditions, including all revisions made necessary by addenda and change orders shall be maintained up-to-date during the progress of the Work.

At a minimum the record drawings shall be reviewed on the 20th working day of every third month after the month in which the final Notice-to-Proceed is given as well as on completion of Work. Failure to maintain the record drawings up-to-date shall be grounds of withholding monthly progress payments until such time as the record drawings are brought up-to-date.

Record drawings shall be accessible to the Engineer at all times during the construction period.

Final payment will not be acted upon until the Contractor-prepared record drawings have been delivered to the Engineer. Said up-to-date record drawings

shall be in the form of a set of prints with carefully plotted information overlaid in pencil.

Upon substantial completion of the Work and prior to final acceptance, the Contractor shall finalize and deliver a complete set of record drawings to the Engineer for transmittal to the Owner, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected drawings showing the reported location of the Work. The information submitted by the Contractor and incorporated in the Record Drawings will be assumed to be correct, and the Engineer will not be responsible for the accuracy of such information, and for any errors or omissions which may appear on the Record Drawings as a result.

2. OPERATION AND MAINTENANCE DATA AND MANUALS.

2.01. Preliminary Operation and Maintenance Manuals. Preliminary electronic copies of each operation and maintenance (O&M) manual shall be submitted to the Engineer prior to the date of shipment of the equipment, but only after shop drawings for the same equipment have been accepted by the Engineer.

Each preliminary O&M manual shall cover items from only one section of the specification unless the item consists of components from several sources.

The Contractor shall submit preliminary O&M manuals to Engineer in electronic copy. Submittals made by any other method shall not be acceptable. Engineer will not accept preliminary O&M manuals from anyone but Contractor. Preliminary O&M manuals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

Engineer's preliminary O&M manual review period shall be 15 consecutive calendar days and shall commence on the first calendar day following receipt of the preliminary O&M manual in Engineer's office.

When the O&M manuals are returned with the review status "RETURNED FOR CORRECTION", the corrections shall be made as instructed by the Engineer and the O&M manuals resubmitted as follows.

2.02. Corrected Operation and Maintenance Manuals. Corrected copies of each operation and maintenance (O&M) manual with corrections and additions made as instructed by the Engineer in the preliminary O&M manual review period shall be submitted to the Engineer not later than 30 days after placing the equipment in operation.

The Contractor shall submit corrected O&M manuals to Engineer in electronic copy according to the methods described in Paragraph 1.02. Submittals made by any other method shall not be acceptable. Engineer will not accept preliminary O&M manuals from anyone but Contractor. Preliminary O&M manuals shall be

consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

All material shall be marked with project identification, and inapplicable information shall be marked out or deleted.

Engineer's review period for the corrected O&M manual shall be 28 consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal in Engineer's office.

When the O&M manuals are returned with review status "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", the Contractor is required to resubmit the O&M manuals in their entirety plus additional or corrected data specifically requested by the Engineer and written responses to Engineer's review comments.

When the O&M manuals are returned with the review status "EXCEPTIONS NOTED, RESUBMITTAL REQUIRED", the corrections shall be made as instructed by Engineer. The select corrected drawings and data as indicated by the Engineer shall be submitted, along with written responses to Engineer's review comments. The Contractor is not required to resubmit the drawings and data in their entirety.

When the O&M manuals are returned with review status "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless specifically requested by Engineer.

Shipment of equipment will not be considered complete until all required manuals and data have been received.

Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the individual equipment sections or the equipment schedule.

Operation and maintenance manuals shall include the following:

a. Equipment function, normal operating characteristics, and limiting conditions.
b. Assembly, installation, alignment, adjustment, and checking instructions.
c. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
d. Lubrication and maintenance instructions.
e. Guide to troubleshooting.
f. Parts lists and predicted life of parts subject to wear.

g. Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.
h. Test data and performance curves, where applicable.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Contractor.

After review by Engineer is complete three hard copies and one electronic copy of each operation and maintenance manual shall be prepared and delivered to Owner not later than 30 days prior to placing the equipment in operation. Procedures for submission of the electronic copy will be provided after award of the Contract. When review of the electronic copy by Engineer and is complete, three copies of each electronic O&M manual shall be delivered on flash drive to Engineer. Each flash drive shall contain only one copy of one manual.

All material shall be marked with Project identification, and inapplicable information shall be marked out or deleted.

Shipment of equipment will not be considered complete until all required manuals and data have been received.

2.01. Hard Copy Operation and Maintenance Manuals. Hard copies submitted shall be temporarily bound in heavy paper covers bearing suitable identification. All manuals and other data shall be printed on heavy, first quality 8-1/2 x 11 inch paper, with standard three-hole punching. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches or 11 x 17 inches. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall be suitably identified on the outside. Each volume containing data for three or more items of equipment shall include a table of contents and index tabs. The final hard copy of each manual shall be prepared and delivered in substantial, permanent, three-ring or three-post binders with a table of contents and suitable index tabs.

2.02. Electronic Operation and Maintenance Manuals. Electronic manuals shall be in Portable Document Format (PDF), and shall be prepared at a resolution between 300 and 600 dots per inch (dpi), depending on document type. Optical Character Recognition (OCR) capture shall be performed on these documents. OCR settings shall be performed with the “original image with hidden text” option in Adobe Acrobat Exchange.

When multiple files are required the least number of files possible shall be created. File names shall be in the format OMXXXXX-YYYZ.pdf, where XXXXX is the five digit number corresponding to the specification section, YYY is a three digit O&M manual number, e.g. 001, and Z is the letter signifying a resubmittal, A, B, C, etc.

Documents prepared in PDF format shall be processed as follows:

1. Pages shall be searchable (processed for optical character recognition) and indexed when multiple files are required.

2. Pages shall be rotated for viewing in proper orientation.

3. A bookmark shall be provided in the navigation frame for each entry in the Table of Contents.

4. Embedded thumbnails shall be generated for each completed PDF file.

5. The opening view for PDF files shall be as follows:

   Initial View: Bookmarks and Page

   Page Number: Title Page (usually Page 1)

   Magnification: Set to Fit in Window

   Page: Single Page

6. Where the bookmark structure is longer than one page the bookmarks shall be collapsed to show the chapter headings only.

7. When multiple files are required the first file of the series (the parent file) shall list every major topic in the Table of Contents. The parent file shall also include minor headings bookmarked based on the Table of Contents. Major headings, whose content is contained in subsequent files (children) shall be linked to be called from the parent to the specific location in the child file. The child file shall contain bookmark entries for both major and minor headings contained in the child file. The first bookmark of any child file shall link back to the parent file and shall read as follows "Return to the *Equipment Name* Table of Contents", e.g. Return to the Polymer Feed System Table of Contents.

8. Drawings shall be bookmarked individually.

9. Files shall be delivered without security settings to permit editing, insertion and deletion of material to update the manual provided by the manufacturer.

2.03. Labeling. As a minimum, the following information shall be included on all final O&M manual materials, including flash drives, jewel cases, and hard copy manuals:

Equipment name and/or O&M title spelled out in complete words.
Project Name.
Owner Project/Contract Number.
Specification Section Number. Example: “Section 15500”
Manufacturer’s name.
File Name and Date.

For example:

Backwash Pump Operation and Maintenance Manual
Somewhere Plant Expansion
Project/Contract No. ____
Specification Section 11110
Manufacturer
OM11110-001.pdf, 5/05/07

End of Section

SUBMITTAL No. _____
SECTION _____
Do not combine multiple sections together unless required by specifications.

(Contractor's Letterhead)

SUBMITTAL IDENTIFICATION & CONTRACTOR'S APPROVAL STATEMENT

DATE: _____ COPIES _____ DRAWING SHEET NO._____

Description submittal contents: _____
Location: _____
Manufacturer_____
Subcontractor or Supplier (Optional) _____

REMARKS: _____
_____
_____
_____

CONTRACTOR'S APPROVAL

(Construction Company) has reviewed and coordinated the submitted documentation and verifies that the equipment and material meet the requirements of the Work and the Contract Documents. We accept sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data contained in the submittal as required by the Contract Documents.

Deviations: □ None □ Yes (See attached Figure 2-01300 for written description)

Approved By: _____ Date: _____

This approval does not release subcontractor / vendor from the contractual responsibilities.

Black & Veatch
Project No. _____Phase_____
Contract No. _____
Project Description: _____
_____

SUBMITTAL No. _____

SECTION _____

Do not combine multiple sections together unless required by specifications.

(Contractor's Letterhead)

SUBMITTAL IDENTIFICATION & CONTRACTOR'S APPROVAL STATEMENT

DATE: _____ COPIES _____ DRAWING SHEET NO._____

Description submittal contents: _____

Location: _____

Manufacturer_____

Subcontractor or Supplier (Optional) _____

DEVIATIONS

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Black & Veatch

Project No. _____Phase_____

Contract No. _____

Project Description: _____

_____

Section 01310

CONSTRUCTION PROGRESS SCHEDULE

1. GENERAL OVERVIEW. A Progress Schedule shall be used to control the Work and to provide a definitive basis for determining project progress. The Progress Schedule shall be prepared, maintained and updated by Contractor and historical dates agreed monthly with Engineer. Contractor shall submit a preliminary Progress Schedule and a Progress Schedule for acceptance by Engineer. These schedules shall be Contractor's working schedules and shall be used to plan, organize and execute the Work, record and report actual performance and progress, and show how Contractor plans to complete all remaining Work as of the end of each progress report period.

The Progress Schedule shall comprise all the detailed construction-related activities using the critical path method (CPM). The Progress Schedule shall provide sufficient detail and clarity to reflect the intricacies and interdependencies of activities so Contractor can plan, schedule, monitor, control and report on the progress of its work. In addition, it shall provide Engineer and Owner a tool to monitor and follow the progress for all phases of the Work.

The Contractor shall have the capability of preparing and utilizing the specified construction progress scheduling techniques. A statement of capability shall be submitted in writing to the Engineer with the return of the executed Agreement to the Owner and will verify that either the Contractor's organization has in-house capability qualified to use the technique or that the Contractor employs a consultant who is so qualified. Capability shall be verified by description of the construction projects to which the Contractor or its consultant has successfully applied the scheduling technique and which were controlled throughout the duration of the project by means of systematic use and updating of the construction progress schedule, the network analysis and associated reports. The submittal shall include the name of the individual on the Contractor's staff who will be responsible for the construction progress schedule and associated reports and for providing the required updating information of same. The Contractor shall submit its proposed progress schedule to the Engineer for review and comment within ten days of the Notice to Award.

2. PRE-CONSTRUCTION SCHEDULING CONFERENCE. The Contractor shall present and discuss the proposed schedule at the preconstruction conference.

3. PRELIMINARY PROGRESS SCHEDULE. Not used.

3. PROGRESS SCHEDULE. The Progress Schedule comprises all the construction-related activities for the Work and shall show the order in which Contractor proposes to carry out the work. Contractor shall include milestones, coordination necessitated by limited access and available work areas, and the availability and use of workforce, material and equipment. Contractor shall use

the Progress Schedule to plan, schedule and coordinate the Work including activities of subcontractors, equipment vendors, and suppliers.

The Progress Schedule shall be to the level of detail acceptable to Engineer, and shall include the following:

a. Organization and structural breakdown of the Project;
b. Milestones and completion dates;
c. Planning for phased or total acceptance by Owner;

Each computer-generated construction progress schedule and associated report shall include the following tabulations: a list of activities in numerical order, a list of activity precedence, schedules sequenced by Early Start Date, Total Float, and Late Start Date. Each schedule and report shall include the following minimum items.

i. Activity Numbers.
ii. Estimated Duration.
iii. Activity Description.
iv. Early Start Date (Calendar Dated).
v. Early Finish Date (Calendar Dated).
vi. Latest Allowable Start Date (Calendar Dated).
vii. Latest Allowable Finish Date (Calendar Dated).
viii. Status (whether critical).
ix. Total Float and Free Float.
x. Resource Plots.

In addition, each construction progress schedule, network analysis and report shall be prefaced with the following summary data:

i. Contract Name and Number.
ii. Contractor's Name.
iii. Contract Duration and Float.
iv. Contract Schedule with critical path.
v. The Effective or Starting Date of The Schedule (the date indicated in the Notice-to-Proceed).

The work day to calendar date correlation shall be based on an 8-hour day and 40-hour week with adequate allowance for holidays, adverse weather and all other special requirements of the Work. Normal work hours are Monday through Friday, 7:30 am to 5:30 pm, any afterhours/weekends work must be approved by the Owner.

To the extent that the construction project schedule, or associated report or any revision thereof shows anything not jointly agreed upon or fails to show anything jointly agreed upon, it shall not be deemed to have been accepted by the Engineer. Failure to include on a schedule any element of Work required for the

performance of this Contract shall not excuse the Contractor from completing all Work required within any applicable completion date, notwithstanding the review of the schedule by the Engineer.

Review and acceptance of the construction progress schedule, and related reports, by the Engineer is advisory only and shall not relieve the Contractor of the responsibility for accomplishing the Work within the contract completion date. Omissions and errors in the construction progress schedule, and related reports shall not excuse performance less than that required by the Contract and in no way make the Engineer an insurer of the Contractor's success or liable for time or cost overruns flowing from any shortcomings in the construction progress schedule, and related reports.

The construction progress schedule shall be based upon the precedence diagramming method of scheduling and shall be prepared in the form of a horizontal bar chart showing in detail the proposed sequence of the Work and identifying all construction activities included but not limited to yard piping, all structures and treatment units and all related Work specified herein to be performed under the Contract. The schedule shall be time scaled, identifying the first day of each week, with the estimated date of starting and completion of each stage of the Work in order to complete the project within the contract time. The project critical path shall be clearly identified.

When the Progress Schedule is accepted by Engineer, Engineer will save a copy of the Progress Schedule as the baseline schedule, and will use it for analysis of Contractor’s progress.

5. ELECTRONIC PROGRESS SCHEDULE FORMAT AND REPORTING. The Progress Schedule shall be created using Primavera P6, or equal, scheduling software.

The data date for schedule calculation in the Progress Schedule shall be set as the date of the Notice to Proceed unless otherwise specified by Engineer.

6. COST-LOADING. Not used.

7. RESOURCE-LOADING. Not used.

8. COORDINATING PROGRESS SCHEDULE WITH OTHER CONTRACT SCHEDULES. Not used.

9. SUBMITTALS. The Progress Schedule and associated reports shall be submitted to Engineer for acceptance within 15 calendar days after Notice to Proceed. If the Progress Schedule is not submitted, no progress payments will be made after the due date until the Progress Schedule has been submitted.

The progress schedule shall be plotted to a 22-inch by 34-inch size and shall be revised and updated monthly, depicting progress through the last day of the current month and scheduled progress through completion. An electronic version of the schedule shall be submitted along with the application for monthly progress payments for the same period.

10. MONTHLY SCHEDULE UPDATES. Monthly Progress Schedule updates shall be submitted for the duration of the Contract on a date agreed to by Owner, Engineer, and Contractor.

The updated schedule shall be reviewed each month in a meeting with Engineer to verify:

a. Actual start dates,
b. Actual completion dates,
c. Activity percent completion,
d. Cost influence of change orders, if any,
e. Revisions due to extension of time.

Prior to each meeting, Contractor shall prepare a complete and accurate report of current procurement and construction progress through the end of the update period, and a depiction of how Contractor plans to continue the Work to meet all contract completion dates. All network changes and status data agreed to during each update meeting shall be considered as accepted by both parties unless written notice of any exceptions is given within five calendar days after the meeting.

If the Contractor desires to make changes in its method of operating which affect the construction progress schedule and related items, it shall notify the Engineer in writing stating what changes are proposed and the reason for the change. If the Engineer accepts these changes, in writing, the Contractor shall revise and submit, without additional cost to the Owner, all of the affected portions of the construction progress schedule, and associated reports. The construction progress schedule and related items shall be adjusted by the Contractor only after prior acceptance, in writing by the Engineer. Adjustments may consist of changing portions of the activity sequence, activity durations, division of activities, or other adjustments as may be required. The addition of extraneous, nonworking activities and activities which add restraints to the construction progress schedule shall not be accepted.

11. DATA DATE. Not used.

12. REVIEW PROCESS. Not Used

13. RESPONSIBILITY FOR SCHEDULE COMPLIANCE. Whenever it becomes apparent from the current Progress Schedule that the critical path is delayed and

the contract completion date will not be met, Contractor shall mitigate the delay by taking some or all of the following actions at no additional cost to Owner:

a. Increase construction workforce in such quantities and crafts as will bring the project back on schedule within the completion dates and milestones.

b. Increase the number of working hours per shift, shifts per day, working days per week, and the amount of construction equipment, or any combination of the foregoing, to substantially eliminate the backlog of work.

c. Re-schedule activities to achieve maximum practical concurrence of activities and to comply with the schedule date(s).

Within 10 calendar days of Engineer's request, Contractor shall submit a recovery schedule and written statement of the steps intended to remove or arrest the delay to the critical path in the schedule. If Contractor fails to submit the required information or should fail to take measures acceptable to Engineer, Engineer with Owner concurrence may direct Contractor to increase workforce, equipment and scheduled work hours to remove or arrest the delay to the critical path and Contractor shall promptly provide such level of effort at no additional cost to Owner.

In the event Contractor fails to follow the updated or revised recovery schedule, Owner may elect to withhold progress payments until Contractor complies with the revised schedule.

Should Contractor's efforts not remove or arrest the delay to the critical path of the accepted schedule, then Owner shall be entitled to supplement Contractor's work-force and equipment to remove and arrest any delay, and shall be entitled to deduct all costs and expenses associated therewith from payments due to Contractor. If insufficient Contract funds remain, Owner may recover such funds from Contractor and its Surety.

Except where earlier completions are specified, schedule dates which show completion of all Work prior to the contract completion date shall, in no event, be the basis for claim for delay against the Owner by the Contractor.

Construction progress schedules and related items which contain activities showing negative float or which extend beyond the contract completion date will be accepted only upon the condition that the Contractor will comply with recovery schedule requirements.

14. CHANGES IN THE WORK, DELAYS, AND EXTENSIONS OF TIME. The contract time will be adjusted only in accordance with the General Requirements and other portions of the Contract Documents as may be applicable. If the

Engineer finds that the Contractor is entitled to any extension of the contract completion date, the Engineer's determination as to the total number of days extension shall be based upon the current construction progress schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule and related items. Actual delays in activities which, according to the construction progress schedule, do not affect any contract completion date will not be the basis for a change therein.

From time to time it may be necessary for the contract schedule of completion time to be adjusted by the Owner in accordance with the General Requirements and other portions of the Contract Documents as may be applicable. Under such conditions, the Engineer will direct the Contractor to reschedule the Work or contract completion time to reflect the changed conditions, and the Contractor shall revise the construction progress schedule and related items accordingly, at no additional cost to the Owner.

Available float time may be used by the Owner through the Owner's Engineer.

The Owner controls the float time and, therefore, without obligation to extend either the overall completion date or any intermediate completion dates, the Owner may initiate changes that absorb float time only. Owner initiated changes that affect the critical path on the network diagram shall be the sole grounds for extending the completion dates. Contractor initiated changes that encroach on the float time may be accomplished only with the Owner's concurrence. Such changes, however, shall give way to Owner-initiated changes competing for the same float time.

Each time impact analysis shall demonstrate the estimated time impact based on the events of the change or the delay; the date the change was given to Contractor or the delay incurred, the status of construction at that point in time, and the event time computation of all activities affected by the change or delay. The event times used in the analysis shall be those included in the latest update of the Progress Schedule or as adjusted for the events of delay.

Three copies of the time impact analysis and an electronic copy on compact disk shall be submitted within seven calendar days of delay occurrence or direction to proceed with a change is given to Contractor. No time extensions will be considered if the time impact analysis is not submitted within the specified time.

Engineer will review Contractor’s time impact analysis. Contractor shall furnish such justification and supporting evidence as Engineer deems necessary to determine whether Contractor is entitled to an extension of time. Engineer’s review of each time impact analysis will be made within five working days of receipt of the time impact analysis and additional information as required by Engineer, unless subsequent meetings and negotiations are necessary.

The Contract Times will be adjusted only for causes specified in paragraph 15. Time extensions will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total or remaining Float along the critical path at the time of actual delay. Delays in activities which are not on the critical path and do not affect Contract Times, will not be considered for an extension of time.

15. CAUSES FOR EXTENSIONS OF TIME. Additional positive total Float in the Progress Schedule generated by efficiencies of Owner or Contractor is a shared commodity to be reasonably used by either party, and belongs exclusively to the Project. Contractor is not entitled to any additional compensation for completion of the project prior to expiration of the Contract Times.

15.01. Owner-Initiated Changes. Owner initiated changes to the Work that absorb Float time will not be considered for an extension of time. Owner-initiated changes that affect the critical path of the Progress Schedule shall be grounds for extending or shortening completion dates. Use of Float time for Contractor initiated changes will require Owner's concurrence. Contractor's changes, however, shall give way to Owner-initiated changes competing for the same Float time.

15.02. Outside Contractor's Control. Events outside of Contractor's control that affect the critical path of the Progress Schedule will be considered for an extension or reduction of the Contract Times.

15.03. Weather Delays. Engineer will determine Contractor's entitlement to an extension of the Contract Times as a result of weather delays.

Any weather-related extension of Contract Times shall be non-compensable. Efficiencies gained as a result of favorable weather within a calendar month, where the number of days of normally anticipated weather days is less than expected, shall contribute to the project Float and shall not affect the Contract Times.

16. AS-BUILT SCHEDULE. Not used.

17. SCHEDULING SOFTWARE APPLICATION. Not used.

18. SCHEDULE SOFTWARE SETTINGS AND RESTRICTIONS: Not used.

19. ACTIVITY CODES. Not used.

20. ACTIVITY RELATIONSHIPS. Not used.

21. PROJECT CALENDARS. Not used.

22. FLOAT. Contractor shall not use Float suppression techniques, including preferential sequencing (arranging critical path through activities more

susceptible to Owner caused delay); lag logic restraints; zero total or free Float constraints; extended activity times; or imposing constraint dates other than as required by the Contract. Float suppression will be cause for rejection of the preliminary Progress Schedule or full Progress Schedule and its updates.

23. MANDATORY MILESTONES. The Contract duration shall be equal to the time period between the Notice to Proceed and the completion of the Work in readiness for final payment. The following milestones are mandatory.

a. Notice to Proceed.
b. Milestones, if any, as indicated in Contractor's Bid.
c. Substantial Completion as indicated in Contractor's Bid.
d. Completion and readiness for final payment, as indicated in Contractor's Bid.

End of Section

Section 01320

CONSTRUCTION PROGRESS DOCUMENTATION

1. GENERAL.

1.01. Units of Measurement. When both inch-pound (English) and SI (metric) units of measurement are specified herein, the values expressed in inch-pound units shall govern.

2. SCHEDULE OF VALUES. After review of the preliminary schedule at the preconstruction conference, and before submission of the first Application for Payment, Contractor shall prepare and submit to Engineer a Schedule of Values covering each lump sum item. The Schedule of Values, showing the value of each kind of work, shall be acceptable to Engineer before any Application for Payment is prepared.

The sum of the items listed in the Schedule of Values shall equal the Contract Price. Such items as Bond premium, temporary construction facilities, and plant may be listed separately in the Schedule of Values, provided the amounts can be substantiated. Overhead and profit shall not be listed as separate items.

The Schedule of Values shall have sufficient detail such that partial completion of separable items of work can easily be calculated. The Schedule of Values shall have separate lines for manufacturer's field services, O&M manuals, and performance testing for each item of equipment requiring such services.

An unbalanced Schedule of Values providing for overpayment of Contractor on items of Work which would be performed first will not be accepted. The Schedule of Values shall be revised and resubmitted until acceptable to Engineer. Final acceptance by Engineer shall indicate only consent to the Schedule of Values as a basis for preparation of applications for progress payments, and shall not constitute an agreement as to the value of each indicated item.

3. SCHEDULE OF PAYMENTS. Within 30 days after award of contract, Contractor shall furnish to Engineer a schedule of estimated monthly payments. The schedule shall be revised and resubmitted each time an Application for Payment varies more than 10 percent from the estimated payment schedule.

4. SURVEY DATA. Not used.

5. LAYOUT DATA. Not used.

End of Section

Section 01400

QUALITY CONTROL

1. GENERAL. The Contractor shall develop and maintain a program, acceptable to Owner and Engineer, to ensure that all work required under this Contract strictly conforms to all requirements of the Contract Documents. The Contractor shall be responsible for and shall supervise the work of all subcontractors, providing instructions to each when their work does not conform to the requirements of the Quality Control Program and the Contract Documents

2. SAMPLING AND TESTING. Unless otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered; however, the Owner reserves the right to use any generally-accepted system of sampling and testing which, in the opinion of the Engineer will insure the Owner that the quality of the work is in full accord with the Contract Documents.

Any waiver by the Owner of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial Work, shall not be construed as a waiver of any requirements of the Contract Documents.

Notwithstanding the existence of such waiver, the Engineer reserves the right to make independent investigations and tests and failure of any portion of the Work to meet any of the requirements of the Contract Documents, shall be reasonable cause for the Engineer to require the removal or correction and reconstruction of any such Work in accordance with the General Conditions.

Testing services shall be provided in accordance with Article 49 of the General Conditions. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer and/or Authority Having Jurisdiction excluding testing as specified to be conducted directly by Contractor. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

Testing services provided by Owner are for the sole benefit of Owner and/or as required by the governing building code; however, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

2.01. Testing Services Provided by Contractor. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:

a. Any Work or part thereof specifically to be inspected, tested or approved by an employee or representative of an Authority Having Jurisdiction. Contractor shall assume full responsibility for arranging and obtaining such inspections, tests or approvals. Contractor shall pay all costs associated for these activities and shall provide the required certificates of inspection or approval.

b. Any inspections, tests or approvals required for Owner or Engineer acceptance of materials or equipment to be incorporated in the Work. This includes any items required for acceptance of materials, concrete mix designs or equipment submitted for approval prior to Contractor's purchase for incorporation in the Work.

c. Testing, adjusting and balancing of mechanical, electrical and other equipment and systems as specified to be incorporated into the Work. This includes services required by manufacturers of equipment or other products such as concrete repair products, pipe, coatings, linings and roof membranes furnished under the Contract Documents.

d. Tightness testing of containment structures and pressure or leakage testing of piping as specified.

e. Any Work (or part thereof) required by the Contract Documents to be approved by Owner, Engineer or other designated individual or entity. Contractor shall assume full responsibility for arranging and obtaining such approvals, pay all costs in connection therewith and submit to Engineer the required certificates of approval.

Excluding those conducted directly by an Authority Having Jurisdiction or expressly specified to be conducted directly by Contractor, inspections and tests shall be performed by independent inspectors, approved agencies or other qualified individuals or entities acceptable to Owner and Engineer.

2.02. Testing Services and Special Inspections Provided by Owner. Unless otherwise specified, Owner shall employ and pay for the services of an independent testing laboratory, approved agency or other qualified individual or entities for inspections, tests or approvals required by the Contract Documents for field quality control.

Contractor shall provide access to the site and Work in accordance with the General Conditions. Contractor shall give timely notice of the readiness of the Work for inspection, tests or approvals and shall cooperate with the inspection and testing personnel to facilitate the required tests and inspections. Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. Contractor shall interrupt the Work when necessary to allow testing, including sampling, to be performed. Contractor shall have no Claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by Engineer or

Agency personnel, Contractor shall furnish personnel and facilities to assist in the activities as required.

2.03. Transmittal of Test Reports. Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings.

The Approved Agency retained by Owner will furnish four copies of a written report of each test. Two copies of each test report will be transmitted to the Resident Project Representative, one copy to Engineer, and one copy to Contractor, within three days after each test is completed.

3. SITE INVESTIGATION AND CONTROL. The Contractor shall verify all dimensions in the field and shall check field conditions continuously during construction. The Contractor shall be solely responsible for any inaccuracies built into the Work due to its failure to comply with this requirement.

The Contractor shall inspect related and appurtenant Work and shall report in writing to the Engineer any conditions which will prevent proper completion of the Work. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor within the scope of the Project

4. RIGHT OF REJECTION. The Engineer, acting for the Owner, shall have the right, at all times and places, to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the Work at the site. If the Engineer or its representative, through an oversight or otherwise, has accepted materials or Work which is defective or which is contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or erection, may be subsequently rejected by the Engineer for the Owner.

The Contractor shall promptly remove rejected articles or materials from the site of the Work after notification of rejection. All costs of removal and replacement of rejected articles or materials as specified herein shall be borne by the Contractor

5. OTHER CONSTRUCTION CONSIDERATIONS.

5.01. Weather Conditions. Work that may be affected by inclement weather shall be suspended until proper conditions prevail. In the event of impending storms, the Contractor shall take necessary precautions to protect all work, materials and equipment from exposure.

5.02. Fire Protection. The Contractor shall take all necessary precautions to prevent fires at or adjacent to the Work, including its own buildings and trailers.

Adequate fire extinguisher and hose line stations shall be provided throughout the work area.

6. OFFSITE INSPECTION. Not used.

7. MANUFACTURER'S FIELD SERVICES.
. Manufacturer's field services shall be as specified herein except as specifically specified in the respective equipment sections.

3.01. Services Furnished Under This Contract. An experienced, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated in the respective equipment section or in the equipment schedule section shall visit the Site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

Each manufacturer's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

End of Section

Section 01610

GENERAL EQUIPMENT STIPULATIONS

1. SCOPE. When an equipment specification section in this Contract references this section, the equipment shall conform to the general stipulations set forth in this section, except as otherwise specified in other sections.

2. COORDINATION. Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Drawings or Specifications.

3. MANUFACTURER'S EXPERIENCE. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

4. WORKMANSHIP AND MATERIALS. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick. When dissimilar metal components are used, consideration shall be given to prevention of galvanic corrosion.

5. SEISMIC DESIGN REQUIREMENTS. All equipment, including non-structural components and non-building structures as defined in ASCE 7, and their anchorage, shall be designed and detailed in accordance with the Meteorological and Seismic Design Criteria section.

6. LUBRICATION. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation.

Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Lubricants for equipment where the lubricants may come in contact with water before or during a potable water treatment process or with potable water, shall be food grade lubricants. This includes lubricants for equipment not normally in contact with water, but where accidental leakage of the lubricants may contaminate the water.

Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

7. ELEVATION. The elevation of the site shall be as indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished shall be designed to meet stipulated conditions and to operate satisfactorily at the specified elevation.

8. ELECTRIC MOTORS. Unless otherwise specified, motors furnished with equipment shall meet the requirements specified in Common Motor Requirements for Process Equipment section or specified in specific equipment sections.

9. DRIVE UNITS. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hour continuous service.

9.01. Gearmotors. The use of gearmotors sharing an integral housing or cutgears into the motor output shaft, or that require removal of lubricant from the gear reducer to change out the motor will not be acceptable.

9.02. Gear Reducers. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.

Unless superseded by individual specification requirements each helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Cycloidal gear reducers shall have a service factor of at least 2.0 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class III. Helical gear reducers shall have a

gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable most current AGMA standards, except the L_{10} bearing life shall be 200, 000 hours.

The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.

Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable in large sized reducers. In small reducers, similar to basin equipment, permanently sealed grease lubricated bearings rated L_{10} 200,000 hour life may be provided at the manufacturer's option. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.

Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

9.03. Adjustable Speed Drives. Each mechanical adjustable speed drive shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor. A spare belt shall be provided with each adjustable speed drive unit employing a belt for speed change. Unless specifically permitted by the detailed equipment specifications, bracket type mounting will not be acceptable for variable speed drives.

9.04. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor.

10. SAFETY GUARDS. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage thick or thicker galvanized, aluminum-clad sheet steel, or stainless sheet steel or from 1/2 inch mesh galvanized expanded metal, or pultrusion molded UV resistant materials. Each safety guard shall be reinforced or shaped to provide suitable strength to prevent

vibration and deflection and shall comply with OSHA. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

11. ANCHOR BOLTS. Equipment suppliers shall design and detail suitable anchor bolts for each item of equipment. Anchor bolts shall be designed for all operating conditions of the equipment, including wind and seismic loadings when applicable. Wind and seismic loads shall be as indicated in the Meteorological and Seismic Design Criteria section.

Requirements for anchor bolt type, material, and minimum diameter shall be as indicated in the Anchorage in Concrete and Masonry section.

Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete or masonry grout is placed.

Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

12. EQUIPMENT BASES. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches high. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components, and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in the Grouting section.

13. SPECIAL TOOLS AND ACCESSORIES. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

14. SHOP PAINTING. All iron and steel surfaces of the equipment shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric

motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an epoxy or polyurethane enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of a universal primer.

Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound as recommended by the equipment manufacturer.

15. PREPARATION FOR SHIPMENT. Equipment shall be prepared for shipment as specified in the Product Delivery Requirements section.

16. STORAGE. Handling and storage of equipment shall be as specified in the Product Storage and Handling Requirements section.

17. INSTALLATION AND OPERATION. Installation and operation shall be as specified in respective equipment sections and the Startup Requirements section.

18. OBSERVATION OF PERFORMANCE TESTS. Where the Specifications require the presence of Engineer, initial tests shall be observed or witnessed by Engineer.

19. PROGRAMMING SOFTWARE. Programming software shall be provided for any equipment which includes a programmable logic controller (PLC) or other digital controller that is user-programmable. The software shall be suitable for loading and running on a laptop personal computer operating with a Windows-based operating system. A copy of the manufacturer's original operating logic program shall be provided for use in maintaining and troubleshooting the equipment. Where multiple pieces of equipment, from the same or different vendors, use the same programming software, only one copy of the software need be provided.

End of Section

Section 01611

METEOROLOGICAL AND SEISMIC DESIGN CRITERIA

1. SCOPE. Buildings, non-structural components and non-building structures shall be designed in accordance with this section. In the event of conflict with requirements in other sections, the more stringent criteria shall be followed.

2. DESIGN CRITERIA. Buildings, non-building structures including anchorage of such items, shall be designed in accordance with the following criteria.

General Design Data:

Building code and references	2020 Florida Building Code (IBC 2018), ASCE 7-16 “Minimum Design Loads and Associated Criteria for Buildings and Other Structures”, AISC 360 “Specification for Structural Steel Buildings”, AISC 341 “Seismic Provisions for Structural Steel Buildings”

Site elevation, above mean sea level 8.5 ft

Design flood elevation, DFE, 8 ft

Wind Design Data:

Basic (Ultimate) Design wind speed, V, 200 mph

Allowable Stress (Nominal) Design wind speed, V_{asd} , 155 mph

Exposure category, D

Ground elevation factor, K_e, 1.00

Risk Category, III

Importance Factor, I_w, 1.00

Seismic Design Data

Mapped MCE short period spectral response acceleration, S_S, 0.021g

Mapped MCE one second period spectral response acceleration, S_1, 0.013g

Design short period spectral response acceleration, S_{DS}, 0.022g

Design one second period spectral response acceleration, S_{D1}, 0.021g

Risk Category III

Building Importance factor, I_e, 1.25

Building Seismic Design Category A

Non-Builidng Structures Importance factors, I_e, 1.25

3. WIND ANCHORAGE. Equipment that is to be located outdoors shall have anchor bolts designed for the effects of wind forces, as determined in accordance with ASCE 7, Chapters 26-31. Design of anchorage shall be in accordance with the Anchorage in Concrete and Masonry section.

4. SEISMIC DESIGN.

4-1. General. Structural systems shall provide continuous load paths, with adequate strength and stiffness to transfer all seismic forces from the point of application to the point of final resistance.

4-2. Pre-Engineered Buildings. Not used.

4-3. Non-Structural Components. Not used.

4-4. Non-Building Structures. Non-building structures are the items described as such in Chapter 15 of ASCE 7.

4-4.01. General. Design of non-building structures shall be in accordance with all applicable provisions of ASCE 7, Chapter 15. Design of anchorage shall be in accordance with the Anchorage in Concrete and Masonry section.

"W" shall include the total dead load and shall also include all normal operating contents of tanks, vessels, bins, and piping.

Non-building structures shall provide sufficient strength and ductility to resist the specified seismic effects, and shall meet all of the design, proportioning, detailing, inspection, and quality assurance provisions of the specified building code and other referenced codes.

The seismic design of non-building structures shall provide sufficient stiffness, strength and ductility to resist the effects of seismic ground motions during the design level earthquake.

Non-building structures shall be designed to be operable during and following a design level seismic event, without collapsing, breaking away from supports, creating an ignition hazard, or releasing any contents.

4-4.02. Construction Documents. Construction documents (fabrication or shop drawings) depicting all seismic force resisting elements of non-building structures shall be sealed by a design professional that is registered in the state of the project.

4-4.03. Submittals. The construction documents shall be submitted in accordance with the Submittal Procedures section.

End of Section

Section 01612

PRODUCT DELIVERY REQUIREMENTS

1. SCOPE. This section covers packaging and shipping of materials and equipment.

2. PREPARATION FOR SHIPMENT. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Grease and lubricating oil shall be applied to all bearings and similar items.

3. SHIPPING. Before shipping each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

End of Section

Section 01614

PRODUCT STORAGE AND HANDLING REQUIREMENTS

1. SCOPE. This section covers delivery, storage, and handling of materials and equipment.

2. DELIVERY. Seller shall bear the responsibility for delivery of equipment, spare parts, special tools, and materials to the Point of Destination determined by the Owner and shall comply with the requirements specified herein and shall provide required information concerning the shipment and delivery of the Goods specified in this Contract. These requirements also apply to any subsuppliers making direct shipments to the Point of Destination.

Installation Contractor shall, either directly or through contractual arrangements with others, accept responsibility for the safe handling and protection of the equipment and materials furnished under this Contract before and after receipt at the Point of Destination agreed with the Owner**.** Acceptance of the equipment shall be made after it is installed, tested, placed in operation and found to comply with all the specified requirements.

All items shall be checked against packing lists immediately on delivery to the Point of Destination Contractor shall check for damage and for shortages. Damage and shortages shall be remedied with the minimum of delay.

3. STORAGE. Upon delivery, all equipment and materials shall immediately be stored and protected by the Installation Contractor until installed.

Stacked items shall be suitably protected from damage by spacers or load distributing supports that are safely arranged. No metalwork (miscellaneous steel shapes and reinforcing steel) shall be stored directly on the ground. Masonry products shall be handled and stored in a manner to hold breakage, chipping, cracking, and spalling to a minimum. Cement, lime, and similar products shall be stored off the ground on pallets and shall be covered and kept completely dry at all times. Pipe, fittings, and valves may be stored out of doors, but must be placed on wooden blocking. PVC pipe, geomembranes, plastic liner, and other plastic materials shall be stored off the ground on pallets and protected from direct sunlight.

Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60°F . Electrical equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

Equipment having moving parts, such as gears, bearings, and seals, shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the Seller. Seller's storage instructions shall be carefully followed.

When required by the Seller, moving parts shall be rotated a minimum of twice a month to ensure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, Installation Contractor shall, at the discretion of Engineer, start the equipment at one-half load for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

When required by the Seller, lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment by Installation Contractor at the time of acceptance.

Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed.

In addition to the protection specified for prolonged storage, the packaging of spare units and spare parts shall be for export packing and shall be suitable for long-term storage in a damp location. Each spare item shall be packed separately and shall be completely identified on the outside of the container.

4. HANDLING. Stored items shall be laid out to facilitate their retrieval for use by others. Care shall be taken when removing the equipment for use to ensure the precise piece of equipment is removed and that it is handled in a manner that does not damage the equipment.

During handling, carbon steel constructed material including chains, straps, and forks on lifting equipment shall not directly contact any equipment or material constructed of stainless steel. It shall be the Installation Contractor’s responsibility to correct any carbon steel contamination of stainless steel.

End of Section

Section 01615

EQUIPMENT AND VALVE IDENTIFICATION

PART 1 – GENERAL

1-1. SCOPE. This section covers the furnishing and installation of nameplates and tags for identification of equipment, valves, panels, and instruments.

1-2. GENERAL. Except as otherwise specified in equipment, valve, and instrumentation sections, nameplates and tags shall be as specified herein. Nameplates or tags shall be provided for all equipment, valves, operator interfaces, control and electrical panels, cabinets, instruments, and instrument racks that have been named and/or tagged on the Drawings.

1-3. SUBMITTALS. Drawings and data shall be submitted in accordance with the requirements of the Submittals Procedures section for each type of tag provided including materials, colors, sizes, letter sizes, and installation instructions.

PART 2 - PRODUCTS

2-1. EQUIPMENT NUMBER PLATES. All equipment tagged on the drawings, except for submerged equipment shall be provided with number plates bearing the equipment tag number identified on the Drawings. Number plates shall be bevelled, 1/8th inch thick laminated black phenolic plastic engraving stock with white core. Lettering on number plates shall be capitalized block letters ¾ inch high. Number plate height shall be twice the letter height. Number plate length shall be as needed, with suitable margins all around. Lettering shall be placed in one row where practicable; however, where necessary due to excessive length, lettering shall be placed on more than one row and centered.

Number plates shall be attached with stainless steel panhead screws, rivets, or drive screws.

When a number plate cannot be installed due to the physical size, space, or mounting surface geometry of the equipment, the Contractor shall provide a 12 gauge stainless steel tag with engraved or imprinted equipment tag number. Lettering on tags shall be ¼ inch high. Tags shall be rectangular with smooth edges, and shall be fastened to the equipment with stainless steel mechanical fasteners or with a stainless steel chain.

2-2. EQUIPMENT INFORMATION PLATES. Equipment shall be provided with engraved or stamped equipment information plates securely affixed with mechanical fasteners to the equipment in an accessible and visible location. Equipment information plates shall be in addition to the number plates specified. Eq

uipment information plates shall indicate the manufacturer's name, address, product name, catalog number, serial number, capacity, operating and power characteristics, labels of tested compliances, and any other pertinent design data. Equipment information plates listing the distributing agent only will not be acceptable.

2-3. VALVE AND GATE TAGS.

2-3.01 Temporary Tags. Not Used.

2-3.02. Permanent Tags. All valves and gates, except buried or submerged valves, that have been assigned a number on the Drawings or in the valve or gate schedule, shall be provided with a permanent number plate. Tags shall be permanently attached to valves and gates with stainless steel mechanical fasteners or with stainless steel chains. Numerals shall be ¾ inch high and shall be black baked enamel on an anodized aluminum plate.

All buried valves shall be tagged with a brass plate cast into a 6-inch by 6 inch concrete pad at grade next to the valve box. The valve number shall be engraved in the brass plate with lettering and numerals at least 1 inch high.

2-4. PANEL NAMEPLATES. Nameplates shall be provided on the face of each panel and cabinet. Panel identification nameplates shall be mounted at the top of the panel shall include the panel descriptive name and tag number as indicated on the Drawings, in two or three lines of text. Lettering shall be ¾ inch high.

Nameplates for devices mounted on or in the panel shall be inscribed with the text as indicated on the Drawings. Where nameplate information is not indicated on the Drawings, inscriptions shall be in accordance with information in the supplier's submittal drawings as guided by information in the relevant specification section. Panel device nameplates shall have engraved letters 3/16 inch high.

Nameplate material and size shall be as specified above for equipment number plates. Nameplates shall be secured to the panel with stainless steel panhead screws.

2-5. INSTRUMENT TAGS.

2 Temporary Tags. Not used.

2-5.02. Permanent Tags. Instruments shall be tagged with the instrument tag number indicated on the Drawings. Tags shall be 12 gauge stainless steel with engraved or imprinted symbols. Lettering on tags shall be ¼ inch high. Tags

shall be rectangular with smooth edges, and shall be fastened to the instrument with stainless steel mechanical fasteners or with a stainless steel chain.

PART 3 – EXECUTION. Not used.

End of Section

Section 01650

Commissioning

1. SCOPE. This section includes the requirements for startup and testing all items of equipment and systems that form a part of this Contract. The purpose of this section is to define the requirements for bringing individual equipment, systems, and facilities online and for proving proper operation and performance of that Work. Contractor is required to develop, submit, and maintain detailed plans, including designation of management and staff, for these activities as specified herein. Additional requirements such as training are specified in other sections.

The startup, testing, and commissioning services referenced or specified herein include the following:

Startup and Testing
    Startup checks
    Functional testing
Functional acceptance testing
Commissioning

1.01. Definitions. Startup and Testing is the transitional phase between completion of construction and start of commissioning and includes the following:

- Pre-Startup Activities and Checks - Inspections, tests and other activities necessary to determine that equipment, systems and subsystems have been properly manufactured and installed. Pre-startup activities shall include an audit of all factory testing of equipment and compiling the results for comparison to startup and commissioning testing.

- Functional Testing – Initial limited operation of equipment, to demonstrate capability of installed components to perform their intended functions, respond to controls, and safely interface with external systems, followed by operation of individual systems in manual and automatic mode to test full functionality of individual systems.

- Commissioning - Ensure that the Work provided as part of this project performs as intented and in conformance with these specifications.

2. GENERAL. The Contractor shall be responsible for and furnish all labor, materials, instruments, incidentals, and equipment required for startup, testing, and commissioning. Temporary facilities required to carry out the specified testing, including temporary pipe, pumps, and other appurtenances, shall be furnished and installed, and removed when no longer required for startup, testing, and commissioning. Refer to the Temporary Facilities section for

requirements concerning water and power for startup and testing. Chemicals required for startup and testing shall be provided by the Contractor except as otherwise specified herein. Wastewater, including treated or test water that cannot be delivered to the system for any reason, shall be disposed of at the expense of the Contractor, in a manner acceptable to the Owner, and in accordance with all laws, regulations**,** and permits.

Startup and testing shall be conducted during normal working hours during the workweek of Monday through Friday, unless otherwise approved by the Owner. Where continuous long-term testing is required, testing may continue over the weekends and holidays with prior approval from the Owner.

2.01. Constraints. Startup and testing shall be conducted in a manner that does not compromise operation of the existing facilities or the quality of treated products released from the facility. Any startup and testing activities affecting operation of the existing facilities shall be coordinated with the Owner and shall be shown on the Progress Schedule. The Owner will cooperate with the Contractor to the extent possible, but will have sole authority in decisions affecting existing operations.

3. STARTUP MANAGER, STARTUP TEAM, AND MANUFACTURER'S FIELD SERVICES REPRESENTATIVES. The Contractor shall maintain a dedicated startup team led by a startup manager. The individual to be designated as startup manager shall be identified within 45 days of the Notice to Proceed and will be reviewed by Owner and Engineer. Once accepted, the Contractor shall not change the startup manager throughout the full period of performance of the Work without written permission of the Owner. Once engaged in the Project, the startup manager shall attend regular construction progress meetings. No startup activities shall begin until the startup manager has arrived at the jobsite.

The startup manager shall be on Site full time at least 30 days prior to any field startup and testing activities and shall remain on site until all startup, testing, and commissioning activities are complete.

3.01. Startup Manager. The startup manager shall be a startup and testing expert with a minimum of 5 years of experience starting up equipment and systems of similar type, size, capacity, and complexity to the equipment and systems included in this Project. The startup manager shall have the necessary experience to fully understand all startup requirements, to manage the Contractor's resources providing the startup services, and to prepare all startup documentation, as specified. The startup manager's assigned duties and responsibilities are those specifically related to planning, supervising, and executing startup activities and shall include, but shall not be limited to the following:

Coordinating all testing and startup activities.

Preparing all startup and field testing plans, documentation, and forms.

Liaising between the Contractor, Engineer, and Owner for all startup and testing activities.

Developing a comprehensive schedule for all startup activities and providing regular schedule updates. The startup and testing schedule shall be incorporated into the Progress Schedule.

Scheduling and leading startup, testing, and commissioning planning meetings.

Conducting coordination meetings during startup, testing, and commissioning at least weekly.

Coordinating manufacturers' services and their certification of proper installation and/or operation of equipment as required by the Specifications.

Overseeing and administering all startup, testing, and commissioning activities, including either direct participation in the activities and/or oversight and monitoring of activities. It shall be the startup manager's responsibility to assure that all tests have been completed in accordance with accepted testing procedures.

Ensuring readiness for and coordinating maintenance, repair, and adjustment of equipment and systems during startup testing, and commissioning.

Conducting or overseeing pre-test checks to ensure readiness for testing. Verify all piping hydrostatic testing and flushing has been completed prior to field testing connected equipment.

Ensuring all testing equipment is in proper working order and has been calibrated to appropriate standards.

Developing safe work policies and procedures including lockout/tagout procedures and personal protective equipment policies, that will be followed during all field startup and testing activities. At a minimum the Contractor shall comply with OSHA and the Owner's established safety guidelines. It shall be the startup manager's responsibility to assure all safety procedures are followed at all times.

Reviewing and approving all equipment training sessions prior to submission to Engineer, to assure that the training is compliant with the

requirements of the Specifications and includes all applicable operation, maintenance, safety, functional, performance, and startup and testing information.

Organizing teams made up of qualified representatives of Suppliers, Subcontractors, and others, as appropriate, to efficiently and expeditiously startup and test the equipment and systems installed and constructed under this Contract. The objective of this program shall be to demonstrate to the Engineer and Owner that the structures, systems, and equipment constructed and installed under this Contract meet all performance requirements and the facility is ready for operation as intended. In addition, the testing program shall produce baseline operating conditions for the Owner to use in a preventive maintenance program.

Ensuring the development and maintenance of records documenting all startup, testing, and commissioning activity. The records shall be organized by major process system into organized files/binders and turned over to the Owner prior to applying for final payment. Testing records shall be accessible to the Engineer and Owner at all times to allow monitoring of the progress.

Ensuring the startup team is equipped and ready to make emergency repairs and adjustments to equipment installed and modified as part of the Project.

Scheduling and conducting a one day workshop with the Owner and Engineer to resolve submittal review comments to the Contractor's startup, testing, and commissioning plan submittal.

Notifying the Owner and all respective equipment manufacturers at least 21 days prior to the date when each equipment system is scheduled for pre-startup activities and checks.

Organize International Electrical Testing Association (NETA) acceptance testing in accordance with the Electrical Equipment Installation section.

3.02. Startup Team. The startup team shall include the startup manager and all staff deemed necessary for successful completion of startup, testing, and commissioning. This will typically include engineers, major equipment vendors, operators, and representatives from the Instrumentation and Control System Supplier. Additional trade representatives may be included as project requirements dictate.

3.03. Manufacturer's Field Services Representative. The manufacturers shall provide a technically qualified field-service representative for the installation, startup, and testing of equipment furnished, as specified in the equipment

sections. The manufacturer shall submit qualifications and experience records for all key personnel to be involved in startup activities.

The manufacturer's field services representative shall be employed full-time in installation, startup, and testing of similar equipment and facilities and work directly for the manufacturer. The representative shall have conducted startup activities similar to those required herein on at least two other projects of similar complexity. The Owner or Engineer shall have the right to reject the manufacturer's field services representative at any time, for immediate replacement by the manufacturer, if the accepted qualifications are not representative of the actual experience or abilities of the representative, as determined by the Owner or Engineer.

4. SUBMITTALS. Contractor shall submit the following information in accordance with the requirements of the Submittals Procedures section.

Startup manager's qualifications and past project experience including contact names, addresses and current telephone numbers of owner representatives that can be used to verify the accuracy of the information. Submittal shall be made at the preconstruction conference.

Manufacturers' field services representative's qualifications and past project experience including contact names, addresses and current telephone numbers that can be used to verify the accuracy of the information. Qualification submittals shall be made 3 weeks before the manufacturer's representative is scheduled to be on Site.

Manufacturer's certification of proper installation of all equipment as specified in the equipment sections.

Equipment and system startup, testing, and commissioning plans and schedule in accordance with the requirements of this section. Startup manager shall coordinate with Subcontractors and include their information in the startup and testing plan.

Unless otherwise specified in the equipment sections, preliminary copies of field calibration results. Submittal shall be made prior to the start of each test for associated systems.

Daily logs.

5. STARTUP AND TESTING REQUIREMENTS.

5.01. Startup Checks**.** Prior to field testing of all equipment, the Contractor shall perform the following:

Inspect and clean equipment, devices, and connected piping so they are free of foreign material.

Lubricate equipment in accordance with manufacturer's instructions.

Turn rotating equipment by hand.

Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

Test and commission related electrical system components in accordance with the requirements specified in the Electrical and the Electrical Equipment Installation sections.

Calibrate all instruments associated with the equipment.

Check for proper rotation, adjustment, alignment, balancing, mechanical and electrical connections, and any other conditions that may damage or impair equipment from functioning properly.

Inspect and verify proper anchorage.

Obtain manufacturer's certification of proper installation where specified in the equipment sections.

All equipment shall be confirmed ready to test by the Engineer based on the following**:**

Acceptance of Contractor's startup and testing plan.

Notification in writing by the startup manager that each piece of equipment or system is ready for testing.

Verification by the Engineer and Owner that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.

Cleanliness of equipment, devices, and connected work.

Adequate completion of work adjacent to or interfacing with equipment to be tested.

Confirmation of manufacturer's representative's availability to assist with testing, where specified, and satisfactory fulfillment of all other manufacturers' responsibilities as specified.

Engineer's inspection of all related civil construction, mechanical, and electrical installations.

Confirmation of completion of acceptable testing of all adjacent piping, duct work and other affected Work.

5.02. Functional Testing. All startup checks shall be completed prior to functional testing. Functional testing shall be in accordance with relevant standards and in accordance with instructions of the manufacturers.

Ancillary and/or temporary facilities necessary to recycle, control, or discharge water, air, chemical, or gas from facilities being tested, shall be operational.

Functional testing shall include the functional operation of each piece of equipment. All moving parts of equipment and machinery shall be tested and adjusted so that they move freely and function satisfactorily. Functional testing shall demonstrate correct operation of all hardwired interlocks and controls.

Functional testing of power actuated valves shall include at least 4 full open-close operations. Testing shall demonstrate the maximum number of operations per hour as recommended by the actuator manufacturer without overheating.

Once functional testing of individual pieces of equipment is completed, individual systems functional testing shall commence. Individual system functional testing shall include startup of the complete system of mechanical, electrical, and instrumentation and control equipment as a functional process system. Field inspection prior to startup as specified in the Instrumentation and Control System section, other testing by the Instrumentation and Control System Supplier required to verify readiness for automatic operation of the individual system, shall be completed before commencement of individual system functional testing.

Individual system functional testing shall include operation in manual and automatic modes, startup operation, and shutdown in normal and emergency modes. Individual systems shall be tested over their entire operating range and for sufficient time to demonstrate the intended functionality of each piece of equipment and the system. If any part of a system shows evidence of unsatisfactory or improper operation during the test period, correction or repairs shall be made and the functional testing shall be repeated until satisfactory results are obtained.

Functional testing of all process and pumping equipment and drive motors, including auxiliary equipment, shall be n accordance with the appropriate and approved test codes, such as those specified by the American Society of Mechanical Engineers, Hydraulic Institute Standards, and IEEE.

Qualified personnel from the electrical and mechanical trades responsible for installation of the equipment, shall be available during functional testing involving electrically operated equipment. Where appropriate, a representative of the Instrumentation and Control System Supplier shall also be available.

5.03. Functional Acceptance Testing. Once the Contractor's functional testing is complete and associated documentation has been submitted and accepted by the Engineer, the Contractor shall conduct functional acceptance testing of each complete process system, to demonstrate individual systems meet the specified requirements. Acceptance testing shall include the successful demonstration of all operating functions and conditions that are specified for the equipment, system, and controls. The manufacturer's representative shall be on Site during acceptance testing when specified in the equipment specifications.

The Functional Acceptance Testing shall include the following submissions prior to commencement:

Prerequisite checklist, to be acknowledged by the Engineer prior to initiating the test, that demonstrates that all testing and other Work required to be completed prior to the test is complete.

Listing of Owner's personnel necessary to operate the system and conduct any related monitoring of performance.

A listing of Contractor's personnel designated to supervise and direct the Owner's operators as required herein.

Listing of standby personnel, equipment, and materials that will be available if needed during the test period.

Step-by-step procedures for operation of the facility showing how local and remote control of equipment will be demonstrated.

Description of all data and other information to be reported in support of the completed test. Include any blank data logs that may be used for recording results.

Descriptions of all necessary calculations that must be completed to verify the specified results are being achieved, including formulas.

Blank sign-off form for the test acknowledging the Contractor's, Engineer's, Owner's, and the equipment manufacturer's acceptance of the test.

Contractor shall provide Owner and Engineer 14 days notice prior to testing of any individual system.

Individual system acceptance testing shall continue for 48 hours without interruption for each system, and all parts shall operate satisfactorily in all respects under a range of conditions to simulate the full operating range of the equipment or system. If there are multiple parallel components or trains, then the testing duration will be 48 hours for each individual train.

If any part of a system shows evidence of unsatisfactory or improper operation during the testing period, correction or repairs shall be made and the test repeated until the test is successfully completed. Testing interrupted by power failure will not be required to be repeated, but the test shall be continued upon restoration of power and extended to the specified duration at no additional cost to the Owner.

During this testing period the Contractor shall operate all equipment.

6. COMMISSIONING. Once startup and testing is complete; documentation of all startup and testing activities shall be submitted for reviewed and accepted by the Engineer. After acceptance, commissioning of the constructed facilities shall be conducted by the Contractor working with the Owner and Engineer. The facility shall be operated in accordance with the operating permit, laws, and regulations. The Contractor shall provide mechanics, electricians, and controls technicians during commissioning as required for troubleshooting and repair.

7. OPERATION ACCEPTANCE TESTING. Not used.8. PERFORMANCE TESTING. Not used.7. STARTUP SCHEDULE AND STARTUP AND COMMISSIONING PLANS. Plans and schedules shall be developed to facilitate coordinated and efficient startup, testing, and commissioning of the Project equipment and systems.

The Contractor shall submit a startup, testing, and commissioning plan and schedule to the Engineer no later than 90 calendar days prior to the commencement of startup and testing. A minimum of 21 days shall be allowed for review by Engineer and Owner. The schedule and plan must be accepted a minimum of 30 days prior to commencement of startup and testing. The schedule and plan shall include sections for startup checks, functional testing, functional acceptance testing andcommissioning.

Forms for startup and testing shall include identification of equipment or system, startup/test date, nature of startup/test, startup/test objectives, startup/test prerequisites, startup/test results, instruments employed for the startup/test and signature spaces for the Engineer's witness (where applicable) and the Contractor's startup manager.

7.01 Startup Schedule. A startup schedule that provides an overall sequence and duration for all startup, testing and commissioning activities, shall be prepared and maintained. This schedule shall serve as a companion to but shall not be a replacement for the startup plan. The startup schedule described in this

section shall be integrated into the overall Progress Schedule and shall be prepared as specified for the Progress Schedule in the Construction Progress Schedule section. The Startup Schedule shall be updated weekly to during the startup, testing, and commissioning period.

7.02. Startup Plan. The Startup Plan shall include the following:

Introduction with a narrative description of the overall testing and startup program. The description shall include all contractual or regulatory treatment requirements to be demonstrated.

A summary of the objectives and approach for startup checks, functional testing, functional acceptance testing and commissioning.

List of the instruments, equipment, and systems that will undergo startup and testing with references to the appropriate PIDs, equipment tags/identification numbers, Specification number and standards for testing procedures.

Schedule for startup and field testing for each instrument, piece of equipment (including redundant equipment), and system.

Safety and emergency response plan including a list of emergency and non-emergency contacts (email and phone).

Organization chart for Contractor's startup and testing personnel with assigned responsibilities for each.

Startup and testing record keeping plan.

Plan for reuse and disposal of water/wastewater from startup, testing, commissioning including information on any required regulatory permits/approvals.

Description of temporary facilities that will be provided.

Within 7 to 14 days of initial submittal of the startup plan, the Contractor shall schedule a workshop with the Owner and Engineer to present the plan. The Contactor shall submit minutes of the workshop, including action items and a schedule for updating the startup plan, to the Engineer within 3 days of the workshop.

Individual plans for each phase of startup, testing, and commissioning can be assembled as chapters in the startup plan or submitted as individual documents but should be correlated to ensure there is not disagreement between chapters or separate documents.

7.02.01 Startup Checks Plan. The startup checks plan shall be subdivided into plans for each system and major component. Each system/major component plan shall include but not be limited to the following:

Identification of information for each component or piece of equipment to be inspected as part of the system. All applicable tag numbers shall be included.

Specific activities to be completed on each component, piece of equipment, or system as required to demonstrate proper installation and connection.

A tracking checklist of prerequisites for the checks and each step of the checking procedure, including any temporary facilities or utility requirements.

Listing of manufacturer's representative(s) to be on site during the check.

Sign off forms for the Contractor's startup manager.

7.02.02 Functional Testing and Functional Acceptance Testing Plans. The functional testing plan shall include procedures and reporting for functional testing. The functional testing plan shall be subdivided into testing plans for each system. Each system test plan shall include but not be limited to the following:

A narrative description of the purpose and goals of the test for each component, piece of equipment, or system, which should include all activities (including those required by vendors/suppliers) necessary to verify proper equipment and system functionality.

Identification of each component or piece of equipment to be tested as part of the system. All applicable tag numbers shall be included.

Schedule and duration for the tests.

Prerequisites for each test, including any temporary facilities or utility requirements.

Pass/fail criteria for the test.

A checklist for tracking testing progress which includes prerequisites for the test and each step of the testing procedure. The check list shall include specified performance criteria that are to be met.

A description of test apparatus required to conduct the test.

Identification of all temporary facilities and chemicals require during startup.

Listing of manufacturer's representative(s) to be on site during the test.

Certificates of proper installation, as applicable to the test.

Step-by-step detailed procedure of the test. The level of detail shall be sufficient for a witness to be able to follow the steps during the test and be confident that the test is being performed as planned. All steps required to proceed through the test in an orderly manner are considered significant and each of these steps shall be included in the procedure.

Copies of the data recording forms that will be used during the test.

Calculation methodologies to be used to evaluate the data and/or test criteria for the test.

Sample computations or analyses for the test with results in the same format as the final report. This item is intended to demonstrate how data collected will be used to generate final results. A sample shall be included for each type of computation required for the test and analysis of results.

Blank sign-off forms for the test acknowledging the startup manager's, Engineer's, Owner's, and equipment manufacturer's acceptance of the test where applicable.

8. REPORTS AND RECORDS. Records of all startup and testing shall be compiled by the Contractor and submitted to the Engineer. Prior to being submitted to the Engineer, the startup manager shall certify that the results recorded and the tested systems comply with the Contract requirements. Records shall include all documentation assembled for each piece of equipment or system involved in the startup and testing, including all certifications, forms, and check lists completed during the startup and test, and sign-off forms.

Records of all startup and testing shall be compiled as separate documents for each system tested, and shall be submitted within 48 hours of completion of the startup and testing for each system. Testing samples that require analysis periods greater than 48 hours shall be clearly defined in the startup plan but shall not preclude delivery of the balance of the records within the 48 hour timeframe.

The Contractor shall provide formal reporting and documentation of failures, malfunctions or defects, and repairs made during the startup and/or testing activities. A "System Problem Report" form is included at the end of this section, and shall be used by the Contractor to document problems that arise during these tests and their resolution. Records submitted shall include "System Problem Report" forms completed during testing.

End of Section

SYSTEM PROBLEM REPORT

Project Name: RAHPEF RAS WAS Pump Replacement			
Test Name:			
Test Number:			
Problem Type: Hardware Software Documentation Unknown Other			
SYMPTOMS:	Time:	Date:	By:
Description:			
Can problem be reproduced at will? Y / N			
DIAGNOSIS:	Time:	Date:	By:
Description:			
CORRECTION:	Time:	Date:	By:
Description:			
FINAL SIGN OFF	Time:	Date:	By:

Section 01739

EQUIPMENT INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers general installation requirements of new equipment units that have been purchased by Contractor as part of this Work. Equipment specific installation requirements are covered in the equipment sections.

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Any existing equipment which is removed and salvaged for reinstallation shall be handled as indicated in the Project Requirements section.
1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services furnished by others. Flanged connections to equipment including the bolts, nuts, and gaskets are covered in the appropriate pipe specification section.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials shall be as follows:

Grout	As specified in the Grouting section.
Anti-Seize thread lubricant for SS bolts	As specified in the Anchorage in Concrete and Masonry section.

PART 3 - EXECUTION

3-1. INSTALLATION. Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results as specified in the Commissioning section.

Each equipment unit shall be leveled, aligned, and shimmed into position. Installation procedures shall be as recommended by the equipment manufacturer and as required herein. Shimming between machined surfaces will not be permitted.

Anti-seize thread lubricant shall be liberally applied to the threaded portion of all stainless steel bolts during assembly.

When specified in the equipment sections, the equipment manufacturer will provide installation supervision and installation checks. For installation supervision, the manufacturer's field representative will observe, instruct, guide, and direct Contractor's erection or installation procedures as specified in the equipment specifications. For installation checks, the manufacturer's field representative will inspect the equipment installation immediately following installation by Contractor, and observe the tests indicated in the Startup Requirements section. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to Owner.

All equipment shall be protected after installation, prior to final acceptance by Owner. Protection provisions shall be as recommended by the manufacturer, and shall include provisions to prevent rust, mechanical damage, and foreign objects entering the equipment.

3-2. STARTUP AND TESTING. Startup requirements, and tests associated with startup shall be as indicated in the Startup Requirements section. Other field tests shall be as indicated in the specific equipment sections. Startup and tests required shall occur in the order listed in the following paragraphs. Tests shall not begin until any installation supervision and installation checks by the equipment manufacturer have been completed, except where noted below.

3-2.01. Preliminary Field Tests. Preliminary field tests shall be conducted on all equipment by Contractor as indicated in the Startup Requirements section. When an installation check is specified in the equipment sections, the equipment manufacturer's representative will participate in these tests to the extent described in the Startup Requirements section and in the equipment sections.

3-2.02. Field System Operation Tests. Field system operation tests shall be conducted on all equipment by Contractor as indicated in the Startup Requirements section. When an installation check is specified in the equipment sections, the equipment manufacturer's service personnel will participate in these tests to the extent described in the Startup Requirements section and in the equipment sections.

3-2.03. Field Demonstration Tests. Field demonstration tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.04. Field Performance Tests & Distribution Tests. Field performance tests or distribution tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.05. Field Baseline Performance Tests. Field baseline performance tests shall be conducted by Contractor on the equipment indicated in the equipment sections, and the tests shall be performed as indicated. When indicated in the equipment sections, the equipment manufacturer will participate in these tests. This test shall not be considered an acceptance test, but rather a test to determine initial performance curves and efficiency just prior to the equipment entering service.

End of Section

Section 01820

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 DESCRIPTION. This section contains requirements for training the Owner's personnel in the proper operation and maintenance of the equipment and systems installed under this contract.

1.02 GENERAL. Where indicated in the Equipment Schedule section and as required by the specifications, the manufacturer's representative shall provide on-the-job training of the Owner's personnel. The training sessions shall be conducted by qualified, experienced, factory trained representatives of the various equipment manufacturers. Training shall include instruction in both operation and maintenance of the subject equipment.

1.03 SUBMITTALS. The following information shall be submitted to the Engineer in accordance with the provisions of the Submittals section. The material shall be submitted not less than 4 weeks prior to the provision of training.

1. Lesson plans, training manuals, handouts, visual aids, and other reference materials for each training session to be conducted by the manufacturer's representatives.

2. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

PART 2 – PRODUCTS

2.01 GENERAL. Where specified, the Contractor shall conduct training sessions for the Owner's personnel to instruct staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs. Approved operation and maintenance manuals shall be available at least 30 days prior to the date schedule for the individual training session.

2.02 LOCATION. Training sessions shall take place at the site of the work at a location designated by the Owner.

2.03 LESSON PLANS. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be

presented along with a description of the visual aids to be utilized during the sessions. Each plan shall contain time allocation for each subject.

One complete set of originals of the lesson plans, training manuals, handouts, visual aids and reference materials shall be the property of the Owner and shall be suitable bound for proper organization and easy reproduction. The Contractor shall furnish ten copies of necessary training manuals, handouts, visual aids, and reference materials at least 1 week prior to each training session.

2.04 FORMAT AND CONTENT. Each training session shall include classroom and time at the location of the subject equipment or system. As a minimum, training sessions shall cover the following subjects for each item of equipment or system:

1. Familiarization

    a. Review catalog, parts lists, drawings, etc., which have been previously provided for the plan files and operation and maintenance manuals.
    b. Guided inspection of the subject equipment.
    c. Demonstration of the subject equipment and how operation in accordance with the specified requirements.

2. Safety

    a. Review and demonstration of safety procedures and related documentation.
    b. Inspection and discussion of hazardous components of the subject equipment.

3. Operation

    a. Review of subject equipment operations literature and theory of operation.
    b. Overview of equipment operation and function.
    c. Explanation and demonstration of all modes of operation including start up, shut down, normal, and emergency operation, and manual and automatic operation through the plant control system.
    d. Explanation of all hardwired interlocks.
    e. Explanation and demonstration of equipment related valves and their purpose.

f. Explanation of all equipment related instruments including primary element, instrument indicator, purpose, and interpretation of information.
g. Check out of Owner's personnel on proper use of the equipment.

4. Preventive maintenance

a. Review preventative maintenance documentation and discussion of maintenance require at various intervals; e.g. daily, weekly, monthly, annually.
b. Demonstrate performance of each preventive maintenance task.
c. Identification of indicators of equipment problems.
d. Discussion of corrosion protection and lubrication requirements.
e. Requirements for periodic exercise of equipment and demonstration of equipment exercise where required.
f. Identification of inspection points and demonstration of inspection covers removal and routine disassembly and assembly of equipment.

5. Corrective Maintenance and Equipment Repair

a. Discussion of common repairs and identification of special problems.
b. Explanation and demonstration of equipment inspection and troubleshooting.
c. Demonstration of calibration procedures.
d. Demonstration of repair procedures where practical.

6. Parts

a. Discussion of the parts list and ordering of parts.
b. Review of spare parts provided with the equipment and identification of other recommended spare part.

7. Local Representatives

a. Name, address, telephone of local representative.
b. Review of contact information for providers of routine and emergency repair and operational assistance.

8. Operation and Maintenance Manuals

a. Review of O&M manual content and organization.
b. Update O&M material as required.

2.05 VIDEO RECORDING. The Contractor shall record each training session and shall give the Owner exclusive rights to each training session recording. The Contractor shall advise all manufacturers providing training sessions that the material will be recorded.

PART 3 – EXECUTION

Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled so that training is performed when equipment is available for operation. The Contractor shall arrange to have the training conducted on consecutive days, with no more than 6 hours of class scheduled for any one day. Concurrent classes will not be permitted.

End of Section

Section 03302

MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1-1. SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and appurtenant work.

1-2. SUBMITTALS. All submittals of drawings and data shall be in accordance with the Submittal Procedures section. Data shall be submitted for all products listed in the “Materials” paragraph that are utilized for the project.

Reinforcement submittals shall include material certifications, bar lists, and placement drawings.

The following items shall be submitted for review related to the concrete mixture:

Aggregate reports (ASTM C33 and ASTM C1778)	
	Source and type
	Gradation
	Deleterious materials
	Alkali-aggregate reactivity
Cement mill report	
Fly ash or slag cement test report	
Admixture data sheets	
Proposed mixture proportions	
Concrete compressive strength at 28 days	

PART 2 - PRODUCTS

2-1. LIMITING REQUIREMENTS. Unless otherwise specified, concrete shall be controlled within the following limiting requirements:

Cement Content	Suitable for meeting the performance requirements of this specification.

Maximum Water-Cement Ratio	The maximum water-cement ratio shall be 0.45 on a weight basis, or, if fly ash or slag cement are used, the combined mass of cement plus fly ash or slag cement shall be used to determine the water-cementitious materials ratio.
Fly Ash or Slag Cement Content	At the option of Contractor, fly ash or slag cement may be substituted for portland cement, on the basis of 1.0 lb added for each 1.0 lb of cement reduction. Fly ash replacement shall be within a range of 15 to 25 percent. Slag cement replacement shall be within a range of 25 to 50 percent.
Concrete Strength	4,500 psi minimum compressive strength at 28 days.
Air Content	6 percent ±1.5 percent.
Coarse Aggregate	Maximum nominal coarse aggregate size, 1 inch. Recycled aggregates, or aggregates created from crushed concrete, will not be acceptable.
Admixtures	A water-reducing admixture and an air-entraining admixture shall be included in all concrete. No calcium chloride or admixture containing chloride from sources other than impurities in admixture ingredients will be acceptable.
Consistency	Workable, without segregation, with slump not more than 5 inches when concrete is placed.

2-2. MATERIALS.

Cement	ASTM C150 Type I, II, or I/II, or ASTM C595 Type IL. ASTM C595 cements that incorporate C1157 cements will not be acceptable.

Fly Ash	ASTM C618, Class F, except loss on ignition shall not exceed 4 percent.
Slag Cement	ASTM C989, Grade 100 or Grade 120.
Fine Aggregate	Non-reactive, clean, natural sand, ASTM C33.
Coarse Aggregate	Non-reactive crushed rock, washed gravel, or other inert granular material conforming to ASTM C33, class 4S, except that clay and shale particles shall not exceed 1 percent.
Water	Potable. Water from concrete mixing operations shall not be used.
Admixtures	
Water-Reducing	ASTM C494, Type A or D.
Air-Entraining	ASTM C260.
High-Range Water Reducing	ASTM C494, Type F or G.
Reinforcing Steel	
Bars	ASTM A615, Grade 60, deformed.
Welded Wire Fabric	ASTM A185 or A497.
Bar Supports	CRSI Class 1, plastic protected; or Class 2, stainless steel protected.
Mechanical Connectors	Splicing system meeting Type 2 tensile requirements of ACI 318. Products shall have a current evaluation report verifying testing per ICC-ES AC 133. Use only where indicated on the drawings.
Form Coating	Nonstaining and nontoxic after 30 days. Product shall not exceed VOC limits established by the federal, state, or local regulatory agency having jurisdiction over the project site.

Evaporation Reducer	Dayton Superior “AquaFilm Concentrate J74”, Euclid "Eucobar", L&M Chemical "E-Con", Master Builders Solutions "MasterKure ER50", or Sika "SikaFilm".
Membrane Curing Compound and Floor Sealer	ASTM C1315, Type I, Class A, minimum 25 percent solids, acrylic, non-yellowing, unit moisture loss 0.40 kg/m^2 maximum in 72 hours. Product shall not exceed VOC limits established by the federal, state, or local regulatory agency having jurisdiction over the project site.
Polyethylene Film	Product Standard PS17 or ASTM D4397, 6 mils or thicker.

2-3. MIXTURE DESIGN AND TESTING. All reports and tests required for Engineer acceptance of materials and concrete mixtures shall be made at the expense of Contractor. Mixtures shall be adjusted in the field as necessary, within the limits specified, to meet the requirements of these specifications. If the source of any concrete materials is changed during the contract, concrete work shall pause until the new materials and the new mixture design are acceptable to Engineer.

2-3.01. Review of Materials. The source and quality of concrete materials shall be submitted to Engineer for review before concrete is placed.

2-3.02. Proposed Mixture Proportions. Proposed proportions of concrete shall meet the limiting requirements indicated herein.

2-3.03. Field Test Record Data. Concrete mixtures may be qualified based on field test record performance data. Field test data records shall be from the production facility being used on the current Project and shall have been performed in the past 24 months. Field test records shall represent a single group of at least 10 consecutive strength tests for one mixture, using the same materials, under the same conditions, and encompassing a period of not less than 45 days.

2-4. FORMS. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions indicated on the drawings. Forms shall be substantial and sufficiently tight to prevent leakage of mortar and shall be maintained in proper position and accurate alignment.

Forms shall be thoroughly cleaned and coated before concrete is placed.

Form-facing materials shall be selected in accordance with ACI 347.3R, based upon the applicable formed concrete surface category. Formed concrete surface categories vary by structure and application, and shall be as indicated in the Finishing Formed Surfaces paragraph.

2-5. REINFORCEMENT. Reinforcement shall be accurately formed and positioned, and shall be maintained in proper position while the concrete is being placed and compacted. Reinforcement shall be free from dirt, loose rust, scale, and contaminants. Mechanical connectors shall be used only as indicated on the drawings.

PART 3 - EXECUTION

3-1. BATCHING, MIXING, AND DELIVERY. Concrete shall be furnished by an acceptable ready-mixed concrete supplier, and shall conform to ASTM C94 except as indicated otherwise in this specification. The time from start of concrete mixing to completion of discharge from the truck shall not exceed 1-1/2 hours.

3-2. PLACEMENT. Concrete shall be conveyed to the point of final deposit and placed by methods which will prevent segregation or loss of the ingredients. During and immediately after placement, concrete shall be thoroughly compacted and worked around all reinforcement and embedments and into the corners of the forms. Unless otherwise authorized, compaction shall be by immersion-type vibrators. The use of "jitterbug" tampers to compact concrete flatwork will not be permitted.

3-2.01. Polyethylene Film. Where concrete is placed against gravel or crushed rock which does not contain at least 25 percent material passing a No. 4 [4.75 mm] sieve, such surfaces shall be covered with polyethylene film. Joints in the film shall be lapped at least 6 inches [150 mm] and taped.

3-2.02. Cold Weather Concreting. Except as modified herein, cold weather concreting shall comply with ACI 306.1.

3-2.03. Hot Weather Concreting. Except as modified herein, hot weather concreting shall comply with ACI 305.1.

3-3. TOLERANCES. Tolerances for cast-in-place concrete work shall be as indicated in ACI 117, and ACI 347.3R based upon the relevant formed concrete surface category.

Formed concrete surfaces that are to have a face-mounted flat steel or FRP member attached, including but not limited to items such as weir plates or shelf angles, shall have more stringent flatness requirements. The surface profile shall permit the installation of the flat member without grinding the concrete surface (except for removal of fins), deforming the flat member, or requiring usage of backer rods or shims.

3-4. FINISHING.

3-4.01. Finishing Formed Surfaces. Formed concrete surfaces shall meet all criteria of the relevant formed concrete surface category (CSC), as defined in ACI 347.3R, except as indicated otherwise herein. Surfaces shall be assigned to CSC's as indicated.

Formed Concrete Surface Category	Applicable Surfaces	Mockup Required
CSC1	Formed concrete surfaces that will be in permanent contact with earth backfill.	No
CSC2	All other formed concrete surfaces not designated otherwise.	No

3-4.01.01. Fins. Fins, form seams, and construction joints shall be ground flush on all surfaces in formed concrete surface category CSC2, and in CSC1 surfaces that are required to be dampproofed.

3-4.01.02. Tie Holes. All tie holes in formed surfaces, regardless of the relevant CSC, shall be cleaned, wetted, and filled with patching mortar. The patches shall be finished flush and cured and shall match the texture and color of the adjacent concrete.

3-4.01.03. Dampproofed Surfaces. Concrete surfaces to be dampproofed shall have fins removed and tie holes filled, but no additional finishing will be required.

3-4.01.04. Painted Surfaces. Concrete surfaces to be painted shall have sharp edges and projections removed to provide an acceptable condition for painting. The concrete surfaces shall have bug holes filled per the Protective Coatings section.

3-4.02. Finishing Unformed Surfaces. Unless otherwise specified, unformed surfaces shall be given a float finish.

3-4.03. Application of Evaporation Reducer. Concrete flatwork subject to rapid evaporation due to hot weather, drying winds, and sunlight shall be protected with an evaporation reducer. The evaporation reducer shall form a continuous film on the surface of fresh, plastic concrete to reduce evaporation.

Immediately following screeding, evaporation reducer shall be sprayed over the entire surface of fresh, plastic concrete flatwork at a rate of not less than 200 square feet per gallon [4 m^2/L], in accordance with the manufacturer's recommendations. The spray equipment shall have sufficient capacity to continuously spray the product at approximately 40 psi [275 kPa] with a suitable nozzle as recommended by the manufacturer.

The sprayable solution shall be prepared as recommended by the manufacturer.

Under severe drying conditions, additional applications of evaporation reducer may be required following each floating or troweling, except the last finishing operation.

End of Section

Section 03920

CONCRETE SURFACE REPAIR

PART 1 - GENERAL

1-1. SCOPE. This section covers the repair of existing concrete surfaces as indicated on the drawings, as specified, or as required to complete the Work. This specification covers the furnishing of all labor, equipment and materials required to repair, rehabilitate or reconstruct spalled, deteriorated, or structurally damaged concrete surfaces. Depth of repairs shall be adequate to restore concrete members to original dimensions and surface profiles.

The Work covered by this section includes, but is not limited to, the following locations:

Concrete Pedestals
Concrete Saddle Supports
Concrete Equipment Pads

1-2. SUBMITTALS. Specifications and data covering physical properties, the mixtures, application procedures, and curing procedures of the materials proposed shall be submitted in accordance with the Submittal Procedures section. Submittals shall include the approvals required from the material manufacturer.

1-3. QUALITY ASSURANCE.

1-3.01. Manufacturer's Field Services. The material manufacturer shall provide engineering field services to review the project and the selected material application prior to any preparation; to approve the applicator, the material used, and the procedure to be used; to observe and approve surface preparation; and to observe application and curing procedures. The field representative of the material manufacturer shall submit, in writing through Contractor, approvals of proposed materials, surface preparation, applicator, and application procedures. The field representative shall instruct the applicator, as needed, to assure that handling, mixing, placing, finishing, and curing of materials are in accordance with specifications and manufacturer’s requirements. The field representative shall be an employee of the material manufacturer.

1-3.02. Applicator. The repair contractor shall have experience and proficiency specific to the repair type and shall be acceptable to Engineer and the material supplier. The applicator shall submit, through Contractor, a satisfactory experience record including references for previous application of the specified materials to concrete structures of similar design and complexity.

1-3.03. Pre-construction Meeting. At least 30 days prior to planned performance

of the Work, Contractor shall conduct a meeting to review the detailed requirements for the Work. Site conditions, surface preparation, proposed equipment, procedures, material mixing, placing and finishing procedures, and curing methods shall be discussed and approved by Engineer and by the manufacturer's field representative. Contractor shall require the attendance of all involved parties, including but not limited to Contractor's superintendent, repair contractor if applicable, manufacturer's field representative and proposed equipment supplier representative. Minutes of the meeting shall be recorded, typed and printed by Contractor and distributed to all parties, including Engineer, within 5 days after the meeting.

1-3.04. Site Conditions. Job conditions shall be maintained at standards that allow material placement within temperature and cleanliness requirements. Unusual conditions or unexpected additional deterioration uncovered during the course of Work by Contractor shall be brought to Engineer's attention for analysis and disposition. These conditions include but are not limited to poor quality base concrete, severely corroded reinforcing steel, random cracks, deep oil penetration and any other condition which would prevent completion of the Work in accordance with manufacturer's recommendations and this specification.

1-4. PRE-BID INSPECTION. Contractor shall visit the site prior to bid submittal to witness and verify the extent of the required repairs. Final bid shall include a lump sum for the Work with a unit price adjustment for each repair type. Unit prices shall be utilized to adjust the final project cost upon completion and acceptance of the Work based on actual quantities more than or less than the bid form estimated quantities.

PART 2 - PRODUCTS

2-1. ACCEPTABLE PRODUCTS. Concrete repair products shall be manufactured by the Euclid Chemical Company, Master Builders Solutions, Sika Corporation, or equal as specified herein. Equivalent products of other manufacturers regularly producing high quality concrete repair materials, providing engineering field services, and meeting the specified quality assurance requirements may be furnished subject to acceptance by Engineer.

2-2. MATERIALS. Unless otherwise specified or authorized, materials shall conform to the requirements specified herein. Types of materials or concrete repair not specified herein shall be as specified in other sections, as indicated on the drawings or, in the absence of any definite requirement, as recommended by the manufacturer's field representative and acceptable to Engineer.

Products shall not exceed VOC limits established by the federal, state, or local regulatory agency having jurisdiction over the project site.

Floor Surface Repairs,	One or two-component, polymer modified,

Thickness of 1/4 Inch or Less	cementitious material.
Compressive Strength	6000 psi at 28 days, using 2 inch cubes, per ASTM C109.
Products	Master Builders Solutions “MasterEmaco N 300 CI”, Euclid “Thin-Top Supreme”, or Sika “SikaTop 121 Plus”.
Bonding Agent	Repair mortar scrub coat, per manufacturer’s instructions.
Floor Surface Repairs, Thickness Beween 1/4 Inch and 1 Inch	One or two-component, polymer modified, cementitious material containing a corrosion inhibitor.
Compressive Strength	7000 psi at 28 days, using 2 inch cubes, per ASTM C109.
Flexural Strength	1100 psi at 28 days, per ASTM C348.
Bond Strength	2000 psi at 28 days, per ASTM C882.
Products	Master Builders Solutions “MasterEmaco T 310 CI”, Euclid “VersaSpeed LS100”, or Sika “SikaTop 122 Plus”.
Bonding Agent	Repair mortar scrub coat, per manufacturer’s instructions.
Floor Surface Repairs, Thickness Greater Than 1 Inch	One-component, polymer modified, cementitious material containing a corrosion inhibitor.
Compressive Strength	6750 psi at 28 days, using 2 inch cubes, per ASTM C109.
Flexural Strength	1100 psi at 28 days, per ASTM C348.
Bond Strength	2400 psi at 28 days, per ASTM C882.
Products	Master Builders Solutions “MasterEmaco N 425”, Euclid “VersaSpeed LS100”, or Sika “SikaTop 122 Plus”.
Bonding Agent	Repair mortar scrub coat, per manufacturer’s instructions.
Vertical and Overhead	One or two-component, polymer modified,

Surface Repairs, Trowel Applied	cementitious material containing a corrosion inhibitor.
Compressive Strength	5500 psi at 28 days, using 2 inch cubes, per ASTM C109.
Flexural Strength	600 psi at 28 days, per ASTM C348.
Bond Strength	1800 psi at 28 days, per ASTM C882.
Products	Master Builders Solutions “MasterEmaco N 400”, Euclid “Eucorepair V100” or “Tamms Structural Mortar”, or Sika “SikaTop 123 Plus”.
Bonding Agent	Repair mortar scrub coat, per manufacturer’s instructions.
Vertical Repairs, Form and Pour, Thickness 6 Inches or Less	One-component, cementitious material containing a corrosion inhibitor. Shrinkage compensated or polymer modified.
Compressive Strength	6500 psi at 28 days, using 2 inch cubes, per ASTM C109.
Flexural Strength	770 psi at 28 days, per ASTM C348.
Bond Strength	2500 psi at 28 days, per ASTM C882.
Rapid Chloride Permeability	Maximum 650 cuolombs at 28 days, per ASTM C1202.
Products	Master Builders Solutions “MasterEmaco S 466CI”, Euclid “Eucorepair SCC Fast”, or Sika “Sikacrete 211 SCC Plus”.
Bonding Agent	Extended open time type; three component, epoxy modified, with corrosion inhibitor, minimum bond strength of 2000 psi at 7 days per ASTM C882. Master Builders Solutions “MasterEmaco P 124”, Euclid “Duralprep A.C.”, or Sika “Armatec 110 EpoCem”.
Vertical Repairs, Thickness Greater Than 6 Inches	Cast-in-place concrete, per the concrete specification.

Bonding Agent	Extended open time type; three component, epoxy modified, with corrosion inhibitor, minimum bond strength of 2000 psi at 7 days per ASTM C882. Master Builders Solutions "MasterEmaco P 124", Euclid "Duralprep A.C.", or Sika "Armatec 110 EpoCem".
Water	Clean and free from deleterious substances.
Reinforcement Anti-Corrosion Coating	Extended open time type; three component, epoxy modified, with corrosion inhibitor, minimum bond strength of 2000 psi at 7 days per ASTM C882. Master Builders Solutions "MasterEmaco P 124", Euclid "Duralprep A.C.", or Sika "Armatec 110 EpoCem".
Penetrating Sealer	Silane-based sealer with minimum 40% active ingredient. Minimum water repellency of 85% per ASTM C642. Master Builders Solutions "MasterProtect H 400", Euclid "Baracade Silane 40 WB", or Sika "Sikagard 740 W".

2-2.01. Coarse Aggregate Extension of Cementitious Mortar. In areas where depth of repair exceeds manufacturer's recommended limits for neat repair mortar, repair mortar may be extended with washed, graded, rounded, high-density, low-absorption coarse aggregate meeting ASTM C33. Aggregate shall be in size and volumes recommended by the product manufacturer. Aggregate extension shall not be permitted unless approved by Engineer.

PART 3 – EXECUTION

3-1. GENERAL. Unless otherwise specified, all materials shall be prepared and applied in strict accordance with the manufacturer's printed installation instructions.

3-2. INSPECTION. Prior to the placement of repair material, the surface to be repaired shall be inspected by the material manufacturer's field representative to assure the surface conditions are correct for the type of repair and the material is being used as specified.

3-3. PREPARATION.

3-3.01. Cleaning. The surface of existing concrete shall be clean and the pores free of any dirt or material that will be detrimental to the bond of the repair material. All oil, dirt, debris, paint, and unsound concrete shall be removed.

Cleaning shall include complete removal of all dust, dirt, and residue by high pressure washing.

3-3.02. Surface Preparation. All prepared surfaces shall conform to the requirements of the material manufacturer. All edges shall be square cut to avoid feather edges. As required, surfaces shall be prepared mechanically using a scabbler, bushhammer, chipping hammer, shotblast, scarifier or hydrodemolition equipment which will give the specified surface profile. Means and methods selected, subject to acceptance by Engineer, shall minimize surface micro-cracking (i.e. “bruising”) and impact on areas surrounding the Work area. Contractor shall provide a minimum Concrete Surface Profile (CSP) equal to that recommended by the material manufacturer.

Remove all loose and unsound concrete per International Concrete Repair Institute (ICRI) Guideline 310.1R “Guide for Surface Preparation.” Repair areas shall be sawcut around the perimeter in a square or rectangular shape. For thin repairs of 1/4 inch or less, the saw cut depth shall not exceed 1/4 inch deep. For thicker repairs, the saw cut depth shall be a minimum of one-half inch but shall be limited to prevent the saw from damaging embedded reinforcement. Saw cuts shall be made perpendicular to the concrete surface and all concrete removal boundaries shall be straight.

Concrete shall be removed within repair boundaries to depth that is as uniform as practicable, and within the minimum and maximum layer thicknesses recommended by the material manufacturer. Exposed concrete surfaces shall be visually examined and tested with a mason’s hammer to confirm soundness of the base material. If delamination, cracking, or otherwise unsound material exists, Contractor shall notify Engineer for direction before continuing with the work.

3-3.03. Cracks. Cracks shall be located and repaired, if required, in accordance with the Concrete Crack Repair specification. All cracks located within or adjacent to Work covered under this specification shall be repaired prior to performance of the Work covered under this specification.

3-3.04. Inspection and Replacement of Reinforcement. If reinforcement is exposed so that more than half the circumference of the bar is visible, the remaining concrete shall be removed to provide 1 inch of clear space all around the bar.

Reinforcement that has lost more than 20 percent of its original cross-sectional area shall be repaired by adding new reinforcement. The new reinforcement shall be spliced or connected to the existing reinforcement on both ends of the damaged portion of the original bar. Splices shall be Class B, and mechanical connectors shall be ACI 318 Type 2.

Contractor shall clean all exposed reinforcing steel to a bare metal finish prior to installation of repair materials.

Repaired reinforcement shall be inspected by Engineer or Owner's representative prior to placement of concrete repair materials.

3-4. APPLICATION. Concrete repair work shall be performed in accordance with the following requirements.

3-4.01. Bonding and Priming. Bonding agent shall be applied per manufacturer's recommendations. The manufacturer's coverage rate shall be followed. For rough surfaces, scrub bonding agent into the surface with a stiff broom.

Apply all prepackaged bonding agent materials within recommended ambient and substrate temperatures published in the manufacturer's printed installation instructions. Materials shall not be applied over frozen or liquid filled surfaces.

Upon completion of all concrete and reinforcing steel demolition, surface preparation, and cleaning operations, apply specified bonding agent to substrate. Provide complete and thorough coverage of surface assuring that bonding agent has been fully worked into profile of surface.

For repair mortar scrub coat bonding agents, the concrete surface shall be saturated with water one hour prior to placement of the scrub coat to provide a saturated substrate. Just prior to application of the scrub coat, water shall be removed by compressed air blasting. Compressed air shall be maintained free of oil and contaminants by filtration as needed. The mortar scrub coat shall be wet and not yet stiffened when repair material is applied.

For extended open time bonding agents, mix bonding agent and apply two uniform coats at manufacturer's published recommended coverage rates to properly prepared surfaces. Allow adequate time between coats per manufacturer's recommendations. The repair material shall be applied within the allowable open time of the bonding agent.

3-4.02. Treatment of Reinforcement and Other Metal Embedments. All existing and new reinforcement shall be secured and properly positioned by tying to other secured bars or supplemental anchoring pins as needed.

All exposed reinforcement and other metal embedments within the repair area shall be treated with two coats of anti-corrosion coating.

3-4.03. Forming. Forms shall be water-tight and constructed with sufficient rigidity to withstand head pressure and prevent excessive deflection during material placement. For pumped applications without open top forms, provide a

port connection or birdmouth of sufficient size to allow pumping into the form. After forms are removed, all birdmouths and other protrusions resulting from the placement method shall be carefully removed and the surface smoothed.

Tolerances for formed work shall be as stipulated in ACI 117 for cast-in-place concrete, unless otherwise indicated. Formed surfaces shall meet Class C requirements for both abrupt and gradual irregularities.

3-4.04. Shoring and Support. When removal and repair of deteriorated concrete may cause temporary weakness, excessive deflections, structural instability, or other unacceptable damage, shoring or other suitable supports shall be provided until completion of the repair work is complete and the material has reached its design compressive strength.

3-4.05. Cold Weather Conditions. Repair materials shall not be applied without protection in temperatures below 45 degrees F, nor when the temperature is expected to fall below 45 degrees F during the curing period, unless more stringent requirements are provided by the material manfacturer's printed installation instructions.

3-5. FINISHING. All surfaces shall be finished to match the surrounding concrete.

3-6. CURING. Immediately following placement and finishing procedures, cure cementitious repair mortars for a minimum of 72 hours. Curing procedures shall be in accordance with ACI 308.1 and the manufacturer's printed installation instructions. The more stringent requirements shall control.

When ambient temperatures below 45 degrees F are expected during the curing period, the repair material shall be maintained at 50 degrees F for the full period. Sudden cooling shall not be permitted. Gradual temperature drop shall be maintained at not more than 20 degrees F in any 24 hour period. Carbon dioxide or exhaust gases from combustion heaters shall not be allowed within enclosures or allowed to contact the repair material. Repair materials shall not be exposed to freezing temperatures until at least 24 hours after the end of the curing period.

Unless specified otherwise, one or more of the following methods shall be used:

3-6.01. Water Curing. Keep concrete surfaces continuously wet with water during the curing period. The method used shall limit water runoff and any runoff shall be directed and controlled. The difference in temperature between the water used for curing and the concrete surface shall not exceed 20 degrees F.

3-6.02. Wet Coverings Curing. Cover the surfaces with moisture retaining curing blankets, burlap, cotton mats, or other suitable moisture retaining materials. The coverings shall not stain or otherwise discolor the repair material or the

surrounding surfaces, and shall keep the repair products fully saturated during the curing period. Lap all coverings at least 8 inches at joints.

3-6.03. Membrane Curing. Membrane curing compounds shall only be used if the repair material manufacturer's printed installation instructions recommend a compound be used instead of water or wet coverings. Membrane curing compounds shall not be used on surfaces to receive a penetrating sealer.

3-7. SEALING. Provide a penetrating sealer over the concrete repair product when recommended by the repair product manufacturer, or when no other sealer is specified on the drawings or other specifications. The penetrating sealer shall be applied in accordance with the manufacturer's instructions.

3-8. FIELD QUALITY CONTROL.

3-8.01. Material Storage and Handling. The material shall be delivered in original, unopened containers. Containers shall be labeled with the manufacturer's name, product name, and lot number. Materials shall be stored at the job site under dry conditions and at temperatures between 50 degrees F and 90 degrees F unless more stringent limitations are required by the manufacturer.

3-8.02. Protection. Repair areas shall be protected from other trades and weather for a minimum of 10 days after material is placed.

3-8.03. Cleaning. Work areas are to be cleaned each day in accordance with the Project Requirements section. Upon completion of the final cleanup, Contractor shall restore all areas affected by repair procedures to their original condition, leaving no trace of material piles or other wasted materials.

End of Section

Section 03930

CONCRETE CRACK REPAIR

PART 1 - GENERAL

1-1. SCOPE. This section covers the repair of concrete and shotcrete cracks and joints.

Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

1-1.01. General Crack Repair. General crack repair is applicable to new and existing construction, and shall include the following:

a. Sealing of all cracks and crack networks that are wider than 10 mils (0.01 inch) [250 µm] as measured at the exposed surface.

b. All necessary repairs to structures that have failed a tightness test, including sealing of construction joints.

Contractor shall review existing construction designated for reuse and include all costs for general crack repair in the Contract Price. General crack repair work is expected to be necessary due to cracks that commonly develop during concrete construction. Cracks discovered during the construction phase shall be brought to the attention of the Owner and/or Owner's designated representative for evaluation.

1-1.02. Not Used

1-1.03. Not Used

1-2. SUBMITTALS. Specifications and data covering physical properties, mixtures, application procedures, and curing procedures of the materials proposed shall be submitted in accordance with the Submittals Procedures section. Submittals shall include the approvals from the material manufacturer.

1-3. QUALITY ASSURANCE.

1-3.01. Manufacturer's Field Services. The material manufacturer shall provide engineering field services to review the Work and the material application prior to any preparation; to approve the applicator, the material used, and the procedure to be used; to observe surface preparation; to approve surface preparation; and to observe application. The field representative of the material manufacturer shall submit, in writing through Contractor, approvals of proposed material,

application procedures, applicator, and surface preparation. The field representative shall be an employee of the material manufacturer.

1-3.02. Applicator. The applicator shall submit through Contractor a satisfactory experience record including references from previous application of the specified materials to structures of similar design and complexity.

1-3.03. Pre-Construction Meeting. At least 30 days prior to concrete crack repairs, Contractor shall conduct a meeting to review the detailed requirements for rehabilitation work. Site conditions, surface preparation, proposed equipment, procedures, material mixing, placing procedures, and curing methods shall be discussed and approved by Engineer and by the manufacturer's field representative. Contractor shall require the attendance of all involved parties, including but not limited to Contractor's superintendent, repair contractor, manufacturer's field representative and proposed equipment supplier representative. Minutes of the meeting shall be recorded, typed and printed by Contractor and distributed to all parties within 5 days after the meeting.

1-3.04. Quality Assurance Certification. Material manufacturers shall be ISO 9001/9002 registered or shall provide proof of documented quality assurance. The documented quality assurance system shall be obtained through an independent auditing registrar.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS. Unless otherwise specified or authorized, repairs shall conform to the requirements specified herein. Types of repairs not specified herein shall be as specified in other sections, as indicated on the Drawings, or, in the absence of any definite requirement, as recommended by the manufacturer's representative and subject to acceptance by Engineer. The following types of repairs shall be performed as required.

2-1.01. Epoxy Resin. Unless indicated otherwise on the drawings, epoxy resin shall be used to seal construction joints and cracks. Epoxy resin shall be pressure-injected for vertical and overhead applications. Epoxy resin may be applied by gravity feed in lieu of pressure injection for cracks in floors, using a very low-viscosity material.

2-1.02. Foam Resin. Foam resin shall be used to seal expansion joints. Otherwise, foam resin shall only be used to seal crack and joints when indicated on the drawings or when permitted by Engineer in lieu of epoxy resin Foam resin shall be pressure-injected.

2-2. ACCEPTABLE PRODUCTS. Repair products/materials shall be as specified herein. Equivalent products of other manufacturers regularly producing high quality concrete crack repair products/materials, providing engineering field services, and meeting the specified quality assurance requirements may be furnished subject to review and acceptance by Engineer.

2-3. MATERIALS. Materials shall be approved by the manufacturer for the type of application, including temperature and moisture conditions encountered. Products used in structures containing potable water shall be certified for NSF/ANSI 61.

Epoxy Resin	ASTM C881, Type I or Type IV, moisture tolerant or moisture insensitive.
Crack Sealant	As recommended by the manufacturer of the epoxy resin product.
Foam Resin	Hydrophilic polyurethane foam; Prime Resins “Prime-Flex 900 XLV”, DeNeef "Sealfoam PURe", Euclid “Dural Aqua-Fil”, or Avanti “AV-333 Injectaflex”.
Foam Resin Accelerator	As recommended by foam resin manufacturer.
Water	Clean and free from deleterious substances.

PART 3 - EXECUTION

3-1. INSPECTION. Prior to the placement of the repair materials, the crack to be repaired shall be inspected by the material manufacturer to assure that preparation and conditions are correct for the type of repair and the product/material being used as specified herein.

3-2. PREPARATION. All cracks and surfaces around the cracks shall be free of objectionable substances and shall conform to the requirements of the material manufacturer. Concrete and shotcrete to be repaired shall be cleaned by methods acceptable to the material manufacturer so that the cracks are free of dirt, oil, grease, laitance, and other foreign matter. All loose and deteriorated existing concrete and shotcrete shall be removed down to sound materials. All

concrete and shotcrete surfaces shall be checked for delamination to ensure that all surfaces are sound. All edges shall be square cut to avoid feather edges.

Any other preparation recommended by the material manufacturer shall be brought to Engineer's attention and may be incorporated into the work if acceptable to Engineer.

Concrete and shotcrete surfaces in the area of a crack to be repaired shall be cleaned by wire brushing, blasting, or other acceptable methods.

Wall surfaces shall be sandblasted clean to expose crack networks and construction joints. If there is active water seepage in the repair area, the seepage shall be stopped as recommended by the injection material manufacturer and as acceptable to Engineer. Injection ports shall be installed, when recommended by the injection material manufacturer.

3-2.01. Injected Epoxy Resin. Preparation for injected epoxy resin shall include sealing the surface at the crack, on both sides when possible, with crack sealant as recommended by the material manufacturer and as acceptable to Engineer for the pressure injection work. Injection ports for epoxy resin shall penetrate through the crack sealant into the cracks at spacings recommended by the material manufacturer.

3-2.02. Injected Foam Resin. Preparation for injected foam resin shall include drilling offset injection holes at an angle that will intersect the crack, joint, or crack network at approximately one-half the thickness of the concrete or shotcrete up to a thickness of 36 inches [900 mm]. Spacing of injection ports shall be determined as recommended by the injection material manufacturer and as acceptable to Engineer. When the injection material manufacturer certifies, in writing, that spacing of injection ports and installation procedures are acceptable, the injection ports may be installed directly into the crack, subject to review by Engineer.

3-3. APPLICATION. Concrete and shotcrete repair work shall be performed in accordance with the following requirements.

3-3.01. Crack Sealant. Crack sealant shall be trowel-applied to a minimum dried thickness of 1/8 inch [3 mm], or thicker if directed by manufacturer’s literature. The concrete surface where the sealant is applied shall be smooth, uniform, and free from irregularities. Crack sealant shall be removed after the injection of resin is completed, except for portions of wall faces that will be at least 12 inches below the finished grade.

3-3.02. Pressure-Injected Resin. The injected areas shall be prepared as specified and as recommended by the manufacturer.

After the joints and cracks are prepared and before the injection of the resin, the joints shall be flushed with water. The water flush shall be terminated when the turbidity of the expelled water is equal to that of the flush water. Unless otherwise acceptable to resin manufacturer and Engineer, cracks shall be dry prior to injecting resin.

The pumping equipment used for the pressure injection of resin shall have pressure metering. Written procedures for use and quality control of the injection equipment shall be furnished to Engineer for review and acceptance. The pump shall be electric. The material and process used for the pressure injection of the resin shall have been in use a minimum of 5 years.

The joints and crack networks shall have a minimum of 90 percent penetration of resin into the joint or crack network. Core samples may be taken at Engineer's discretion.

3-3.02.01. Epoxy Resin. Epoxy resin shall be injected into the structure in accordance with the material manufacturer's recommendations and as acceptable to Engineer. Epoxy resin shall be injected until the resin appears at the next injection port.

3-3.02.02. Foam Resin. Foam resin shall be premixed and injected into the structure in accordance with the material manufacturer's recommendations and as acceptable to Engineer. Foam resin shall be injected into the structure until the resin appears at the next injection port.

Surfaces of cracks and joints may need to be sealed with crack sealant.

3-3.03. Gravity Fed Resin. A bead of the epoxy resin shall be placed over the entire surface of the crack. Enough resin shall be applied so that there is a visible heaping above the floor surface. The applicator shall periodically inspect the resin to verify that it has penetrated the crack and flattened against the floor surface. After the resin has flattened, another bead shall be applied, and the process repeated until the crack cannot receive additional resin.

3-3.04. Cold Weather. When ambient temperatures below 40°F [4°C] are expected during the curing period, the repair materials shall be maintained at a temperature of at least 50°F [10°C] for 14 days or 75°F [24°C] for 7 days after placement. Sudden cooling of the repair materials shall not be permitted.

3-4. PROTECTION. Post-placement curing and protection shall be as specified herein and in accordance with the manufacturer's recommendations.

3-5. CLEANING. Work areas shall be cleaned each day in accordance with the Project Requirements section. Upon completion of the final cleanup, Contractor shall restore all areas affected by the repair procedures to their original condition, leaving no trace of material piles or other wasted materials.

End of Section

Section 05120

STRUCTURAL METALS

PART 1 - GENERAL

1-1. SCOPE. This section covers the fabrication and erection of structural metal items.

Except as otherwise specified or indicated on the Drawings, all work shall conform to the applicable provisions of the AISC "Steel Construction Manual" (15th edition) with the exception of the “Code of Standard Practice for Steel Buildings and Bridges”; and the Aluminum Association "Specification for Aluminum Structures".

Special inspection during the fabrication and erection of structural steel, if required by the local building code, is addressed in the Code-Required Special Inspections and Procedures section.

1-2. SUBMITTALS. Complete data, fabrication drawings, and setting or erection drawings covering all structural metal items shall be submitted in accordance with the Submittal Procedures section.

All bolted connections and welds shall be properly identified on the shop drawings.

Submittals for high strength bolts, tension control bolts and load indicator washers shall include statements from the bolt and washer manufacturers certifying satisfactory compliance with the governing standards and the specified tests.

Submittals for items that are designed by the fabricator shall include drawings sealed by a professional engineer registered in the state of the project. Data shall include confirmation that the design meets all applicable code requirements. Calculations shall be submitted when requested by Engineer.

1-3. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent bends, dents, significant coating damage, or corrosion. Damaged materials shall be promptly replaced. Structural metal work shall be stored on blocking so that no metal touches the ground and water cannot collect thereon. The material shall be protected against bending under its own weight or superimposed loads.

Bolting materials shall be stored indoors. Weld rod shall be stored in accordance with the supplier’s instructions and AWS D1.1.

1-4. FABRICATOR QUALIFICATION. All fabricating plants providing structural steel shall be qualified fabricators who participate in the AISC Certification program and are designated an AISC Certified Plant, Category BU.

PART 2 - PRODUCTS

2-1. GENERAL. All materials needed for both shop and field assembly shall be furnished.

2-2. MATERIALS.

Steel

Shapes (W, WT)	ASTM A992.
Shapes (S, M, HP, C)	ASTM A36 or ASTM A572 Grade 50.
Other Shapes (angles)	ASTM A36.
Plates and Bars	ASTM A36.
Sheets	ASTM A1008 CS Type B or A1011 CS Type B.
Pipe	ASTM A53, Type E or S, Grade B, (F_y = 35 ksi).
Round Structural Tubing	ASTM A500, Grade C (F_y = 46 ksi).
Square and Rectangular Structural Tubing	ASTM A500, Grade C (F_y = 50 ksi).

Bolts and Nuts

Bolts, High Strength	ASTM F3125, Grade A325.
Bolts, Tension Control Type (Twist off)	ASTM F3125, Grade 1852.
Bolts, unfinished	ASTM A307.
Nuts, Heavy-Hex	ASTM A563, grade and finish compatible with bolts.
Nuts, Self-Locking	Prevailing torque type; IFI-100, Grade A.

Washers		
	Flat, Hardened	ASTM F436, Type 1.
	Lock	ANSI/ASME B18.21.1, helical spring type.
	Beveled	ASTM F436.
	Load Indicator	ASTM F959, compressible-washer-type direct tension indicator; type compatible with bolts tested in accordance with Article 10.2 of ASTM F959.
Threaded Rods (Including Hanger Rods for Pipe Supports)		ASTM A36. Threaded rods shall have sufficient threading to permit the maximum adjustment available. Continuously threaded rod is not acceptable for rods over 12 inches in length.
Forged Steel Sleeve Nuts		AISI C-1018, Grade 2.
Stainless Steel		
Shapes		ASTM A1069 or A276, Type 316L.
Plates		ASTM A240, Type 316L.
Pipe		ASTM A312, Grade TP316L.
Tube		ASTM A269, Grade TP316L.
Bolts		ASTM F593, Alloy Group 1 or 2, minimum yield strength of 45 ksi.
Nuts		ASTM F594, Alloy Group shall match that of the bolts. Nuts shall have a minimum proof stress equal to or greater than the minimum full-size tensile strength of the bolts.
Washers		
	Flat	ANSI/ASME B18.22.1, Type 316.

Lock	ANSI/ASME B18.21.1, helical spring type, Type 316.
Threaded Rods (Including Hanger Rods for Pipe Supports)	ASTM A593, Alloy Group 1 or 2, minimum yield strength of 45 ksi.
Shop Coatings	
Galvanizing	ASTM A123, A153, A385, and F2329 as applicable.

2-3. Not Used

2-4. Not Used

2-5. STRUCTURAL STEEL BOLTED CONNECTIONS. Bolt holes shall have a diameter nominally 1/16 inch larger than the nominal bolt diameter. Bolt holes for one ply of vertical diagonal bracing connections may be oversized to a diameter nominally 3/16 inch larger than the nominal bolt diameter.

2-6. SHOP COATING. All items shall be shop coated as specified herein. The requirements for field painting are covered in the Protective Coatings section.

Contact surfaces of structural steel slip critical bolted connections shall not be shop coated. Contact surfaces of structural steel bearing type bolted connections may be shop coated.

2-6.01. Cleaning. Surfaces shall be dry and of proper temperature when coated, and shall be free of grease, oil, dirt, dust, grit, rust, loose mill scale, weld flux, slag, weld spatter, and other objectionable substances. Articles to be galvanized shall be pickled before galvanizing. All other ferrous metal surfaces shall be cleaned by solvent, high-speed power wire brushing or by blasting to the extent recommended by the paint manufacturer and as required in the Protective Coatings section.

2-6.02. Edge Grinding. Sharp projections of cut or sheared edges of ferrous metals which will be submerged in operation, except for items specified to be hot-dip galvanized, shall be ground to a radius as needed to ensure satisfactory paint adherence and as required in the Protective Coatings section.

2-6.03. Not Used

2-6.04. Galvanizing. Steel materials required to be galvanized are indicated on the Drawings. All galvanizing shall be done by the hot-dip process after fabrication. An approved zinc-rich paint shall be used to touch up minor coating

damage, in accordance with ASTM A780. Materials with significant coating damage shall be regalvanized or replaced.

Bolts, nuts, and washers shall be galvanized when connected materials are galvanized or where indicated on the Drawings. The use of zinc-plated bolts will not be acceptable.

2-6.05. Stainless Steel. Unless otherwise specified, all items fabricated from stainless steel shall be thoroughly cleaned and degreased after fabrication. Pickling or a light blast cleaning shall produce a modest etch and remove all embedded iron and heat tint. Surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect the presence of residual embedded iron and shall be retreated as needed to remove all traces of iron contamination. Surfaces shall be adequately protected during shipping and handling to prevent contact with iron or steel objects or surfaces.

2-6.06. Not Used

PART 3 - EXECUTION

3-1. STRUCTURAL STEEL ERECTION. Structural steel shall be erected so that individual pieces are plumb, level, and aligned within a tolerance of 1:500. The elevations of the top of floor and roof members shall be within 1/16 inch of the elevations indicated on the Drawings. The faces of girts and other supporting members for rigid wall panels shall be in vertical planes within a maximum variation of 1/8 inch.

All members and parts, as erected, shall be free of warps, local deformations, and unauthorized bends. All parts shall be assembled accurately as indicated on the Drawings. Light drifting will be permitted to draw parts together, but drifting to match unfair holes will not be permitted. Any enlargement of holes necessary to make connections in the field shall be done by reaming with twist drills and only with the approval of Engineer. Enlarging holes by burning will not be permitted.

Baseplates shall be set level in exact position and grouted in place.

3-1.01. Inspection and Testing. Special inspection will be performed as indicated in the Code Required Special Inspections and Procedures section. The erector shall provide access as needed to facilitate all inspections and shall provide timely notification during erection when inspection milestones are approaching.

3-1.02. Not Used

3-2. STRUCTURAL STEEL BOLTED CONNECTIONS. Unless otherwise indicated on the Drawings, bolted connections for structural steel, as defined in

the AISC manual, shall be made with ASTM F3125 high strength bolts conforming to the "Specification for Structural Joints Using High-Strength Bolts" as approved by the Research Council on Structural Connections. The method of installation, pretensioning procedures, bolting equipment and tools shall likewise conform to the above referenced standard.

When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts, or washers, shall be free of loose mill scale, dirt, burrs, oil, and other foreign material that would prevent solid seating of the parts.

Beveled washers shall be used when the bearing faces of bolted parts have a slope of 1:20 or greater with respect to a plane perpendicular to the bolt axis. Bolt length shall be increased as needed to accommodate the beveled washers.

Tightening of each connection assembly shall progress systematically from the most rigid part of the joint toward the free edges until all have been sufficiently rotated or the load indicator washers on all bolts have been closed to the average gap stipulated by the load indicator washer manufacturer.

Except as otherwise indicated on the Drawings or specified herein, bolted connections shall be bearing type with threads excluded from the shear plane. Slip critical connections shall be used in diagonal bracing connections, where oversize holes or slotted holes parallel to the direction of the load are used, and where indicated on the Drawings.

Bolts in all structural steel connections, both bearing and slip critical, shall be fully pretensioned in accordance with the AISC standards unless specifically noted otherwise on the Drawings. The calibrated wrench method of pretensioning bolts will not be acceptable. Acceptable pretensioning methods are as follows:

Connection Type	Acceptable Pretensioning Method
Bearing	Turn of the nut method and load-indicator washers are acceptable. Tension control (twist-off) type bolts may be used only if approved by Engineer.
Slip-Critical	Load indicator washers.

3-2.01. Turn of the Nut Method. The bolt, nut, and material shall be match marked. A wax lumber marker or paint shall be used to clearly mark the assembly.

3-2.02. Load-Indicator Washers. Load indicator washers shall be installed in accordance with the manufacturer's recommendations, as supplemented herein. To facilitate proper tightening of fastener assemblies with load indicator washers, a hardened flat washer shall be installed under the turned element (bolt head or nut) and between the turned element and the load indicator washer protrusions, in all cases. Whenever possible, the load indicator washer shall be installed on

the head end of the bolt. If the bolt head will not be visible for inspection of the indicator washer after installation, or if the bolt head must be turned to tighten the assembly, the load indicator washer may be installed on the nut end of the bolt.

3-2.03. Tension Control (Twist-off) Bolts. Patented tension control bolts shall be of equivalent size and strength to the indicated high strength bolts, and shall be installed in strict accordance with the manufacturer's instructions. Load-indicator washers are not required on tension control bolts.

3-3. STRUCTURAL AND STAINLESS STEEL WELDING. Welding and related operations shall conform to applicable provisions of AWS D1.1 for steel and AWS D1.6 for stainless steel. All welding shall be performed in accordance with written procedures, using only those joint details which have prequalified status. All welding shall be performed by welders qualified in accordance with the American Welding Society.

Welds not dimensioned on the Drawings shall be sized to develop the full strength of the least strength component of the connection.

All butt and miter welds shall be continuous and, where exposed to view, shall be ground smooth. Intermittent welds shall have an effective length of at least 2 inches and shall be spaced not more than 6 inches apart.

Surfaces within 2 inches of a weld shall be free from loose or thick scale, slag, rust, moisture, grease, paint and other foreign materials that would prevent proper welding or release objectionable fumes.

Only shielded metal arc, gas metal arc, flux cored arc, submerged arc, and gas tungsten arc welding are permitted. For flux cored arc welding, only E70xx one (1) or five (5) wire electrodes with supplemental gas shielding shall be permitted. Use of electroslag or electrogas welding processes or the short-circuiting transfer mode of the gas metal arc process will not be acceptable.

Field welded connections shall not be substituted for field bolted connections indicated on the Drawings.

3-4. Not Used

End of Section

Section 05800

ANCHORAGE IN CONCRETE AND MASONRY

PART 1 - GENERAL

1-1. SCOPE. This section covers the design and installation of anchors in concrete and masonry. It includes cast-in-place anchor bolts and anchor rods, adhesive anchors for both threaded rods and reinforcing bars, expansion anchors, and undercut anchors.

1-2. GENERAL.

1-2.01. Anchors Designed by Engineer. Cast-in-place and post-installed anchors that are fully detailed on the Drawings have been designed by Engineer and may not be changed to a different type without written approval of Engineer.

1-2.02. Anchors Designed by Contractor's Suppliers. Contractor's material suppliers shall be responsible for design of anchors for railings, ladders, equipment, pre-engineered structures, and other manufactured items, as indicated in the Drawings and Specifications. Anchors shall be designed for all operating conditions, including wind and seismic loadings when indicated in the Meteorological and Seismic Design Criteria section.

Cast-in-place anchors shall be used unless post-installed types are indicated on the Drawings or accepted by Engineer. Post installed anchors into concrete or masonry shall be designed in accordance with the anchor manufacturer's research report.

Adhesive anchors used in vibrating applications shall only be used if the anchor manufacturer submits documentation indicating that the product is suitable for the anticipated service conditions.

Seismic anchorage design for non-structural components shall include the overstrength factors indicated in ASCE 7, Tables 13.5-1 and 13.6-1, when applicable.

Design of anchorage into concrete shall be in accordance with ACI 318 Chapter 17, shall consider concrete to be cracked, and shall not include the strengthening effects of supplementary reinforcement or anchor reinforcement unless approved by Engineer.

Design of anchorage into masonry shall be in accordance with TMS 402.

Shop drawings for anchor bolts, anchor rods, and post-installed anchors shall include full details and shall be sealed by a professional engineer licensed in the state of the project. Calculations shall be furnished when requested by Engineer.

1-2.03. Materials. Unless otherwise indicated, anchors of structural steel members connected to concrete shall have a diameter of at least 3/4 inch, and structural members connected to masonry shall have a diameter of at least 5/8 inch. Anchors for ladders and equipment shall have a diameter of at least 1/2 inch. Anchors for pedestrian railing systems shall have a diameter of at least 3/8 inch.

Unless otherwise indicated on the Drawings, anchors used in the following locations and applications shall be of the indicated materials.

Cast-In-Place Anchor Bolts and Anchor Rods

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Galvanized steel.
Other exterior locations	Galvanized steel.
Interior locations not subject to corrosion	Carbon steel.

Adhesive, Expansion, and Undercut Anchors

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Stainless steel.
Other exterior locations	Stainless steel.
Interior locations not subject to corrosion	Carbon steel.

1-3. SUBMITTALS. Data, catalog cuts, and manufacturer's research reports (from independent organizations such as ICC-ES or IAPMO UES) indicating the manufacturer and types of adhesive anchors, expansion anchors, and undercut anchors to be supplied shall be submitted in accordance with the Submittal Procedures section.

If Contractor requests use of products other than those indicated herein, calculations may be required as part of the submittal package. Calculations shall be prepared by a professional engineer licensed in the state of the project, using methods and procedures required by the building code. Contractor shall demonstrate that the proposed substitute anchors are equivalent in all necessary criteria, including strength, spacing and edge distance limitations, embedment depth limitations, temperature limitations, and any other criteria required by Engineer.

1-4. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage or corrosion. Damaged materials shall be promptly replaced. Materials shall be shipped and stored in original manufacturer's packaging.

PART 2 - PRODUCTS

2-1. MATERIALS. Unless otherwise indicated on the drawings, materials shall be as indicated below.

Cast-In-Place Anchor Bolts and Anchor Rods

Carbon steel	ASTM F1554, Grade 36 with compatible nuts.
Galvanized steel	ASTM F1554, Grade 36 with compatible nuts; hot-dip galvanized, ASTM F2329.
Stainless steel	Bolts, ASTM F593, Alloy Group 2 (minimum yield strength of 45 ksi); nuts, ASTM F594, Alloy Group 2.
Flat Washers	ANSI B18.22.1; of the same material as anchor bolts and nuts.

Expansion Anchors in Concrete	Products shall be single component anchors tested in accordance with ICC AC193, and shall have a manufacturer's research report in compliance with the applicable building code. The anchors shall be approved for use in cracked concrete, and for resisting seismic forces. Hilti "Kwik-Bolt TZ2", Simpson "Strong-Bolt 2", or DeWalt "Power-Stud+SD2" (carbon steel), "Power-Stud+SD4" (304 stainless steel), and "Power-Stud+SD6" (316 stainless steel).
Expansion Anchors in Grouted Concrete Masonry Units	Products shall be single component anchors tested in accordance with ICC AC01, and shall have a manufacturer's research report in compliance with the applicable building code. Hilti "Kwik-Bolt 1", Simpson "Wedge-All", or DeWalt "Power-Stud+ SD1".
Undercut Anchors in Concrete	Products shall be tested in accordance with ICC AC193, and shall have a manufacturer's research report in compliance with the applicable building code. Hilti "HDA Undercut Anchor" (carbon steel) and "HDA-R Undercut Anchor" (stainless steel), or DeWalt "Atomic+ Undercut Anchor" (A36 carbon steel).
Adhesive Anchors in Concrete	Products shall be tested in accordance with ICC AC308, and shall have a manufacturer's research report in compliance with the applicable building code. The anchors shall be approved for use in cracked concrete, and for resisting seismic forces.
Threaded Rods and Nuts (Carbon Steel)	ASTM A307 or ASTM F1554 Grade 36.
Threaded Rods and Nuts (Stainless Steel)	ASTM F593, CW.

Reinforcing Bars	ASTM A615, Grade 60, deformed.
Reinforcing Bars, weldable	ASTM A706, Grade 60, deformed.
Adhesive	Hilti “HIT-HY 200", or DeWalt “Pure 110+”.
Adhesive Anchors in Grouted Concrete Masonry Units	Products shall be tested in accordance with ICC AC58, and shall have a manufacturer’s research report in compliance with the applicable building code.
Threaded Rods and Nuts (Carbon Steel)	ASTM A307 or ASTM F1554 Grade 36.
Threaded Rods and Nuts (Stainless Steel)	ASTM F593 CW (Hilti or Powers systems), or ASTM A193 Grades B6, B8, or B8M (for Simpson system).
Adhesive	Hilti "HIT-HY 270", DeWalt “AC100+ Gold”, or Simpson “SET XP”.
Adhesive Anchors in Hollow Concrete Masonry Units	Products shall be tested in accordance with ICC AC58, and shall have a manufacturer’s research report in compliance with the applicable building code.
Threaded Rods and Nuts (Carbon Steel)	ASTM A307 or ASTM F1554 Grade 36.
Threaded Rods and Nuts (Stainless Steel)	ASTM F593 CW (Hilti or Powers systems), or ASTM A193 Grades B6, B8, or B8M (for Simpson system).
Adhesive	Hilti “HIT-HY 270”, DeWalt “AC100+ Gold”, or Simpson “SET XP”.
Screen Tubes	As recommended by the manufacturer.
Adhesive Anchors in Unreinforced Brick Masonry	Products shall be tested in accordance with ICC AC60, and shall have a manufacturer’s research report in compliance with the applicable building code.

Threaded Rods and Nuts	ASTM A307.
Adhesive	Hilti “HIT-HY 270”, DeWalt “AC100+ Gold”, or Simpson “SET”.
Screen Tubes	As recommended by the manufacturer.

2-2. ANCHORS.

2-2.01. Cast-in-Place Anchor Bolts and Anchor Rods. Cast-in-place anchor bolts and anchor rods shall have forged heads or embedded nuts and washers. Anchors shall be delivered in time to permit setting prior to the placing of structural concrete or masonry grout. Anchor sleeves shall not be used unless acceptable to Engineer. Unless installed in sleeves, anchor bolts and anchor rods shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two nuts, a jam nut, and a washer shall be furnished for cast-in-place anchor bolts and anchor rods indicated on the Drawings to have locknuts; two nuts and a washer shall be furnished for cast-in-place anchor bolts and anchor rods without locknuts.

2-2.02. Adhesive, Expansion, and Undercut Anchors. When adhesive, expansion, or undercut anchors are indicated on the Drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the Drawings. Alternative anchoring systems may be used only when specifically accepted by Engineer.

Unless otherwise noted, single nuts and washers shall be provided with adhesive anchors, expansion anchors, and undercut anchors. Adhesive anchors shall be free of coatings that would weaken the bond with the adhesive.

Adhesive anchors in hollow CMU masonry and unreinforced brick masonry shall utilize screen tubes as recommended by the manufacturer.

PART 3 - EXECUTION

3-1. GENERAL. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchors immediately before tightening of the nuts.

3-1.01. Compliance With Manufacturer’s Instructions. Post-installed anchors shall be installed in accordance with the manufacturer’s printed installation instructions and all applicable requirements of the manufacturer’s research report for the specific anchor system. If conflicts are found between the Drawings, the

manufacturer's printed installation instructions, and the manufacturer's research report installation requirements, Contractor shall notify Engineer for resolution.

3-1.02. Special Inspection. Special inspection requirements for cast-in-place and post-installed anchors shall be as indicated in the Code-Required Special Inspections and Procedures section. Anchorage work shall be performed in a manner that allows the inspections to take place without adversely impacting the schedule.

3-2. CAST-IN-PLACE ANCHOR BOLTS AND ANCHOR RODS. Cast-in-place anchor bolts and anchor rods shall be carefully positioned with templates and secured in the forms prior to placing concrete, or in masonry bond beams prior to placing grout. Contractor shall verify that anchorage devices are positioned in accordance with the Drawings and with applicable equipment or structure submittal drawings.

Threads, bolts, and nuts spattered with concrete or masonry grout during placement shall be cleaned prior to final installation of the bolts and nuts.

Sleeves shall be filled with non-shrink grout.

3-3. ADHESIVE ANCHORS. Adhesive shall be statically mixed in the field during application. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

Anchors or bars shall be installed in holes hammer drilled into hardened concrete or masonry. Drill shall be set to rotation-only mode when drilling into hollow CMU or into brick. Diameter of holes shall be 1/16 inch larger than the outside diameter of the rod or bar unless recommended otherwise by the anchor system manufacturer. Holes shall be prepared by removing all dust and debris using procedures recommended by the adhesive manufacturer.

Adhesive anchors and holes shall be clean, dry, and free of grease and other foreign matter at the time of installation. The adhesive shall be placed and the rods or bars shall be set in accordance with the recommendations of the manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids.

3-3.01. Concrete Installation. Unless indicated otherwise on the Drawings, reinforcing bars shall be embedded to a depth of 15 bar diameters, and threaded rods shall be embedded to a depth that will develop the yield strength of the rod.

Adhesive anchors in concrete shall be installed under the following conditions.

Minimum Age of Concrete Prior to Anchor Installation	21 days.

Concrete Temperature Range	Maximum short-term temperature 162 F, maximum long-term temperature 110 F.
Moisture Condition	Dry concrete.
Type of Lightweight Concrete	N/A
Hole Drilling and Preparation	Hammer drill only.

Installation of adhesive anchors into concrete that are either horizontal or upwardly inclined shall be performed only by personnel certified by the ACI/CRSI Adhesive Anchor Installation Certification Program.

3-3.02. Masonry Installation. Anchors shall be installed to meet all criteria in the manufacturer's installation instructions and ICC-ES reports, including but not limited to minimum compressive strength at time of installation, minimum edge distances, minimum clearances from mortar joints, minimum anchor spacing, and use of screen tubes.

3-4. EXPANSION AND UNDERCUT ANCHORS. Expansion and undercut anchors shall be installed using all procedures and accessory devices recommended by the anchor manufacturer.

End of Section

Section 09940

PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 SCOPE

A. This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for equipment and surfaces designated to be coated with heavy-duty maintenance coatings. Regardless of the number of coats previously applied, at least two field coats in addition to any shop coats or field prime coats shall be applied to all surfaces unless otherwise specified.

1.2 GENERAL

A. Cleaning, surface preparation, coating application, and thickness shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the manufacturer's minimum recommendations. When equivalent products are acceptable to Engineer, Contractor shall comply with this Specification and the coating manufacturer's recommendations.

B. Governing Standards

1. All cleaning, surface preparation, coating application, thickness, testing, and coating materials (where available) shall be in accordance with the referenced standards of the following AWWA, ANSI, NACE, SSPC, NSF, and ASTM.

C. Delivery and Storage

1. All coating products shall be received and stored in accordance with the coating manufacturer's recommendations.

1.3 SUBMITTALS

A. General Submittals and Data

1. Contractor shall submit color cards for all coatings proposed for use, together with complete descriptive specifications, manufacturer's product data sheet and the completed Coating System Data Sheets, to Engineer for review and color selection. Each product data sheet shall include application temperature limits including recoat time requirements for the ambient conditions at the site, including temperatures up to 130° F. Requests for review submitted directly to Engineer by coating suppliers will not be considered.

B. NSF 61 Compliance

1. When the proposed products will be in contact with treated or raw water in potable water treatment facilities, Contractor shall submit certifications that the proposed systems are in compliance with ANSI/NSF 61.

C. Data Sheets

1. Contractor shall submit a Coating System Data Sheet for each separately identified surface in the Metal Surfaces Coating Schedule, Concrete and Masonry Surfaces Coating Schedule, and the Miscellaneous Surfaces Coating Schedule that will be used in the Project, using the appropriate Coating System Data Sheet forms Figures 1-09940 and 2-09940 at the end of this section. Each field coating system shall be acceptable to the coating material manufacturer.

a. Coating System Data Sheets shall be assigned a unique number with a prefix letter based on the following:

Prefix	Surfaces	Fig. 09940
A	Iron and steel (coated entirely in field)	1
A	Iron and steel (shop primed)	2
C	Concrete and concrete block	1
E	Equipment submerged	1
E	Equipment Non-submerged	2
F	Nonferrous metal	1
G	Galvanized	1
H	High temperature	1
P	PVC and FRP	1

b. Each coating system that will be applied entirely in the field shall be assigned only a prefix letter and no suffix letter. Fig 1-09940 shall be submitted for each surface coated entirely in the field.

c. Each shop-applied coating system that includes one or more field applied coats shall be assigned both a prefix letter and suffix letter "F." Fig 2-09940 shall be submitted for each surface having a shop applied coating and one or more field applied finish coats.

d. A separate Coating System Data Sheet shall be developed and submitted for each surface scheduled to be coated or variation or change in a coating system. The number identifying the surface and coating system shall be of the form $A1_1$ or $A1_2$-F. The subscript number shall be assigned by the Contractor so that each surface and coating system combination is uniquely identified. For example:

   1) $A1_1$-F may be assigned to "Epoxy – one coat to metal curbs for skylights and power roof ventilators that have been shop primed."
   2) $A2_1$ may be assigned to "Epoxy – two coats to non-galvanized structural and miscellaneous steel exposed to view inside buildings."
   3) $C2_1$ may be assigned to "Epoxy – two coats to all concrete and concrete block in corrosive area (Except floors and surfaces scheduled to receive other coatings) which are exposed to view."
   4) $C2_2$ may be assigned to "Epoxy – two coats to walls, floors, and curbed areas, adjacent to corrosive chemical storage and feed equipment as indicated on the Drawings."

D. Color Submittals

1. For the epoxy and for aliphatic polyurethane, a total of not more than 15 custom colors (excluding deep tone or high level colors) may be required. The manufacturer's standard colors will be acceptable for all other coatings.

2. The manufacturer's standard colors will be acceptable for all coatings.

E. Coating System Maintenance and Repair Manual, including names and telephone numbers of emergency contacts from coating supplier.

1.4 QUALITY ASSURANCE

A. Coating System Data Sheet Certifications

1. The coating applicator and coating manufacturer shall review and approve in writing the coating manufacturer's written recommendations for the coating system and the intended service. Any variations from the Specifications or the coating manufacturers published recommendations

shall be submitted in writing and approved by the coating manufacturer. The coating manufacturer shall observe the surface preparation, mixing, and application of the coating systems and submit a written report of his observations and any additional recommendations.

B. Special Interior Coating Systems

1. The coating system for pumps, valves, fittings and concrete supports shall be as specified in data sheets attached at the end of this specification section. In case of conflict with other requirements of these specifications, the requirements of coating systems 13S2 and 13S3 shall prevail.

	Title	Surface
	Epoxy Flake Filled (EPF)/Epoxy (EPS)	Exterior of Ductile Iron Pipe.
	Concrete Repair Material (SPC)/Epoxy (EPS)	

2. In addition to the requirements for all coating systems, the coating applicator and coating manufacturer shall develop and submit, in writing, the proposed detailed procedures for handling, storing, surface preparation, mixing, and application to verify compliance with this Specification and the coating manufacturer's written recommendations. The procedures shall include copies of the coating manufacturer's published recommendations and the proposed method for complying with these recommendations and these Specifications. Contractor, coating applicator, and coating manufacturer shall review and approve, in writing, the proposed detail procedures before they are submitted for review.

3. Contractor and coating manufacturer shall inspect coating application of the appropriate application methods.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Alternative Manufacturers

1. In addition to the coatings listed herein, equivalent products of other manufacturers that distribute globally will also be considered for approval by Engineer. .

B. Equivalent Coatings

1. Whenever a coating is specified by the name of a proprietary product or of a particular manufacturer or vendor, it shall be understood as establishing the desired type and quality of coating. Other manufacturers' coatings will be considered for approval, provided that sufficient information is submitted to enable Engineer to determine that the proposed coatings are equivalent to those named. Information on proposed coatings shall be submitted for review in accordance with the Submittals Procedures section. Requests for review of equivalency will be accepted only from Contractor and will be considered only after the contract has been awarded.

2.2 MATERIALS

A. All coatings shall be delivered to the job in original, unopened containers, with labels intact. Coatings shall be stored indoors and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the coating formulation shall be added to the coating for any purpose.

B. All coatings shall conform to the air quality regulations applicable at the location of use. Coating materials that cannot be guaranteed by the manufacturer to conform, whether or not specified by product designation, shall not be used.

C. With the exception of heat resistant coatings, the coatings specified have been selected on the basis of the manufacturer's statement that the VOC content of the product is 2.8 lbs per gallon or less; however, it shall be the Contractor's responsibility to use only coating materials that are in compliance with the requirements of all regulatory agencies. Local regulations may require some coatings to have a lower VOC content than specified herein. The coatings specified may meet the VOC limits in the unthinned (as shipped) condition but may exceed the limits if thinned according to the manufacturer's recommendations. In such case, the coatings shall not be thinned beyond the 2.8 lbs per gallon limit, and if the product cannot be thinned to suit the application method or temperature limits, another manufacturer's coating shall be used, subject to acceptance by Engineer's coating shall be used, subject to acceptance by Engineer.

D. Contractor shall be responsible for ensuring the compatibility of field coatings with each other or with any previously applied coatings. Coatings used in successive field coats shall be produced by the same manufacturer. The first

field coat over shop coated or previously coated surfaces shall cause no wrinkling, lifting, or other damage to underlying coats.

E. All intermediate and finish coating materials that will be in contact with wastewater atmosphere shall be guaranteed by the manufacturer to be fume proof and suitable for wastewater plant atmosphere that contains hydrogen sulfide. Coatings that cannot be so guaranteed shall not be used. Leadfree, chromium-free, and mercury free coatings shall be used.

F. Primers

Universal Primer (tie coat)	PPG “Amerlock Sealer,” Carboline “Rustbond Series,” International Devoe “Devran 201H,” Tnemec “Series 27 F.C. Typoxy,” or Sherwin-Williams “Dura Plate 235.”
Zinc Primer	PPG “Dimetate 9 Series,” Carboline “Carbo Zinc II Series,” International Devoe “Catha-Coat 302H,” Tnemec «Series 90-97 Zinc Primer », or Sherwin-Williams “Zinc Clad II Series.”

G. Fillers and Surfacers

Epoxy Concrete Filler and Surfacer	**See data sheet attachment 13S3.**

H. Intermediate and Finish Coatings

Epoxy (NSF certified systems)

Ferrous Metal Surfaces and Concrete Surfaces in Contact with Treated or Raw Water in Potable Water Facilities	PPG “Amerlock 400 High-Solids Epoxy Coating,” Carboline “Carboguard 891 VOC,” International Devoe “Bar-Rust 233H” Tnemec “Series N140 Pota-Pox Plus,” or Sherwin-Williams “Dura Plate 235 NSF”; immersion service.

Epoxy

Concrete Floors	PPG “Amerlock 2/400,” Carboline “Carboguard 890,” International Devoe “Devran 224V,” Tnemec “Series N69 Hi-Build Epoxoline II,” or Sherwin-Williams “Armorseal 1000HS”; nonskid.
Ferrous Metal Surfaces and Masonry or Concrete Surfaces Other Than Floors	PPG “Amercoat 385 Epoxy,” Carboline “Carboguard 890,” International Devoe Devran “224V,” Tnemec “Series N69 Hi-Build Epoxoline II,” or Sherwin-Williams “Dura Plate 235.”
Flake-Filled Epoxy	**See Data Sheet attachment 13S2.**
Aliphatic Polyurethane	PPG “Pitthane Ultra,” Carboline “Carbothane 134HG,” International “Intervane 990V” Tnemec “Series 1074 Endura-Shield II,” or Sherwin-Williams “Acrolon 218HS.”
Coal Tar Epoxy/ High-build coal tar epoxy	PPG Amercoat “78HB Coal Tar Epoxy,” Carboline “Bitumastic 300 M,” Tnemec “46H-413 Hi-Build Tneme-Tar,” International “Interzone 954 Black" or Sherwin-Williams “Targuard Coal Tar Epoxy”
Medium Consistency Coal Tar	PPG Amercoat 240 Black, Carboline “Bitumastic 50” International “Devoe Bar-Rust 236 Black” or Tnemec “46-465 H.B. Tnemecol.”
Vinyl Ester	Tnemec “Series 120 Vinester” Carboline “Plasite 4110” or Sherwin-Williams “Magnalux 304FF.” International Paint «Ceilcote 232 Flakeline »
Heat-Resistant (Suitable for temperatures up to 400□ F [207□ C]	PPG “Hi Temp 500,” Carboline “Thermaline 450,” Tnemec “43-36 Chrome Aluminum,” International “Interbond 2340UPC” or Sherwin-Williams “Heat-Flex Hi-Temp 500.”
High Heat-Resistant (Suitable for temperatures up to 1000□ F [537□ C]	PPG “Hi Temp 1000,” Carboline “Thermaline 4700 VOC,” or Sherwin-Williams “Heat-Flex Hi-Temp 1000.”

Acrylic Latex Emulsion (Flat)	PPG “Pitt Tech Series”, Carboline “Carbocrylic 3359”, International “Intercryl 520 Waterborne Acrylic” or Tnemec “Series 1026 Enduratone”.
Acrylic Latex Emulsion (semi-gloss)	PPG “Pitt Tech Series”, Carboline “Carbocrylic 3359”, Sherwin-Williams “SherCryl HPA Semi-Gloss”, or Tnemec “Series 1029 Enduratone”.
Acrylic Latex Emulsion (Gloss)	PPG “Pitt Tech Series”, Carboline “Carbocrylic 3359”, Sherwin-Williams “SherCryl HPA Gloss”, International “Intercryl 530 Waterborne Acrylic” or Tnemec “Series 1028 Enduratone”.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. All surfaces to be coated shall be clean and dry and shall meet the recommendations of the coating manufacturer for surface preparation. Freshly coated surfaces shall be protected from dust and other contaminants. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss on previously coated surfaces shall be dulled if necessary for proper adhesion of topcoats.

B. Surfaces shall be free of cracks, pits, projections, or other imperfections that would interfere with the formation of a smooth, unbroken coating film, except for concrete block construction where a rough surface is an inherent characteristic.

C. When applying touchup coating or repairing previously coated surfaces, the surfaces to be coated shall be cleaned as recommended by the coating manufacturer, and the edges of the repaired area shall be feathered by sanding or wire brushing to produce a smooth transition that will not be noticeable after the coating is applied. All coatings made brittle or otherwise damaged by heat of welding shall be completely removed.

D. Galvanized Surfaces

1. When a coating is required, galvanized surfaces shall be prepared for coating according to the instructions of the manufacturer of the epoxy. Any chemical treatment of galvanized surfaces shall be followed by thorough rinsing with clean water.

E. Ferrous Metal Surfaces

1. Ungalvanized ferrous metal surfaces shall be prepared for coating by using one or more of the following cleaning procedures specified here-in: solvents (SSPCSP1); abrasive blasting (SSPC-SP5, -SP10, -SP6, or -SP7) power tools (SSPCSP3 or -SP11); or hand tools (SSPCSP2). Oil and grease shall be completely removed in accordance with SSPCSP1 before beginning any other cleaning method. Surfaces of welds shall be scraped and ground as necessary to remove all slag and weld spatter. Tools which produce excessive roughness shall not be used.

2. All components of equipment that can be properly prepared and coated after installation shall be installed prior to surface preparation. Components that will be inaccessible after installation shall have the surfaces prepared and coated before installation. Motors, drive trains, and bearings shall be protected during surface preparation in accordance with the equipment manufacturer's recommendations.

3. All cut or sheared edges shall be ground smooth to a 1/8 inch minimum radius for all material 1/4 inch thickness and larger. For material thickness less than 1/4 inch all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of the 1/16 inch will not be required.

4. All ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard SP0178, Appendix C, Designation C and sharp edges ground smooth, if not previously prepared in the shop. Instead of blending of the weld with the base metal as required by the NACE standard, it will be acceptable to furnish a welded joint that has a smooth transition of the weld to the base metal. All welds shall be ground smooth to ensure satisfactory adhesion of paint.

5. The cleaning methods and surface profiles specified herein are minimums, and if the requirements printed in the coating manufacturer's data sheets exceed the limits specified, the value printed on the data sheets shall become the minimum requirement.

6. Ferrous Metal Surfaces – Non-immersion Service

   a. Ferrous metal surfaces, including fabricated equipment, in non-immersion service shall be cleaned to the degree recommended by the coating manufacturer for surfaces to be coated with coal tar epoxy, epoxy, and heat-resistant coatings, except galvanized surfaces. Surface preparation of ferrous metal surfaces in non- immersion service shall consist of abrasive blast cleaning to NAPF 500-03-04, and the first application of coating shall be performed on the same

day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of Engineer. Surface profile shall be as recommended by coating manufacturer, but not less than 20 mils per coating system Data Sheet 13S2.

7. Ferrous Metal Surfaces - Immersion Service

   a. Surface preparation of ferrous metal surfaces in immersion service shall consist of abrasive blast cleaning to at least SSPC-SP10 and the first application of coating shall be performed on the same day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of Engineer. Surface profile shall be as recommended by coating manufacturer, but not less than 3.5 mils.

F. Concrete Surfaces

1. All concrete surfaces shall be free of objectionable substances and shall meet the coating manufacturer's recommendations for surface preparation. Concrete surfaces shall be prepared in accordance with SSPC-SP13/NACE 6. Any other surface preparation recommended by the coating material manufacturer shall be brought to Engineer's attention and may be incorporated into the work if acceptable to Engineer.

2. All concrete surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, and other objectionable substances. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started.

3. New concrete shall have sufficiently cured for at least 4 weeks or reached moisture content levels at or below the material manufacturer's requirements before coating is applied. Concrete surfaces shall be tested for capillary moisture in accordance with ASTM D4263. There shall be no capillary moisture when coatings are applied on concrete.

4. All surfaces to be coated shall be cleaned and prepared in accordance with the printed manufacturer's requirements or ASTM D4258 and abraded in accordance with ASTM D4259. Surface profile shall be at least 25 percent of the dry film thickness specified for the coating system. Prior to application of the coating, the surfaces shall be thoroughly washed or cleaned by air blasting to remove all dust and residue. Spalled areas, voids, and cracks shall be repaired in accordance with the Concrete section and as acceptable to the Engineer. Fins and other surface projections shall be removed to provide a flush surface before application of coating.

5. Except where epoxy is applied as damp-proofing, the concrete surfaces, including those with bug holes less than 1 inch in any dimension, shall be prepared as recommended by the manufacturer, using an epoxy concrete filler and surfacer. Where coating with a vinyl ester the concrete filler and surfacer shall be as recommended by the manufacturer to be compatible with vinyl ester.

G. Concrete Block Surfaces

1. Voids and openings in concrete block surfaces shall be pointed. All exposed exterior surfaces and surfaces to be coated with epoxy, including the joints, shall be filled so that a continuous unbroken coating film is obtained.

H. Copper Tubing

1. All flux residue shall be removed from joints in copper tubing. Immediately before coating is started, tubing shall be wiped with a clean rag soaked in xylol.

I. Plastic Surfaces

1. All wax and oil shall be removed from plastic surfaces that are to be coated, including PVC and FRP, by wiping with a solvent compatible with the specified coating.

J. Hardware

1. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to coating if there is no evidence of dirt, corrosion, or foreign material.

K. Aluminum

1. When a coating system is required, remove all oil or deleterious substance with neutral detergent or emulsion cleaner or blast lightly with fine abrasive.

L. Stainless Steel

1. When a coating system is required, surface preparation shall conform to the coating manufacturer’s recommendations.

M. Existing Coated Surfaces.

1. Existing surfaces which are anticipated to be modified or disturbed by the Work have been tested for lead and chromium and the results are presented in the existing Hazardous Environmental Condition report identified in the Supplemental Conditions. Some surfaces tested positive for lead and

chromium. As indicated in the Project Requirements section, Contractor shall abate all paint, protective coatings, and linings containing detectable quantities of lead, chromium, or other heavy metals that are in areas potentially impacted, damaged, or disturbed during execution of the Work.

2. Existing Piping. Testing of the existing coatings on existing piping to be coated shall be conducted to determine adhesion capability and compatibility with the coatings specified herein. Existing coatings on piping shall be checked and prepared as recommended by the coating manufacturer and topcoated with the specified coatings. If necessary, existing coatings shall be removed to bare substrate. The piping shall be cleaned, primed, and coated as specified.

3. Existing Concrete and Concrete Block Surfaces. Existing concrete and concrete block surfaces which have been coated shall be prepared in accordance with ASTM D4261 and ASTM D4258 and the coating manufacturer's recommendations.

4. Existing Equipment Surfaces. Existing surfaces of equipment that is modified shall be prepared as indicated above for non-immersion or immersion service as applicable.

3.2 Other Existing Coated Surfaces. Other existing coated surfaces which are indicated on the drawings to be recoated shall be prepared in accordance with the coating manufacturer's recommendations.

3.3 MIXING AND THINNING

A. Coating shall be thoroughly mixed each time any is withdrawn from the container. Coating containers shall be kept tightly closed except while coating is being withdrawn.

B. Coating shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied coating be reduced, by addition of coating thinner or otherwise, below the thickness recommended by the coating manufacturer. Thinning shall be done in compliance with all applicable air quality regulations.

3.4 APPLICATION

A. Coating shall be applied in a neat manner that will produce an even film of uniform and proper thickness, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be thoroughly dry and hard before the next coat is applied. Each coat shall be a different color, if available. In no case shall coating be applied at a rate of coverage greater than the maximum rate recommended by the coating manufacturer.

B. Coating failures will not be accepted and shall be entirely removed down to the substrate and the surface recoated. Failures include but are not limited to sags, checking, cracking, teardrops, fat edges, fisheyes, or delamination.

C. Priming

1. Edges, corners, crevices, welds, and bolts shall be given a brush coat (stripe coat) of primer before application of the primer coat. The stripe coat shall be applied by a brush and worked in both directions. Special attention shall be given to filling all crevices with coating. When using zinc primers the stripe coat shall follow the initial prime coat.

2. Abraded and otherwise damaged portions of shop-applied coating shall be cleaned and recoated as recommended by the manufacturer of the finish coating. Welded seams and other uncoated surfaces, heads and nuts of field-installed bolts, and surfaces where coating has been damaged by heat shall be given a brush coat of the specified primer. Before the specified spot or touchup coating of metal surfaces, edges, corners, crevices, welds, and bolts in the area of the spot or touchup coating shall be given a brush coat of primer. This patch, spot, or touchup coating shall be completed, and the paint film shall be dry and hard, before additional coating is applied.

D. Epoxy

1. When used, epoxy shall be applied in accordance with the coating manufacturer’s recommendations, including temperature limitations and protection from sunlight until top-coated.

2. When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

3. When applying high build epoxy coatings with a roller or brush and where a dry film thickness of at least 4-6 mils per coat is required, two or more coats shall be applied to achieve the recommended dry film thickness equal to a spray applied coating.

E. Coal Tar Epoxy

1. When used, the application of coal tar epoxy, including time limits for recoating, shall conform to the recommendations of the coating manufacturer.

2. When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

F. Vinyl Ester

1. When used, the application of vinyl ester coating system, including time limits for recoating and temperature requirements of the materials, shall conform to the recommendations of the coating manufacturer.

G. Film Thickness

1. The total coating film thickness including intermediate coats and finish coat, shall be not less than the following:

Type of Coating	Minimum Dry Film Thickness
Medium consistency coal tar	20 mils.
Coal tar epoxy (two coats)	20 mils
Epoxy	
Floors (two coats)	10 mils.
Surfaces with first coat of epoxy and final coat of aliphatic polyurethane	7 mils (5 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Surfaces with first and second coat of epoxy and final coat of aliphatic polyurethane	12 mils 300 µm (10 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Other surfaces (two coats)	10 mils.
Immersion service (three coats)	15 mils.
Flake-filled epoxy (two coats)	**See data sheet Attachment 13S2.**
Vinyl ester	30 mils
Zinc, epoxy, polyurethane	
Surfaces with first coat of zinc, intermediate coat of epoxy, and	10 mils, 3 mils 75 µm zinc,

Type of Coating	Minimum Dry Film Thickness
final coat of aliphatic polyurethane	5 mils epoxy, plus 2 mils for aliphatic polyurethane.
Heat-resistant (silicone)	3 mils.
High heat-resistant (silicone)	3 mils.
Other (one coat)	5 mils.
Other (two coats)	10 mils.

H. Weather Conditions

1. Coatings shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied coating.

2. Coatings shall not be applied at temperatures lower than the minimum temperature recommended by the coating manufacturer, or to metal surfaces such as tanks or pipe containing cold water, regardless of the air temperature, when metal conditions are likely to cause condensation. When necessary for proper application, a temporary enclosure shall be erected and kept heated until the coating has fully cured.

3. Coatings shall not be applied at temperatures higher than the maximum temperature recommended by the coating manufacturer. Where coatings are applied during periods of elevated ambient temperatures, Contractor and the coatings manufacturer shall be jointly responsible to ensure that proper application is performed including adherence to all re-coat window requirements. Precautions shall be taken to reduce the temperature of the surface application, especially for metal, at elevated temperatures above 100° F including shading application area from direct sunlight, applying coating in the evening or at night, and ventilating the area to reduce the humidity and temperature,

4. Vinyl ester coating materials, when required, shall be maintained during transportation, storage, mixing, and application at the temperature required by the coating manufacturer, 35° F to 90° F.

3.5 REPAIRING FACTORY FINISHED SURFACES

A. Factory finished surfaces damaged prior to acceptance by Owner shall be spot primed and recoated with materials equivalent to the original coatings. If, in the opinion of Engineer, spot repair of the damaged area is not satisfactory, the entire surface or item shall be recoated.

3.6 PROTECTION OF SURFACES

A. Throughout the work Contractor shall use drop cloths, masking tape, and other suitable measures to protect adjacent surfaces. Contractor shall be responsible for correcting and repairing any damage resulting from its or its subcontractors' operations. Coatings spilled or spattered on adjacent surfaces which are not being coated at the time shall be immediately removed. Exposed concrete or masonry not specified to be coated which is damaged by coatings shall be either removed and rebuilt or, where authorized by Owner, coated with two coats of masonry coating.

3.7 FIELD QUALITY CONTROL

A. The following inspection and testing shall be performed: surface profile, visual inspection, spark testing, and wet and dry film thickness testing. All inspection and testing shall be witnessed by Engineer.

B. Surface Profile Testing

1. The surface profile for ferrous metal surfaces shall be measured for compliance with the specified minimum profile. The surface profile for concrete shall comply with SSPC 13/NACE 6 Table 1 for severe service.

C. Visual Inspection

1. The surface of the protective coatings shall be visually inspected.

D. Film Thickness

1. Coating film thickness shall be verified by measuring the film thickness of each coat as it is applied and the dry film thickness of the entire system. Wet film thickness shall be measured with a gauge that will measure the wet film thickness within an accuracy of ±0.5 mil. Dry film thickness shall be measured in accordance with SSPC-PA 2.

E. Spark Testing

1. Coatings shall be spark tested by the coating manufacturer using an acceptable electrical spark tester set at the recommended voltage. Engineer shall observe the spark testing and shall verify the testing equipment is working properly before the spark testing of the coating is started. The electrode movement shall be continuous and shall proceed in a systematic manner that will cover 110 percent of the coated surface.

2. Spark testing for coatings on metal shall be done in accordance with ASTM D5162. Spark testing for coating on concrete shall be done in accordance with ASTM D4787.

3. All detected holidays and pinholes shall be marked and repaired as recommended by the coating material manufacturer.

F. Adhesion Testing – Not Used

3.8 FIELD PRIMING SCHEDULE

A. In general, steel and cast-iron surfaces of equipment are specified to be shop primed. Any such surfaces which have not been shop primed shall be field primed. Damaged or failed shop coatings which have been determined unsuitable by Engineer shall be removed and the surfaces shall be field coated, including prime coat (if any). Galvanized, aluminum, stainless steel, and insulated surfaces shall be field primed. Primers used for field priming, unless otherwise required for repair of shop primers, shall be:

Surface To Be Primed	Material
Equipment, surfaces to be coated with	
Aliphatic polyurethane	Universal primer.
Epoxy	Same as finish coats.
Coal tar coating	Same as finish coats.
Vinyl ester	Same as finish coats.
Steel and cast iron, surfaces to be coated with	
Epoxy	Same as finish coats or inorganic zinc.
Coal tar coating	Same as finish coats.
Aluminum	Epoxy.
Galvanized	Epoxy.
Copper	Epoxy.
Stainless steel	Epoxy.
Plastic surfaces, including PVC and FRP	Same as finish coats.
Insulated steel or cast iron piping	Universal primer.
Piping Insulation	As Recommended by manufacturer of finish coats.

Surface To Be Primed	Material
Concrete, surfaces to be coated with epoxy	
For damp-proofing	Epoxy.
For all other surfaces	Epoxy concrete filler and surfacer **(See data sheet Attachment 13S3)**.
Concrete block exposed in exterior locations	Epoxy concrete block filler.
Concrete block to be coated with epoxy	Epoxy concrete block filler **(See data sheet Attachment 13S3)**.

B. Unless otherwise recommended by the coating manufacturer or specified herein, priming will not be required on concrete, or concrete block, nor on metal surfaces specified to be coated with coal tar epoxy, and heat-resistant coatings. Concrete surfaces to be coated with epoxy shall be filled with epoxy concrete filler and surfacer so that a continuous film is obtained, except where concrete is damp-proofed with epoxy.

3.9 FINISH COATING SYSTEMS

A. The following schedule lists coatings systems and coating surface designations. See Article 1-3 for a definition of the surface designations.

No.	Finish Coating Systems	Coating Surface Designation						
		A	C	E	F	G	H	P
1.	Epoxy – One coat	x			x	x		
2.	Epoxy – Two coats Epoxy – Finish coat **(See data sheet attachment 13S3)**	x	x	x	x	x		x
3.	Epoxy / NSF – Two coats		x	x				
4.	Epoxy – Three coats	x	x	x				
5.	Epoxy / NSF – Three coats	x	x	x				
6.	Epoxy – First coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		x
7.	Epoxy – First and second coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		

No.	Finish Coating Systems	Coating Surface Designation						
		A	C	E	F	G	H	P
8.	Universal primer – First coat Aliphatic polyurethane – Finish coat	x		x				
9.	Medium consistency coal tar – Two coats	x	x	x				
10.	Coal tar epoxy – Two coats	x	x	x				
11.	Vinyl ester – Two coats	x	x	x				
12.	Heat resistant – Two coats						x	
13.	High heat resistant – Two coats						x	
14.	Zinc primer – First coat Epoxy – Intermediate coat Aliphatic polyurethane – Final coat	x		x				
15.	Flake-filled epoxy – First coat Epoxy – Finish coat **(See data sheet attachment 13S2)**	x		x				
16.	Acrylic Latex Emulsion		x					x

B. Surfaces Not To Be Coated

1. Unless otherwise specified, the following surfaces shall be left uncoated:

   a. Exposed aluminum, except ductwork.
   b. Polished or finished stainless steel. Unfinished stainless steel, except flashings and counter flashings, shall be coated.
   c. Nickel or chromium.
   d. Galvanized surfaces, except piping, conduit, ductwork, and other items specifically noted Hot dipped galvanized fabrications, including fabricated pipe supports, except where specifically noted. Rubber and plastics, except as specified.
   e. Exterior concrete.
   f. FRP wastewater troughs.
   g. Surfaces specified to be factory finished.

C. Shop Finishing

1. Items to be shop finished including the following. Shop finishing shall be in accordance with the coating manufacturer's recommendations.

a. All slide gates.
b. All conveyors.
c. Other surfaces where blast cleaning cannot be or is not recommended to be performed in the field.
d. Other items as otherwise specified.

D. Field Coating

1. Items to be field coated include the following. Field coating shall be in accordance with the field priming schedule, the coating schedule, and the manufacturer's recommendations.

a. Exterior surface of the sludge hopper.
b. Surfaces not indicated to be shop finished and surfaces where blast cleaning can be performed in the field.
c. All interior ferrous metal surfaces except stainless steel on the digester cover.
d. Other items as otherwise specified.

3.10 METAL SURFACES COATING SCHEDULE

Surfaces to be coated shall include new work, including Owner furnished equipment and surfaces disturbed by the Work. Surfaces that are not disturbed will not require recoating unless noted otherwise on the Drawings.

Surface To Be Coated	Finish Coating System
Non-galvanized and galvanized structural and miscellaneous steel exposed to view or to the elements in exterior locations.	A6, A7, A14
Non-galvanized and galvanized structural and miscellaneous steel exposed to view inside buildings.	A2
Unless otherwise specified, pumps, motors, speed reducers, and other machines and equipment exposed to view.	E15
Actuator surfaces for sluice gates, gates, weirs, unless factory finished.	Indoor – E15
Ductile Iron and steel piping inside buildings, including piping to be insulated, valves, fittings, flanges, bolts, pipe support, hangers, and accessories and galvanized surfaces after proper priming.	A15
Pipe supports, hangers, bolts, and accessories inside buildings and galvanized surfaces after proper priming.	A15

Surface To Be Coated	Finish Coating System
Copper pipe and tubing, including fittings and valves.	F1
Copper pipe and tubing, including fittings and valves exposed to view in exterior locations.	F6
Supports and miscellaneous metal for equipment handling corrosive chemicals.	Outdoor – A6 Indoor – A2
Aluminum in contact with concrete.	F1
Aluminum and galvanized ductwork and conduit indoors.	F2 or G2
Aluminum and galvanized ductwork and conduit exposed to elements outdoors.	F7 or G7

3.11 CONCRETE AND MASONRY SURFACES COATING SCHEDULE

Surfaces to be coated shall include new work and surfaces disturbed by the Work. Surfaces that are not disturbed will not require recoating unless noted otherwise on the Drawings.

Surface To Be Coated	Finish Coating System
All concrete and concrete block [in corrosive areas] (Except floors and surfaces scheduled to receive other coatings) which are exposed to view.	Indoor –C2 Outdoor –C7
Interior surfaces of filter wash water flumes.	C5
Filter wash water troughs.	C5
Interior surfaces of sludge drawoff boxes.	C10
Concrete block surfaces in carbon handling rooms and janitors closets.	C2
Where indicated on the Drawings, walls, floors, and curbed areas, adjacent to corrosive chemical storage and feed equipment.	C2
All walls in contact with liquid where the opposite face forms a part of an interior room or dry pit.	C4C5
All walls in contact with treated or potable water where the opposite face is above grade or which form is a part of an interior room or a dry pit.	C5

All surfaces, including basin walls, in contact with treated or potable water.	C5
All interior surfaces of walls in flocculation basins where the wall is also part of an interior room or dry pit.	C5
All interior surfaces of walls in a clearwell where the wall is also part of an interior room or dry pit.	C5
Interior walls of filter boxes, full height above underdrains and including edges of walkways.	C5
Interior walls for architectural finish only	C2,C15

3.12 MISCELLANEOUS SURFACES COATING SCHEDULE.

Plastic Surfaces, including PVC and FRP.	Outdoor – P6 Indoor – P2
Piping Insulation	Outdoor – P6 Indoor – P2

3.13 PIPING IDENTIFICATION SCHEDULE

A. Exposed piping and piping in accessible chases shall be identified with lettering or tags designating the service of each piping system, marked with flow directional arrows, and color coded.

B. Piping scheduled to be color coded shall be completely coated with the indicated colors, except surfaces specified to remain uncoated shall include sufficiently long segments of the specified color to accommodate the lettering and arrows. All other piping shall be coated to match adjacent surfaces, unless otherwise directed by Engineer.

C. Location

1. Lettering and flow direction arrows shall be provided on pipe near the equipment served, adjacent to valves, on both sides of wall and floor penetrations, at each branch or tee, and at least every 50 feet 15 m in straight runs of pipe. If, in the opinion of Engineer, this requirement will result in an excessive number of labels or arrows, the number required shall be reduced as directed.

D. Metal Tags

1. Where the outside diameter of pipe or pipe covering is 5/8 inch or smaller, aluminum or stainless steel tags shall be provided instead of lettering. Tags shall be stamped as specified and shall be fastened to the pipe with suitable chains. Pipe identified with tags shall be color coded as specified.

E. Lettering

1. Lettering shall be painted or stenciled on piping or shall be applied as snapon markers. Snapon markers shall be plastic sleeves, Brady "BradysnapOn B915," Seton "Setmark," or equal. Letter size shall be as follows:

Outside Diameter of Pipe or Covering	Minimum Height of Letters
5/8 inch and smaller	Metal tags -1/4 inch
3/4 to 4 inches	3/4 inch
5 inches and larger	2 inches

F. Color Coding and Lettering

1. All piping for the following services shall be color coded. Bands shall be 6 inches wide spaced along the pipe at 5 foot intervals. For services not listed, the color coding and lettering shall be as directed by the Engineer.

2. Contractor shall confirm topcoat color with Owner and Engineer prior to application.

Piping Identification		
Service	**Color of Pipe**	**Color of Letters**
Chlorine (solution)	Yellow	Black
Drain	Dark gray	White
Non-potable Water (downstream of backflow preventer)	Purple	Black[2]
Plant Effluent Water	Purple	Black[3]
Plumbing Vents	Dark gray	White
Potable Water (hot or cold)	Dark blue	White[4]
Scum	Dark brown	White
Sludge	Dark brown	White

G. Notes:

1. Lettering shall read, “CAUTION: NONPOTABLE WATER, DO NOT DRINK.”

2. Lettering shall be on a yellow background and shall read, “CAUTION: NONPOTABLE WATER, DO NOT DRINK.” Each outlet on the non-potable water line shall be similarly labeled.

3. Lettering shall read, “CAUTION: RECLAIMED WATER, DO NOT DRINK.”

4. Lettering shall be on a light green background.

5. Electrical conduit shall be coated to match adjacent ceiling or wall surfaces as directed by Engineer. Vent lines shall be coated to match surfaces they adjoin.

6. In addition, special coating of the following items will be required:

Item	Color
Valve handwheels and levers	Consistent with piping color where valve is used.

7. Numerals at least 2 inches high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the Drawings or in the Specifications by number.

H. Coating System Maintenance and Repair Manual

1. Contractor shall submit a coating maintenance and repair instructions manual specific to the coating systems provided as part of this Work.

2. Manual shall be prepared by the coating system supplier and shall include procedures for handling regular maintenance and emergency repairs and field applications; and names and emergency telephone numbers of coating field service representatives who can be contacted during an emergency.

End of Section

SURFACE DESCRIPTION	SYSTEM NO. -

SURFACE PREPARATION DESCRIPTION
☐ Solvent SSPC-SP1
☐ Ferrous Metal Nonimmersion SSPC-SP6
☐ Ferrous Metal Immersion
☐ SSPC-SP10
☐ SSPC-SP-5
☐ Other

COATING	DFT mils [µm]	MANUFACTURER AND PRODUCT
First Coat (Primer)		
Second Coat		
Third Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 1-09940

SHOP PRIMED SURFACE DESCRIPTION	SYSTEM NO. -	-F

SURFACE PREPARATION DESCRIPTION
☐ Solvent SSPC-SP1 ☐ Other:

COATING	DFT mils [µm]	MANUFACTURER AND PRODUCT
Shop (Primer)		(Identify Product/Type)
Touchup		
Intermediate Coat		
Finish Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 2-09940

Project	409283 – Richard A. Heyman Environmental Protection Facility
Description	Flake glass epoxy base coat and epoxy finish (available in a wide range of colors for client selection)
Surfaces	Exterior of ductile iron pipe

Regulatory Compliance	Products must comply with all regulations regarding volatile organic compound (VOC) content and any restricted solvents for the point of application and, as required, for the site location.

Approved Products	Coating manufacturers and products other than those listed herein are subject to Engineer's review/approval.	
Manufacturer	**First Coat**	**Second Coat**
Carboline	Carboguard 890 GF	Carboguard 890
Sherwin-Williams	Sher-Glass FF	Macropoxy 646

Surface Preparation	NAPF 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe, and NAPF 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
Remarks	

Dry Film Thickness (DFT)

	Generic Coating Type	Minimum DFT	Maximum DFT	Shop (S) or Field (F) Applied	Remarks
First Coat	EPF	10 mils (250 μm)	14 mils (350 μm)	S	
Second Coat	EPS	4 mils (100 μm)	6 mils (150 μm)	S	
Completed System		14 mils (350 μm)	20 mils (500 μm)		Dry film thickness to be verified in accordance with SSPC-PA 2.

Project	409283 – Richard A. Heyman Environmental Protection Facility
Description	Concrete repair material, epoxy primer, epoxy finish
Surfaces	Concrete pedestals

Regulatory Compliance	Products must comply with all regulations regarding volatile organic compound (VOC) content and any restricted solvents for the point of application and, as required, for the site location.

Approved Products	Coating manufacturers and products other than those listed herein are subject to Engineer's review/approval.	
Manufacturer	**First Coat**	**Second Coat**
Carboline	Rustbond	Carboguard 890
Sherwin-Williams	Macropoxy 5000	Macropoxy 646

Surface Preparation	Thoroughly clean surfaces followed by removal of all loose coating and abrading of existing tightly adhered coating and feather edging.
Remarks	Fill cracks and resurface to original profile with an epoxy putty or a cementitious surfacer (the latter will require full cure before overcoating).

Dry Film Thickness (DFT)

	Generic Coating Type	Minimum DFT	Maximum DFT	Shop (S) or Field (F) Applied	Remarks
First Coat	EPS	1 mil (25 µm)	2 mils (50 µm)	F	
Second Coat	EPS	4 mils (100 µm)	6 mils (150 µm)	F	
Completed System		5 mils (125 µm)	8 mils (200 µm)		

Section 11150

SUBMERSIBLE PUMPS

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing pedestal, single-stage, submersible, non-clog, end suction centrifugal pumping units and controls as indicated herein or on the Drawings.

Pump application.	Return Activated Sludge (RAS)	Waste Activated Sludge (WAS)
Number of pumps.	4	2
Tag numbers.	RAS-PMP-01, RAS-PMP-02, RAS-PMP-03, RAS-PMP-04	WAS-PMP-01, WAS-PMP-02
Pump location.	Ground level of Pump Room	Ground level of Pump Room

Each pumping unit shall be complete with a close-coupled, submersible electric motor, and all other appurtenances specified, or otherwise required for proper operation. Adjustable frequency drives shall be provided for the RAS pumps.

Each pumping unit, including motor and all integral controls, shall be rated and labelled for use in a Non area as defined by the National Electric Code.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer. Hydraulic considerations and definition of terms shall be as set forth in the Hydraulic Institute Standards.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence.

1-2.02. Seismic Design Requirements. Seismic design requirement for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

1-2.03. Tagging. Each item of equipment and each part shipped separately shall be tagged and identified with indelible markings for the intended service.

Tag numbers shall be clearly marked on all shipping labels and on the outside of all containers.

1-2.04. Power Supply. Unless otherwise indicated, power supply to the equipment shall be 480 volts, 60 Hz, 3 phase.

1-2.05. Identification. Pumps shall be identified in accordance with the Drawings and Equipment and Valve Identification section.

1-2.06. Delivery, Storagen and Handling. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section and manufacturer's recommendation.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittal Procedures section. The data and specifications for each unit shall include, but shall not be limited to, the following:

Pumps
- Name of manufacturer.
- Type and model.
- Tag number.
- Pump designation.
- Pump location.
- Rotative speed.
- Size of suction nozzle.
- Size of discharge nozzle.
- Net weight of pump and motor only.
- Net weight with pedestal, when specified.
- Complete performance curves showing capacity versus head, NPSH required, pump efficiency, wire-to-water efficiency, and pump input power.
- Data on shop painting.

Motors
- Name of manufacturer.
- Type and model.
- Type of bearings and method of lubrication.
- Rated size of motor, hp, and service factor.
- Insulation class and temperature rise.
- Full load rotative speed.
- Efficiency at full load and rated pump condition.
- Full load current.

Locked rotor current.

Adjustable Frequency Drives

As specified in 16150, Low Voltage Variable Frequency Drives.

Control Components

Type and manufacturer.

Model.

Enclosure rating.

Published descriptive data on all components, indicating all specific characteristics and options.

Seismic Design Requirements

Confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section.

1-3.02. Operation and Maintenance Data and Manuals. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. QUALITY ASSURANCE.

1-4.01. Balance. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the unfiltered vibration velocity, as measured at any point on the machine including top of motor, shall not exceed the maximum velocity as indicated in Figure 11.6.9.4 of the governing standard.

At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

1-5. SPARE PARTS. A list of proposed spare parts shall be provided.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS.

The equipment provided under this section shall be suitable for the following service conditions:

Seismic design requirements.	See Meteorological and Seismic Design Criteria section
Maximum ambient air temperature (dry pit).	104 °F

Maximum liquid temperature.	80	°F
Maximum solids concentration, by weight.	0.5	%
Pumps start and stop against a closed valve.	No	
Site elevation.	See Meteorological and Seismic Design Criteria section	

All equipment furnished shall be designed to meet all specified conditions and to operate satisfactorily at the elevation indicated.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS.

Pumping units shall be designed for the following performance and design requirements:

Pump tag numbers.	RAS-PMP-01 RAS-PMP-02 RAS-PMP-03 RAS-PMP-04	WAS-PMP-01 WAS-PMP-02	
Rated head.	24.4	16.1	ft
Capacity at rated head.	1580	259	gpm
Operating head range for full speed continuous operation.	12 to 36	8 to 24	ft
Minimum shutoff head.	47	28	ft
Maximum nominal pump speed.	1140	1140	rpm
Minimum head at reduced speed.	6	NA	ft
Capacity at minimum head at reduced speed.	800	NA	gpm
Approximate minimum pump speed.	1150	NA	rpm
Maximum power required at pump input shaft at any point from minimum operating head to shutoff head.	25	5	hp
Pump efficiency at rated head.	71	69	%

Pump tag numbers.	RAS-PMP-01 RAS-PMP-02 RAS-PMP-03 RAS-PMP-04	WAS-PMP-01 WAS-PMP-02	
Minimum NSPHA at rated head.	10.7	5	ft
Minimum pump suction nozzle size (pedestal mounted).	8	3	in
Minimum pump discharge nozzle/elbow size.	8	4	in
Minimum test sphere diameter.	3	3	in

All specified conditions shall be at rated speed unless otherwise indicated.

Overall (wire-to-water) efficiency for constant speed pumps shall include losses in the pump and motor. Overall (wire-to-water) efficiency for variable speed pumps shall include losses in the pump, motor, and if required, variable frequency drive, and any transformers supplied as part of the variable frequency drive equipment.

The minimum hydrostatic test pressure shall be 1.5 times shutoff head plus max suction pressure.

Pump performance shall be stable and free from cavitation and noise throughout the specified operating head range at minimum suction submergences. The design running clearance between the impeller inlet and the casing wearing ring (if provided) shall be not less than 0.01 inch or 1 mil per inch of casing wearing ring diameter, whichever is greater.

2-3. MATERIALS.

Stator Housing, Oil Chamber Housing, and Impeller Casing	Cast iron, ASTM A48.
Impeller (if enclosed)	Cast iron, ASTM A48.
Casing Wearing Ring	Bronze ASTM B62; or rubber.
Impeller Wearing Ring	Martensitic stainless steel, Brinell 200-250.

Bottom Wearing Plate	Hardened cast iron, ASTM A48 with spiral grooves, Brinell Hardness of 650+.
Shaft	Alloy steel, hard chrome plated; or martensitic stainless steel, AISI Type 416 or 420.
Mechanical Seals	2 tandem single type, oil lubricated with silicon or tungsten carbide seal rings at all points, except the upper rotating seal, which shall be carbon.
Discharge Base	Cast iron or fabricated steel.
Pedestal Base	Concrete.
Epoxy Coating	
Primer & Finish Coat	Carboline "Carboguard 891" or Tnemec "Series N140 Pota-Pox Plus".

2-4. PUMP CONSTRUCTION.

2-4.01. Impeller Casing. The impeller casing shall have well-rounded water passages and smooth interior surfaces free from cracks, porosity, blowholes, or other irregularities. The discharge nozzle shall be flanged, with dimensions and drilling conforming to ANSI B16.1, Class 125.

2-4.02. Impeller. The impeller shall be an enclosed. The impeller shall be a recessed radial one-piece casting with the impeller completely out of the flow path. The interior water passages shall have uniform sections and smooth surfaces and shall be free from cracks and porosity. The impeller shall be dynamically balanced and securely locked to the shaft by means of a key and self-locking bolt or nut.

2-4.03. Wearing Rings. Wearing rings or wearing plates shall be provided on the casing.

A renewable wearing ring or an axially variable wearing plate shall be provided in the casing. Casing wearing ring shall be securely fastened to the impeller casing front cover to provide either an axial or radial running clearance. Axially adjustable wearing plate shall be arranged to permit adjustment of the axial running clearance between the impeller and plate. The wearing plate shall have an outward spiralling groove designed to force stringy solids outward and away from the impeller.

2-4.04. Oil Chamber Housing. The oil chamber shall contain a drain plug and a vent plug.

2-4.05. Mechanical Seals. Each pump shall be provided with two mechanical rotating shaft seals arranged in tandem and running in an oil chamber. Each interface shall be held in contact by an independent spring system designed to withstand maximum suction submergence. The seals shall require neither maintenance nor adjustment and shall be readily accessible for inspection and replacement.

Shaft seals lacking positively driven rotating members or conventional double mechanical seals which utilize a common single or double spring acting between the upper and lower units and requiring a pressure differential to offset external pressure and effect sealing, will not be acceptable. The seals shall not rely upon the pumped media for lubrication and shall not be damaged if the pumps are run unsubmerged for extended periods while pumping under load.

2-4.06. Sealing of Mating Surfaces. All mating surfaces of major components shall be machined and fitted with O-rings where watertight sealing is needed. Sealing shall be accomplished by O-ring contact on four surfaces and O-ring compression in two planes, without reliance on a specific fastener torque or tension to obtain a watertight joint. The use of elliptical O-rings, gaskets, or seals requiring a specific fastener torque value to obtain and maintain compression and watertightness will not be acceptable. The use of secondary sealing compounds, gasket cement, grease, or other devices to obtain watertight joints will not be acceptable.

2-4.07. Guiderail Mounted Base. Not used.

2-4.08. Pedestal Mounted Base. Unless otherwise indicated or specified, all equipment will be installed on concrete bases at least 6 inches high. Each pedestal mounted pump shall be mounted on a pedestal base extending from the impeller casing to below the bottom of the suction long radius elbow inlet flange. All seams and contact surfaces between steel shapes and plates of fabricated steel pedestals shall be continuously welded and ground smooth. Each pedestal shall be suitable for grouting and bolting to the floor of the wetwell.

2-4.08.01. Suction Elbow. Each pedestal-mounted pump shall be provided with a flanged suction long radius elbow complete with a cleanout handhole with contoured interior surfaces. The elbow may be integral with the pedestal base. The diameter and drilling of the inlet flange shall conform to ANSI B16.1, Class 125.

2-4.09. Skid Mounted Base. Not Used.

2-4.10. Access Hatch Cover. Not used

2-4.11. Shop Painting. All iron and steel parts which will be in contact with pumped liquid or submerged after installation, including the inside of the casing and the discharge elbow, shall be shop cleaned in accordance with the coating manufacturer's recommendations. The exterior of the pump shall be painted with the epoxy coating system specified. The coating shall have a dry film thickness of at least 10 mils and shall consist of a prime (first) coat and one or more finish coats. At least 1 quart of the finish coat material shall be furnished with each pump for field touch-up.

All iron and steel parts inside the pump, including the surfaces of cast iron impellers, shall be painted with a suitable rust protective coating to protect the impeller during shipment, storage, and installation.

The shop painting of other surfaces shall be in accordance with the shop painting requirements in the General Equipment Stipulations.

2-4.12. Hoist Assembly. Not used.

2-5. ELECTRIC MOTORS. Each pump shall be driven by an air-filled, totally submersible electric motor provided by the pump manufacturer. Motor nameplate rating shall exceed the maximum power required by the pump in the operating head range. Each motor shall be rated for the power supply provided to the pump, and shall have a service factor of 1.00 except for VFD driven motors which shall be 1.15. The stator housing shall be an air-filled, watertight casing. A cooling jacket shall encase the motor housing for each pump where needed to maintain adequate cooling. The cooling jacket shall require no external source of cooling water. Motor insulation shall be moisture resistant, Class H, 155°C. Each motor shall be NEMA Design B for continuous duty at 40°C ambient temperature, and designed for at least 10 starts per hour.

The motor bearings shall be antifriction, permanently lubricated type. The lower bearing shall be fixed to carry the pump thrust and the upper bearing free to move axially. The bearings shall have a calculated ABMA L_{10} Life Rating of 40,000 hours when operating at maximum operating head. Maximum shaft runout at the mechanical seals shall not exceed 2 mils at any point in the operating head range.

Each motor installed in a drypit shall be capable of continuous operation in air under pump full load conditions, without exceeding the temperature rise limits for the motor insulation system.

Each pump shall be equipped with one or more multiconductor cable assemblies for power and control. Each multiconductor assembly containing power cables shall be provided with a separate grounding conductor. Each cable assembly

shall bear a permanently embossed code or legend indicating the cable is suitable for submerged use. Cable sizing shall conform to NEC requirements.

All cables for drywell mounted pumps shall be of sufficient length to terminate in a junction box as indicated on the Drawings, with 10 feet of slack which will be coiled at the motor.

The cable entry water seal shall include a strain relief and a grommet type seal designed so that a specific fastener torque is not required to ensure a watertight, submersible seal. The cable entry junction box and motor shall be separated by a stator lead sealing gland or a terminal board. The junction box shall isolate the motor interior from moisture gaining access through the top of the stator housing.

2-5.01. Variable Frequency Drives. As specified in 16150, Low Voltage Variable Frequency Drives.

2-6. CONTROLS.

2-6.01. Liquid Level Sensors. Not used.

2-6.02. Pump Controls. Each motor shall be protected by one motor temperature switch embedded in each phase winding. Each switch shall be designed to operate at 140°C (± 5°C). Each switch shall be normally closed automatic reset type rated 5 amps at 120 volts ac. The switches shall be wired in series with end leads wired to terminals within the motor housing.

2-7. SHOP TESTS.
Each pump shall be tested at the factory for capacity, power requirements, and efficiency at specified rated head, shutoff head, operating head extremes, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards. Acceptance testing shall be per Table 11.6.5.4 Grade 1U, with no minus tolerance or margin allowed.

Wire-to-water efficiency shall be based on certified efficiency data of the variable frequency drive, and the isolation transformer if provided with the drive. Certified efficiency data shall be included in the report.

Five certified copies of a report covering each test shall be prepared by the pump manufacturer and delivered to Engineer not less than 10 days prior to the shipment of the equipment from the factory. The report shall include data and test information as stipulated in the Hydraulic Institute Standards, copies of the test log originals, test reading to curve conversion equations, and certified performance curves. The curves shall include head, bhp [brake kW], pump efficiency, and shop test NPSH available, plotted against capacity. The curves

shall be easily read and plotted to scales consistent with performance requirements. All test points shall be clearly shown.

PART 3 - EXECUTION

3-1. INSTALLATION. Each pumping unit shall be installed in accordance with the Hydraulic Institute Standards, the Equipment Installation section, and as specified herein.

The equipment base for dry pit type pumping units shall be grouted after initial fitting and alignment, but before final bolting of connecting piping. Special care shall be taken to maintain alignment of pumping unit components. No stresses shall be transmitted to the pump flanges. After final alignment and bolting, connections to pumping equipment shall be tested for applied piping stresses by loosening the flange bolts. If any movement or opening of the joints is observed, piping shall be adjusted to proper fit.

Control cables shall be supported to prevent tension and damage. Mounting of cable supports in wetwells shall be coordinated by the pump supplier.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Section 01650, Startup Requirements, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the contract price.

3-2.02. Installation Supervision. Installation supervision by the manufacturer is not required.

Manufacturers' installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures.

3-2.02. Field Vibration Tests. Not Used.

End of Section

Section 13500

INSTRUMENTATION AND CONTROL SYSTEM

PART 1 – GENERAL

1-1. SCOPE. This section covers the interface of four 4 new RAS pumps and two 2 new WAS pumps. The pump controllers, VFDs and/or MCC starters, and field instrumentation shall interface to existing inputs and outputs in the existing PLC panel, FP2-1. Contractor shall identify any need for additional programming that is required to provide a complete and fully functional system, and the associated scope of work, for review and consideration by Engineer.

Panel drawings are not available. The Contractor shall field verify panel terminations as necessary while referring to the PLC program print out showing module terminations attached as an appendix to this specification.

The system shall be furnished as specified, complete with the testing necessary for proper operation.

1-1.02. Associated Sections. This section also includes the equipment and services specified in the following sections.

Section 11150	Submersible Pumps
Section 13562	Flow Instruments
Section 13563	Pressure Instruments

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. Not used.

1-2.02. Drawings. The Drawings indicate locations and arrangements of equipment and may include installation details and block and one-line diagrams showing connections and interfaces with other equipment. The input/output I/O are shown on the Drawings.

1-2.03. Codes, Permits and Agency Approvals. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Contractor shall, as part of their work, arrange for and obtain all necessary permits, inspections, and approvals by

the authorities having local jurisdiction of such work. This shall include any third-party inspections and testing of panels and equipment.

1-2.04. Related Equipment and Materials. Related equipment and materials may include, but will not be limited to, instrumentation, motor controllers, valve actuators, chemical feeders, analytical measuring devices, conduit, cable, and piping as described in other sections or furnished under other contracts.

1-2.07. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with Contractor equipment drawings and shall be as close as practical to the tag numbers used on the Drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered or tape labels will not be acceptable.

1-3. GENERAL REQUIREMENTS. The Drawings and Specifications indicate the extent and general arrangement of the systems. If any departures from the Drawings or Specifications are deemed necessary, details of such departures and the reasons shall be submitted to Engineer for review with or before the first submittal. No departures shall be made without prior written acceptance.

The specifications describe the minimum requirements for hardware and software.

1-3.01. Governing Standards. Equipment furnished under this section shall be designed, constructed, and tested in accordance with IEEE 519, ANSI C37.90, FCC Part 15 - Class A, and NEMA ICS-1-109.60.

1-3.02. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values. .

1-3.03. Workmanship and Materials. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except for testing.

1-3.04. Corrosive Fluids. All parts which are exposed to corrosive conditions

shall be made from corrosion resistant materials. Contractor shall submit certification that the instrument manufacturer approves the selection of materials of primary elements that are in contact with the specified process fluid to be inert to the effects of the process fluid.

1-4. SUBMITTALS. Complete dimensional, assembly, and installation drawings, wiring and schematic diagrams; and details, specifications, and data covering the materials used and the parts, devices and accessories forming a part of the system furnished, shall be submitted in accordance with the Submittal Procedures section. Equipment tag numbers or identifications used on the Drawings shall be referenced where applicable.

1-5. PREPARATION FOR SHIPMENT. All electronic equipment and instruments shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements, shall be kept dry at all times, and shall not be exposed to adverse ambient conditions.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces that are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Each shipment shall include an appropriate shipping list that indicates the contents of the package, including the specific tags. The shipping list shall be accessible without exposing the instruments to the atmosphere. The shipping list shall also contain any cautionary notes regarding storage of the instruments, including requirements to protect the instrument from static discharge, desensitizing chemicals solvents, paints, etc., or ambient atmospheric conditions.

Components which are shipped loose due to transportation limitations shall be assembled and disassembled by the manufacturer prior to shipment to assure that all components fit together and are adequately supported.

1-6. DELIVERY, STORAGE, AND SHIPPING. Shipping shall be in accordance with the Product Delivery Requirements section.

PART 2 - PRODUCTS

2-1. GENERAL REQUIREMENTS. All equipment furnished under each section referenced in SCOPE is a part of this section and shall be selected by Contractor for its superior quality and intended performance. Equipment and materials used shall be subject to review.

2-1.01. Standard Products. The systems furnished shall be standard products. Where two or more units of the same type of equipment are supplied, they shall

be the products of the same manufacturer; however, all components of the systems furnished hereunder need not be the products of one manufacturer unless specified herein.

To the extent possible, instruments used for similar types of functions and services shall be of the same brand and model line. Similar components of different instruments shall be the products of the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished. PART 3 – EXECUTION

3-1. INSTALLATION REQUIREMENTS. The installation of equipment furnished hereunder shall be by the Contractor or their assigned subcontractors.

3-1.01. Field Wiring. Field wiring materials and installation shall be in accordance with the electrical section.

3-1.02. Salvage of Existing Equipment. Existing equipment and materials removed or replaced under this contract shall be delivered to Owner at a location designated by Owner, or shall be properly disposed of at Owner's discretion. Care shall be taken to avoid damage to equipment delivered to Owner.

Any mounting brackets, enclosures, stilling wells, piping, conduits, wiring, or openings that remain after removal of equipment and support hardware shall be removed or repaired in a manner acceptable to Owner and Engineer. Transmitters or switches containing mercury shall be removed and disposed of by personnel trained in the handling of hazardous materials and using approved procedures.

3-2. SYSTEMS CHECK.

3-2.01. Field Manager. Not used.

3-2.02. Field Inspection at Delivery. Not used.

3-2.03. Field Inspection Prior to Start Up. After installation and wiring connections are complete, the Contractor shall verify that each external connection to the system is correctly wired and field process components and devices are functioning as intended. A minimum of 5 working days shall be included for this task, but Contractor shall be responsible for completing the following scope of work.

3-2.03.01. Analog Signals. Currently, there are no analog input signals from the VFDs. Analog outputs shall be generated at FP 2-1, and verified to be received with the correct polarity, at the respective receiving device. Other analog devices such as flow meters that are replaced shall have their signals verified upon reinstallation.

3-2.03.02. Discrete Signals. Discrete input and output signals shall be simulated and verified that they are received at FP 2-1, and at the proper voltage.

3-3. TESTING. The system shall be acceptance tested on site.

Contractor shall prepare a testing procedure to be approved by Owner and Engineer that shall demonstrate that the system conforms to the specifications. The testing procedure shall be submitted at least 10 days in advance of testing. The testing shall be conducted by Contractor and witnessed by Owner and/or Engineer.

Contractor shall notify Engineer and Owner in writing at least 14 days before the proposed testing date. Contractor shall reimburse Owner and Engineer for all expenses incurred in connection with attending repeated site testing necessitated by system failure or inadequate preparation.

3-3.01. Site Acceptance Testing. After installation and checkout by Contractor's personnel, the system shall be subjected to an acceptance test.

Contractor shall verify that all field signal changes are reflected in the proper address locations in the system database.

The number of working days of continuous operation for the test shall be 5. The operational demonstration shall confirm that the status, alarm, and process variable signals are valid and are being updated appropriately, and that the discrete and analog output signals from the control system are being correctly transmitted and implemented. Any errors or abnormal occurrences shall be recorded by Contractor's field representative. The log shall include a description of the problem, its apparent cause, and any corrective action taken.

3-3.01.02. Completion of Test. Successful completion of the site acceptance test, including the operational demonstration, is prerequisite to Substantial Completion as specified in the Supplementary Conditions.

3-4. TRAINING. None.

End of Section

RSLogix 500 Project Report

Processor Information

Processor Type: 1747-L542B 5/04 CPU - 32K Mem. OS401

Processor Name: FP-2-1

Total Memory Used: 1800 Instruction Words Used - 2090 Data Table Words Used

Total Memory Left: 26872 Instruction Words Left

Program Files: 15

Data Files: 15

Program ID: 7c75

I/O Configuration

0	1747-L542B	5/04 CPU - 32K Mem. OS401
1	1746-NI4	Analog 4 Channel Input Module
2	1746-NI4	Analog 4 Channel Input Module
3	1746-NI4	Analog 4 Channel Input Module
4	1746-NI4	Analog 4 Channel Input Module
5	1746-NO4I	Analog 4 Ch. Current Output
6	1746-NO4I	Analog 4 Ch. Current Output
7	1746-NO4I	Analog 4 Ch. Current Output
8	1746-IA16	16-Input 100/120 VAC
9	1746-IA16	16-Input 100/120 VAC
10	1746-IA16	16-Input 100/120 VAC
11	1746-OA16	16-Output (TRIAC) 100/240 VAC
12	1746-OA16	16-Output (TRIAC) 100/240 VAC
--	---	---
13		
14	1746-IA16	16-Input 100/120 VAC
15	1746-IA16	16-Input 100/120 VAC
16	1746-IA16	16-Input 100/120 VAC
17	1746-IA16	16-Input 100/120 VAC
18	1746-IA16	16-Input 100/120 VAC
19	1746-IA16	16-Input 100/120 VAC
20	1746-OA16	16-Output (TRIAC) 100/240 VAC
21	1746-OA16	16-Output (TRIAC) 100/240 VAC
22	1746-OA16	16-Output (TRIAC) 100/240 VAC
23	1746-OA16	16-Output (TRIAC) 100/240 VAC
24	1746-OA16	16-Output (TRIAC) 100/240 VAC
25	1746-OA16	16-Output (TRIAC) 100/240 VAC

PID Configuration

PID - Rung #4:28 - N11:0

Controller Gain, Kc: 0.5	Setpoint: 7168
Reset Term, Ti: 0.2	Maximum Setpoint Limit: 16383
Rate Term, Td: 0.02	Minimum Setpoint Limit: 0
Loop Update Time: 0.05	Control Variable Percent (CV%): 88
Control Mode: E = SP - PV	Output Max CV(%): 99
PID Control: Auto	Output Min CV(%): 1
Time Mode: Timed	Derivative Action(DA): No
Output Limiting: Yes	Deadband: 1
Reset and Gain: No	

PID - Rung #6:18 - N12:0

Controller Gain, Kc: 7.0	Setpoint: 8192
Reset Term, Ti: 0.3	Maximum Setpoint Limit: 16383
Rate Term, Td: 0.00	Minimum Setpoint Limit: 0
Loop Update Time: 1.00	Control Variable Percent (CV%): 0
Control Mode: E = SP - PV	Output Max CV(%): 99
PID Control: Auto	Output Min CV(%): 0
Time Mode: Timed	Derivative Action(DA): No
Output Limiting: Yes	Deadband: 10
Reset and Gain: No	

PID - Rung #7:22 - N13:0

Controller Gain, Kc: 0.5	Setpoint: 3823
Reset Term, Ti: 0.2	Maximum Setpoint Limit: 16383
Rate Term, Td: 0.00	Minimum Setpoint Limit: 0
Loop Update Time: 1.00	Control Variable Percent (CV%): 2
Control Mode: E = SP - PV	Output Max CV(%): 99
PID Control: Auto	Output Min CV(%): 1
Time Mode: Timed	Derivative Action(DA): No
Output Limiting: Yes	Deadband: 1
Reset and Gain: No	

Channel Configuration

GENERAL
   Channel 1 Write Protected: No
   Channel 1 Edit Resource/Owner Timeout(x1 sec): 60
   Channel 1 Passthru Link ID(dec): 2

   Channel 0 Write Protected: No
   Channel 0 Edit Resource/Owner Timeout(x1 sec): 60
   Channel 0 Passthru Link ID(dec): 1
   Channel 0 Current Mode: System
   Channel 0 Mode Change Enabled: No
   Channel 0 Mode Change Attention Character: \1b
   Channel 0 Mode Change System Character: S
   Channel 0 Mode Change User Character: U

CHANNEL 1 (SYSTEM) - Driver: DH+
   Node : 23 (octal)
   Baud: 57.6K

CHANNEL 0 (SYSTEM) - Driver: DF1 Full Duplex
   Source ID: 1 (decimal)
   Baud: 1200
   Parity: NONE
   Stop Bits: 1
   Control Line : No Handshaking
   Error Detection: CRC
   Embedded Responses: Enabled
   Duplicate Packet Detect: Yes
   ACK Timeout(x20 ms): 50
   NAK Retries: 3
   ENQ Retries: 3

CHANNEL 0 (USER) - Driver: ASCII
   Baud: 1200
   Parity: NONE
   Stop Bits: 1
   Data Bits: 8
   Control Line : No Handshaking
   Delete mode: Ignore
   Echo: No
   XON/XOFF: No
   Termination Character 1: \d
   Termination Character 2: \ff
   Append Character 1: \d
   Append Character 2: \a

Program File List

Name	Number	Type	Rungs	Debug	Bytes
[SYSTEM]	0	SYS	0	No	0
	1	SYS	0	No	0
ALM /TOTLS	2	LADDER	22	No	857
AERATORS	3	LADDER	43	No	1963
RAS	4	LADDER	51	No	1836
WAS	5	LADDER	30	No	1197
W-3 PUMPS	6	LADDER	43	No	1639
W-1	7	LADDER	34	No	1306
CL2	8	LADDER	12	No	375
SCUM PUMPS	9	LADDER	17	No	697
CLARIFIERS	10	LADDER	13	No	515
	11	LADDER	1	No	3
BLOWERS ?	12	LADDER	11	No	405
SST/EFFWEL	13	LADDER	16	No	675
JUDRUNG	14	LADDER	3	No	83

0000
Reset Button
I:14
2
1746-IA16
Main Alarm Reset
B3:0
1

0001
Acknowledge Button
I:14
0
1746-IA16
Main Fail Acknowledge
B3:0
2

0002
Test Button
I:14
1
1746-IA16
Main Fail Test Button
B3:0
3

0003
Alarm Flasher Timer
T4:0
DN
Alarm Flasher Timer
TON
Timer On Delay
Timer T4:0
Time Base 1.0
Preset 3<
Accum 1<
EN
DN

0004
Alarm Flasher Timer
LES
Less Than (A<B)
Source A T4:0.ACC 1<
Source B 2 2<
Alarm Flasher Relay
B3:0
0

0005
One-second Timer for Totalizers
T4:1
DN
One-second Timer for Totalizers
TON
Timer On Delay
Timer T4:1
Time Base 1.0
Preset 1<
Accum 0<
EN
DN

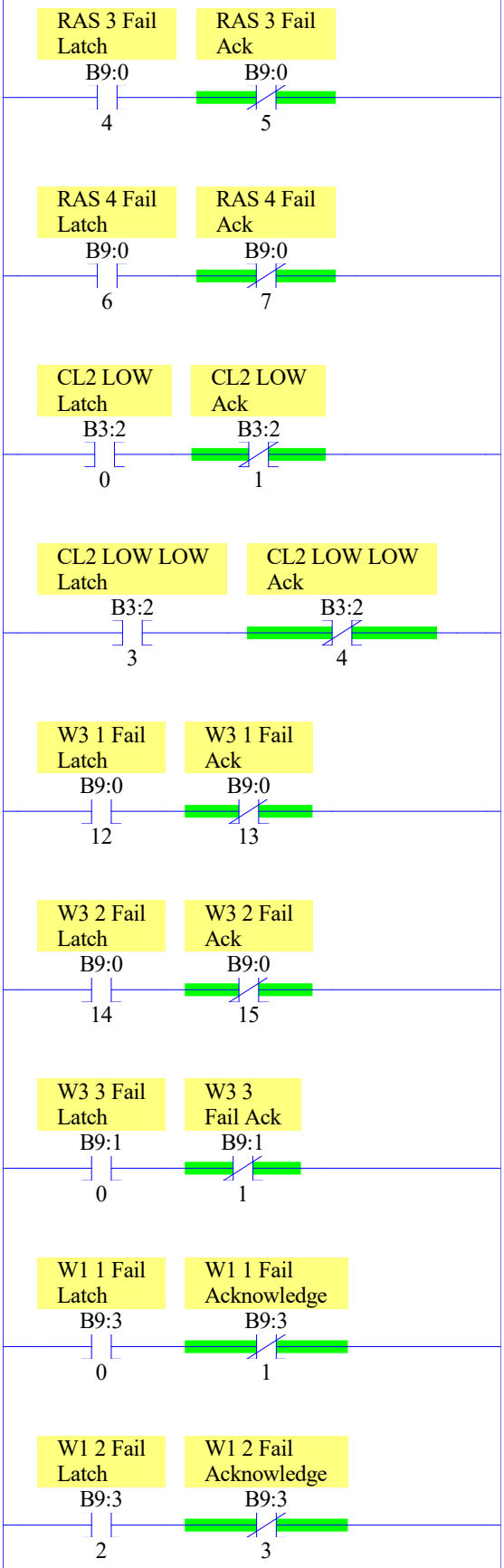
This timer pauses the equipment Fail Timers when utility power isn't available. It allows the Fail Timers to resume when the power has been back on for the preset time(30 seconds)

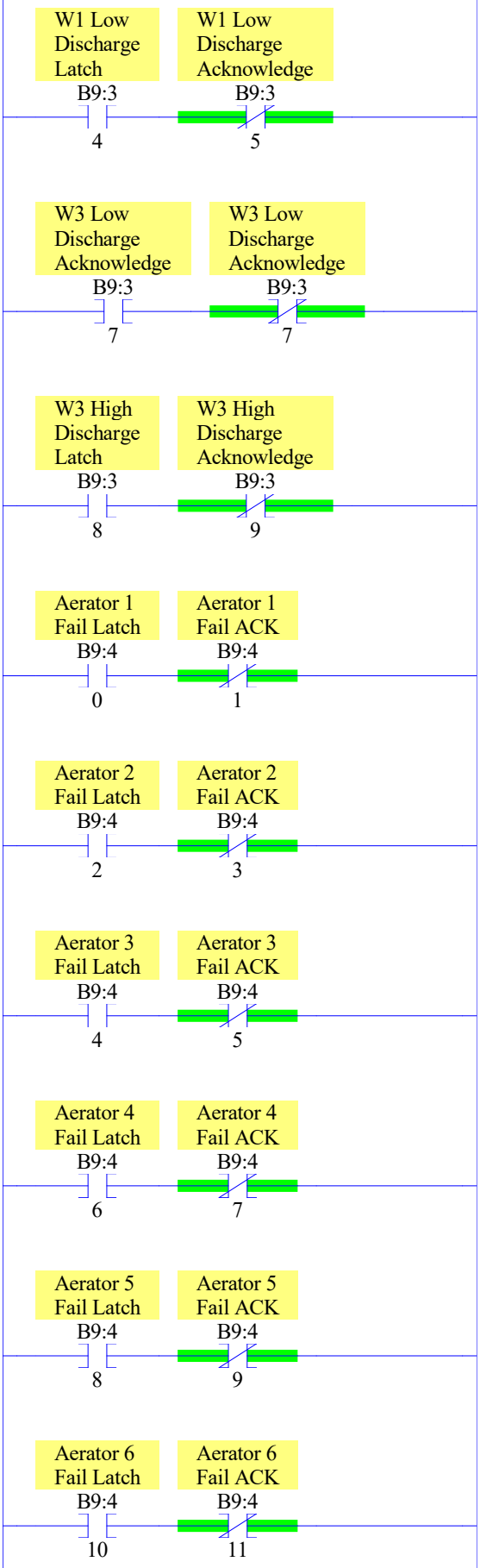
0006
Utility Power Available
I:10
13
1746-IA16
TOF
Timer Off Delay
Timer T4:4
Time Base 1.0
Preset 30<
Accum 30<
EN
DN

Sends the program scan to the ladder file listed in the Jump-to-Subroutine function.

0007
JSR
Jump To Subroutine
SBR File Number U:3


0008
JSR
Jump To Subroutine
SBR File Number U:4
0009
JSR
Jump To Subroutine
SBR File Number U:5
0010
JSR
Jump To Subroutine
SBR File Number U:6
0011
JSR
Jump To Subroutine
SBR File Number U:7
0012
JSR
Jump To Subroutine
SBR File Number U:8
0013
JSR
Jump To Subroutine
SBR File Number U:9
0014
JSR
Jump To Subroutine
SBR File Number U:10
0015
JSR
Jump To Subroutine
SBR File Number U:11
0016
JSR
Jump To Subroutine
SBR File Number U:12
0017
JSR
Jump To Subroutine
SBR File Number U:13
0018
JSR
Jump To Subroutine
SBR File Number U:14
0019
RAS 1 Fail Latch
B9:0
0
RAS 2 Fail Latch
B9:0
2
Common Fail Output
O:12
15
1746-OA16
RAS 2 Fail Latch
B9:0
2
RAS 2 Fail Ack
B9:0
3


RAS 3 Fail Latch
B9:0
4
RAS 3 Fail Ack
B9:0
5
RAS 4 Fail Latch
B9:0
6
RAS 4 Fail Ack
B9:0
7
CL2 LOW Latch
B3:2
0
CL2 LOW Ack
B3:2
1
CL2 LOW LOW Latch
B3:2
3
CL2 LOW LOW Ack
B3:2
4
W3 1 Fail Latch
B9:0
12
W3 1 Fail Ack
B9:0
13
W3 2 Fail Latch
B9:0
14
W3 2 Fail Ack
B9:0
15
W3 3 Fail Latch
B9:1
0
W3 3 Fail Ack
B9:1
1
W1 1 Fail Latch
B9:3
0
W1 1 Fail Acknowledge
B9:3
1
W1 2 Fail Latch
B9:3
2
W1 2 Fail Acknowledge
B9:3
3


W1 Low Discharge Latch
B9:3
4
W1 Low Discharge Acknowledge
B9:3
5
W3 Low Discharge Acknowledge
B9:3
7
W3 Low Discharge Acknowledge
B9:3
7
W3 High Discharge Latch
B9:3
8
W3 High Discharge Acknowledge
B9:3
9
Aerator 1 Fail Latch
B9:4
0
Aerator 1 Fail ACK
B9:4
1
Aerator 2 Fail Latch
B9:4
2
Aerator 2 Fail ACK
B9:4
3
Aerator 3 Fail Latch
B9:4
4
Aerator 3 Fail ACK
B9:4
5
Aerator 4 Fail Latch
B9:4
6
Aerator 4 Fail ACK
B9:4
7
Aerator 5 Fail Latch
B9:4
8
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B9:4
9
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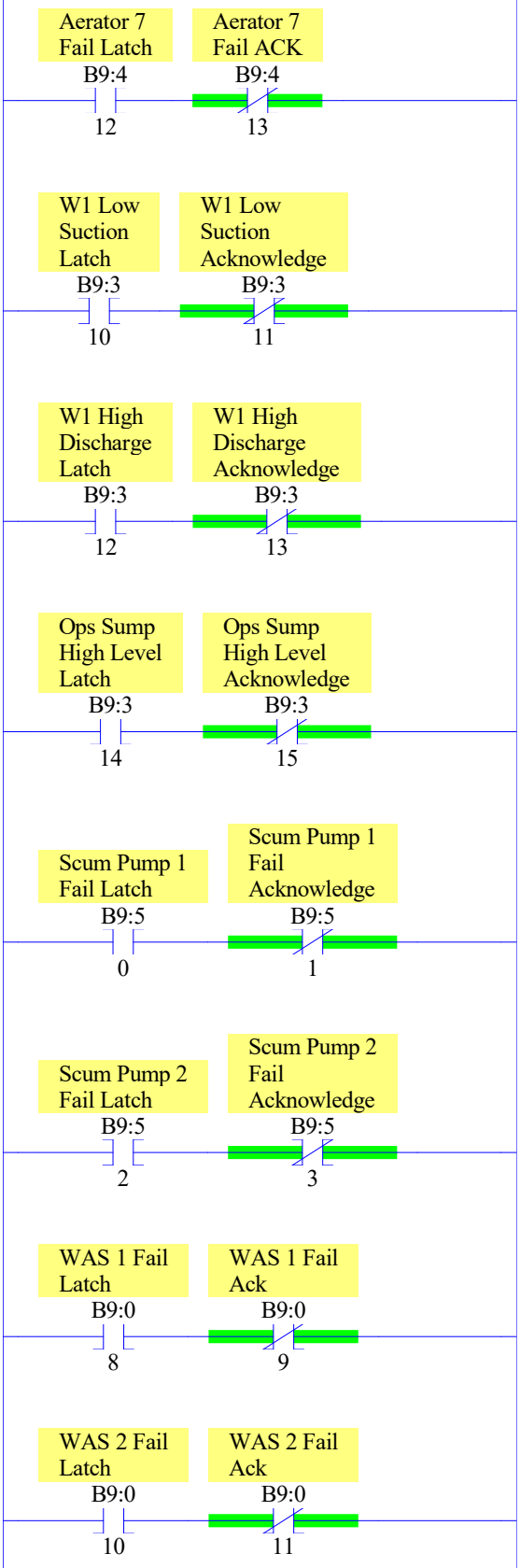
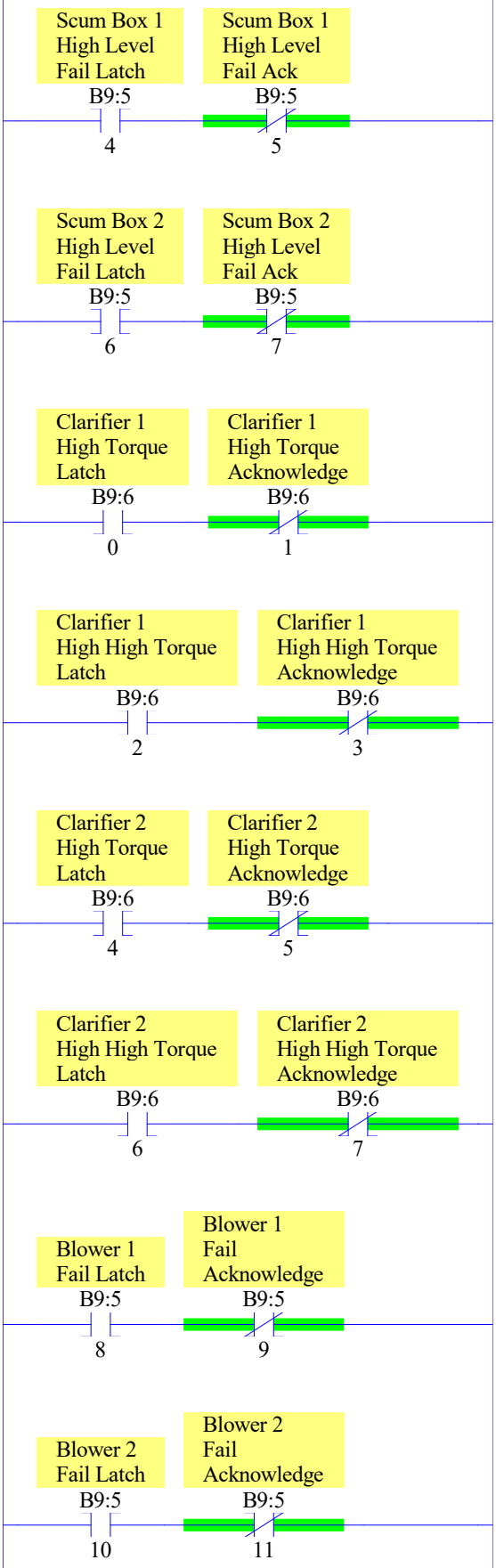
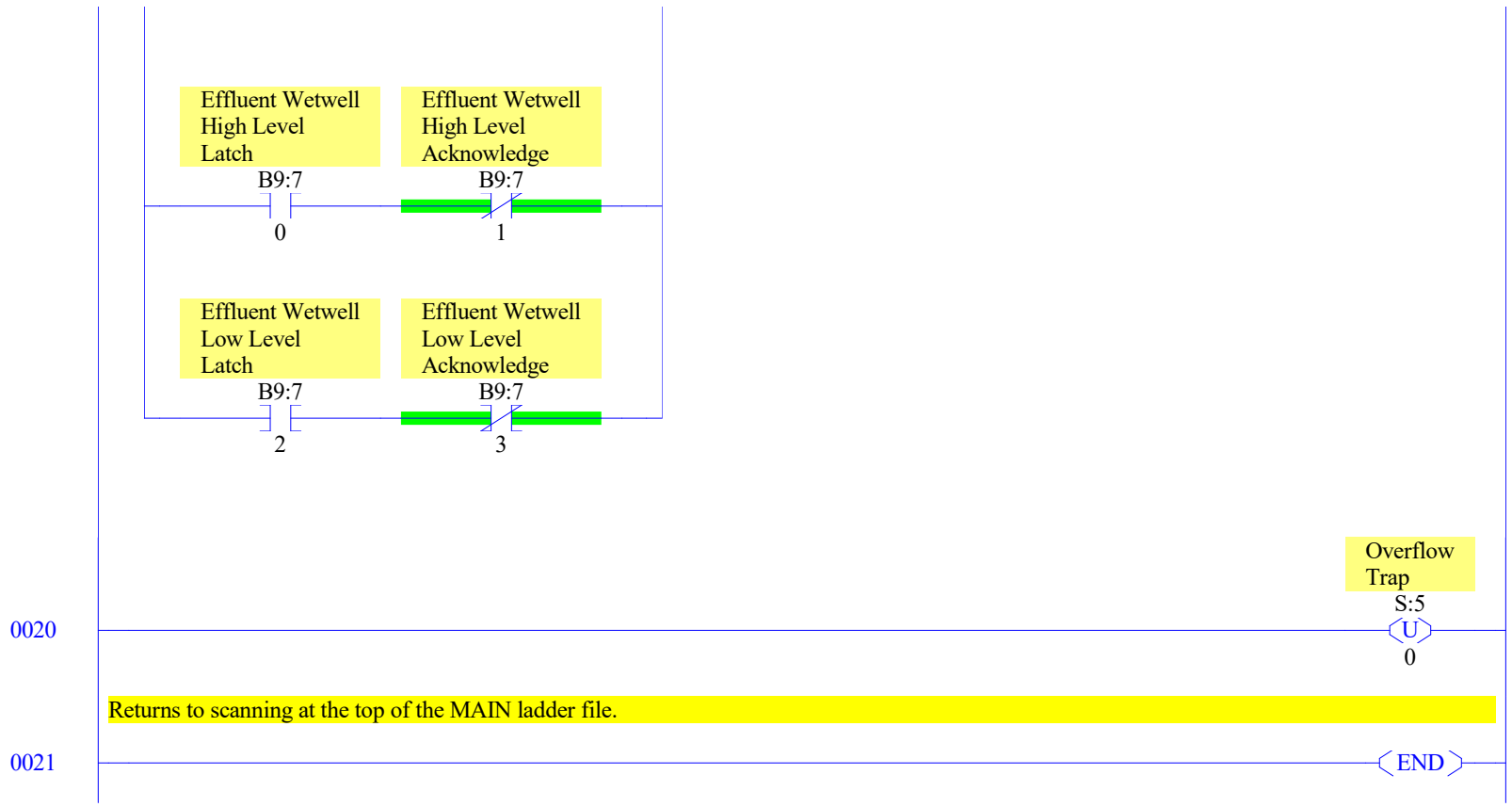
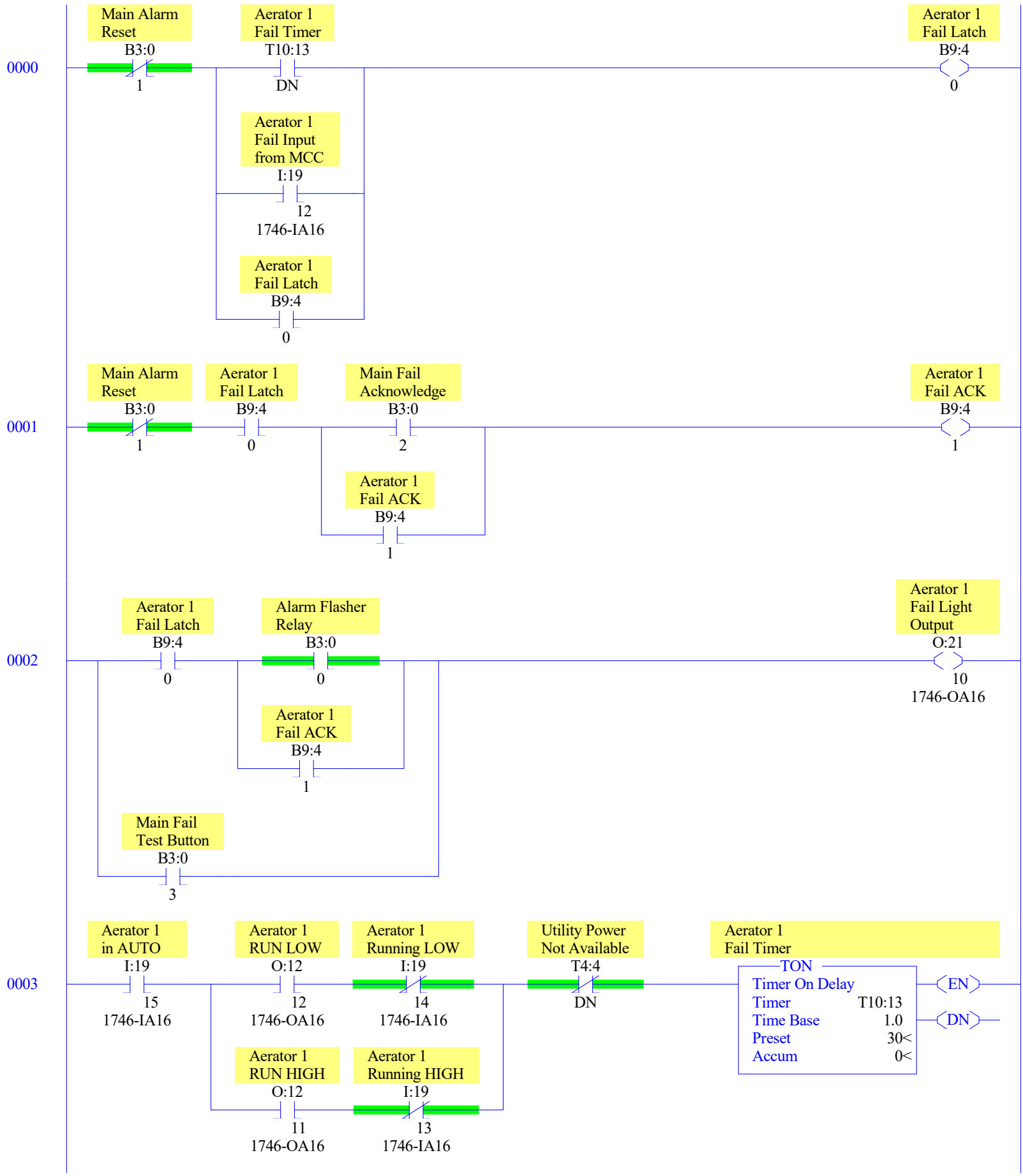
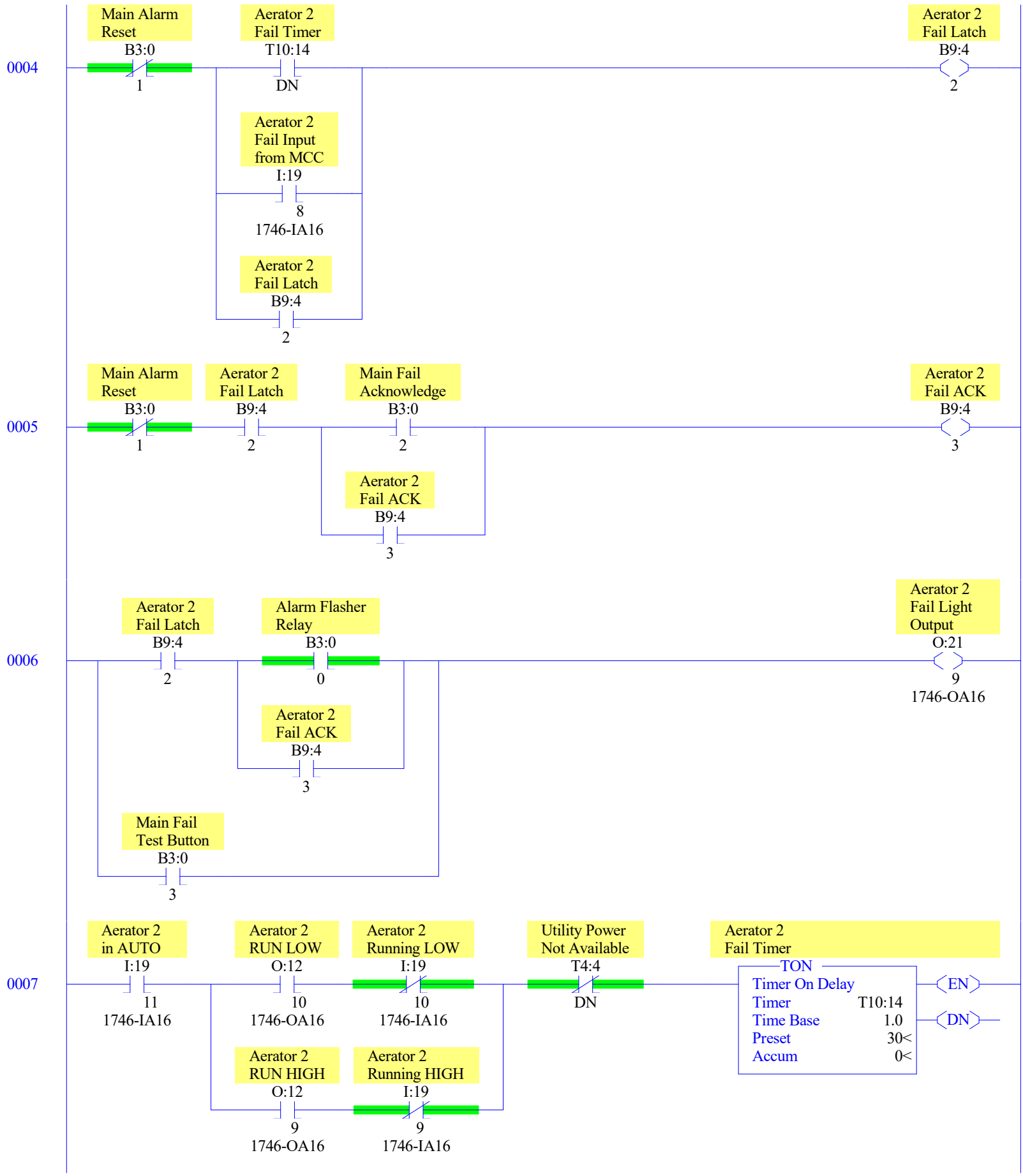
B9:4
10
Aerator 6 Fail ACK
B9:4
11

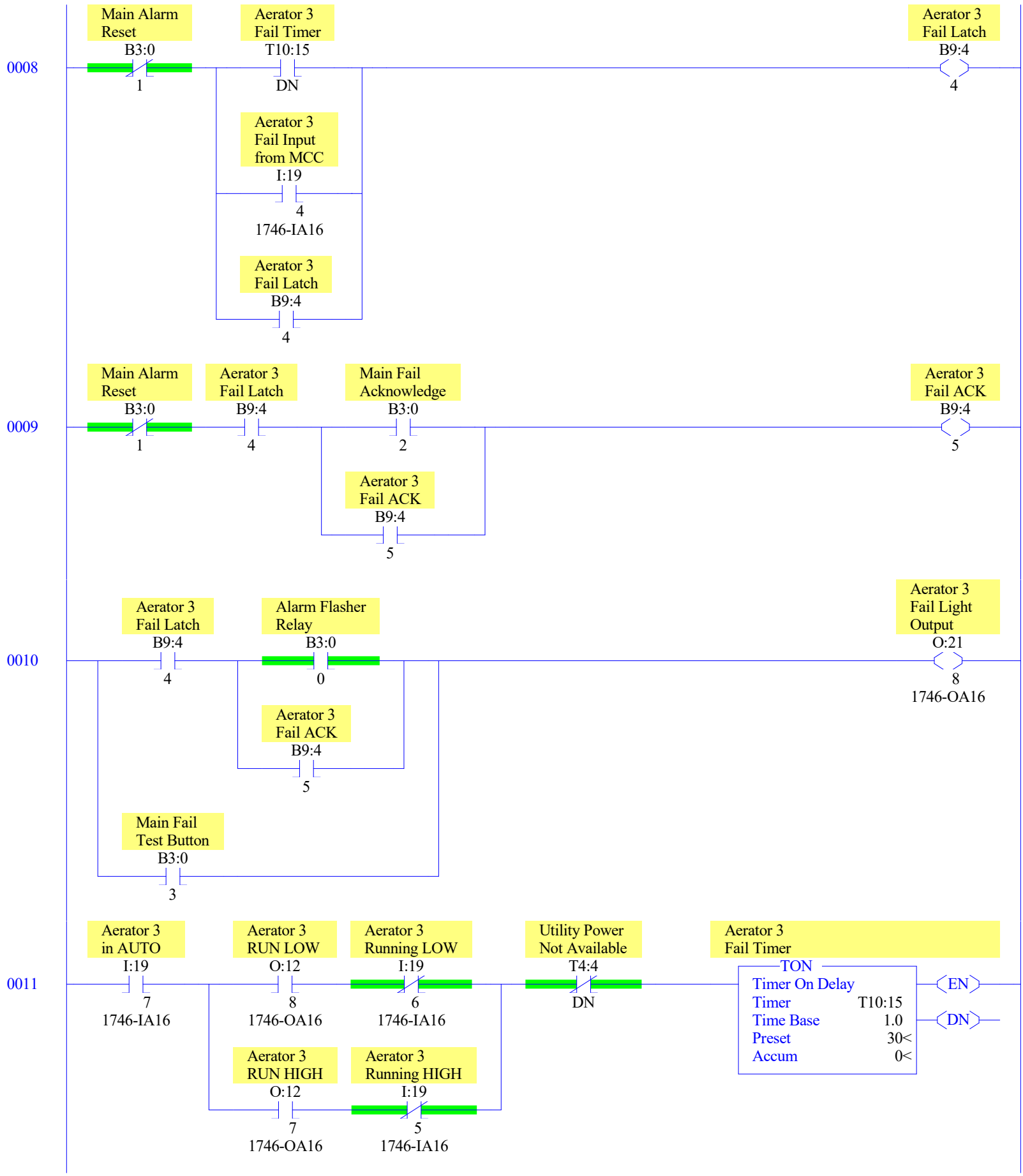

Aerator 7 Fail Latch
B9:4
12
Aerator 7 Fail ACK
B9:4
13
W1 Low Suction Latch
B9:3
10
W1 Low Suction Acknowledge
B9:3
11
W1 High Discharge Latch
B9:3
12
W1 High Discharge Acknowledge
B9:3
13
Ops Sump High Level Latch
B9:3
14
Ops Sump High Level Acknowledge
B9:3
15
Scum Pump 1 Fail Latch
B9:5
0
Scum Pump 1 Fail Acknowledge
B9:5
1
Scum Pump 2 Fail Latch
B9:5
2
Scum Pump 2 Fail Acknowledge
B9:5
3
WAS 1 Fail Latch
B9:0
8
WAS 1 Fail Ack
B9:0
9
WAS 2 Fail Latch
B9:0
10
WAS 2 Fail Ack
B9:0
11

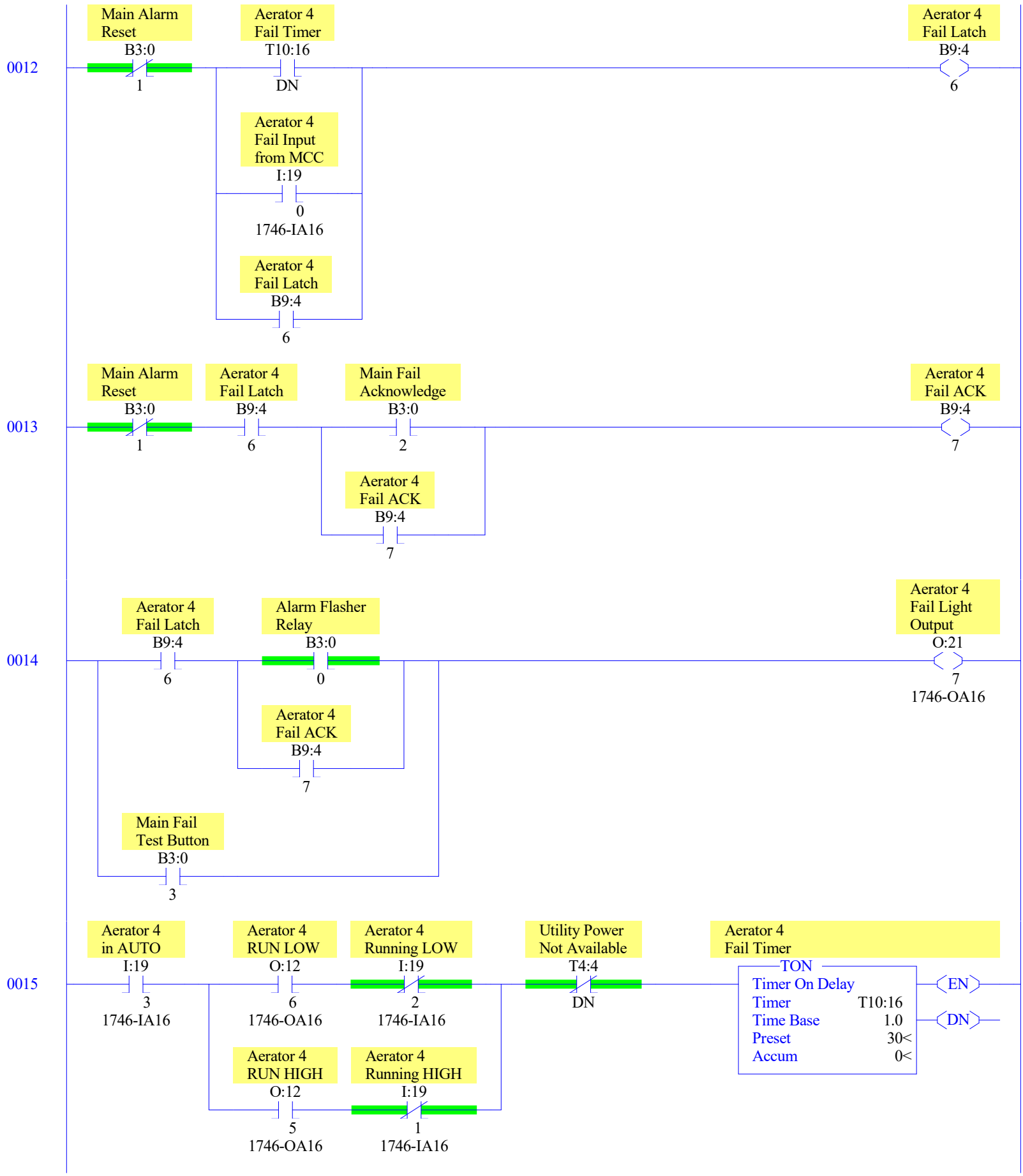

Scum Box 1 High Level Fail Latch
B9:5
4
Scum Box 1 High Level Fail Ack
B9:5
5
Scum Box 2 High Level Fail Latch
B9:5
6
Scum Box 2 High Level Fail Ack
B9:5
7
Clarifier 1 High Torque Latch
B9:6
0
Clarifier 1 High Torque Acknowledge
B9:6
1
Clarifier 1 High High Torque Latch
B9:6
2
Clarifier 1 High High Torque Acknowledge
B9:6
3
Clarifier 2 High Torque Latch
B9:6
4
Clarifier 2 High Torque Acknowledge
B9:6
5
Clarifier 2 High High Torque Latch
B9:6
6
Clarifier 2 High High Torque Acknowledge
B9:6
7
Blower 1 Fail Latch
B9:5
8
Blower 1 Fail Acknowledge
B9:5
9
Blower 2 Fail Latch
B9:5
10
Blower 2 Fail Acknowledge
B9:5
11

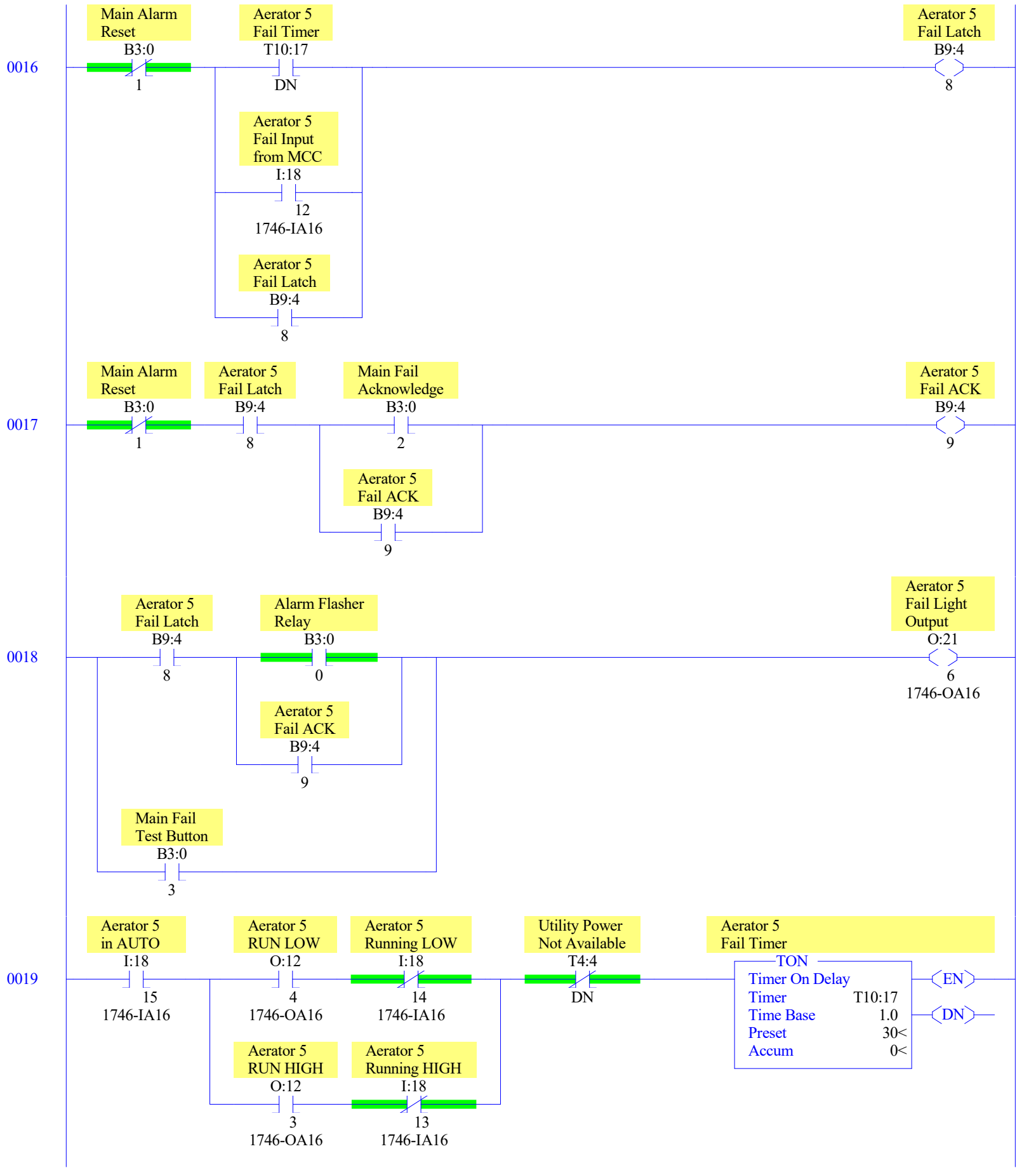

Effluent Wetwell
High Level
Latch
B9:7
0
Effluent Wetwell
High Level
Acknowledge
B9:7
1
Effluent Wetwell
Low Level
Latch
B9:7
2
Effluent Wetwell
Low Level
Acknowledge
B9:7
3
Overflow
Trap
S:5
U
0
0020
Returns to scanning at the top of the MAIN ladder file.
0021
END

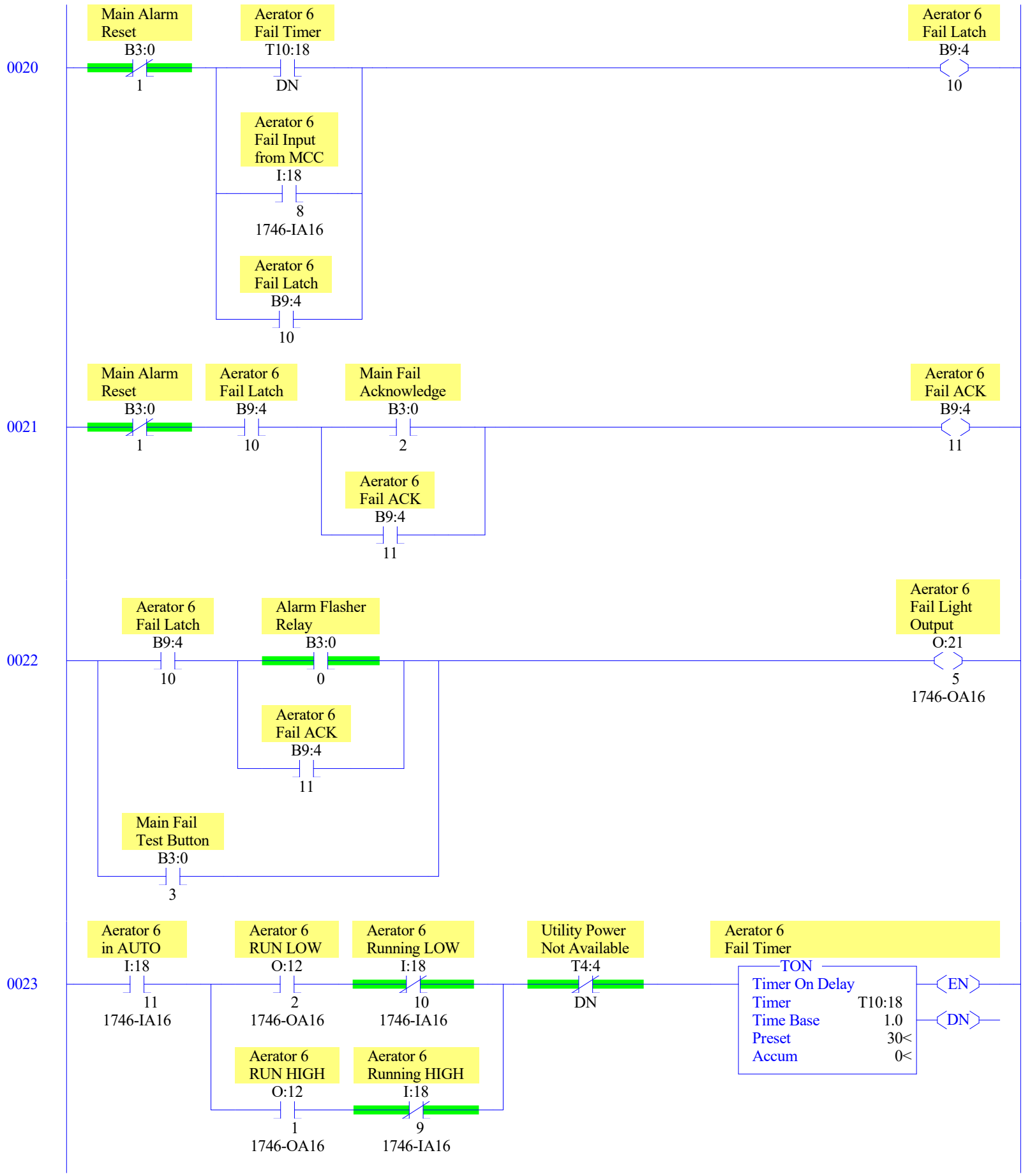

0000
Main Alarm Reset
B3:0
1
Aerator 1 Fail Timer
T10:13
DN
Aerator 1 Fail Input from MCC
I:19
12
1746-IA16
Aerator 1 Fail Latch
B9:4
0
Aerator 1 Fail Latch
B9:4
0
0001
Main Alarm Reset
B3:0
1
Aerator 1 Fail Latch
B9:4
0
Main Fail Acknowledge
B3:0
2
Aerator 1 Fail ACK
B9:4
1
Aerator 1 Fail ACK
B9:4
1
0002
Aerator 1 Fail Latch
B9:4
0
Alarm Flasher Relay
B3:0
0
Aerator 1 Fail ACK
B9:4
1
Main Fail Test Button
B3:0
3
Aerator 1 Fail Light Output
O:21
10
1746-OA16
0003
Aerator 1 in AUTO
I:19
15
1746-IA16
Aerator 1 RUN LOW
O:12
12
1746-OA16
Aerator 1 Running LOW
I:19
14
1746-IA16
Utility Power Not Available
T4:4
DN
Aerator 1 Fail Timer
TON
Timer On Delay
Timer T10:13
Time Base 1.0
Preset 30<
Accum 0<
EN
DN
Aerator 1 RUN HIGH
O:12
11
1746-OA16
Aerator 1 Running HIGH
I:19
13
1746-IA16

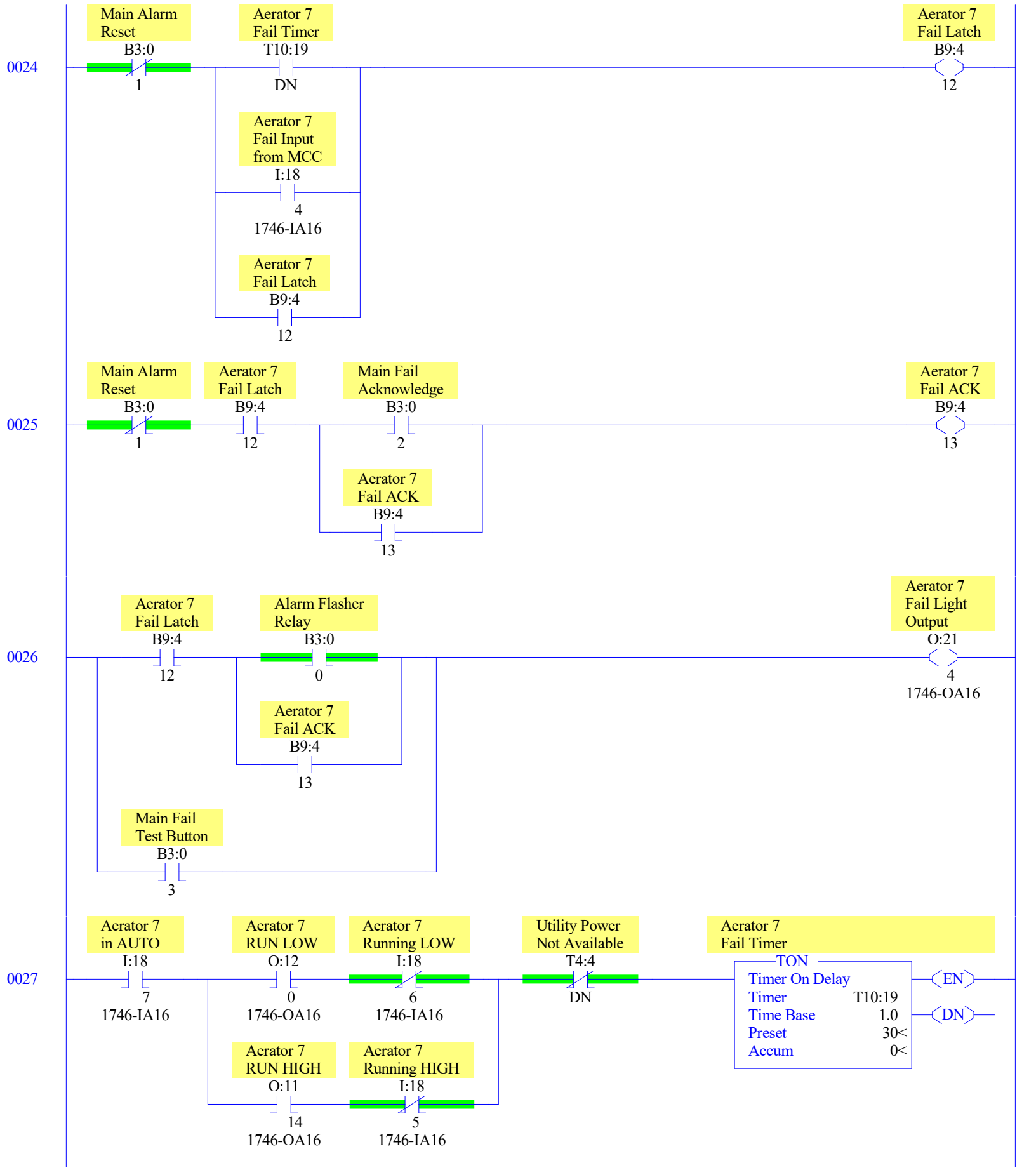

0004
Main Alarm Reset
B3:0
1
Aerator 2 Fail Timer
T10:14
DN
Aerator 2 Fail Input from MCC
I:19
8
1746-IA16
Aerator 2 Fail Latch
B9:4
2
Aerator 2 Fail Latch
B9:4
2
0005
Main Alarm Reset
B3:0
1
Aerator 2 Fail Latch
B9:4
2
Main Fail Acknowledge
B3:0
2
Aerator 2 Fail ACK
B9:4
3
Aerator 2 Fail ACK
B9:4
3
0006
Aerator 2 Fail Latch
B9:4
2
Alarm Flasher Relay
B3:0
0
Aerator 2 Fail ACK
B9:4
3
Main Fail Test Button
B3:0
3
Aerator 2 Fail Light Output
O:21
9
1746-OA16
0007
Aerator 2 in AUTO
I:19
11
1746-IA16
Aerator 2 RUN LOW
O:12
10
1746-OA16
Aerator 2 Running LOW
I:19
10
1746-IA16
Utility Power Not Available
T4:4
DN
Aerator 2 Fail Timer
TON
Timer On Delay
Timer T10:14
Time Base 1.0
Preset 30<
Accum 0<
EN
DN
Aerator 2 RUN HIGH
O:12
9
1746-OA16
Aerator 2 Running HIGH
I:19
9
1746-IA16

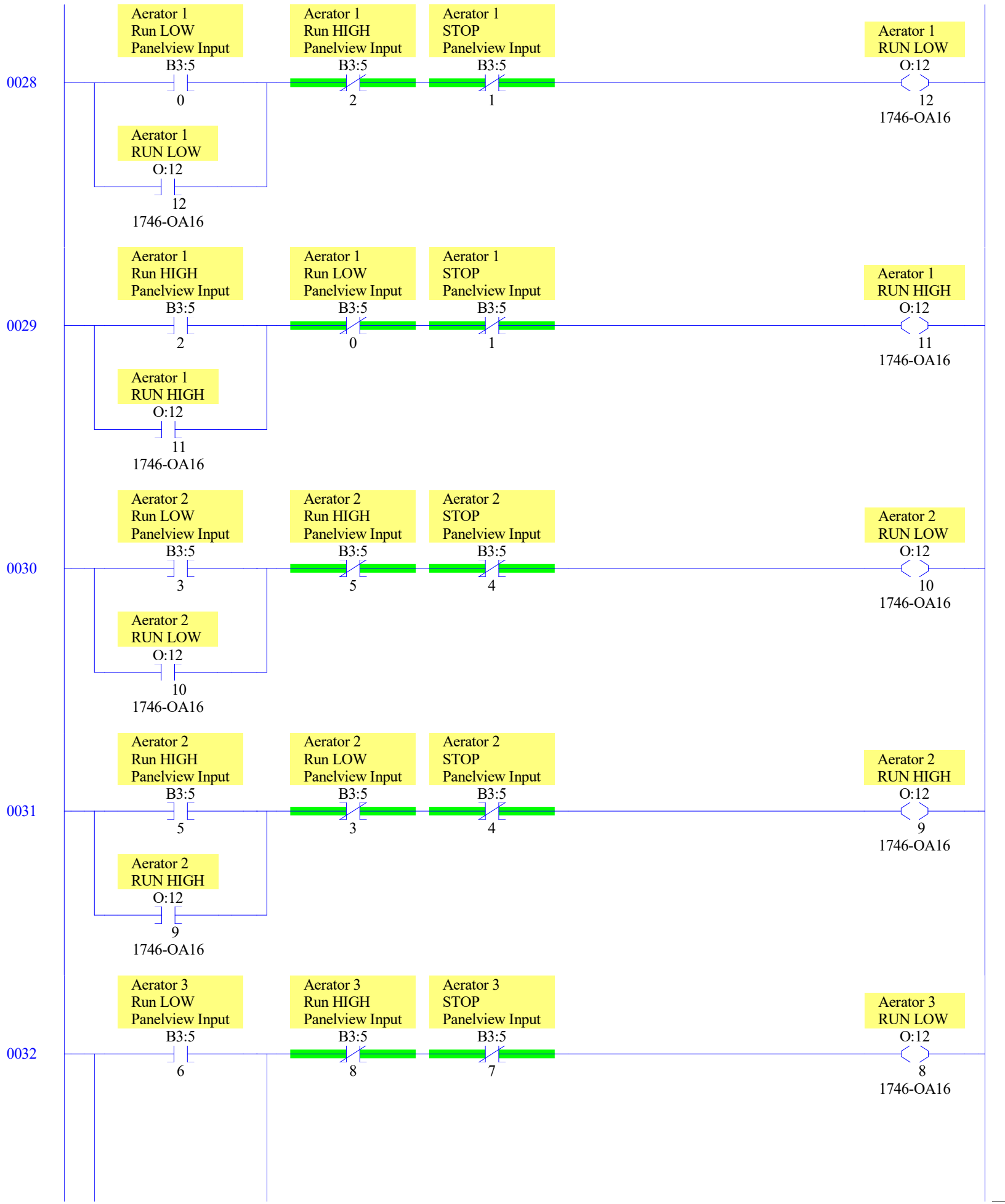

0008
Main Alarm Reset
B3:0
1
Aerator 3 Fail Timer
T10:15
DN
Aerator 3 Fail Input from MCC
I:19
4
1746-IA16
Aerator 3 Fail Latch
B9:4
4
Aerator 3 Fail Latch
B9:4
4
0009
Main Alarm Reset
B3:0
1
Aerator 3 Fail Latch
B9:4
4
Main Fail Acknowledge
B3:0
2
Aerator 3 Fail ACK
B9:4
5
Aerator 3 Fail ACK
B9:4
5
0010
Aerator 3 Fail Latch
B9:4
4
Alarm Flasher Relay
B3:0
0
Aerator 3 Fail Light Output
O:21
8
1746-OA16
Aerator 3 Fail ACK
B9:4
5
Main Fail Test Button
B3:0
3
0011
Aerator 3 in AUTO
I:19
7
1746-IA16
Aerator 3 RUN LOW
O:12
8
1746-OA16
Aerator 3 Running LOW
I:19
6
1746-IA16
Utility Power Not Available
T4:4
DN
Aerator 3 Fail Timer
TON
Timer On Delay
Timer T10:15
Time Base 1.0
Preset 30<
Accum 0<
EN
DN
Aerator 3 RUN HIGH
O:12
7
1746-OA16
Aerator 3 Running HIGH
I:19
5
1746-IA16

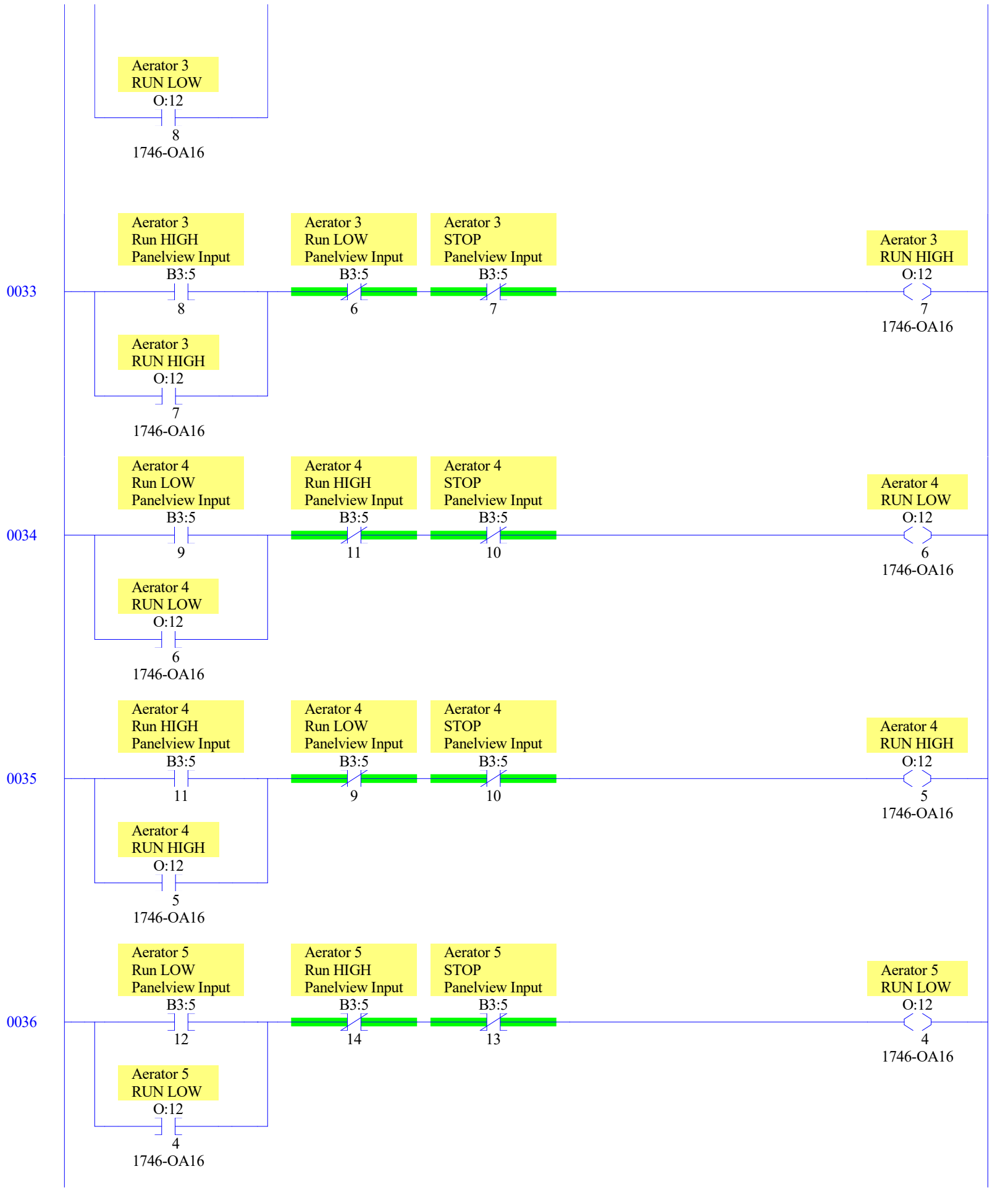

0012
Main Alarm Reset
B3:0
1
Aerator 4 Fail Timer
T10:16
DN
Aerator 4 Fail Input from MCC
I:19
0
1746-IA16
Aerator 4 Fail Latch
B9:4
6
Aerator 4 Fail Latch
B9:4
6
0013
Main Alarm Reset
B3:0
1
Aerator 4 Fail Latch
B9:4
6
Main Fail Acknowledge
B3:0
2
Aerator 4 Fail ACK
B9:4
7
Aerator 4 Fail ACK
B9:4
7
0014
Aerator 4 Fail Latch
B9:4
6
Alarm Flasher Relay
B3:0
0
Aerator 4 Fail ACK
B9:4
7
Main Fail Test Button
B3:0
3
Aerator 4 Fail Light Output
O:21
7
1746-OA16
0015
Aerator 4 in AUTO
I:19
3
1746-IA16
Aerator 4 RUN LOW
O:12
6
1746-OA16
Aerator 4 Running LOW
I:19
2
1746-IA16
Aerator 4 RUN HIGH
O:12
5
1746-OA16
Aerator 4 Running HIGH
I:19
1
1746-IA16
Utility Power Not Available
T4:4
DN
Aerator 4 Fail Timer
TON
Timer On Delay
Timer T10:16
Time Base 1.0
Preset 30<
Accum 0<
EN
DN

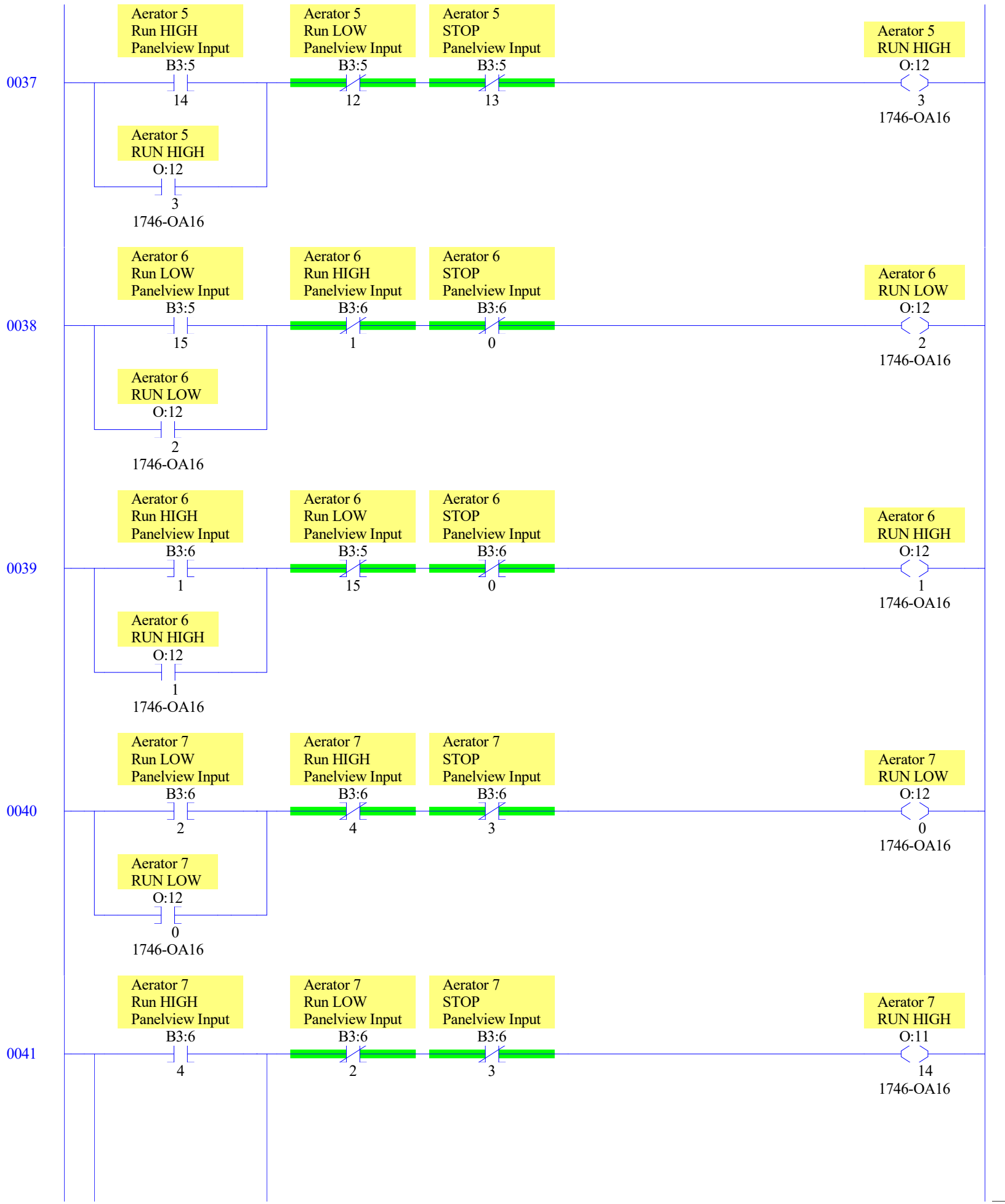

0016
Main Alarm Reset
B3:0
1
Aerator 5 Fail Timer
T10:17
DN
Aerator 5 Fail Input from MCC
I:18
12
1746-IA16
Aerator 5 Fail Latch
B9:4
8
Aerator 5 Fail Latch
B9:4
8
0017
Main Alarm Reset
B3:0
1
Aerator 5 Fail Latch
B9:4
8
Main Fail Acknowledge
B3:0
2
Aerator 5 Fail ACK
B9:4
9
Aerator 5 Fail ACK
B9:4
9
0018
Aerator 5 Fail Latch
B9:4
8
Alarm Flasher Relay
B3:0
0
Aerator 5 Fail Light Output
O:21
6
1746-OA16
Aerator 5 Fail ACK
B9:4
9
Main Fail Test Button
B3:0
3
0019
Aerator 5 in AUTO
I:18
15
1746-IA16
Aerator 5 RUN LOW
O:12
4
1746-OA16
Aerator 5 Running LOW
I:18
14
1746-IA16
Utility Power Not Available
T4:4
DN
Aerator 5 Fail Timer
TON
Timer On Delay
Timer T10:17
Time Base 1.0
Preset 30<
Accum 0<
EN
DN
Aerator 5 RUN HIGH
O:12
3
1746-OA16
Aerator 5 Running HIGH
I:18
13
1746-IA16

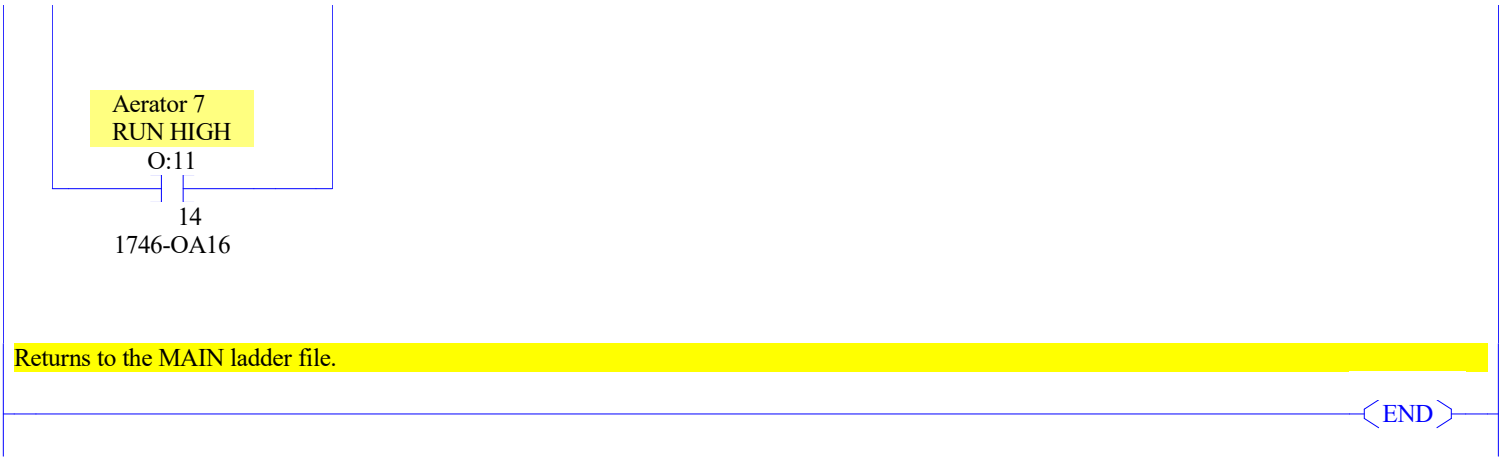

0020
Main Alarm Reset
B3:0
1
Aerator 6 Fail Timer
T10:18
DN
Aerator 6 Fail Latch
B9:4
10
Aerator 6 Fail Input from MCC
I:18
8
1746-IA16
Aerator 6 Fail Latch
B9:4
10
0021
Main Alarm Reset
B3:0
1
Aerator 6 Fail Latch
B9:4
10
Main Fail Acknowledge
B3:0
2
Aerator 6 Fail ACK
B9:4
11
Aerator 6 Fail ACK
B9:4
11
0022
Aerator 6 Fail Latch
B9:4
10
Alarm Flasher Relay
B3:0
0
Aerator 6 Fail Light Output
O:21
5
1746-OA16
Aerator 6 Fail ACK
B9:4
11
Main Fail Test Button
B3:0
3
0023
Aerator 6 in AUTO
I:18
11
1746-IA16
Aerator 6 RUN LOW
O:12
2
1746-OA16
Aerator 6 Running LOW
I:18
10
1746-IA16
Utility Power Not Available
T4:4
DN
Aerator 6 Fail Timer
TON
Timer On Delay
Timer T10:18
Time Base 1.0
Preset 30<
Accum 0<
EN
DN
Aerator 6 RUN HIGH
O:12
1
1746-OA16
Aerator 6 Running HIGH
I:18
9
1746-IA16


0024
Main Alarm Reset
B3:0
1
Aerator 7 Fail Timer
T10:19
DN
Aerator 7 Fail Input from MCC
I:18
4
1746-IA16
Aerator 7 Fail Latch
B9:4
12
Aerator 7 Fail Latch
B9:4
12
0025
Main Alarm Reset
B3:0
1
Aerator 7 Fail Latch
B9:4
12
Main Fail Acknowledge
B3:0
2
Aerator 7 Fail ACK
B9:4
13
Aerator 7 Fail ACK
B9:4
13
0026
Aerator 7 Fail Latch
B9:4
12
Alarm Flasher Relay
B3:0
0
Aerator 7 Fail ACK
B9:4
13
Main Fail Test Button
B3:0
3
Aerator 7 Fail Light Output
O:21
4
1746-OA16
0027
Aerator 7 in AUTO
I:18
7
1746-IA16
Aerator 7 RUN LOW
O:12
0
1746-OA16
Aerator 7 Running LOW
I:18
6
1746-IA16
Utility Power Not Available
T4:4
DN
Aerator 7 Fail Timer
TON
Timer On Delay
Timer T10:19
Time Base 1.0
Preset 30<
Accum 0<
EN
DN
Aerator 7 RUN HIGH
O:11
14
1746-OA16
Aerator 7 Running HIGH
I:18
5
1746-IA16


0028
Aerator 1
Run LOW
Panelview Input
B3:5
0
Aerator 1
Run HIGH
Panelview Input
B3:5
2
Aerator 1
STOP
Panelview Input
B3:5
1
Aerator 1
RUN LOW
O:12
12
1746-OA16
Aerator 1
RUN LOW
O:12
12
1746-OA16
0029
Aerator 1
Run HIGH
Panelview Input
B3:5
2
Aerator 1
Run LOW
Panelview Input
B3:5
0
Aerator 1
STOP
Panelview Input
B3:5
1
Aerator 1
RUN HIGH
O:12
11
1746-OA16
Aerator 1
RUN HIGH
O:12
11
1746-OA16
0030
Aerator 2
Run LOW
Panelview Input
B3:5
3
Aerator 2
Run HIGH
Panelview Input
B3:5
5
Aerator 2
STOP
Panelview Input
B3:5
4
Aerator 2
RUN LOW
O:12
10
1746-OA16
Aerator 2
RUN LOW
O:12
10
1746-OA16
0031
Aerator 2
Run HIGH
Panelview Input
B3:5
5
Aerator 2
Run LOW
Panelview Input
B3:5
3
Aerator 2
STOP
Panelview Input
B3:5
4
Aerator 2
RUN HIGH
O:12
9
1746-OA16
Aerator 2
RUN HIGH
O:12
9
1746-OA16
0032
Aerator 3
Run LOW
Panelview Input
B3:5
6
Aerator 3
Run HIGH
Panelview Input
B3:5
8
Aerator 3
STOP
Panelview Input
B3:5
7
Aerator 3
RUN LOW
O:12
8
1746-OA16

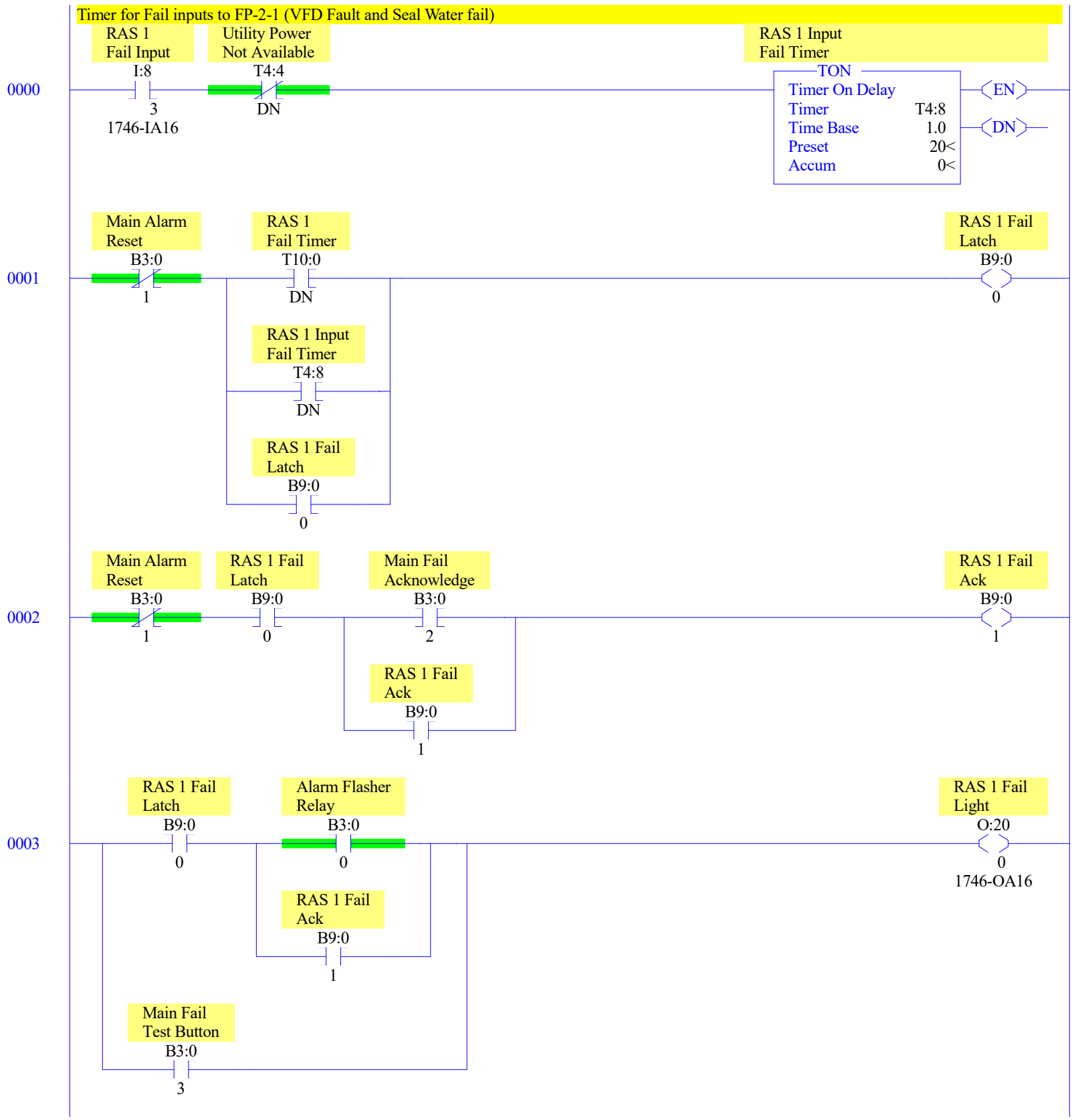

Aerator 3
RUN LOW
O:12
8
1746-OA16
0033
Aerator 3
Run HIGH
Panelview Input
B3:5
8
Aerator 3
Run LOW
Panelview Input
B3:5
6
Aerator 3
STOP
Panelview Input
B3:5
7
Aerator 3
RUN HIGH
O:12
7
1746-OA16
Aerator 3
RUN HIGH
O:12
7
1746-OA16
0034
Aerator 4
Run LOW
Panelview Input
B3:5
9
Aerator 4
Run HIGH
Panelview Input
B3:5
11
Aerator 4
STOP
Panelview Input
B3:5
10
Aerator 4
RUN LOW
O:12
6
1746-OA16
Aerator 4
RUN LOW
O:12
6
1746-OA16
0035
Aerator 4
Run HIGH
Panelview Input
B3:5
11
Aerator 4
Run LOW
Panelview Input
B3:5
9
Aerator 4
STOP
Panelview Input
B3:5
10
Aerator 4
RUN HIGH
O:12
5
1746-OA16
Aerator 4
RUN HIGH
O:12
5
1746-OA16
0036
Aerator 5
Run LOW
Panelview Input
B3:5
12
Aerator 5
Run HIGH
Panelview Input
B3:5
14
Aerator 5
STOP
Panelview Input
B3:5
13
Aerator 5
RUN LOW
O:12
4
1746-OA16
Aerator 5
RUN LOW
O:12
4
1746-OA16


0037
Aerator 5
Run HIGH
Panelview Input
B3:5
14
Aerator 5
Run LOW
Panelview Input
B3:5
12
Aerator 5
STOP
Panelview Input
B3:5
13
Aerator 5
RUN HIGH
O:12
3
1746-OA16
Aerator 5
RUN HIGH
O:12
3
1746-OA16
0038
Aerator 6
Run LOW
Panelview Input
B3:5
15
Aerator 6
Run HIGH
Panelview Input
B3:6
1
Aerator 6
STOP
Panelview Input
B3:6
0
Aerator 6
RUN LOW
O:12
2
1746-OA16
Aerator 6
RUN LOW
O:12
2
1746-OA16
0039
Aerator 6
Run HIGH
Panelview Input
B3:6
1
Aerator 6
Run LOW
Panelview Input
B3:5
15
Aerator 6
STOP
Panelview Input
B3:6
0
Aerator 6
RUN HIGH
O:12
1
1746-OA16
Aerator 6
RUN HIGH
O:12
1
1746-OA16
0040
Aerator 7
Run LOW
Panelview Input
B3:6
2
Aerator 7
Run HIGH
Panelview Input
B3:6
4
Aerator 7
STOP
Panelview Input
B3:6
3
Aerator 7
RUN LOW
O:12
0
1746-OA16
Aerator 7
RUN LOW
O:12
0
1746-OA16
0041
Aerator 7
Run HIGH
Panelview Input
B3:6
4
Aerator 7
Run LOW
Panelview Input
B3:6
2
Aerator 7
STOP
Panelview Input
B3:6
3
Aerator 7
RUN HIGH
O:11
14
1746-OA16



Returns to the MAIN ladder file.

0042 END


Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)
0000
RAS 1 Fail Input
I:8
3
1746-IA16
Utility Power Not Available
T4:4
DN
RAS 1 Input Fail Timer
TON
Timer On Delay
Timer T4:8
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0001
Main Alarm Reset
B3:0
1
RAS 1 Fail Timer
T10:0
DN
RAS 1 Fail Latch
B9:0
0
RAS 1 Input Fail Timer
T4:8
DN
RAS 1 Fail Latch
B9:0
0
0002
Main Alarm Reset
B3:0
1
RAS 1 Fail Latch
B9:0
0
Main Fail Acknowledge
B3:0
2
RAS 1 Fail Ack
B9:0
1
RAS 1 Fail Ack
B9:0
1
0003
RAS 1 Fail Latch
B9:0
0
Alarm Flasher Relay
B3:0
0
RAS 1 Fail Light
O:20
0
1746-OA16
RAS 1 Fail Ack
B9:0
1
Main Fail Test Button
B3:0
3

The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the VFD is called to run by the ladder logic, and the VFD is not running, and utility power is available

0004

RAS 1 in Auto — I:8 — 1 — 1746-IA16

RAS 1 Run Output — O:11 — 0 — 1746-OA16

RAS 1 is On — I:8 — 2 — 1746-IA16

Utility Power Not Available — T4:4 — DN

RAS 1 Fail Timer

TON

Timer On Delay Timer	T10:0
Time Base	1.0
Preset	20<
Accum	0<

EN

DN

0005

RAS 1 or 2 in Lead — I:8 — 0 — 1746-IA16

RAS 1 Fail Latch — B9:0 — 0

RAS 1 Run Output — O:11 — 0 — 1746-OA16

RAS 1 or 2 in Lead — I:8 — 0 — 1746-IA16

RAS 2 Fail Latch — B9:0 — 2

Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)

0006

RAS 2 Fail Input — I:8 — 6 — 1746-IA16

Utility Power Not Available — T4:4 — DN

RAS 2 Input Fail Timer

TON

Timer On Delay Timer	T4:9
Time Base	1.0
Preset	20<
Accum	0<

EN

DN

0007

Main Alarm Reset — B3:0 — 1

RAS 2 Fail Timer — T10:1 — DN

RAS 2 Fail Latch — B9:0 — 2

RAS 2 Input Fail Timer — T4:9 — DN

RAS 2 Fail Latch — B9:0 — 2

0008

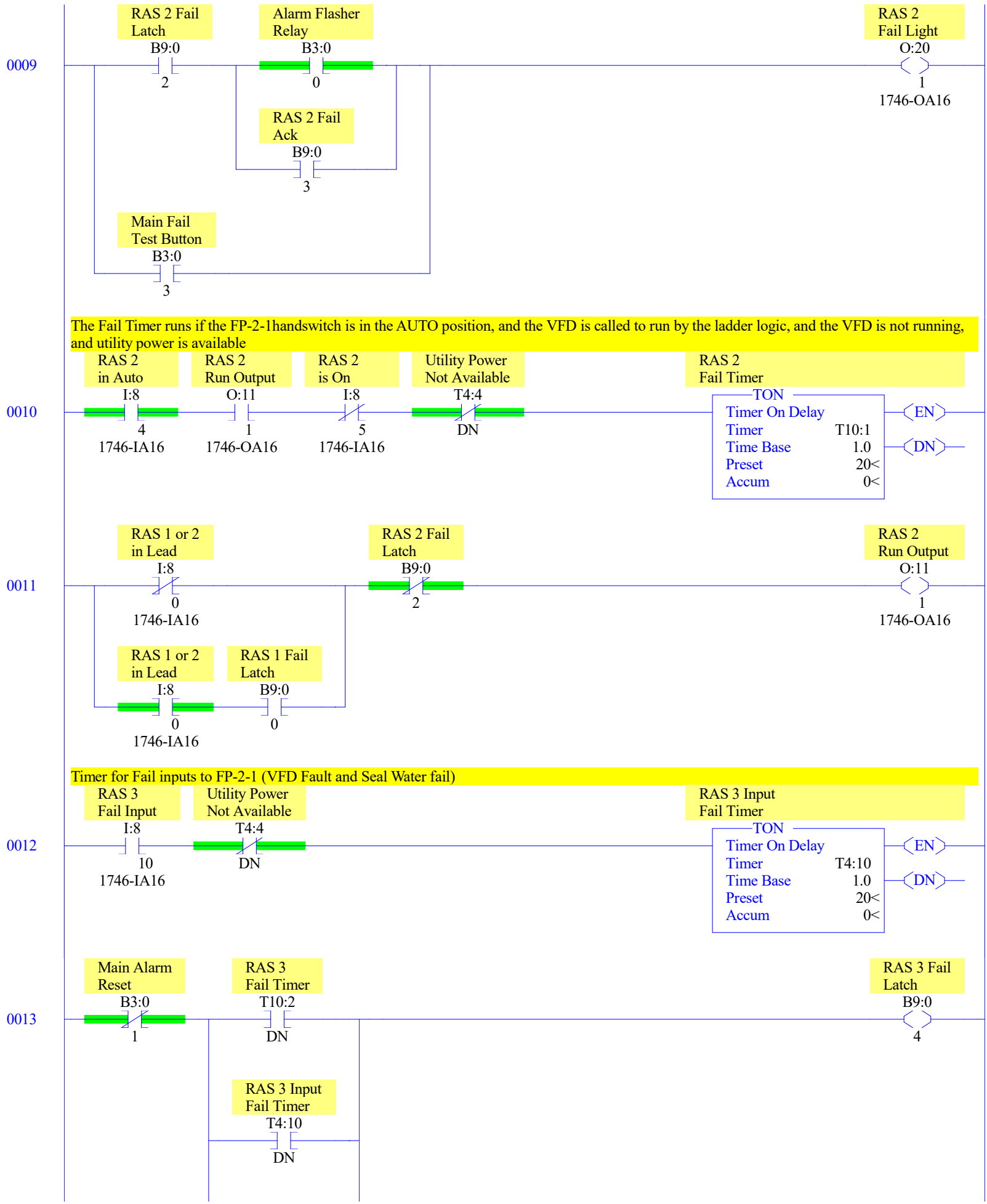
Main Alarm Reset — B3:0 — 1

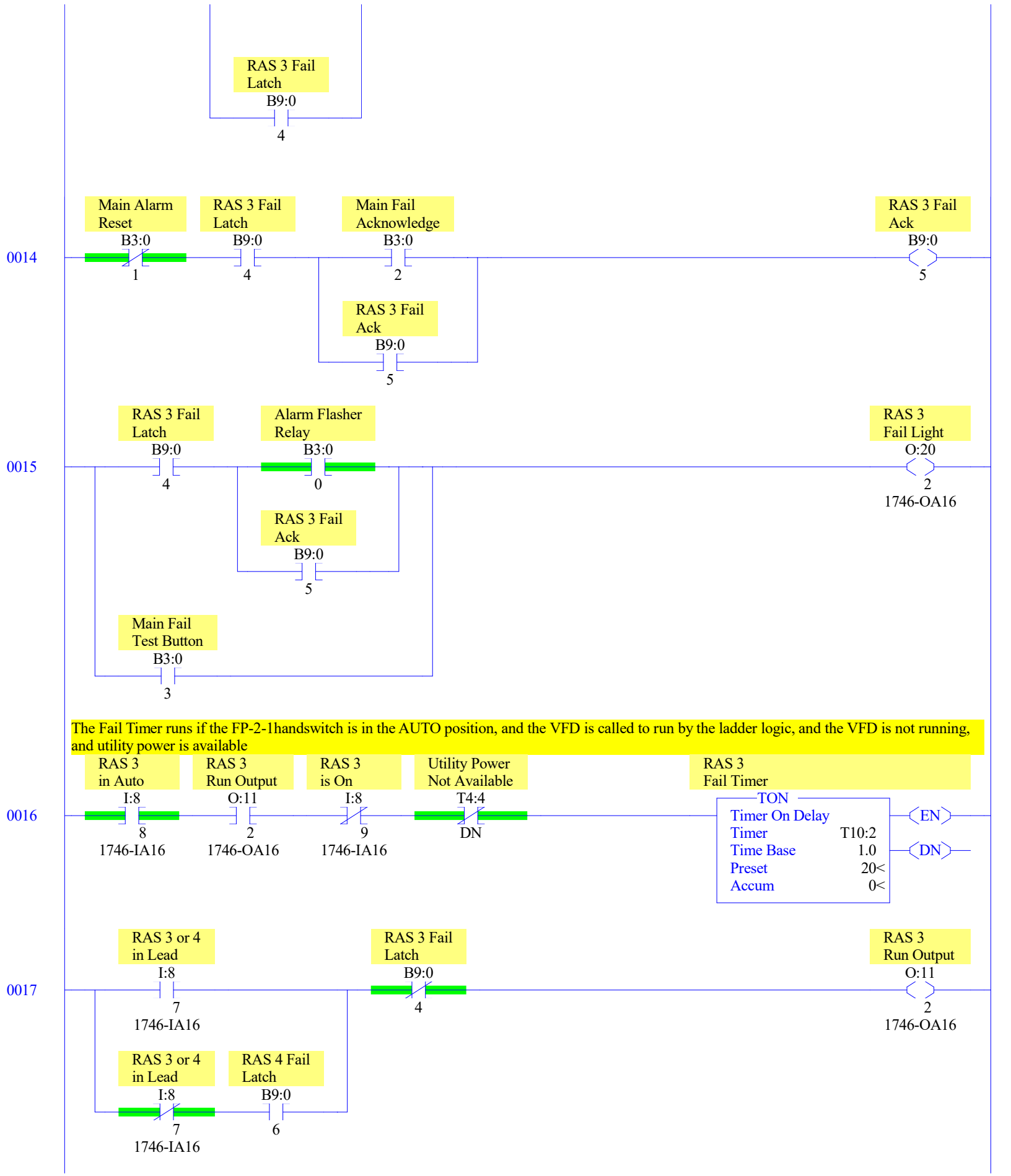
RAS 2 Fail Latch — B9:0 — 2

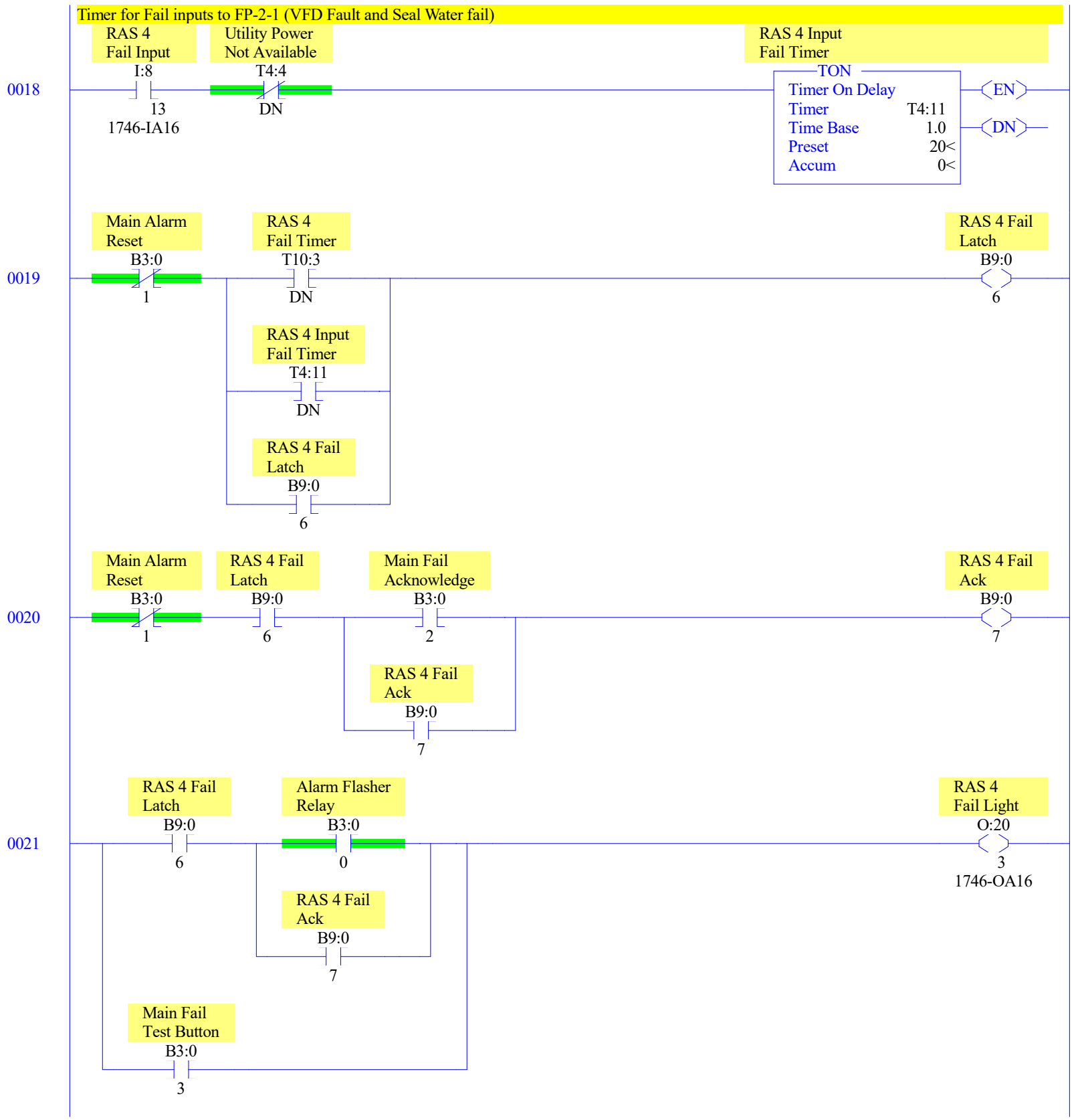
Main Fail Acknowledge — B3:0 — 2

RAS 2 Fail Ack — B9:0 — 3

RAS 2 Fail Ack — B9:0 — 3


0009
RAS 2 Fail Latch
B9:0
2
Alarm Flasher Relay
B3:0
0
RAS 2 Fail Ack
B9:0
3
Main Fail Test Button
B3:0
3
RAS 2 Fail Light
O:20
1
1746-OA16
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the VFD is called to run by the ladder logic, and the VFD is not running, and utility power is available
0010
RAS 2 in Auto
I:8
4
1746-IA16
RAS 2 Run Output
O:11
1
1746-OA16
RAS 2 is On
I:8
5
1746-IA16
Utility Power Not Available
T4:4
DN
RAS 2 Fail Timer
TON
Timer On Delay
Timer T10:1
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0011
RAS 1 or 2 in Lead
I:8
0
1746-IA16
RAS 2 Fail Latch
B9:0
2
RAS 2 Run Output
O:11
1
1746-OA16
RAS 1 or 2 in Lead
I:8
0
1746-IA16
RAS 1 Fail Latch
B9:0
0
Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)
0012
RAS 3 Fail Input
I:8
10
1746-IA16
Utility Power Not Available
T4:4
DN
RAS 3 Input Fail Timer
TON
Timer On Delay
Timer T4:10
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0013
Main Alarm Reset
B3:0
1
RAS 3 Fail Timer
T10:2
DN
RAS 3 Fail Latch
B9:0
4
RAS 3 Input Fail Timer
T4:10
DN


RAS 3 Fail Latch
B9:0
4
0014
Main Alarm Reset
B3:0
1
RAS 3 Fail Latch
B9:0
4
Main Fail Acknowledge
B3:0
2
RAS 3 Fail Ack
B9:0
5
RAS 3 Fail Ack
B9:0
5
0015
RAS 3 Fail Latch
B9:0
4
Alarm Flasher Relay
B3:0
0
RAS 3 Fail Light
O:20
2
1746-OA16
RAS 3 Fail Ack
B9:0
5
Main Fail Test Button
B3:0
3
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the VFD is called to run by the ladder logic, and the VFD is not running, and utility power is available
0016
RAS 3 in Auto
I:8
8
1746-IA16
RAS 3 Run Output
O:11
2
1746-OA16
RAS 3 is On
I:8
9
1746-IA16
Utility Power Not Available
T4:4
DN
RAS 3 Fail Timer
TON
Timer On Delay
Timer T10:2
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0017
RAS 3 or 4 in Lead
I:8
7
1746-IA16
RAS 3 Fail Latch
B9:0
4
RAS 3 Run Output
O:11
2
1746-OA16
RAS 3 or 4 in Lead
I:8
7
1746-IA16
RAS 4 Fail Latch
B9:0
6


Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)
0018
RAS 4 Fail Input
I:8
13
1746-IA16
Utility Power Not Available
T4:4
DN
RAS 4 Input Fail Timer
TON
Timer On Delay
Timer T4:11
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0019
Main Alarm Reset
B3:0
1
RAS 4 Fail Timer
T10:3
DN
RAS 4 Fail Latch
B9:0
6
RAS 4 Input Fail Timer
T4:11
DN
RAS 4 Fail Latch
B9:0
6
0020
Main Alarm Reset
B3:0
1
RAS 4 Fail Latch
B9:0
6
Main Fail Acknowledge
B3:0
2
RAS 4 Fail Ack
B9:0
7
RAS 4 Fail Ack
B9:0
7
0021
RAS 4 Fail Latch
B9:0
6
Alarm Flasher Relay
B3:0
0
RAS 4 Fail Light
O:20
3
1746-OA16
RAS 4 Fail Ack
B9:0
7
Main Fail Test Button
B3:0
3

The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the VFD is called to run by the ladder logic, and the VFD is not running, and utility power is available

0022

RAS 4 in Auto — I:8 — 11 — 1746-IA16

RAS 4 Run Output — O:11 — 3 — 1746-OA16

RAS 4 is On — I:8 — 12 — 1746-IA16

Utility Power Not Available — T4:4 — DN

RAS 4 Fail Timer

TON

Timer On Delay	
Timer	T10:3
Time Base	1.0
Preset	20<
Accum	0<

EN

DN

0023

RAS 3 or 4 in Lead — I:8 — 7 — 1746-IA16

RAS 4 Fail Latch — B9:0 — 6

RAS 4 Run Output — O:11 — 3 — 1746-OA16

RAS 3 or 4 in Lead — I:8 — 7 — 1746-IA16

RAS 3 Fail Latch — B9:0 — 4

Puts the flow signal from the online AB into N7:0

0024

RAS flowing to AB-1 — B3:0 — 8

Unscaled RAS Flow to AB 1 or 2 (3277 - 16384)

MOV

Move	
Source	I:1.0
	9006<
Dest	N7:0
	8998<

Puts the flow signal from the online AB into N7:0

0025

RAS flowing to AB-1 — B3:0 — 8

Unscaled RAS Flow to AB 1 or 2 (3277 - 16384)

MOV

Move	
Source	I:1.1
	5987<
Dest	N7:0
	8998<

Scales the value of N7:0 for use in the PID controller.

Scaled Input for RAS PID Control (0 - 16383)

0026

SCP
Scale w/Parameters

Input	N7:0
	8998<
Input Min.	3277
	3277<
Input Max.	16384
	16384<
Scaled Min.	0
	0<
Scaled Max.	16383
	16383<
Output	N11:28
	7151<

Scales the RAS flow setpoint (entered on Panelview) for use in the PID controller.

RAS Flow Setpoint Input to PID Control (0-16383)

0027

SCP
Scale w/Parameters

Input	F8:6
	3.5<
Input Min.	0.0
	0.0<
Input Max.	8.0
	8.0<
Scaled Min.	0.0
	0.0<
Scaled Max.	16383.0
	16383.0<
Output	N11:2
	7168<

Controls the speed of the RAS pumps based on the setpoint entered on the Panelview and the flow signal.

RAS Pump Speed Control

0028

PID
PID

Control Block	N11:0
Process Variable	N11:28
Control Variable	N11:29
Control Block Length	23
Setup Screen	<

Changes the ratio of RAS flow from the clarifiers, based on inputs from the Panelview.

Increase Clarifier 1 Ratio

B3:0

6

0029

Clarifier 1/2 Ratio

ADD
Add

Source A	N7:1
	10056<
Source B	1
	1<
Dest	N7:1
	10056<

Changes the ratio of RAS flow from the clarifiers, based on inputs from the Panelview.

Decrease Clarifier 1 Ratio
B3:0
7

0030

Clarifier 1/2 Ratio

SUB
Subtract
Source A N7:1 10056<
Source B 1 1<
Dest N7:1 10056<

Defines the signal to RAS pumps 1 and 2 (from Clarifier 1), based on the ratio entered on the Panelview.

RAS Flow From Clarifier 1 (Ratio from Panelview)

0031

CPT
Compute
Dest N7:2 14476<
Expression (N11:29 * N7:1) * 0.0001

Defines the signal to RAS pumps 3 and 4 (from Clarifier 2), based on the ratio entered on the Panelview.

RAS Flow From Clarifier 2 (Ratio from Panelview)

0032

CPT
Compute
Dest N7:3 14314<
Expression (N11:29 * (20000 - N7:1)) * 0.0001

Scales the ratio of the Clarifier flows, for display on the Panelview

0033

DIV
Divide
Source A N7:1 10056<
Source B 10000.0 10000.0<
Dest F8:7 1.0056<

Calculates the speed output for RAS pump 1.

RAS 1 Speed Output (mA signal) (6242-31208)

0034

SCP
Scale w/Parameters
Input N7:2 14476<
Input Min. 0 0<
Input Max. 16383 16383<
Scaled Min. 6242 6242<
Scaled Max. 31208 31208<
Output O:5.0 28305<

Calculates the speed output for RAS pump 2.

RAS 2 Speed Output (mA signal) (6242-31208)

0035

SCP
Scale w/Parameters

Input	N7:2
	14476<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	6242
	6242<
Scaled Max.	31208
	31208<
Output	O:5.1
	28305<

Scales output to RAS pumps 1 and 2 in % for display on Panelview

0036

SCP
Scale w/Parameters

Input	N7:2
	14476<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	12
	12<
Scaled Max.	60
	60<
Output	N7:13
	54<

Calculates speed output for RAS pump 3.

RAS 3 Speed Output (mA signal) (6242-31208)

0037

SCP
Scale w/Parameters

Input	N7:3
	14314<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	6242
	6242<
Scaled Max.	31208
	31208<
Output	O:5.2
	28058<

Calculates speed output for RAS pump 4.

RAS 4 Speed
Output (mA signal)
(6242-31208)

0038

SCP
Scale w/Parameters

Input	N7:3
	14314<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	6242
	6242<
Scaled Max.	31208
	31208<
Output	O:5.3
	28058<

Scales output to RAS pumps 3 and 4 in % for display on Panelview

0039

SCP
Scale w/Parameters

Input	N7:3
	14314<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	12
	12<
Scaled Max.	60
	60<
Output	N7:14
	54<

Scales the flow signal for RAS flow to AB1 for use in the totalizer.

RAS Flow to AB-1
(0 - 0.0926 kgps)

0040

SCP
Scale w/Parameters

Input	I:1.0
	9006<
Input Min.	3277.0
	3277.0<
Input Max.	16383.0
	16383.0<
Scaled Min.	0.0
	0.0<
Scaled Max.	0.0926
	0.0926<
Output	F8:0
	0.04042153<

Totalizes RAS flow to AB-1

0041

RAS flowing to AB-1
B3:0
8

One-second Timer for Totalizers
T4:1
DN

Total RAS Flow to AB-1 (x1000 gallons)

ADD
Add
Source A F8:0 0.04042153<
Source B F8:3 1465.625<
Dest F8:3 1465.625<

Resets totalizer for AB-1 RAS flow

0042

Reset AB-1 RAS Totalizer (from Panelview)
B3:0
4

Total RAS Flow to AB-1 (x1000 gallons)

MOV
Move
Source 0.0 0.0<
Dest F8:3 1465.625<

Makes the lines flash on the Panelview

0043

RAS flowing to AB-1
B3:0
8

AB-1 RAS Flow Indication (for Panelview)
T4:2
DN

AB-1 RAS Flow Indication (for Panelview)

TON
Timer On Delay
Timer T4:2
Time Base 0.01
Preset 300<
Accum 46<
EN
DN

Scales the flow signal for RAS flow to AB2 for use in the totalizer.

0044

RAS Flow to AB-2 (0 - 0.0926 kgps)

SCP
Scale w/Parameters
Input I:1.1 5987<
Input Min. 3277.0 3277.0<
Input Max. 16383.0 16383.0<
Scaled Min. 0.0 0.0<
Scaled Max. 0.0926 0.0926<
Output F8:1 0.01914035<

Totalizes the RAS flow to AB-2

0045

RAS flowing to AB-1
B3:0
8

One-second Timer for Totalizers
T4:1
DN

Total RAS Flow to AB-2 (x1000 gallons)

ADD
Add
Source A F8:1 0.01914035<
Source B F8:4 0.0<
Dest F8:4 0.0<

Resets the totalizer for AB-2

0046

Reset AB-2 RAS Totalizer (from Panelview)
B3:0
5

Total RAS Flow to AB-2 (x1000 gallons)

MOV
Move
Source 0.0 0.0<
Dest F8:4 0.0<

Makes the lines flash on the Panelview

0047

RAS flowing to AB-1
B3:0
8

AB-2 RAS Flow Indication (for Panelview)
T4:3
DN

AB-2 RAS Flow Indication (for Panelview)

TON
Timer On Delay
Timer T4:3
Time Base 1.0
Preset 30<
Accum 0<
EN
DN

0048

AB-1 RAS Flow (0 - 8 MGD) (for Panelview)

SCP
Scale w/Parameters
Input I:1.0 9006<
Input Min. 3277.0 3277.0<
Input Max. 16383.0 16383.0<
Scaled Min. 0.0 0.0<
Scaled Max. 8.0 8.0<
Output F8:2 3.492141<

AB-2 RAS Flow
(0 - 8 MGD)
(for Panelview)

0049

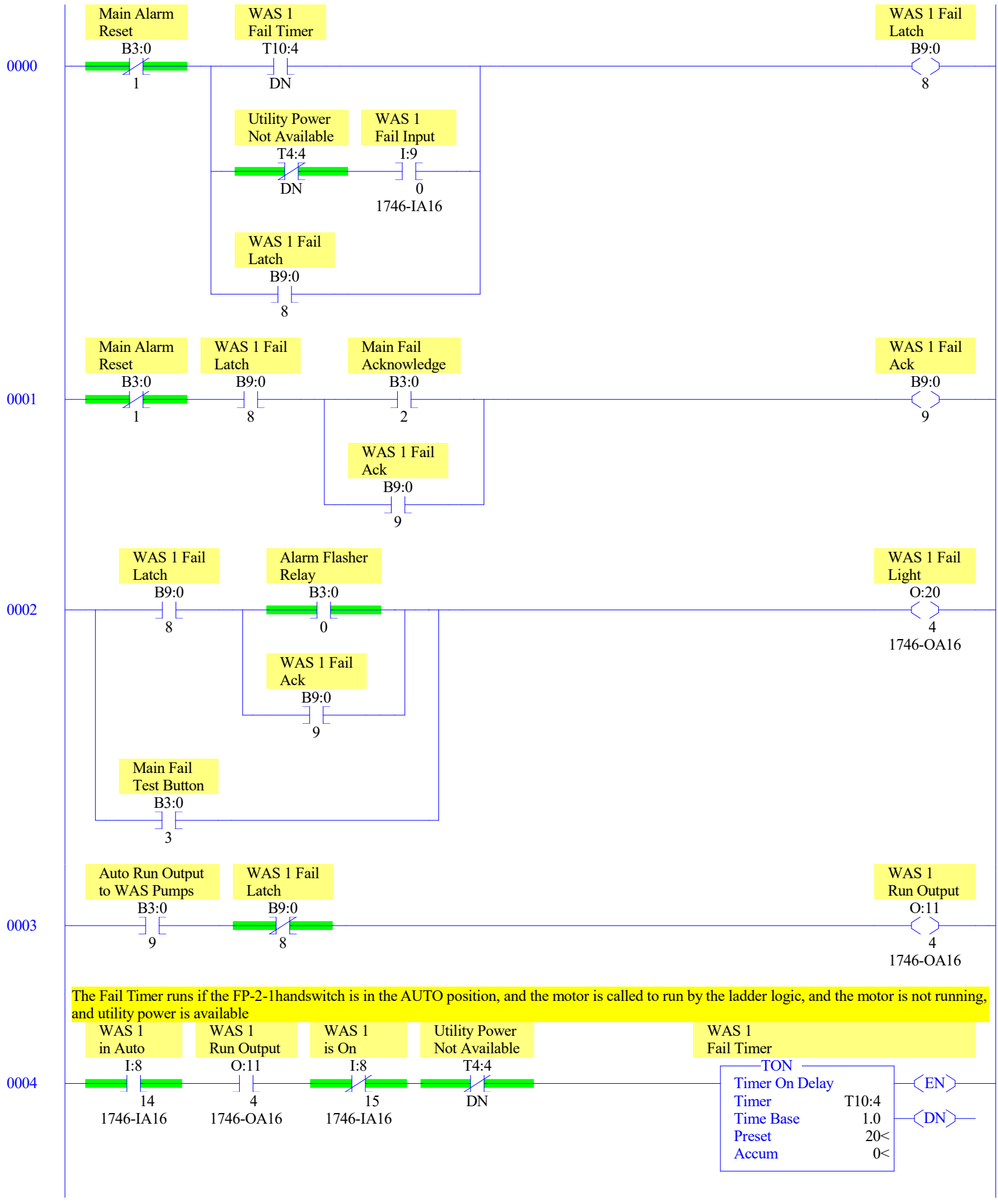
SCP
Scale w/Parameters

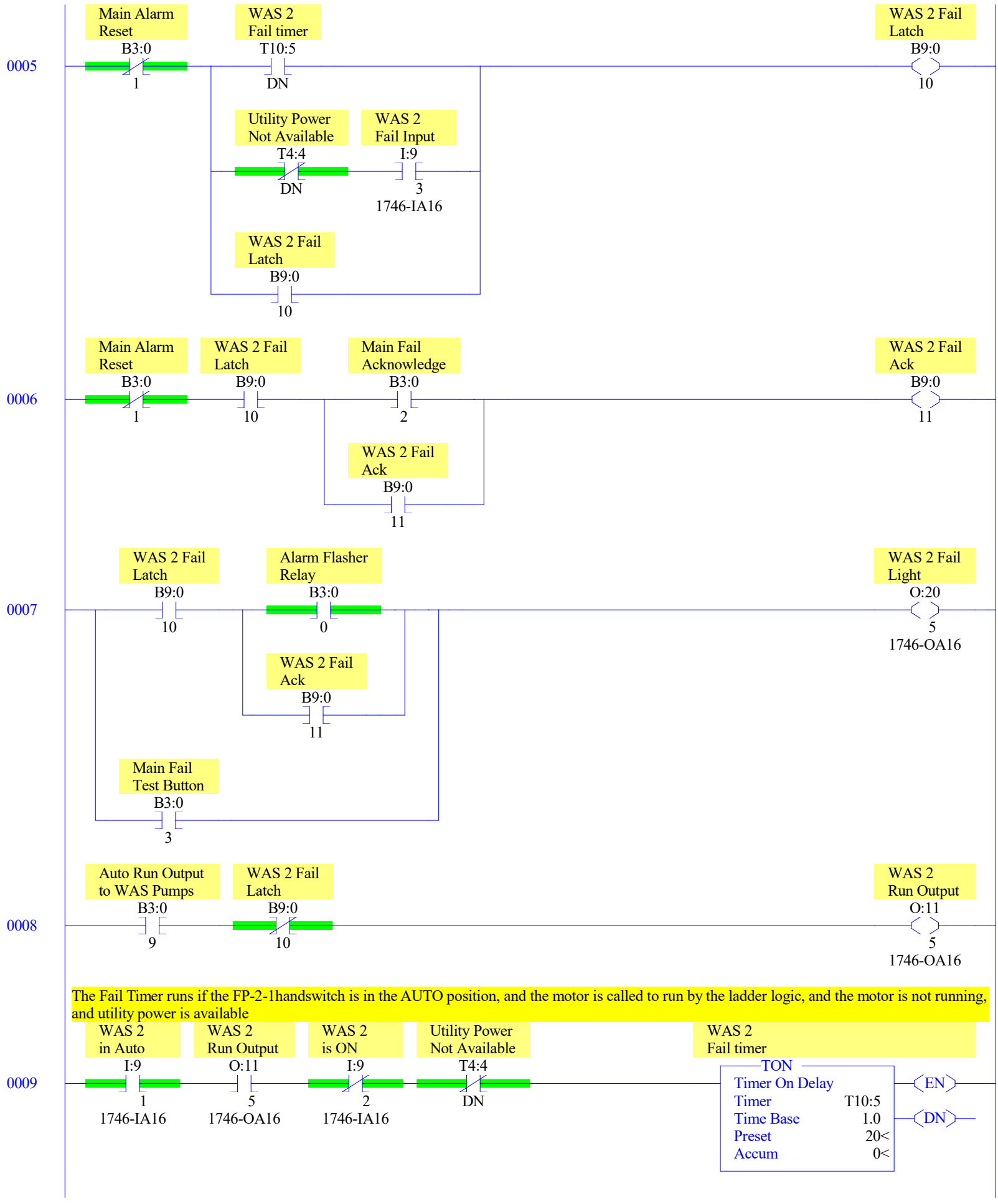
Input	I:1.1
	5987<
Input Min.	3277.0
	3277.0<
Input Max.	16383.0
	16383.0<
Scaled Min.	0.0
	0.0<
Scaled Max.	8.0
	8.0<
Output	F8:5
	1.653594<

Returns to the MAIN ladder file.

0050

END


Main Alarm Reset
B3:0
1
WAS 1 Fail Timer
T10:4
DN
WAS 1 Fail Latch
B9:0
8
0000
Utility Power Not Available
T4:4
DN
WAS 1 Fail Input
I:9
0
1746-IA16
WAS 1 Fail Latch
B9:0
8
Main Alarm Reset
B3:0
1
WAS 1 Fail Latch
B9:0
8
Main Fail Acknowledge
B3:0
2
WAS 1 Fail Ack
B9:0
9
0001
WAS 1 Fail Ack
B9:0
9
WAS 1 Fail Latch
B9:0
8
Alarm Flasher Relay
B3:0
0
WAS 1 Fail Light
O:20
4
1746-OA16
0002
WAS 1 Fail Ack
B9:0
9
Main Fail Test Button
B3:0
3
Auto Run Output to WAS Pumps
B3:0
9
WAS 1 Fail Latch
B9:0
8
WAS 1 Run Output
O:11
4
1746-OA16
0003
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the motor is called to run by the ladder logic, and the motor is not running, and utility power is available
WAS 1 in Auto
I:8
14
1746-IA16
WAS 1 Run Output
O:11
4
1746-OA16
WAS 1 is On
I:8
15
1746-IA16
Utility Power Not Available
T4:4
DN
WAS 1 Fail Timer
TON
Timer On Delay
Timer T10:4
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0004


0005
Main Alarm Reset
B3:0
1
WAS 2 Fail timer
T10:5
DN
WAS 2 Fail Latch
B9:0
10
Utility Power Not Available
T4:4
DN
WAS 2 Fail Input
I:9
3
1746-IA16
WAS 2 Fail Latch
B9:0
10
0006
Main Alarm Reset
B3:0
1
WAS 2 Fail Latch
B9:0
10
Main Fail Acknowledge
B3:0
2
WAS 2 Fail Ack
B9:0
11
WAS 2 Fail Ack
B9:0
11
0007
WAS 2 Fail Latch
B9:0
10
Alarm Flasher Relay
B3:0
0
WAS 2 Fail Light
O:20
5
1746-OA16
WAS 2 Fail Ack
B9:0
11
Main Fail Test Button
B3:0
3
0008
Auto Run Output to WAS Pumps
B3:0
9
WAS 2 Fail Latch
B9:0
10
WAS 2 Run Output
O:11
5
1746-OA16
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the motor is called to run by the ladder logic, and the motor is not running, and utility power is available
0009
WAS 2 in Auto
I:9
1
1746-IA16
WAS 2 Run Output
O:11
5
1746-OA16
WAS 2 is ON
I:9
2
1746-IA16
Utility Power Not Available
T4:4
DN
WAS 2 Fail timer
TON
Timer On Delay
Timer T10:5
Time Base 1.0
Preset 20<
Accum 0<
EN
DN

Scales the raw input from the WAS 1 flowmeter to 0-300GPM

0010

WAS 1 Flow
(0-350 GPM)

SCP
Scale w/Parameters
Input I:1.2
3278<
Input Min. 3277
3277<
Input Max. 16384
16384<
Scaled Min. 0
0<
Scaled Max. 462
462<
Output N7:6
0<

Totalizes WAS 1 flow.

0011

WAS 1
is On
I:8
15
1746-IA16

One-second Timer
for Totalizers
T4:1
DN

WAS 1
Totalizer

CPT
Compute
Dest N7:7
0<
Expression N7:7 + (N7:6 * 0.016667)

Increase the value of the WAS 1 flow totalizer counter, and resets the totalizer value to 0 every time it reaches 1000.

0012

WAS 1
Totalizer

GEQ
Grtr Than or Eql (A>=B)
Source A N7:7
0<
Source B 1000
1000<

WAS 1 Totalizer
Counter(x1000)

CTU
Count Up
Counter C5:0
Preset 30000<
Accum 0<
CU
DN

WAS 1
Totalizer

MOV
Move
Source 0
0<
Dest N7:7
0<

Scales the raw input from the WAS 2 flowmeter to 0-462GPM

0013

WAS 2 Flow
(0-462 GPM)

SCP
Scale w/Parameters
Input I:1.3
3273<
Input Min. 3277
3277<
Input Max. 16384
16384<
Scaled Min. 0
0<
Scaled Max. 462
462<
Output N7:8
0<

WAS 2 Flow (0-462 GPM)

0014

LES
Less Than (A<B)
Source A N7:8 0<
Source B 0 0<

WAS 2 Flow (0-462 GPM)

MOV
Move
Source 0 0<
Dest N7:8 0<

Totalizes WAS 2 flow.

WAS 2 is ON
I:9
2
1746-IA16

One-second Timer for Totalizers
T4:1
DN

0015

WAS 2 Totalizer

CPT
Compute
Dest N7:9 0<
Expression N7:9 + (N7:8 * 0.016667)

Increase the value of the WAS 2 flow totalizer counter, and resets the totalizer value to 0 every time it reaches 1000.

WAS 2 Totalizer

0016

GEQ
Grtr Than or Eql (A>=B)
Source A N7:9 0<
Source B 1000 1000<

WAS 2 Totalizer Counter(x1000)

CTU
Count Up
Counter C5:1
Preset 30000<
Accum 0<
CU
DN

WAS 2 Totalizer

MOV
Move
Source 0 0<
Dest N7:9 0<

Adds WAS 1 and WAS 2 totalizer counter values.

Wasting Totalizer

0017

ADD
Add
Source A C5:0.ACC 0<
Source B C5:1.ACC 0<
Dest N7:10 0<

Checks to see if wasting has been completed

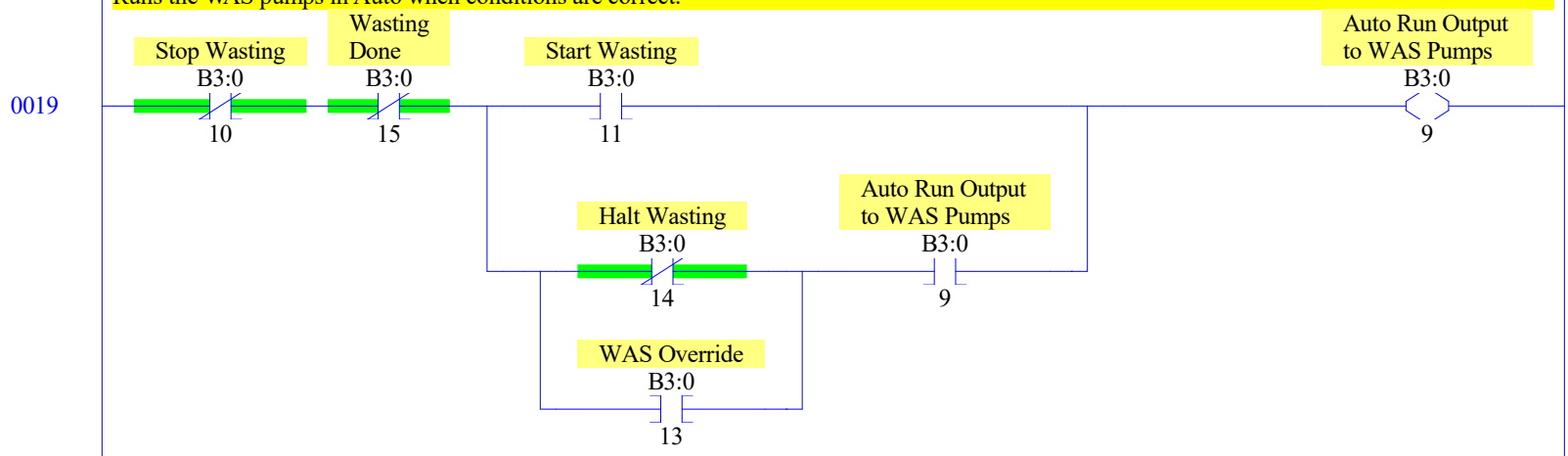
Wasting Totalizer

0018

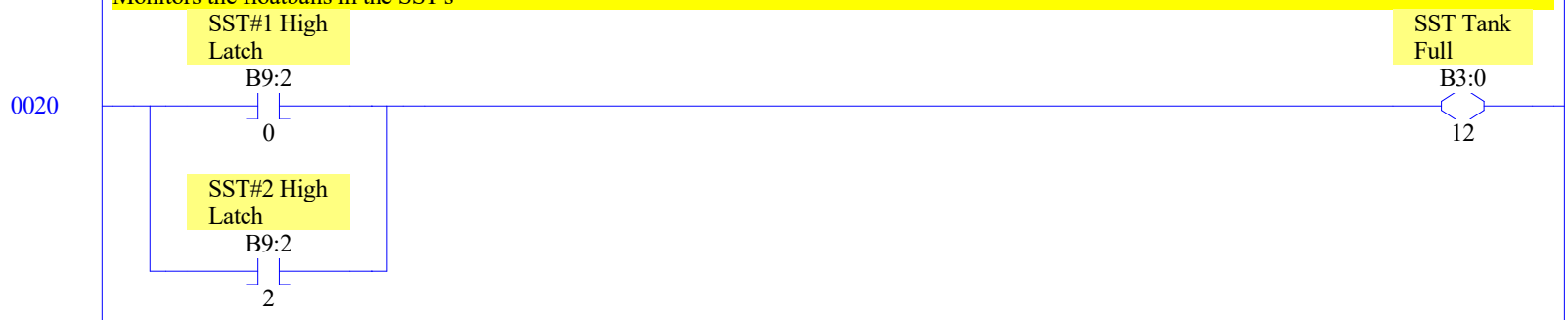
GEQ
Grtr Than or Eql (A>=B)
Source A N7:10 0<
Source B N7:11 150<

Wasting Done
B3:0
15

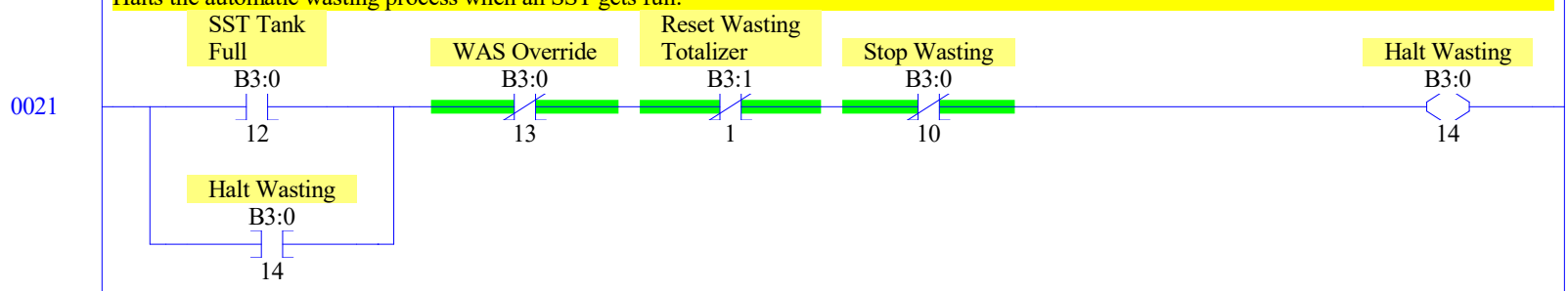
Runs the WAS pumps in Auto when conditions are correct.



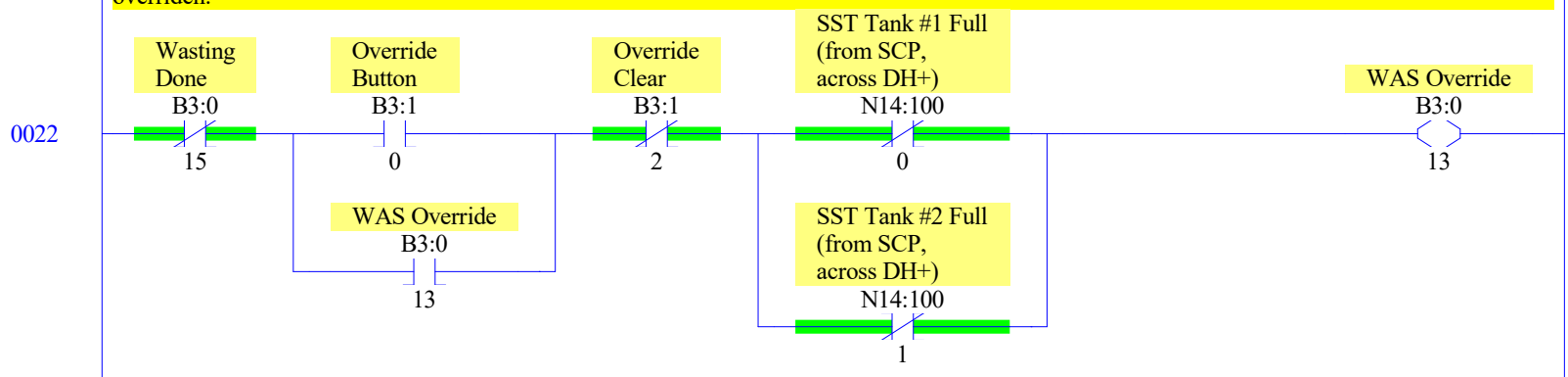
Monitors the floatballs in the SST's

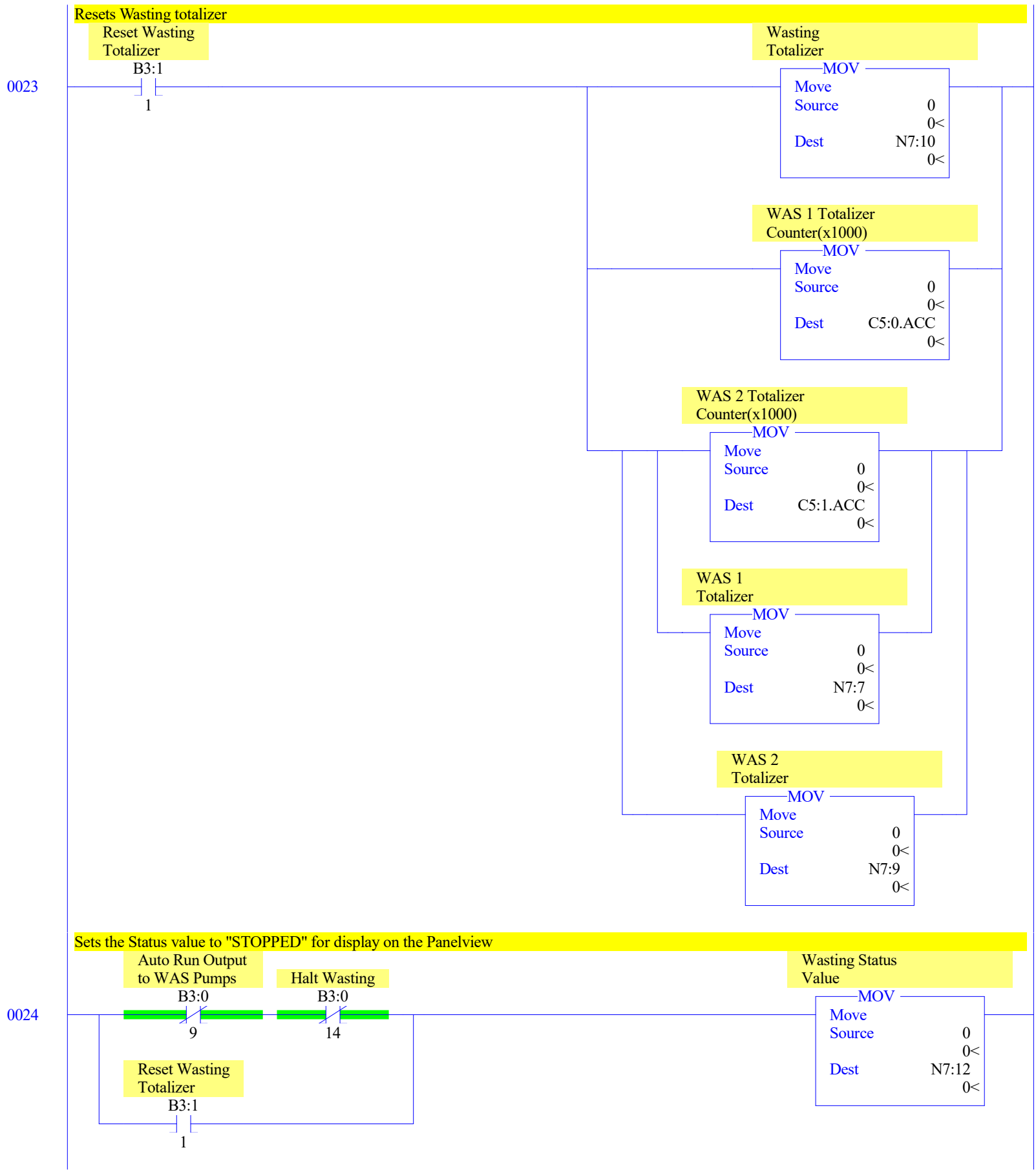


Halts the automatic wasting process when an SST gets full.



Allows the Operator to override the Halt feature of the automatic wasting process when one SST tank gets full. If both are full, the system cannot be overriden.




Resets Wasting totalizer
Reset Wasting Totalizer
B3:1
1
0023
Wasting Totalizer
MOV
Move
Source 0
0<
Dest N7:10
0<
WAS 1 Totalizer Counter(x1000)
MOV
Move
Source 0
0<
Dest C5:0.ACC
0<
WAS 2 Totalizer Counter(x1000)
MOV
Move
Source 0
0<
Dest C5:1.ACC
0<
WAS 1 Totalizer
MOV
Move
Source 0
0<
Dest N7:7
0<
WAS 2 Totalizer
MOV
Move
Source 0
0<
Dest N7:9
0<
Sets the Status value to "STOPPED" for display on the Panelview
Auto Run Output to WAS Pumps
B3:0
9
Halt Wasting
B3:0
14
0024
Reset Wasting Totalizer
B3:1
1
Wasting Status Value
MOV
Move
Source 0
0<
Dest N7:12
0<

Sets the Status value to "WASTING" for display on the Panelview

0025

Auto Run Output to WAS Pumps B3:0 9

WAS Override B3:0 13

Wasting Status Value

MOV
Move Source 1 1<
Dest N7:12 0<

Sets the Status value to "HALTED" for display on the Panelview

0026

Halt Wasting B3:0 14

Wasting Status Value

MOV
Move Source 2 2<
Dest N7:12 0<

Sets the Status value to "OVERRIDING" for display on the Panelview

0027

WAS Override B3:0 13

Auto Run Output to WAS Pumps B3:0 9

Wasting Status Value

MOV
Move Source 3 3<
Dest N7:12 0<

Sets the Status value to "FINISHED" for display on the Panelview

0028

Wasting Done B3:0 15

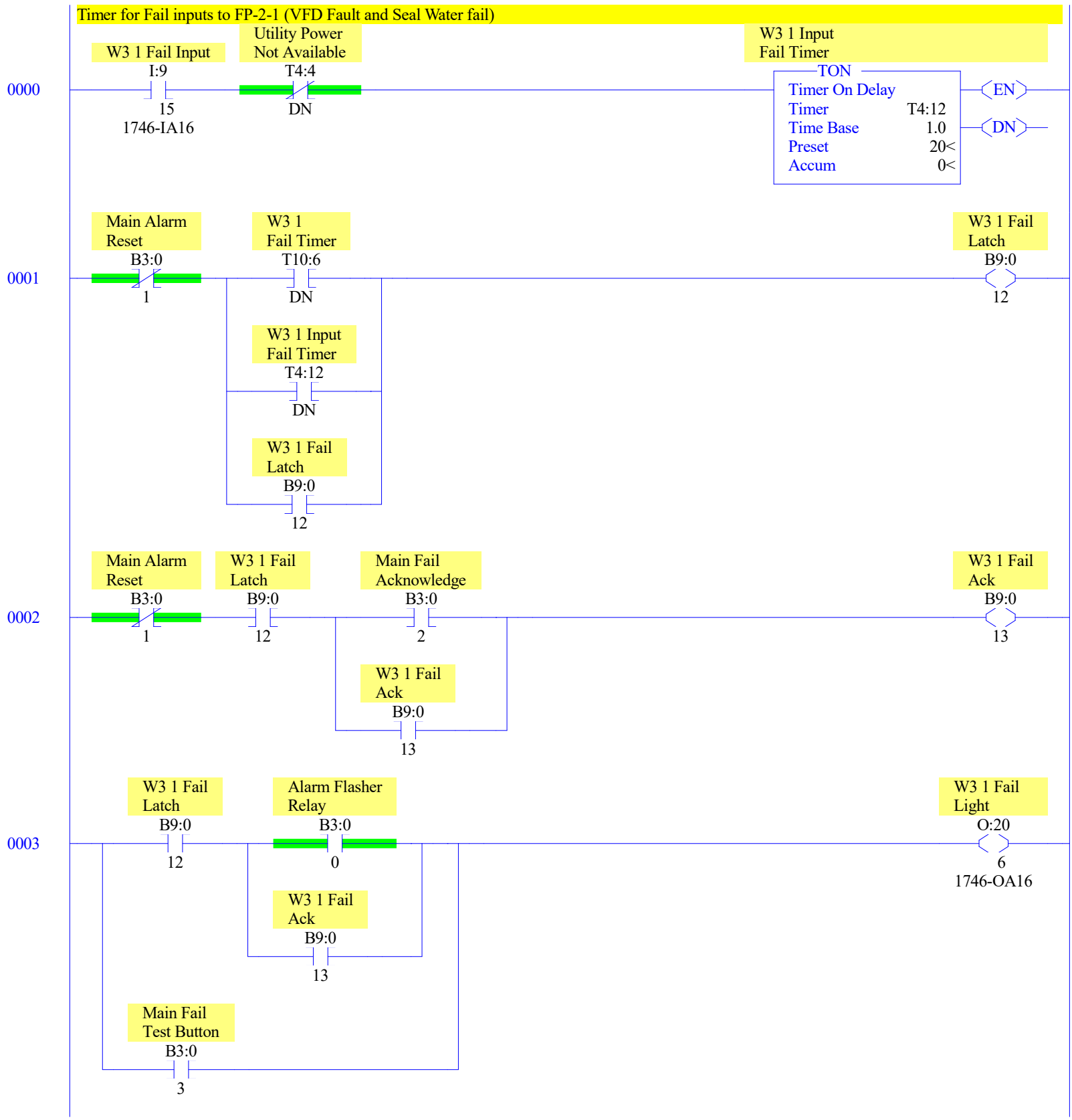
Wasting Status Value

MOV
Move Source 4 4<
Dest N7:12 0<

Returns to the MAIN ladder file.

0029

END


Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)
0000
W3 1 Fail Input
I:9
15
1746-IA16
Utility Power
Not Available
T4:4
DN
W3 1 Input
Fail Timer
TON
Timer On Delay
Timer T4:12
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0001
Main Alarm
Reset
B3:0
1
W3 1
Fail Timer
T10:6
DN
W3 1 Fail
Latch
B9:0
12
W3 1 Input
Fail Timer
T4:12
DN
W3 1 Fail
Latch
B9:0
12
0002
Main Alarm
Reset
B3:0
1
W3 1 Fail
Latch
B9:0
12
Main Fail
Acknowledge
B3:0
2
W3 1 Fail
Ack
B9:0
13
W3 1 Fail
Ack
B9:0
13
0003
W3 1 Fail
Latch
B9:0
12
Alarm Flasher
Relay
B3:0
0
W3 1 Fail
Light
O:20
6
1746-OA16
W3 1 Fail
Ack
B9:0
13
Main Fail
Test Button
B3:0
3

The Fail Timer runs if the FP-2-1handswitch is not in the OFF position, and the VFD is called to run by the ladder logic, and the VFD is not running and utility power is available

0004

W3 1 in OFF
I:9
13
1746-IA16

W3 1 Run Output
O:11
7
1746-OA16

W3 1 is On
I:9
14
1746-IA16

Utility Power Not Available
T4:4
DN

W3 1 Fail Timer
TON
Timer On Delay
Timer T10:6
Time Base 1.0
Preset 45<
Accum 0<
EN
DN

Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)

0005

W3 2 Fail Input
I:9
9
1746-IA16

Utility Power Not Available
T4:4
DN

W3 2 Input Fail Timer
TON
Timer On Delay
Timer T4:13
Time Base 1.0
Preset 20<
Accum 0<
EN
DN

0006

Main Alarm Reset
B3:0
1

W3 2 Fail Timer
T10:7
DN

W3 2 Fail Latch
B9:0
14

W3 2 Input Fail Timer
T4:13
DN

W3 2 Fail Latch
B9:0
14

0007

Main Alarm Reset
B3:0
1

W3 2 Fail Latch
B9:0
14

Main Fail Acknowledge
B3:0
2

W3 2 Fail Ack
B9:0
15

W3 2 Fail Ack
B9:0
15

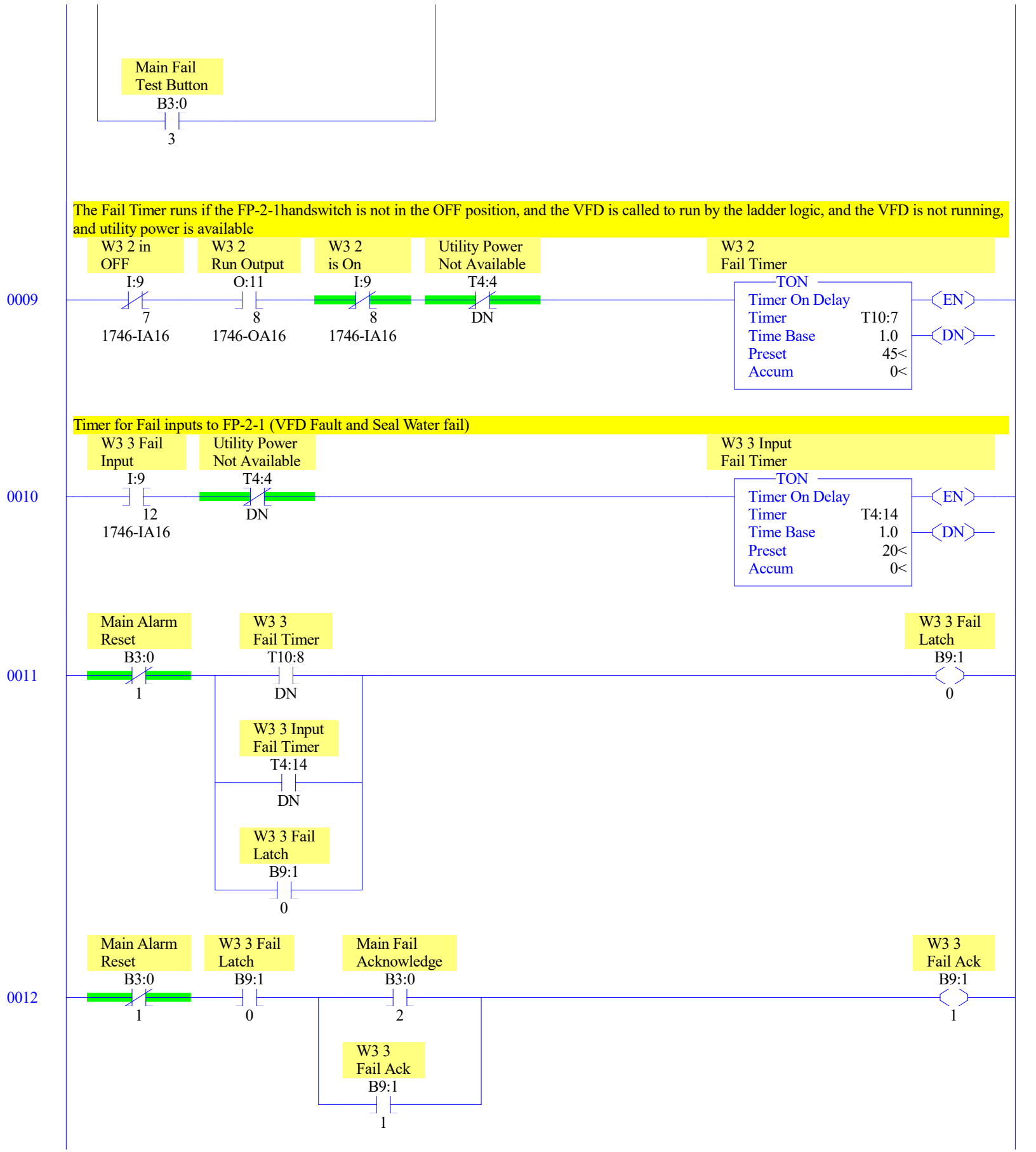
0008

W3 2 Fail Latch
B9:0
14

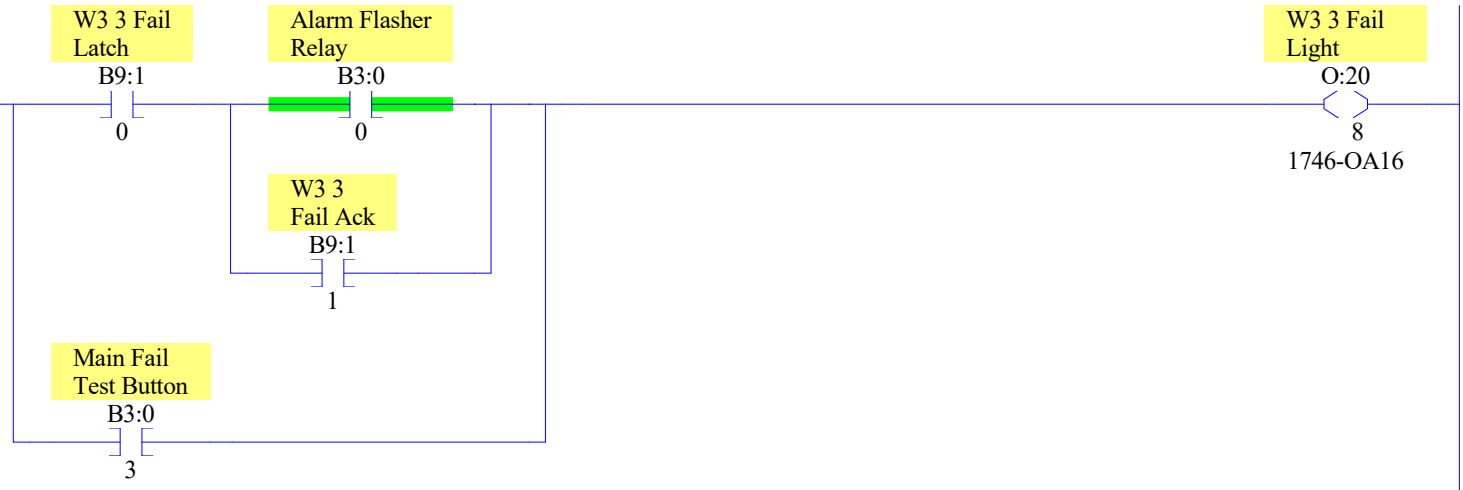
Alarm Flasher Relay
B3:0
0

W3 2 Fail Light
O:20
7
1746-OA16

W3 2 Fail Ack
B9:0
15

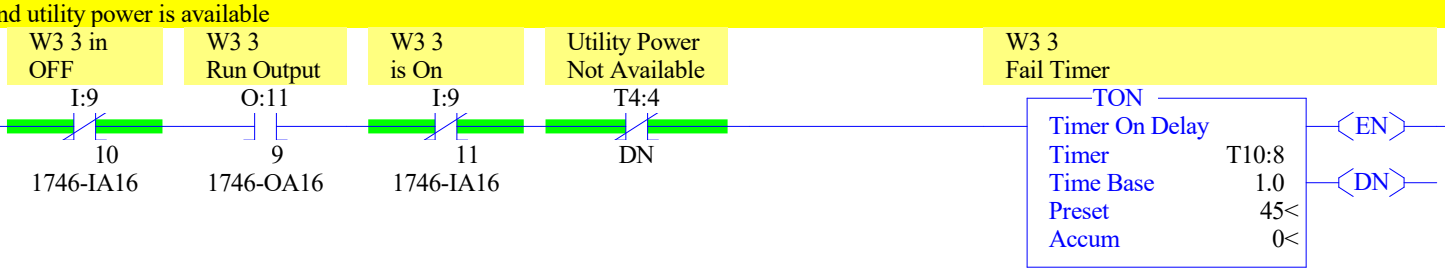

Main Fail
Test Button
B3:0
3
The Fail Timer runs if the FP-2-1handswitch is not in the OFF position, and the VFD is called to run by the ladder logic, and the VFD is not running, and utility power is available
0009
W3 2 in
OFF
I:9
7
1746-IA16
W3 2
Run Output
O:11
8
1746-OA16
W3 2
is On
I:9
8
1746-IA16
Utility Power
Not Available
T4:4
DN
W3 2
Fail Timer
TON
Timer On Delay
Timer T10:7
Time Base 1.0
Preset 45<
Accum 0<
EN
DN
Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)
0010
W3 3 Fail
Input
I:9
12
1746-IA16
Utility Power
Not Available
T4:4
DN
W3 3 Input
Fail Timer
TON
Timer On Delay
Timer T4:14
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0011
Main Alarm
Reset
B3:0
1
W3 3
Fail Timer
T10:8
DN
W3 3 Fail
Latch
B9:1
0
W3 3 Input
Fail Timer
T4:14
DN
W3 3 Fail
Latch
B9:1
0
0012
Main Alarm
Reset
B3:0
1
W3 3 Fail
Latch
B9:1
0
Main Fail
Acknowledge
B3:0
2
W3 3
Fail Ack
B9:1
1
W3 3
Fail Ack
B9:1
1

0013



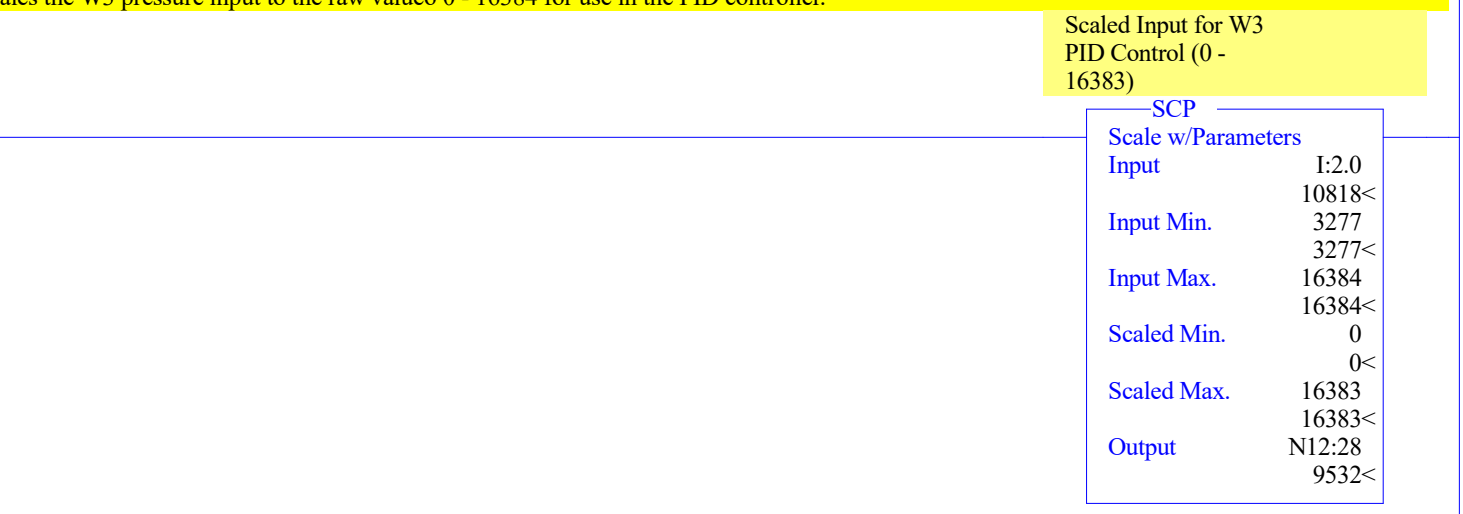
The Fail Timer runs if the FP-2-1handswitch is not in the OFF position, and the VFD is called to run by the ladder logic, and the VFD is not running, and utility power is available

0014



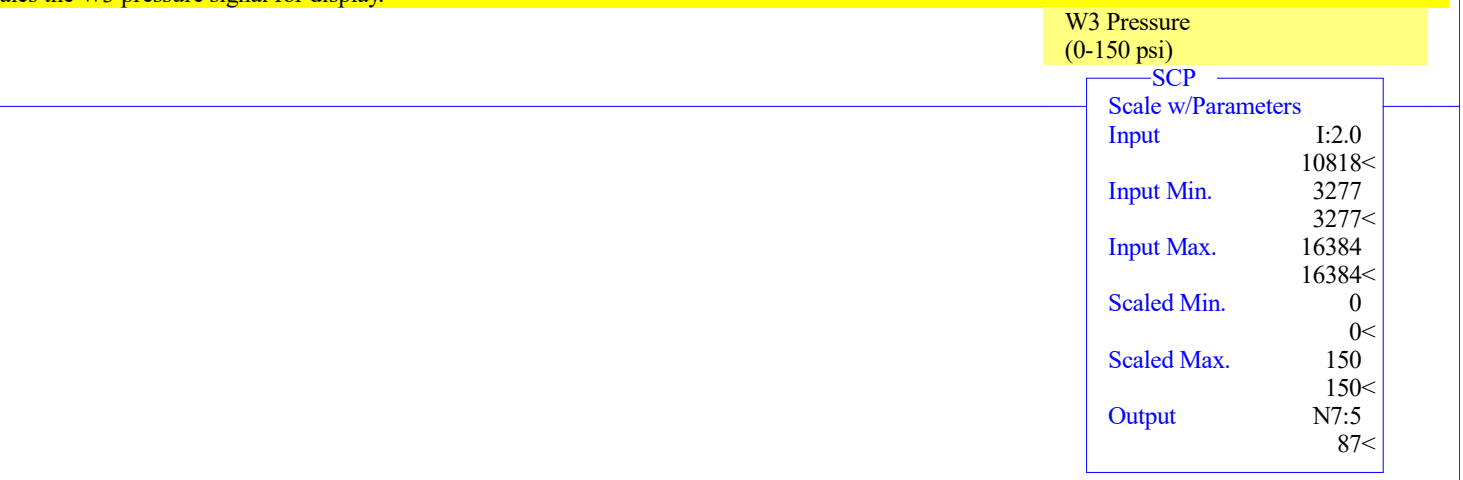
Scales the W3 pressure input to the raw valueo 0 - 16384 for use in the PID controller.

0015



Scales the W3 pressure signal for display.

0016



Takes the setpoint for the W3 pressure (0 - 100 psi) and scales it to the raw vlaue of 0 - 16384 for use in the PID controller.

0017

W3 Pressure Setpoint
Input to PID Control

SCP
Scale w/Parameters

Input	N7:4
	75<
Input Min.	0.0
	0.0<
Input Max.	150.0
	150.0<
Scaled Min.	0.0
	0.0<
Scaled Max.	16383.0
	16383.0<
Output	N12:2
	8192<

Controls the speed of the W3 pumps based on the pressure and the setpoint.

0018

PID
PID

Control Block	N12:0
Process Variable	N12:28
Control Variable	N12:29
Control Block Length	23
Setup Screen	<

Scales the raw output (0 - 16384) from the PID controller to a percentage value.

0019

W3 Percent Speed
Output from
PID Control

SCP
Scale w/Parameters

Input	N12:29
	0<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	0
	0<
Scaled Max.	100
	100<
Output	N7:18
	0<

Scales the PID output to VFD frequency

0020

W3 VFD
Frequency

SCP
Scale w/Parameters

Input	N12:29
	0<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	20
	20<
Scaled Max.	60
	60<
Output	N7:26
	20<

Automatically adjusts the speed output for the W3 VFD's

W3 Speed
Auto Control
B3:3
1

0021

W3 #1
Speed Output
(4 - 20mA)

SCP
Scale w/Parameters
Input N7:18
0<
Input Min. 0
0<
Input Max. 100
100<
Scaled Min. 6242
6242<
Scaled Max. 31208
31208<
Output O:6.0
21222<

Manually adjusts the speed output for the W3 VFD's

W3 Speed
Auto Control
B3:3
1

0022

W3 #1
Speed Output
(4 - 20mA)

SCP
Scale w/Parameters
Input N7:17
60<
Input Min. 0
0<
Input Max. 100
100<
Scaled Min. 6242
6242<
Scaled Max. 31208
31208<
Output O:6.0
21222<

Copies the speed output value from W3 #1 to W3 #2.

0023

W3 #2
Speed Output
(4 - 20mA)

MOV
Move
Source O:6.0
21222<
Dest O:6.1
21222<

Copies the speed output value from W3 #1 to W3 #3

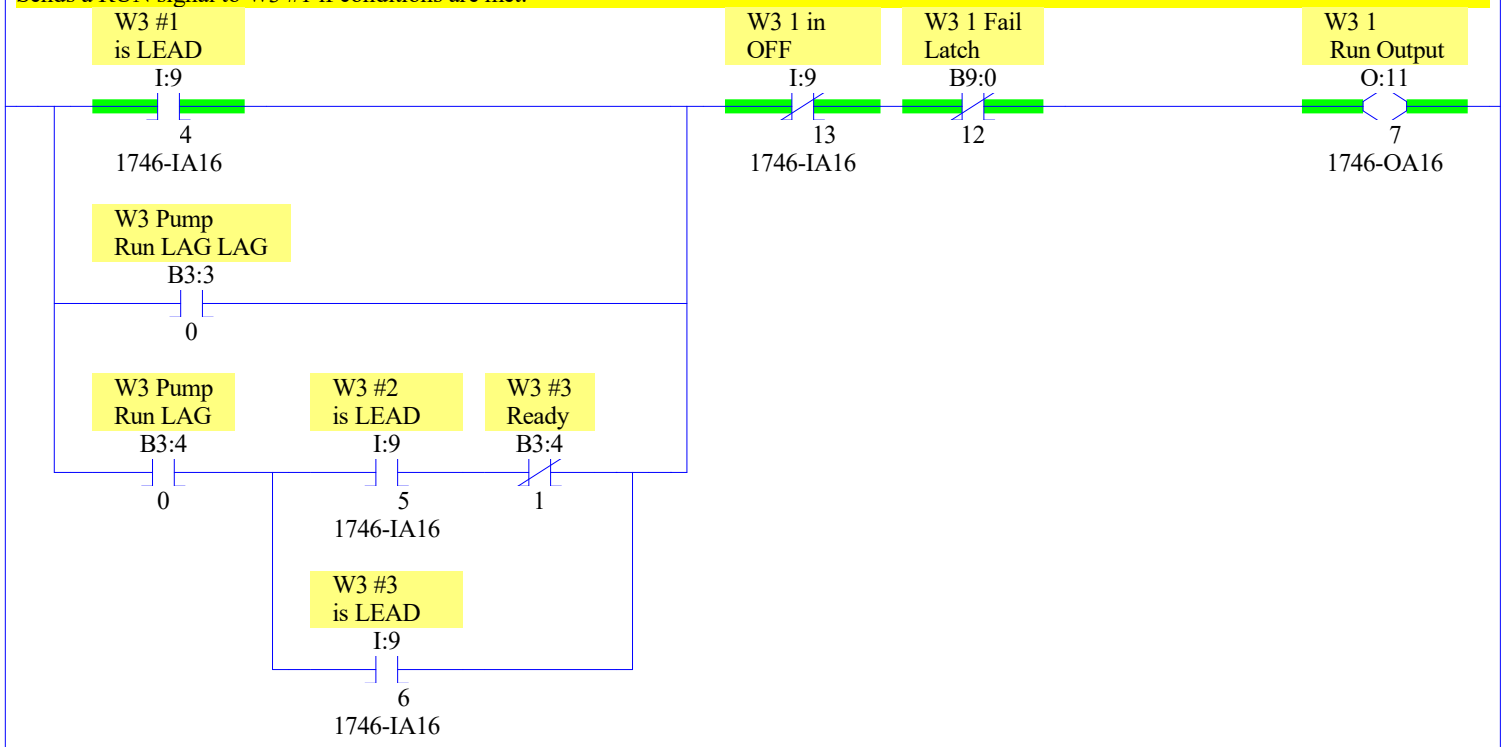
0024

W3 #3
Speed Output
(4 - 20mA)

MOV
Move
Source O:6.0
21222<
Dest O:6.2
21222<

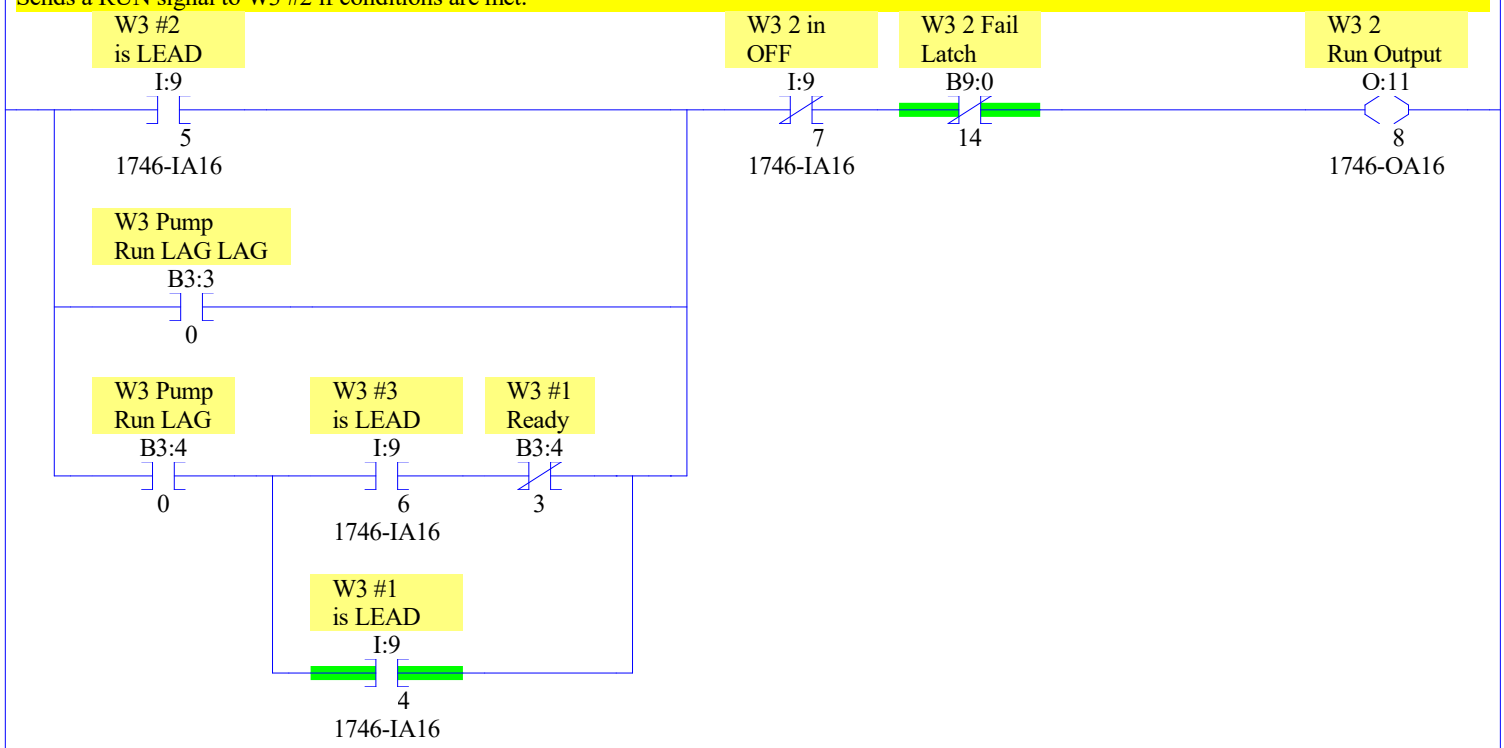
Sends a RUN signal to W3 #1 if conditions are met.

0025



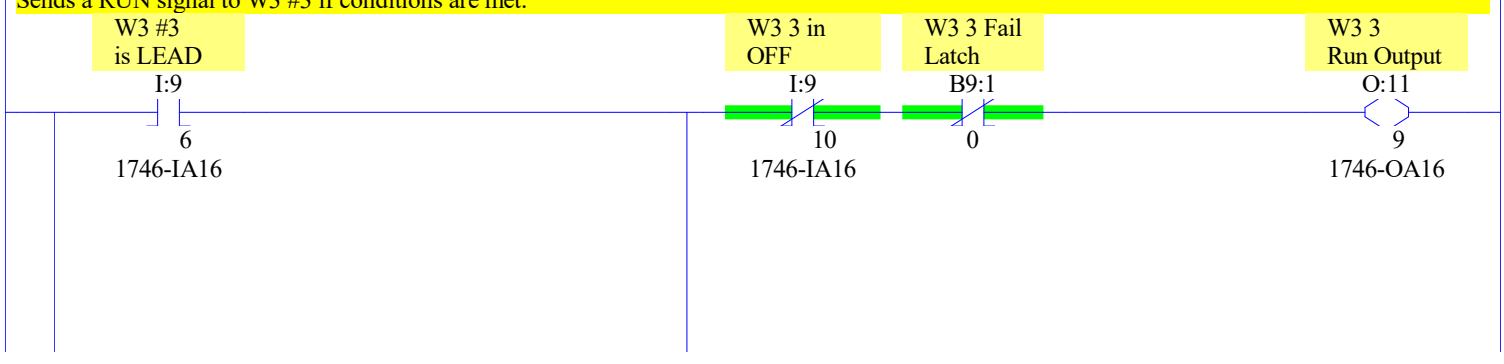
Sends a RUN signal to W3 #2 if conditions are met.

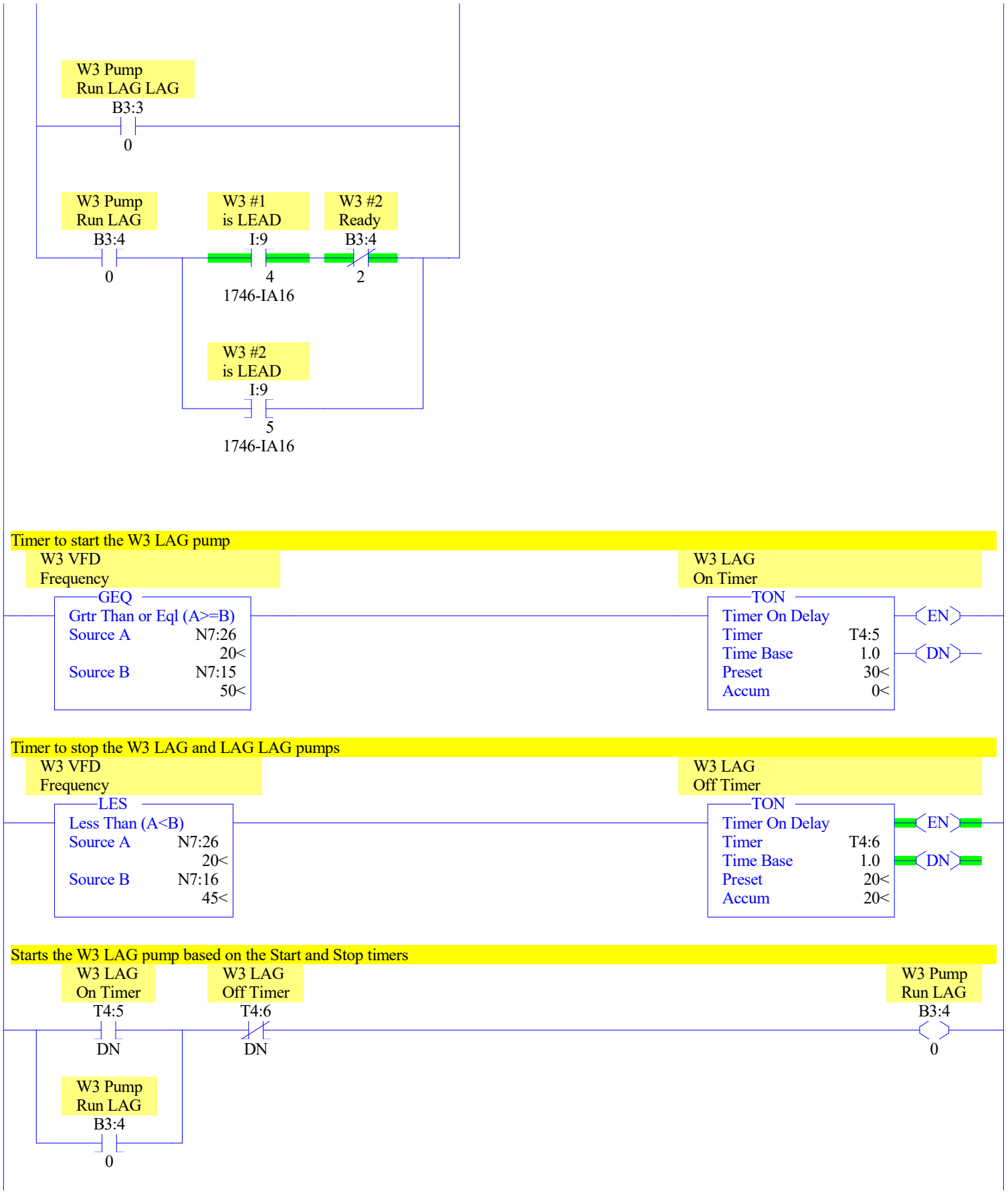
0026



Sends a RUN signal to W3 #3 if conditions are met.

0027




W3 Pump
Run LAG LAG
B3:3
0
W3 Pump
Run LAG
B3:4
0
W3 #1
is LEAD
I:9
4
1746-IA16
W3 #2
Ready
B3:4
2
W3 #2
is LEAD
I:9
5
1746-IA16
Timer to start the W3 LAG pump
W3 VFD
Frequency
GEQ
Grtr Than or Eql (A>=B)
Source A N7:26
20<
Source B N7:15
50<
W3 LAG
On Timer
TON
Timer On Delay
Timer T4:5
Time Base 1.0
Preset 30<
Accum 0<
EN
DN
0028
Timer to stop the W3 LAG and LAG LAG pumps
W3 VFD
Frequency
LES
Less Than (A<B)
Source A N7:26
20<
Source B N7:16
45<
W3 LAG
Off Timer
TON
Timer On Delay
Timer T4:6
Time Base 1.0
Preset 20<
Accum 20<
EN
DN
0029
Starts the W3 LAG pump based on the Start and Stop timers
W3 LAG
On Timer
T4:5
DN
W3 LAG
Off Timer
T4:6
DN
W3 Pump
Run LAG
B3:4
0
W3 Pump
Run LAG
B3:4
0
0030

Timer to start the W3 LAG LAG pump

0031

W3 Pump Run LAG B3:4 0

W3 VFD Frequency

GEQ Grtr Than or Eql (A>=B)
Source A N7:26 20<
Source B N7:15 50<

W3 LAG LAG On Timer

TON Timer On Delay
Timer T4:7
Time Base 1.0
Preset 120<
Accum 0<
EN
DN

Starts the W3 LAG LAG pump based on the Start and Stop timers

0032

W3 LAG LAG On Timer T4:7 DN

W3 LAG Off Timer T4:6 DN

W3 Pump Run LAG LAG B3:3 0

W3 Pump Run LAG LAG B3:3 0

Verifies that the FP-2-1 handswitch is not in OFF position, and that the pump hasn't failed

0033

W3 1 in OFF I:9 13 1746-IA16

W3 1 Fail Latch B9:0 12

W3 #1 Ready B3:4 3

Verifies that the FP-2-1 handswitch is not in OFF position, and that the pump hasn't failed

0034

W3 2 in OFF I:9 7 1746-IA16

W3 2 Fail Latch B9:0 14

W3 #2 Ready B3:4 2

Verifies that the FP-2-1 handswitch is not in OFF position, and that the pump hasn't failed

0035

W3 3 in OFF I:9 10 1746-IA16

W3 3 Fail Latch B9:1 0

W3 #3 Ready B3:4 1

0036

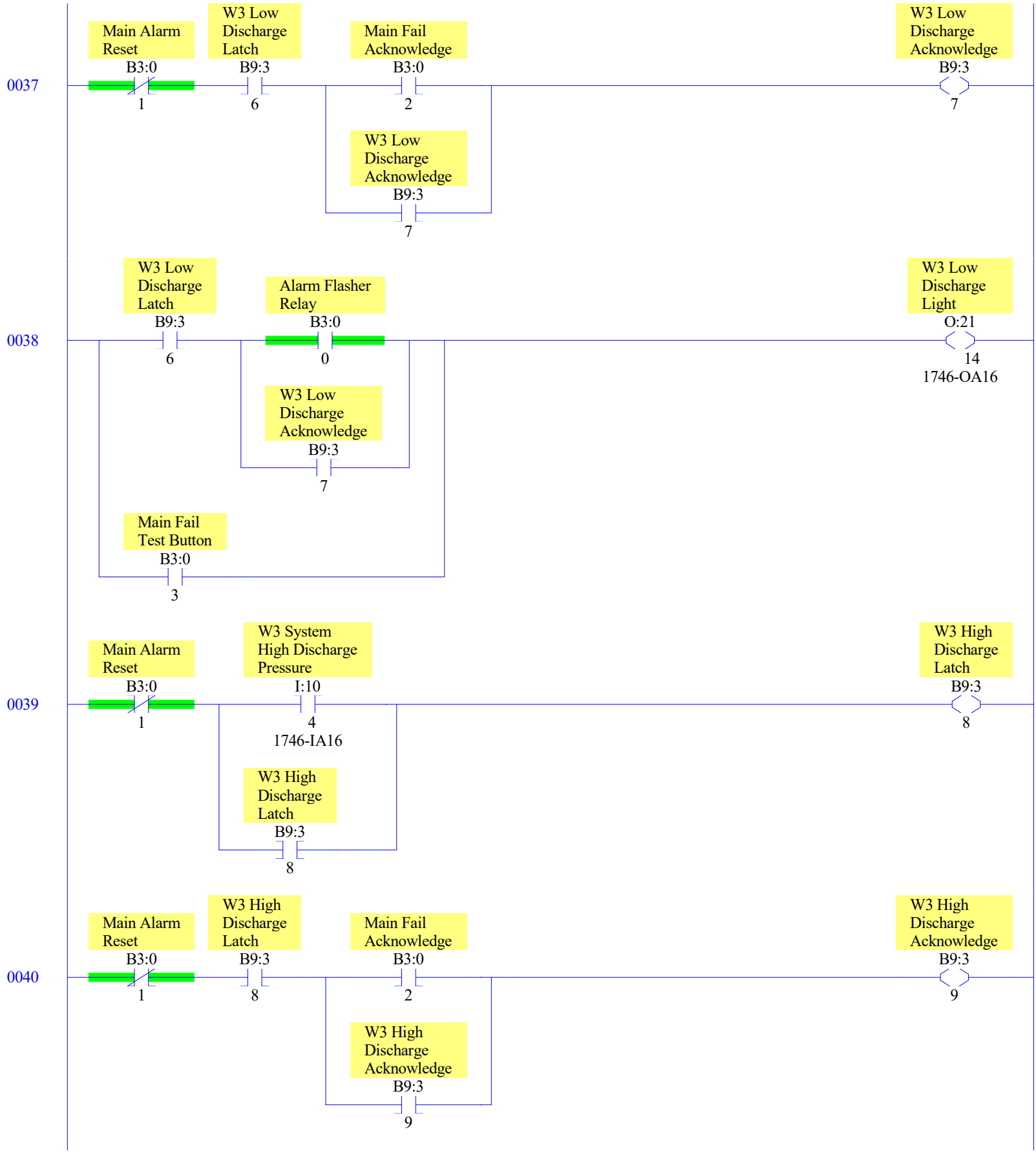
Main Alarm Reset B3:0 1

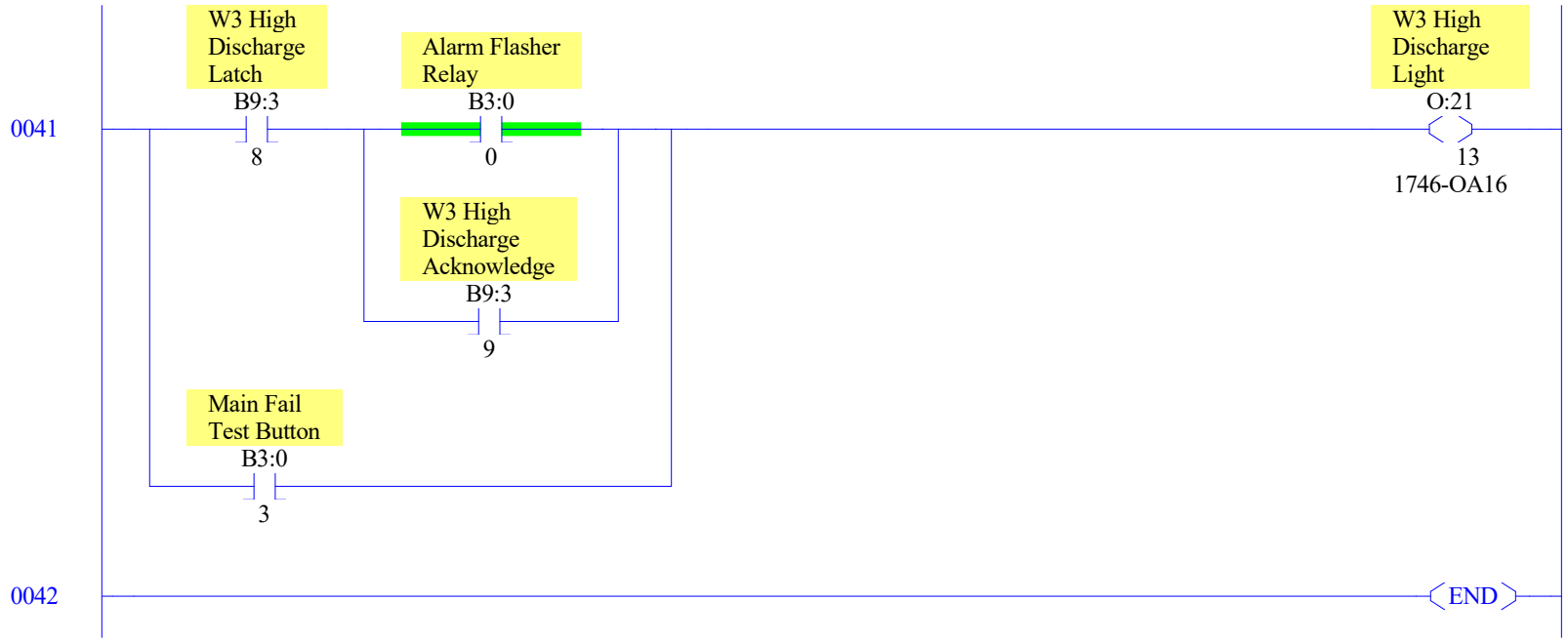
W3 System Low Discharge Pressure I:10 3 1746-IA16

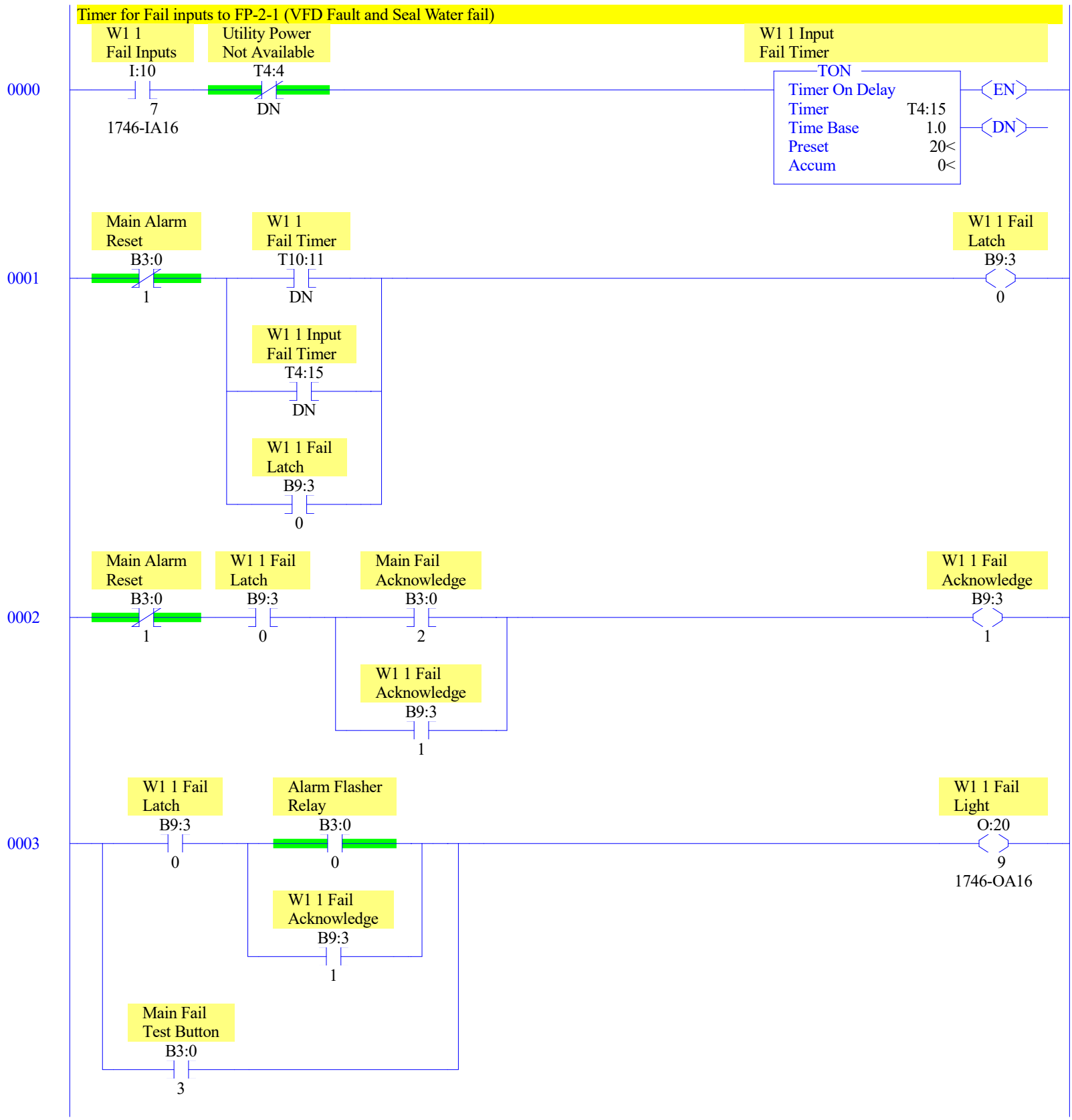
W3 Low Discharge Latch B9:3 6

W3 Low Discharge Latch B9:3 6

W3 Low Discharge Latch B9:3 6


0037
Main Alarm Reset
B3:0
1
W3 Low Discharge Latch
B9:3
6
Main Fail Acknowledge
B3:0
2
W3 Low Discharge Acknowledge
B9:3
7
W3 Low Discharge Acknowledge
B9:3
7
0038
W3 Low Discharge Latch
B9:3
6
Alarm Flasher Relay
B3:0
0
W3 Low Discharge Acknowledge
B9:3
7
Main Fail Test Button
B3:0
3
W3 Low Discharge Light
O:21
14
1746-OA16
0039
Main Alarm Reset
B3:0
1
W3 System High Discharge Pressure
I:10
4
1746-IA16
W3 High Discharge Latch
B9:3
8
W3 High Discharge Latch
B9:3
8
0040
Main Alarm Reset
B3:0
1
W3 High Discharge Latch
B9:3
8
Main Fail Acknowledge
B3:0
2
W3 High Discharge Acknowledge
B9:3
9
W3 High Discharge Acknowledge
B9:3
9


W3 High Discharge Latch
B9:3
8
Alarm Flasher Relay
B3:0
0
W3 High Discharge Acknowledge
B9:3
9
Main Fail Test Button
B3:0
3
W3 High Discharge Light
O:21
13
1746-OA16
0041
0042
END


Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)
0000
W1 1 Fail Inputs
I:10
7
1746-IA16
Utility Power Not Available
T4:4
DN
W1 1 Input Fail Timer
TON
Timer On Delay
Timer T4:15
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0001
Main Alarm Reset
B3:0
1
W1 1 Fail Timer
T10:11
DN
W1 1 Fail Latch
B9:3
0
W1 1 Input Fail Timer
T4:15
DN
W1 1 Fail Latch
B9:3
0
0002
Main Alarm Reset
B3:0
1
W1 1 Fail Latch
B9:3
0
Main Fail Acknowledge
B3:0
2
W1 1 Fail Acknowledge
B9:3
1
W1 1 Fail Acknowledge
B9:3
1
0003
W1 1 Fail Latch
B9:3
0
Alarm Flasher Relay
B3:0
0
W1 1 Fail Light
O:20
9
1746-OA16
W1 1 Fail Acknowledge
B9:3
1
Main Fail Test Button
B3:0
3

The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the VFD is called to run by the ladder logic, and the VFD is not running, and utility power is available

0004

W1 1 in AUTO — I:10 — 9 — 1746-IA16

W1 1 Run Output — O:11 — 15 — 1746-OA16

W1 1 is ON — I:10 — 8 — 1746-IA16

Utility Power Not Available — T4:4 — DN

W1 1 Fail Timer

TON
Timer On Delay
Timer T10:11
Time Base 1.0
Preset 20<
Accum 0<
EN
DN

Timer for Fail inputs to FP-2-1 (VFD Fault and Seal Water fail)

0005

W1 2 Fail Inputs — I:10 — 10 — 1746-IA16

Utility Power Not Available — T4:4 — DN

W1 2 Input Fail Timer

TON
Timer On Delay
Timer T4:16
Time Base 1.0
Preset 20<
Accum 0<
EN
DN

0006

Main Alarm Reset — B3:0 — 1

W1 2 Fail Timer — T10:12 — DN

W1 2 Fail Latch — B9:3 — 2

W1 2 Input Fail Timer — T4:16 — DN

W1 2 Fail Latch — B9:3 — 2

0007

Main Alarm Reset — B3:0 — 1

W1 2 Fail Latch — B9:3 — 2

Main Fail Acknowledge — B3:0 — 2

W1 2 Fail Acknowledge — B9:3 — 3

W1 2 Fail Acknowledge — B9:3 — 3

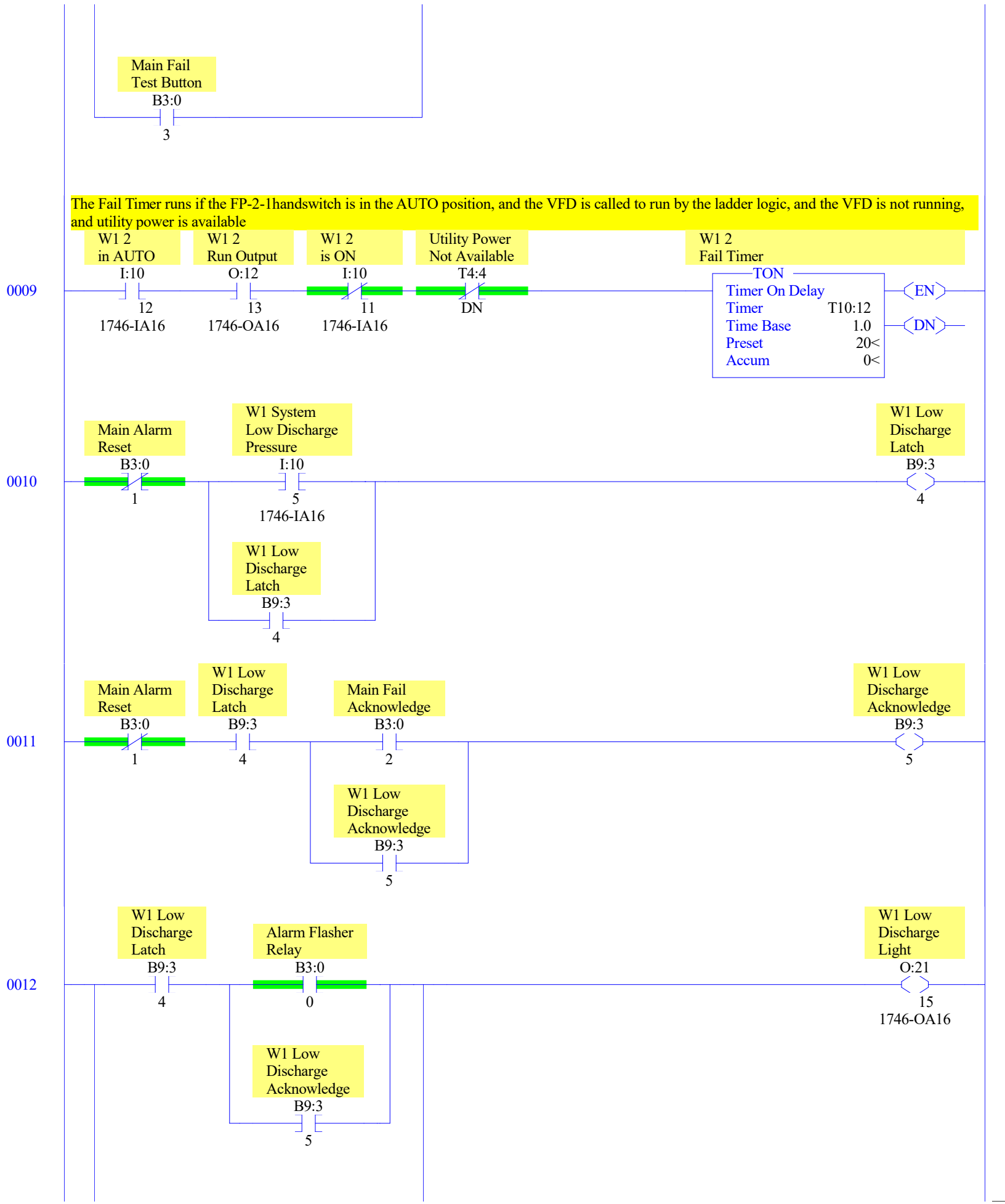
0008

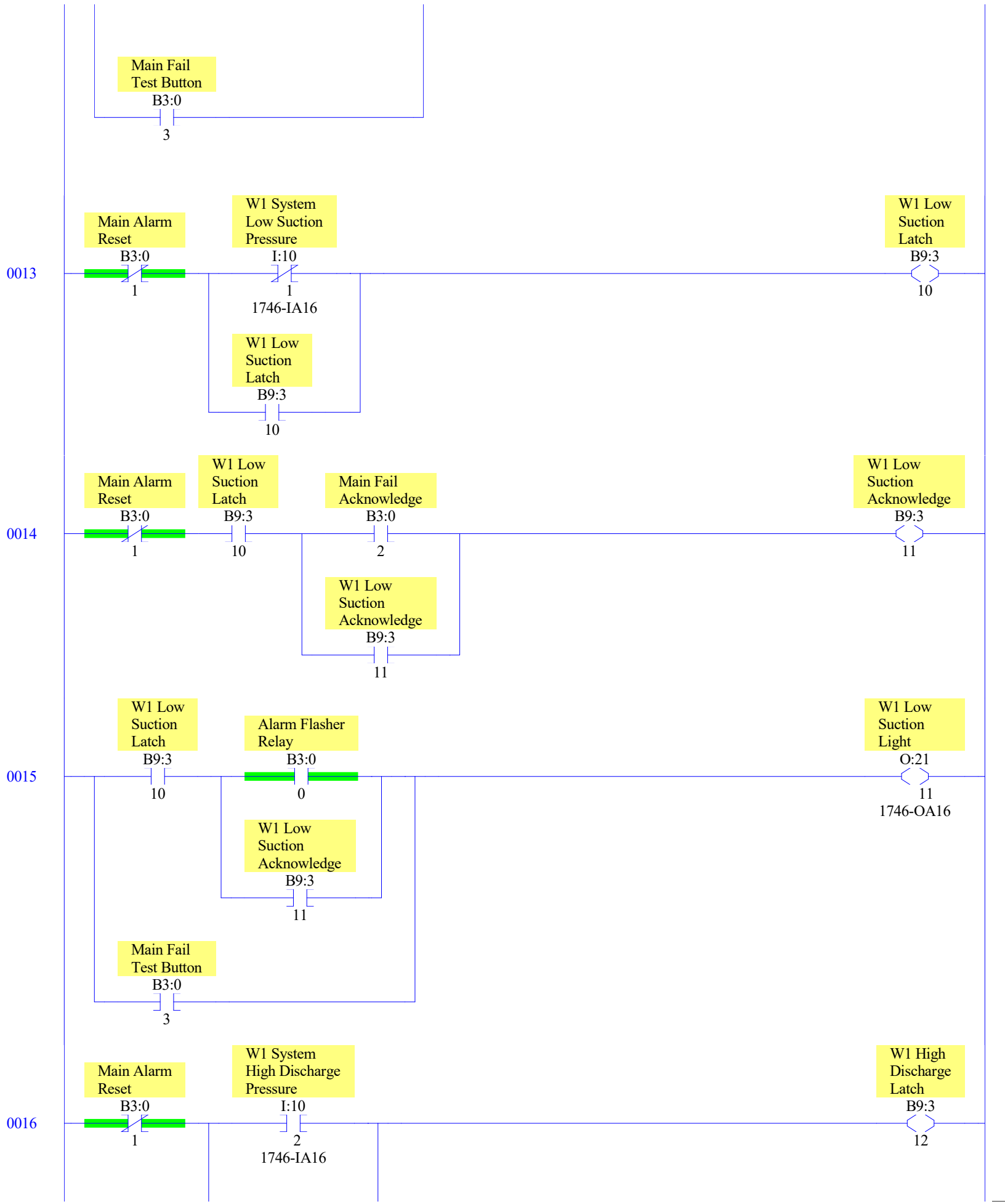
W1 2 Fail Latch — B9:3 — 2

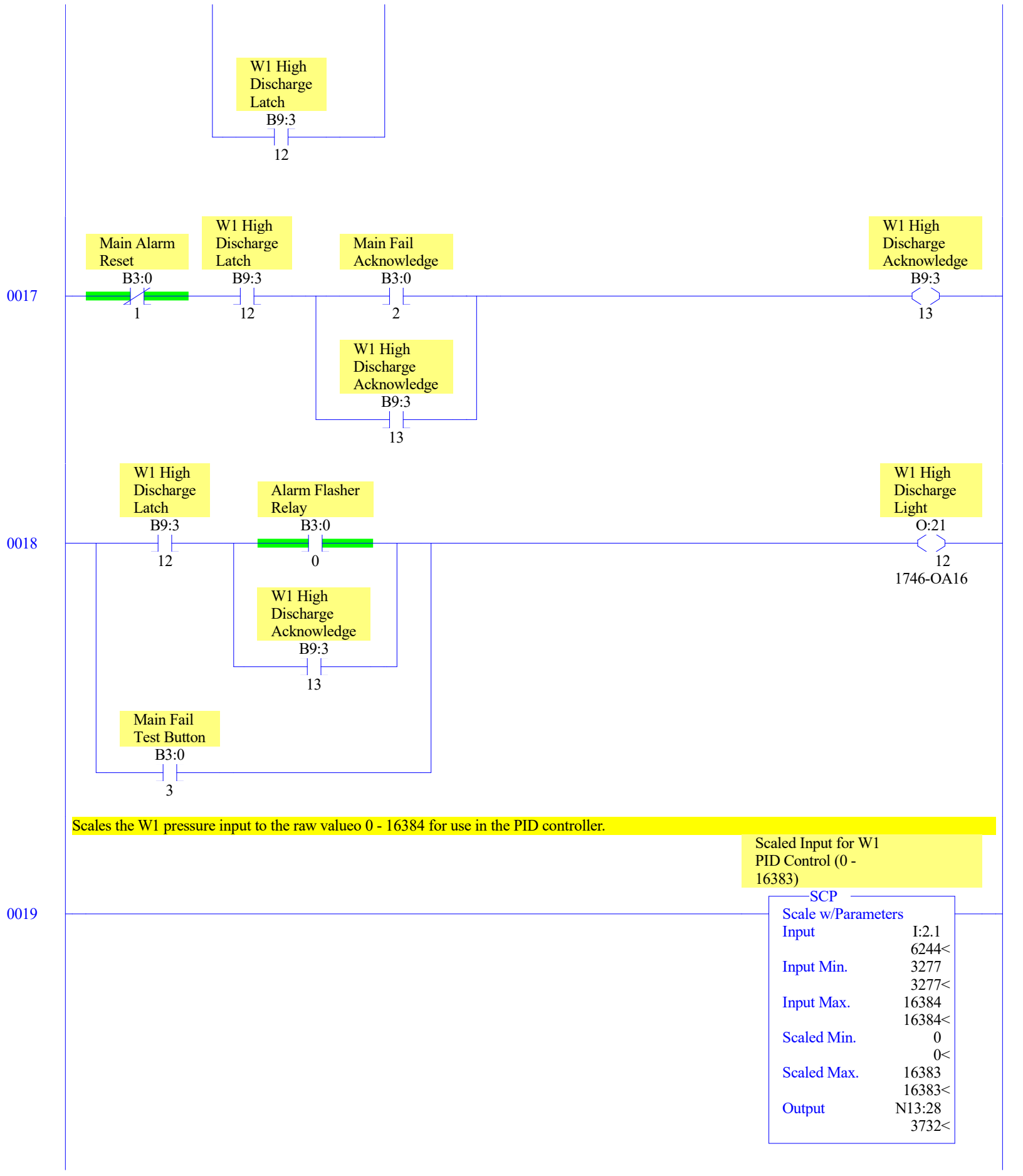
Alarm Flasher Relay — B3:0 — 0

W1 2 Fail Light — O:20 — 10 — 1746-OA16

W1 2 Fail Acknowledge — B9:3 — 3


Main Fail
Test Button
B3:0
3
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the VFD is called to run by the ladder logic, and the VFD is not running, and utility power is available
0009
W1 2
in AUTO
I:10
12
1746-IA16
W1 2
Run Output
O:12
13
1746-OA16
W1 2
is ON
I:10
11
1746-IA16
Utility Power
Not Available
T4:4
DN
W1 2
Fail Timer
TON
Timer On Delay
Timer T10:12
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0010
Main Alarm
Reset
B3:0
1
W1 System
Low Discharge
Pressure
I:10
5
1746-IA16
W1 Low
Discharge
Latch
B9:3
4
W1 Low
Discharge
Latch
B9:3
4
0011
Main Alarm
Reset
B3:0
1
W1 Low
Discharge
Latch
B9:3
4
Main Fail
Acknowledge
B3:0
2
W1 Low
Discharge
Acknowledge
B9:3
5
W1 Low
Discharge
Acknowledge
B9:3
5
0012
W1 Low
Discharge
Latch
B9:3
4
Alarm Flasher
Relay
B3:0
0
W1 Low
Discharge
Acknowledge
B9:3
5
W1 Low
Discharge
Light
O:21
15
1746-OA16


Main Fail Test Button
B3:0
3
0013
Main Alarm Reset
B3:0
1
W1 System Low Suction Pressure
I:10
1
1746-IA16
W1 Low Suction Latch
B9:3
10
W1 Low Suction Latch
B9:3
10
0014
Main Alarm Reset
B3:0
1
W1 Low Suction Latch
B9:3
10
Main Fail Acknowledge
B3:0
2
W1 Low Suction Acknowledge
B9:3
11
W1 Low Suction Acknowledge
B9:3
11
0015
W1 Low Suction Latch
B9:3
10
Alarm Flasher Relay
B3:0
0
W1 Low Suction Acknowledge
B9:3
11
W1 Low Suction Light
O:21
11
1746-OA16
Main Fail Test Button
B3:0
3
0016
Main Alarm Reset
B3:0
1
W1 System High Discharge Pressure
I:10
2
1746-IA16
W1 High Discharge Latch
B9:3
12


W1 High Discharge Latch
B9:3
12
0017
Main Alarm Reset
B3:0
1
W1 High Discharge Latch
B9:3
12
Main Fail Acknowledge
B3:0
2
W1 High Discharge Acknowledge
B9:3
13
W1 High Discharge Acknowledge
B9:3
13
0018
W1 High Discharge Latch
B9:3
12
Alarm Flasher Relay
B3:0
0
W1 High Discharge Acknowledge
B9:3
13
Main Fail Test Button
B3:0
3
W1 High Discharge Light
O:21
12
1746-OA16
Scales the W1 pressure input to the raw valueo 0 - 16384 for use in the PID controller.
Scaled Input for W1 PID Control (0 - 16383)
0019
SCP
Scale w/Parameters
Input I:2.1
6244<
Input Min. 3277
3277<
Input Max. 16384
16384<
Scaled Min. 0
0<
Scaled Max. 16383
16383<
Output N13:28
3732<

Scales the W1 pressure signal for display.

W1 Pressure
(0-150 psi)

0020

SCP
Scale w/Parameters

Input	I:2.1
	6244<
Input Min.	3277
	3277<
Input Max.	16384
	16384<
Scaled Min.	0
	0<
Scaled Max.	150
	150<
Output	N7:19
	34<

Takes the setpoint for the W1 pressure (0 - 150 psi) and scales it to the raw vlaue of 0 - 16384 for use in the PID controller.

W1 Pressure Setpoint
Input to PID Control

0021

SCP
Scale w/Parameters

Input	N7:20
	35<
Input Min.	0.0
	0.0<
Input Max.	150.0
	150.0<
Scaled Min.	0.0
	0.0<
Scaled Max.	16383.0
	16383.0<
Output	N13:2
	3823<

Controls the speed of the W1 pumps based on the pressure and the setpoint.

0022

PID
PID

Control Block	N13:0
Process Variable	N13:28
Control Variable	N13:29
Control Block Length	23
Setup Screen	<

Scales the raw output (0 - 16384) from the W1 PID controller to a percentage value.

W1 Percent Speed
Output from
PID Control

0023

SCP
Scale w/Parameters

Input	N13:29
	352<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	0
	0<
Scaled Max.	100
	100<
Output	N7:21
	2<

Scales the PID output to VFD frequency

0024

W1 VFD
Frequency
(20 - 60 Hz)

SCP
Scale w/Parameters

Input	N13:29
	352<
Input Min.	0
	0<
Input Max.	16383
	16383<
Scaled Min.	20
	20<
Scaled Max.	60
	60<
Output	N7:25
	21<

Automatically adjusts the speed output for the W1 VFD's

0025

W1 Speed
Auto Control
B3:3
2

W1 #1
Speed Output
(4 - 20mA)

SCP
Scale w/Parameters

Input	N7:21
	2<
Input Min.	0
	0<
Input Max.	100
	100<
Scaled Min.	6242
	6242<
Scaled Max.	31208
	31208<
Output	O:6.3
	6741<

Manually adjusts the speed output for the W1 VFD's

0026

W1 Speed
Auto Control
B3:3
2

W1 #1
Speed Output
(4 - 20mA)

SCP
Scale w/Parameters

Input	N7:22
	61<
Input Min.	0
	0<
Input Max.	100
	100<
Scaled Min.	6242
	6242<
Scaled Max.	31208
	31208<
Output	O:6.3
	6741<

Copies the speed output value from W1 #1 to W1 #2.

0027

W1 #2
Speed Output
(4 - 20mA)

MOV
Move
Source O:6.3
6741<
Dest O:7.0
6741<

Sends a RUN signal to W1 #1 if conditions are met, or if W1 #2 fails.

0028

W1 #1
is LEAD
I:10
6
1746-IA16

W1 1
in AUTO
I:10
9
1746-IA16

W1 1 Fail
Latch
B9:3
0

W1 1
Run Output
O:11
15
1746-OA16

W1 Pump
Run LAG
B3:3
3

W1 Low
Discharge
Latch
B9:3
4

W1 2 Fail
Latch
B9:3
2

Sends a RUN signal to W1 #2 if conditions are met, or if W1 #1 fails.

0029

W1 #1
is LEAD
I:10
6
1746-IA16

W1 2
in AUTO
I:10
12
1746-IA16

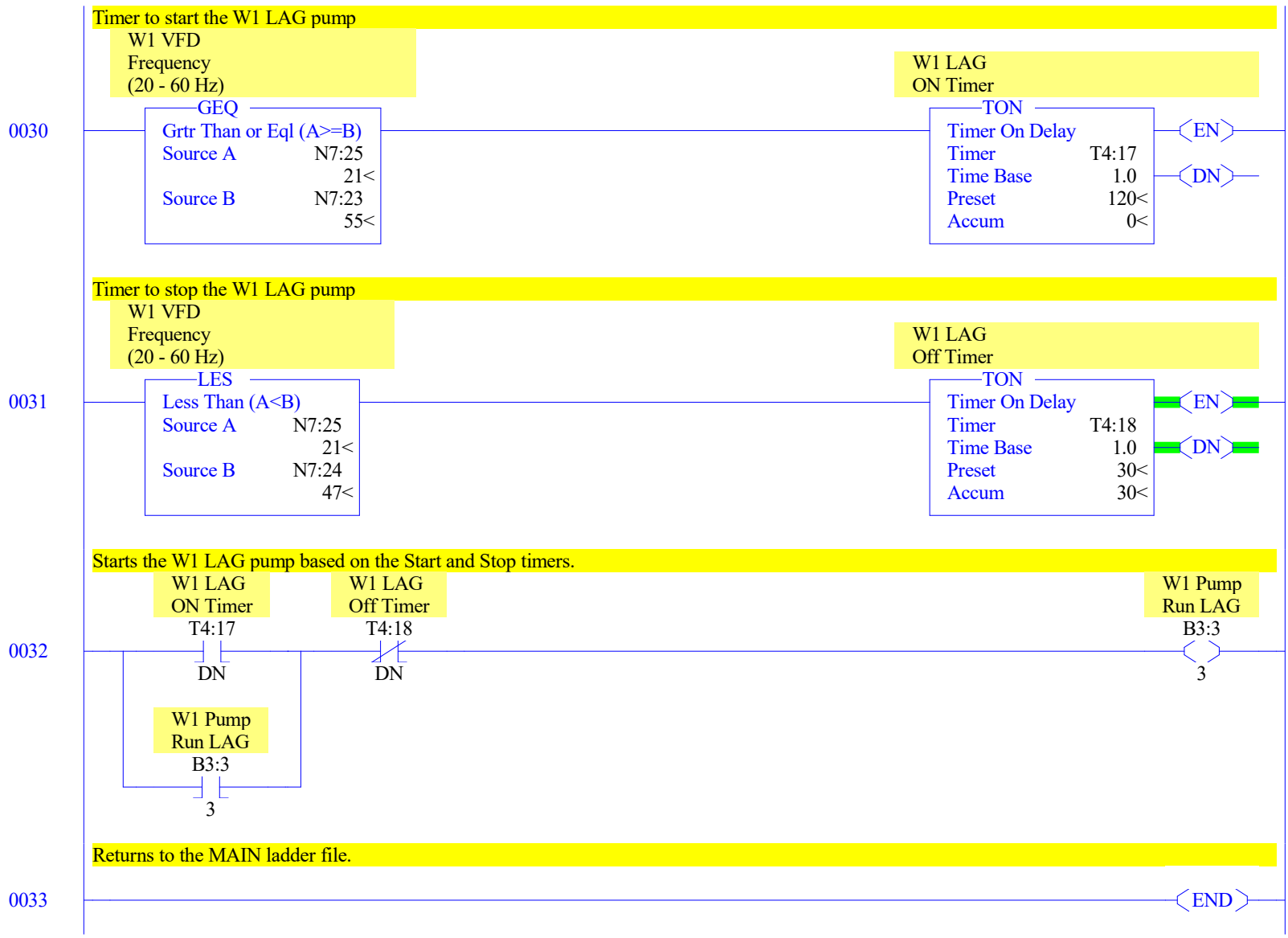
W1 2 Fail
Latch
B9:3
2

W1 2
Run Output
O:12
13
1746-OA16

W1 Pump
Run LAG
B3:3
3

W1 Low
Discharge
Latch
B9:3
4

W1 1 Fail
Latch
B9:3
0


Timer to start the W1 LAG pump
W1 VFD Frequency (20 - 60 Hz)
W1 LAG ON Timer
0030
GEQ
Grtr Than or Eql (A>=B)
Source A N7:25 21<
Source B N7:23 55<
TON
Timer On Delay
Timer T4:17
Time Base 1.0
Preset 120<
Accum 0<
EN
DN
Timer to stop the W1 LAG pump
W1 VFD Frequency (20 - 60 Hz)
W1 LAG Off Timer
0031
LES
Less Than (A<B)
Source A N7:25 21<
Source B N7:24 47<
TON
Timer On Delay
Timer T4:18
Time Base 1.0
Preset 30<
Accum 30<
EN
DN
Starts the W1 LAG pump based on the Start and Stop timers.
W1 LAG ON Timer T4:17
DN
W1 LAG Off Timer T4:18
DN
W1 Pump Run LAG B3:3
3
0032
W1 Pump Run LAG B3:3
3
Returns to the MAIN ladder file.
0033
END

Starts timer when CL2 residual is below the LOW setpoint. The setpoint and contact closure comes from the chlorine analyzer downstairs in the pump room.

0000

CL2 Residual LOW
I:10
14
1746-IA16

CL2 LOW Timer
TON
Timer On Delay
Timer T10:9
Time Base 1.0
Preset 30<
Accum 0<
EN
DN

Latches CL2 LOW alarm.

0001

Main Alarm Reset
B3:0
1

CL2 LOW Timer
T10:9
DN

CL2 LOW Latch
B3:2
0

CL2 LOW Latch
B3:2
0

Acknowledges CL2 LOW alarm.

0002

Main Alarm Reset
B3:0
1

CL2 LOW Latch
B3:2
0

Main Fail Acknowledge
B3:0
2

CL2 LOW Ack
B3:2
1

CL2 LOW Ack
B3:2
1

Turns on CL2 LOW light.

0003

CL2 LOW Latch
B3:2
0

Alarm Flasher Relay
B3:0
0

CL2 LOW Light
O:20
14
1746-OA16

CL2 LOW Ack
B3:2
1

Main Fail Test Button
B3:0
3

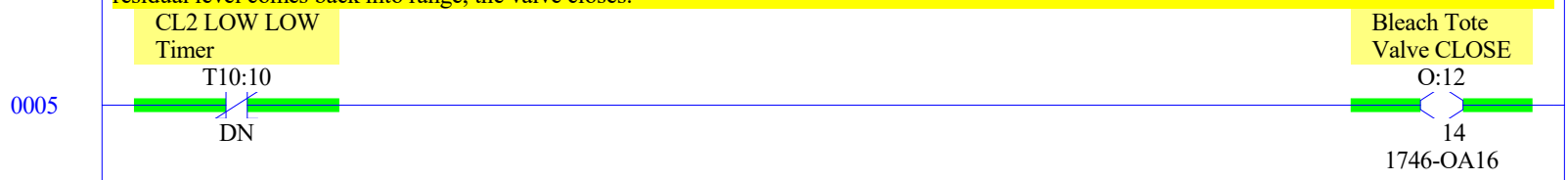
Starts timer when CL2 residual is below the LOW LOW setpoint. The setpoint and contact closure comes from the chlorine analyzer downstairs in the pump room.

0004

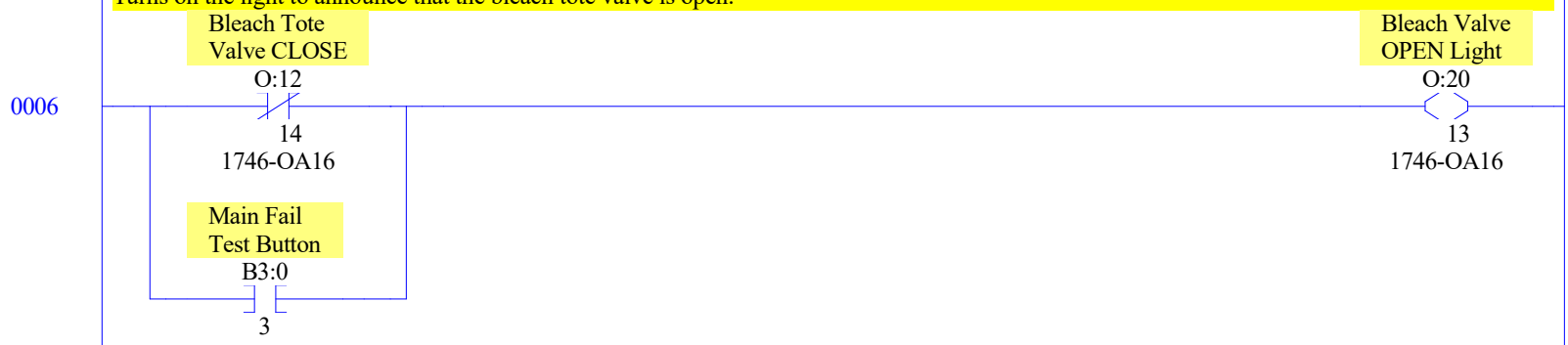
CL2 Residual LOW LOW
I:10
15
1746-IA16

CL2 LOW LOW Timer
TON
Timer On Delay
Timer T10:10
Time Base 1.0
Preset 30<
Accum 0<
EN
DN

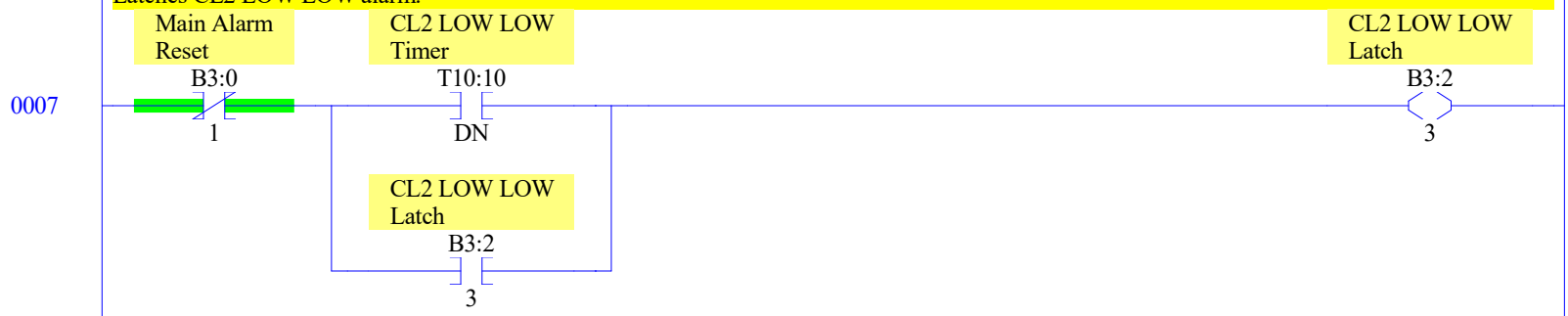
When the CL2 residual drops below the LOW LOW setpoint, the electric valve opens on the bleach tote on the CL2 contact chambers. When the residual level comes back into range, the valve closes.



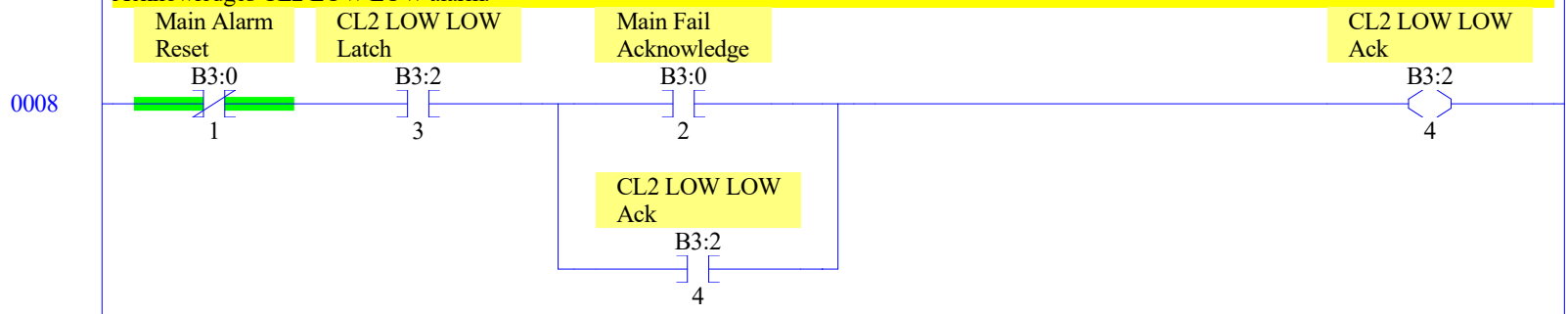
Turns on the light to announce that the bleach tote valve is open.



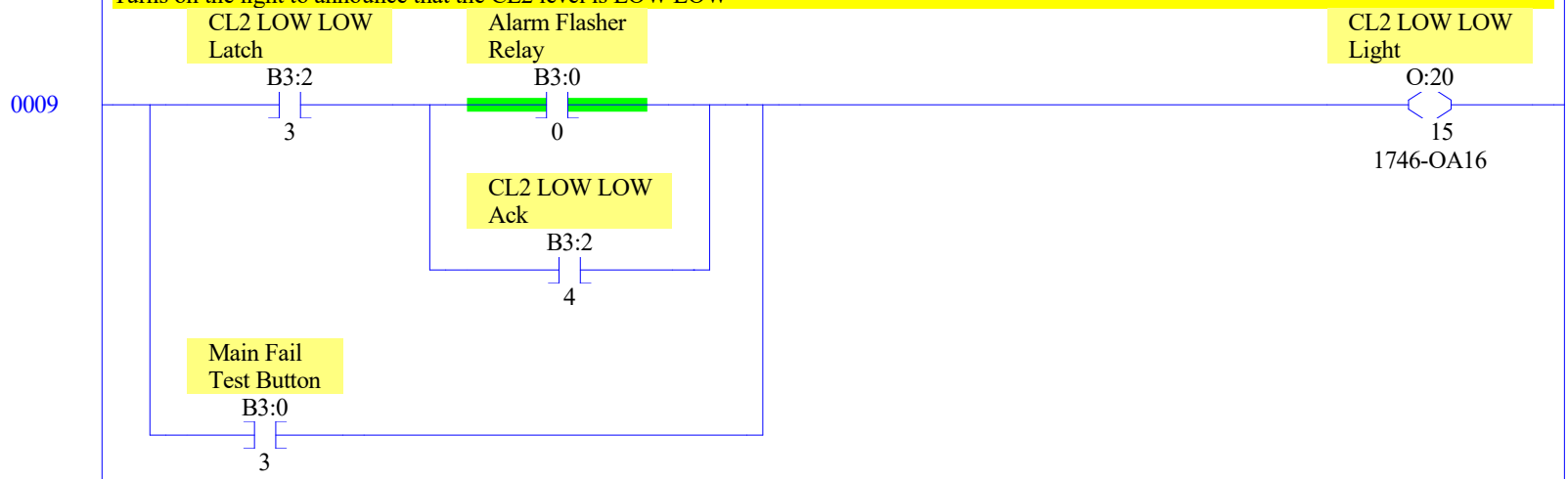
Latches CL2 LOW LOW alarm.



Acknowledges CL2 LOW LOW alarm.



Turns on the light to announce that the CL2 level is LOW LOW



Scales the CL2 Residual input signal to display on the Panelview

Scaled CL2 Residual
(0-5 ppt)

0010

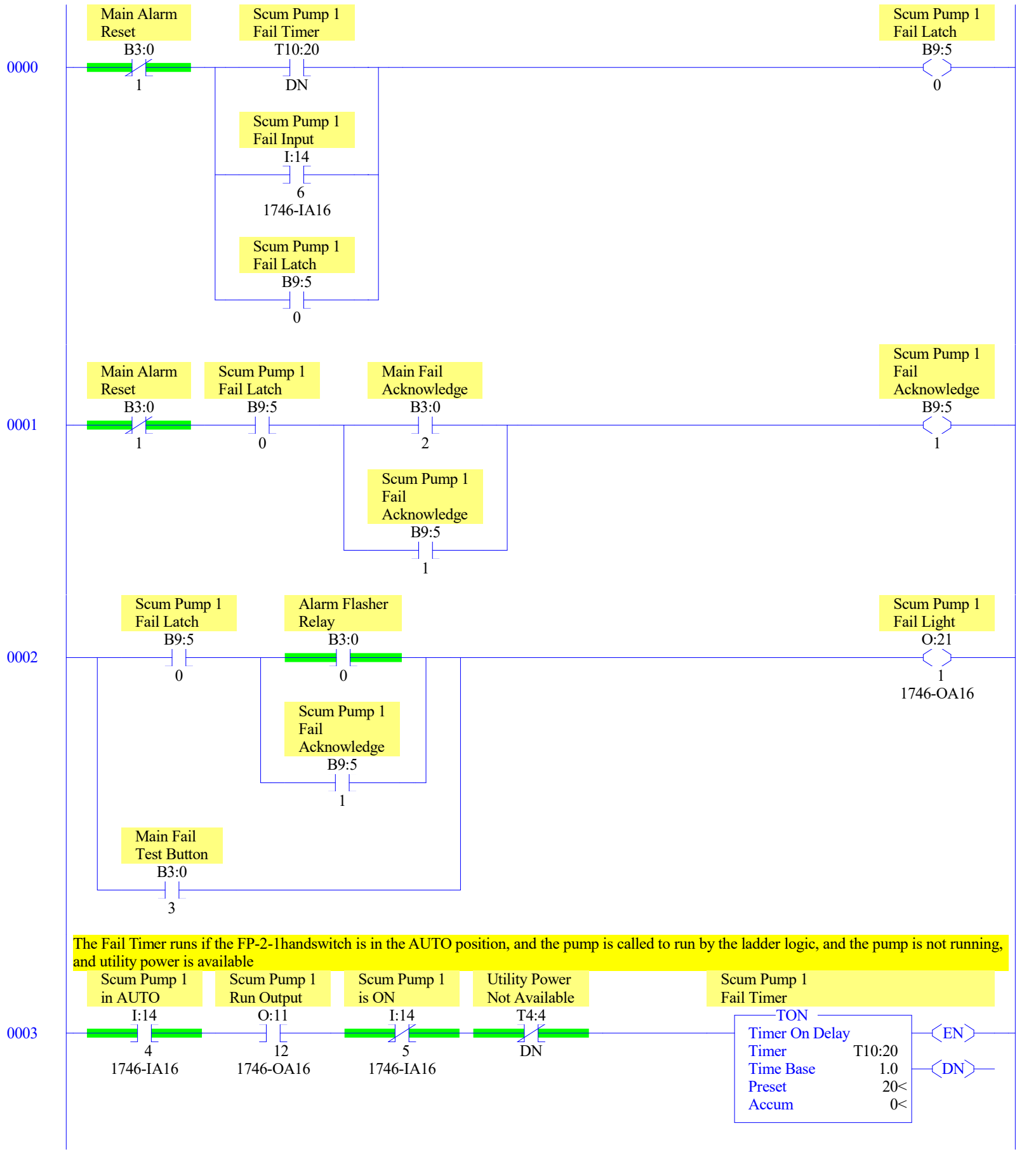
SCP
Scale w/Parameters

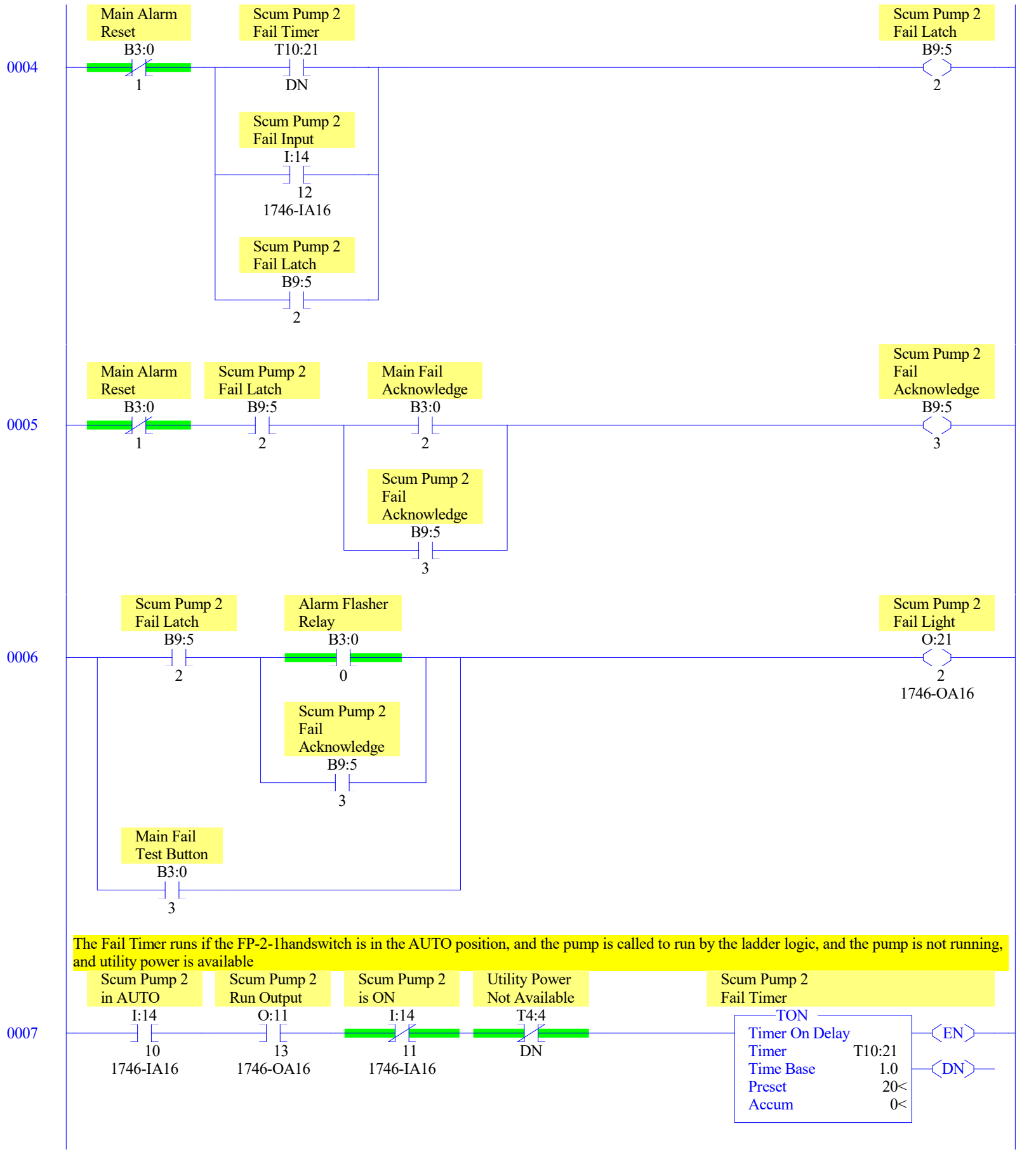
Input	I:3.0
	-1<
Input Min.	3277.0
	3277.0<
Input Max.	16384.0
	16384.0<
Scaled Min.	0.0
	0.0<
Scaled Max.	5.0
	5.0<
Output	F8:8
	-1.250477<

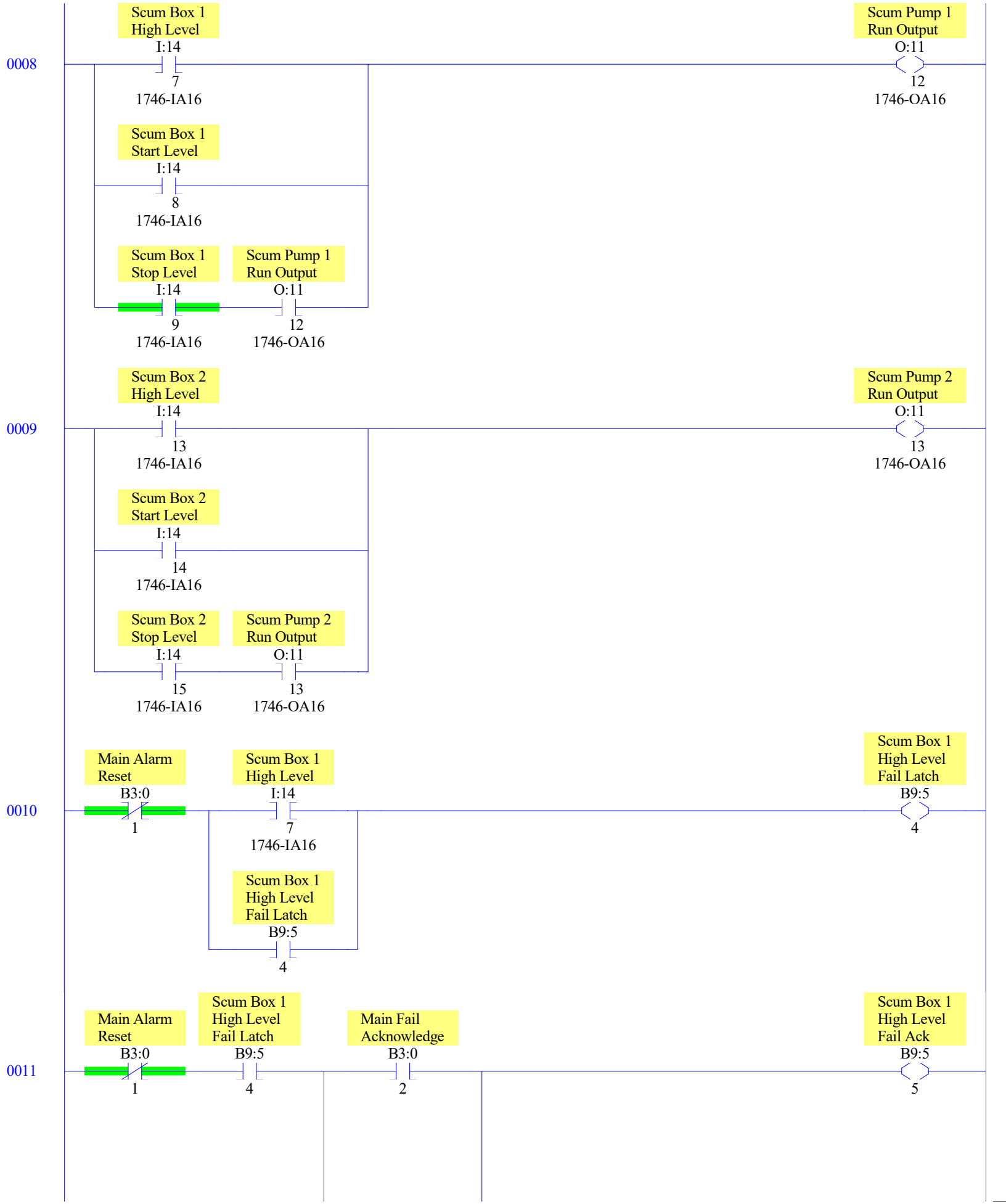
Returns to the MAIN ladder file.

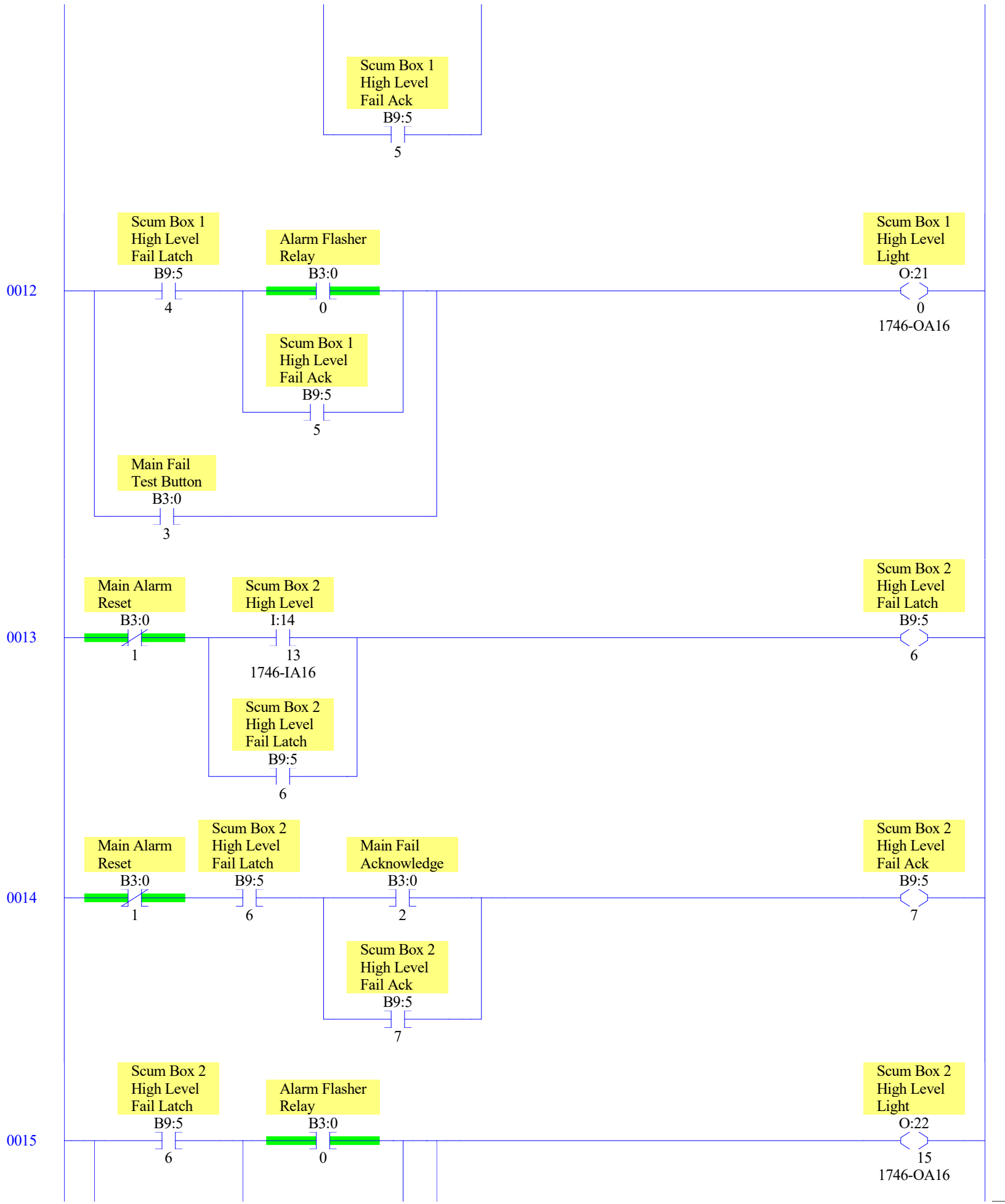
0011

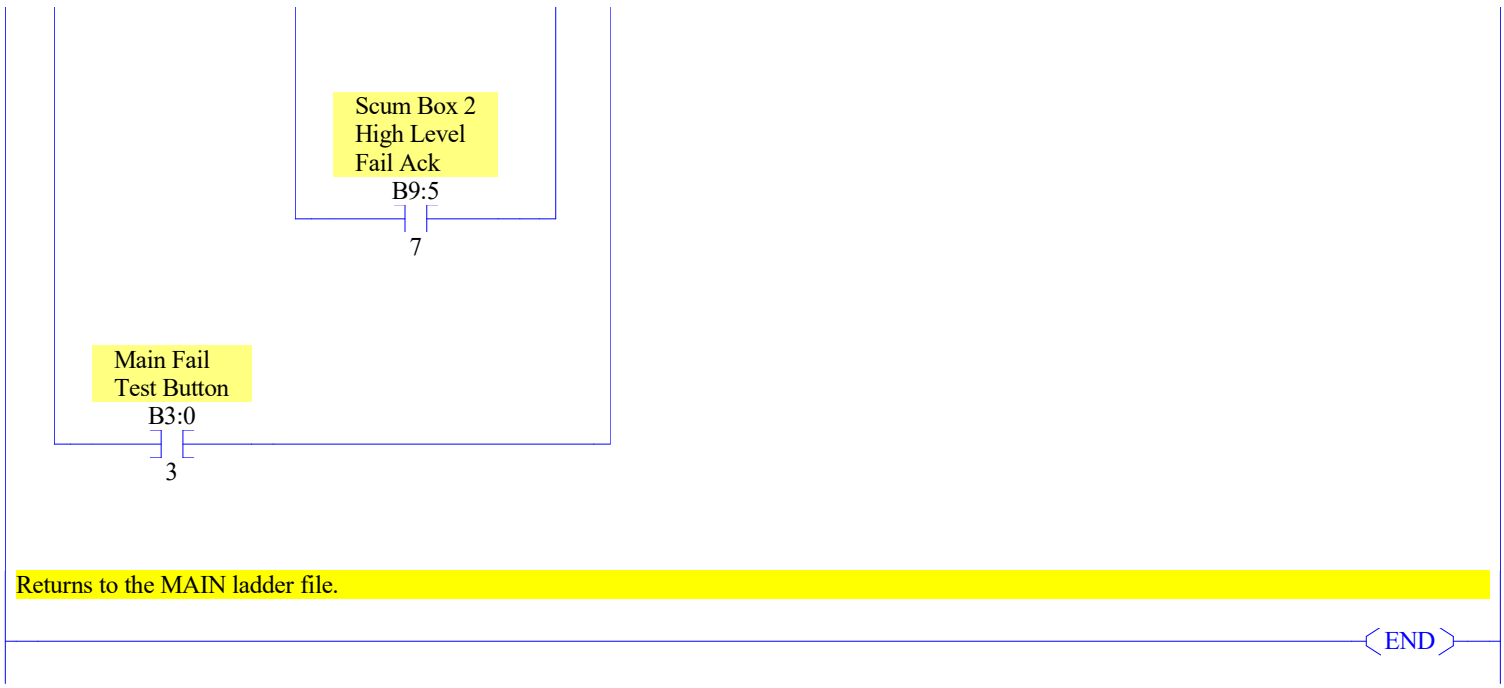
END


Main Alarm Reset
B3:0
1
Scum Pump 1 Fail Timer
T10:20
DN
Scum Pump 1 Fail Latch
B9:5
0
Scum Pump 1 Fail Input
I:14
6
1746-IA16
Scum Pump 1 Fail Latch
B9:5
0
0000
Main Alarm Reset
B3:0
1
Scum Pump 1 Fail Latch
B9:5
0
Main Fail Acknowledge
B3:0
2
Scum Pump 1 Fail Acknowledge
B9:5
1
Scum Pump 1 Fail Acknowledge
B9:5
1
0001
Scum Pump 1 Fail Latch
B9:5
0
Alarm Flasher Relay
B3:0
0
Scum Pump 1 Fail Light
O:21
1
1746-OA16
Scum Pump 1 Fail Acknowledge
B9:5
1
Main Fail Test Button
B3:0
3
0002
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the pump is called to run by the ladder logic, and the pump is not running, and utility power is available
Scum Pump 1 in AUTO
I:14
4
1746-IA16
Scum Pump 1 Run Output
O:11
12
1746-OA16
Scum Pump 1 is ON
I:14
5
1746-IA16
Utility Power Not Available
T4:4
DN
Scum Pump 1 Fail Timer
TON
Timer On Delay
Timer T10:20
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0003


0004
Main Alarm Reset
B3:0
1
Scum Pump 2 Fail Timer
T10:21
DN
Scum Pump 2 Fail Input
I:14
12
1746-IA16
Scum Pump 2 Fail Latch
B9:5
2
Scum Pump 2 Fail Latch
B9:5
2
0005
Main Alarm Reset
B3:0
1
Scum Pump 2 Fail Latch
B9:5
2
Main Fail Acknowledge
B3:0
2
Scum Pump 2 Fail Acknowledge
B9:5
3
Scum Pump 2 Fail Acknowledge
B9:5
3
0006
Scum Pump 2 Fail Latch
B9:5
2
Alarm Flasher Relay
B3:0
0
Scum Pump 2 Fail Acknowledge
B9:5
3
Main Fail Test Button
B3:0
3
Scum Pump 2 Fail Light
O:21
2
1746-OA16
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the pump is called to run by the ladder logic, and the pump is not running, and utility power is available
0007
Scum Pump 2 in AUTO
I:14
10
1746-IA16
Scum Pump 2 Run Output
O:11
13
1746-OA16
Scum Pump 2 is ON
I:14
11
1746-IA16
Utility Power Not Available
T4:4
DN
Scum Pump 2 Fail Timer
TON
Timer On Delay
Timer T10:21
Time Base 1.0
Preset 20<
Accum 0<
EN
DN

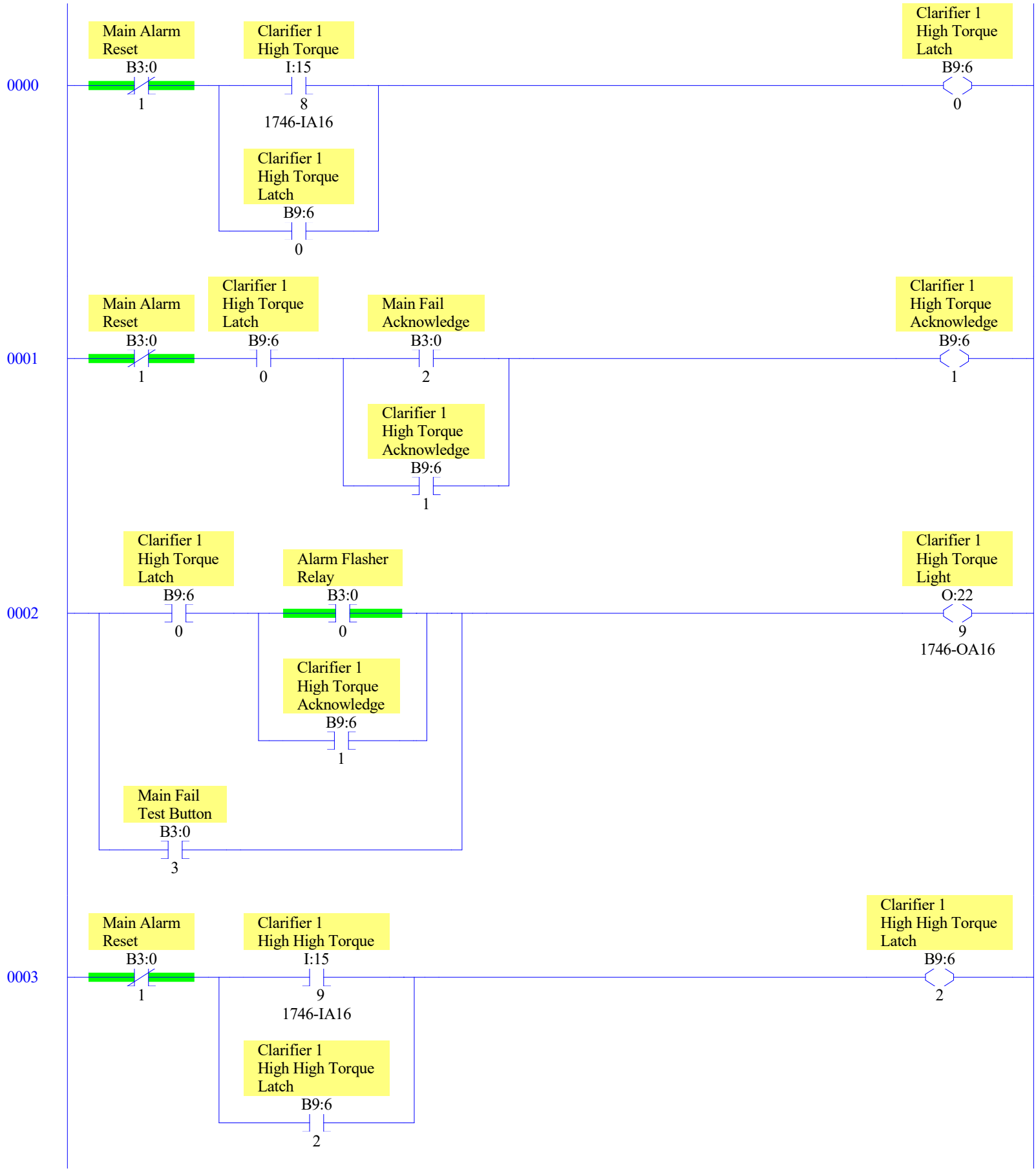

0008
Scum Box 1 High Level
I:14
7
1746-IA16
Scum Box 1 Start Level
I:14
8
1746-IA16
Scum Box 1 Stop Level
I:14
9
1746-IA16
Scum Pump 1 Run Output
O:11
12
1746-OA16
Scum Pump 1 Run Output
O:11
12
1746-OA16
0009
Scum Box 2 High Level
I:14
13
1746-IA16
Scum Box 2 Start Level
I:14
14
1746-IA16
Scum Box 2 Stop Level
I:14
15
1746-IA16
Scum Pump 2 Run Output
O:11
13
1746-OA16
Scum Pump 2 Run Output
O:11
13
1746-OA16
0010
Main Alarm Reset
B3:0
1
Scum Box 1 High Level
I:14
7
1746-IA16
Scum Box 1 High Level Fail Latch
B9:5
4
Scum Box 1 High Level Fail Latch
B9:5
4
Scum Box 1 High Level Fail Latch
B9:5
4
0011
Main Alarm Reset
B3:0
1
Scum Box 1 High Level Fail Latch
B9:5
4
Main Fail Acknowledge
B3:0
2
Scum Box 1 High Level Fail Ack
B9:5
5

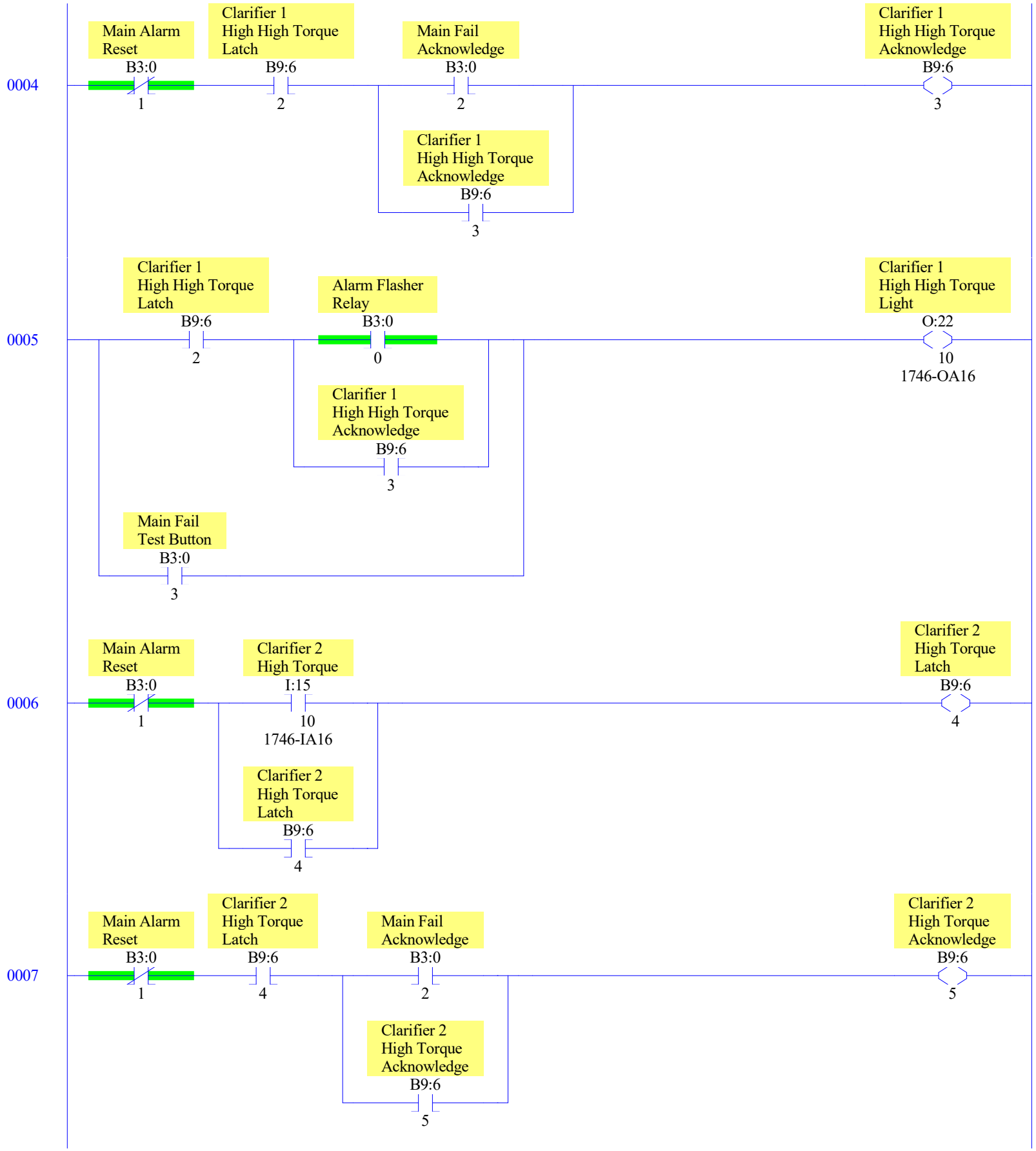

Scum Box 1
High Level
Fail Ack
B9:5
5
0012
Scum Box 1
High Level
Fail Latch
B9:5
4
Alarm Flasher
Relay
B3:0
0
Scum Box 1
High Level
Light
O:21
0
1746-OA16
Scum Box 1
High Level
Fail Ack
B9:5
5
Main Fail
Test Button
B3:0
3
0013
Main Alarm
Reset
B3:0
1
Scum Box 2
High Level
I:14
13
1746-IA16
Scum Box 2
High Level
Fail Latch
B9:5
6
Scum Box 2
High Level
Fail Latch
B9:5
6
0014
Main Alarm
Reset
B3:0
1
Scum Box 2
High Level
Fail Latch
B9:5
6
Main Fail
Acknowledge
B3:0
2
Scum Box 2
High Level
Fail Ack
B9:5
7
Scum Box 2
High Level
Fail Ack
B9:5
7
0015
Scum Box 2
High Level
Fail Latch
B9:5
6
Alarm Flasher
Relay
B3:0
0
Scum Box 2
High Level
Light
O:22
15
1746-OA16

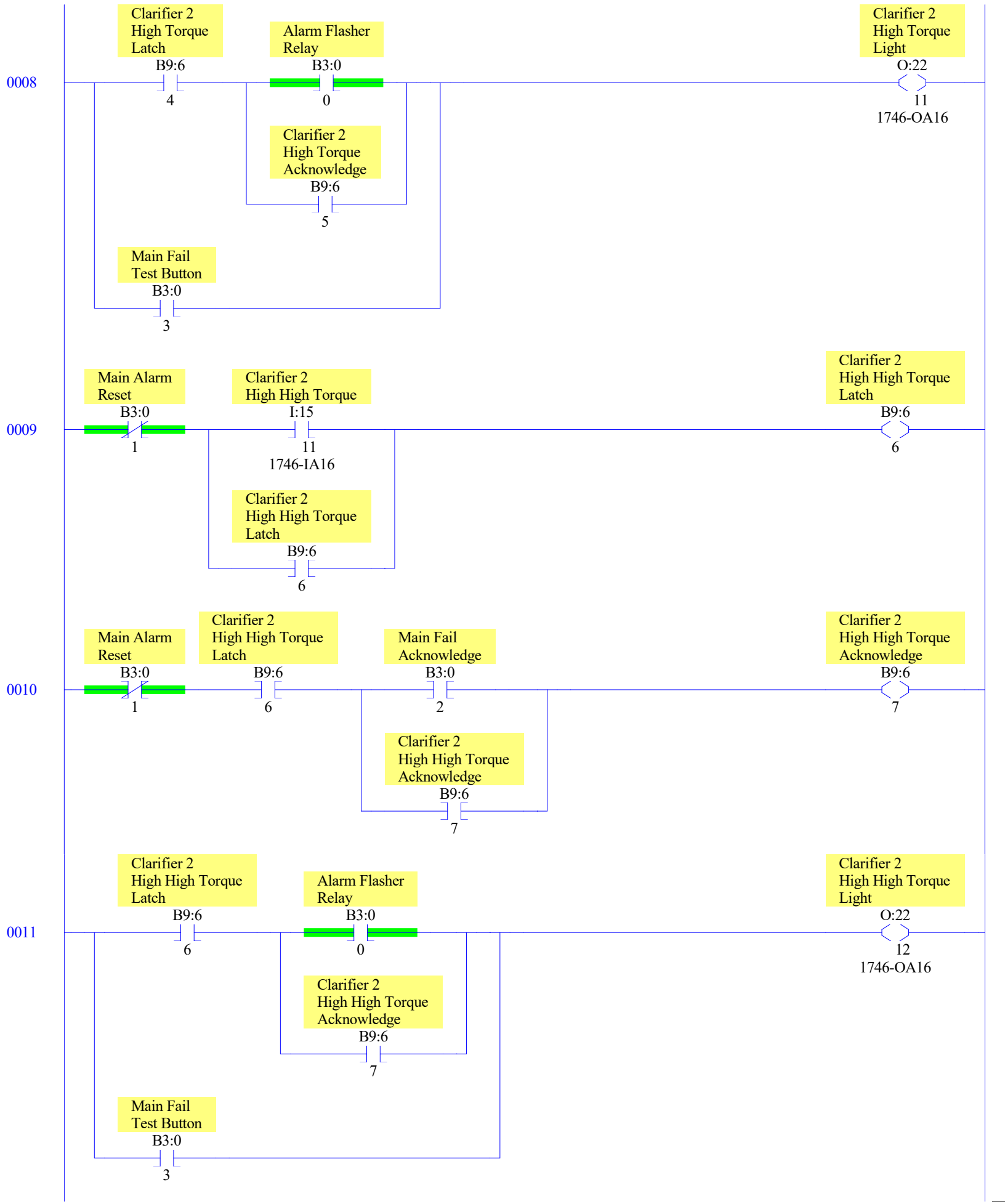


Returns to the MAIN ladder file.

0016 END


0000
Main Alarm Reset
B3:0
1
Clarifier 1 High Torque
I:15
8
1746-IA16
Clarifier 1 High Torque Latch
B9:6
0
Clarifier 1 High Torque Latch
B9:6
0
0001
Main Alarm Reset
B3:0
1
Clarifier 1 High Torque Latch
B9:6
0
Main Fail Acknowledge
B3:0
2
Clarifier 1 High Torque Acknowledge
B9:6
1
Clarifier 1 High Torque Acknowledge
B9:6
1
0002
Clarifier 1 High Torque Latch
B9:6
0
Alarm Flasher Relay
B3:0
0
Clarifier 1 High Torque Acknowledge
B9:6
1
Main Fail Test Button
B3:0
3
Clarifier 1 High Torque Light
O:22
9
1746-OA16
0003
Main Alarm Reset
B3:0
1
Clarifier 1 High High Torque
I:15
9
1746-IA16
Clarifier 1 High High Torque Latch
B9:6
2
Clarifier 1 High High Torque Latch
B9:6
2

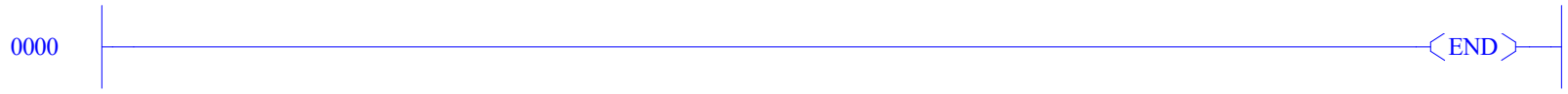

0004
Main Alarm Reset
B3:0
1
Clarifier 1 High High Torque Latch
B9:6
2
Main Fail Acknowledge
B3:0
2
Clarifier 1 High High Torque Acknowledge
B9:6
3
Clarifier 1 High High Torque Acknowledge
B9:6
3
0005
Clarifier 1 High High Torque Latch
B9:6
2
Alarm Flasher Relay
B3:0
0
Clarifier 1 High High Torque Acknowledge
B9:6
3
Clarifier 1 High High Torque Light
O:22
10
1746-OA16
Main Fail Test Button
B3:0
3
0006
Main Alarm Reset
B3:0
1
Clarifier 2 High Torque
I:15
10
1746-IA16
Clarifier 2 High Torque Latch
B9:6
4
Clarifier 2 High Torque Latch
B9:6
4
0007
Main Alarm Reset
B3:0
1
Clarifier 2 High Torque Latch
B9:6
4
Main Fail Acknowledge
B3:0
2
Clarifier 2 High Torque Acknowledge
B9:6
5
Clarifier 2 High Torque Acknowledge
B9:6
5

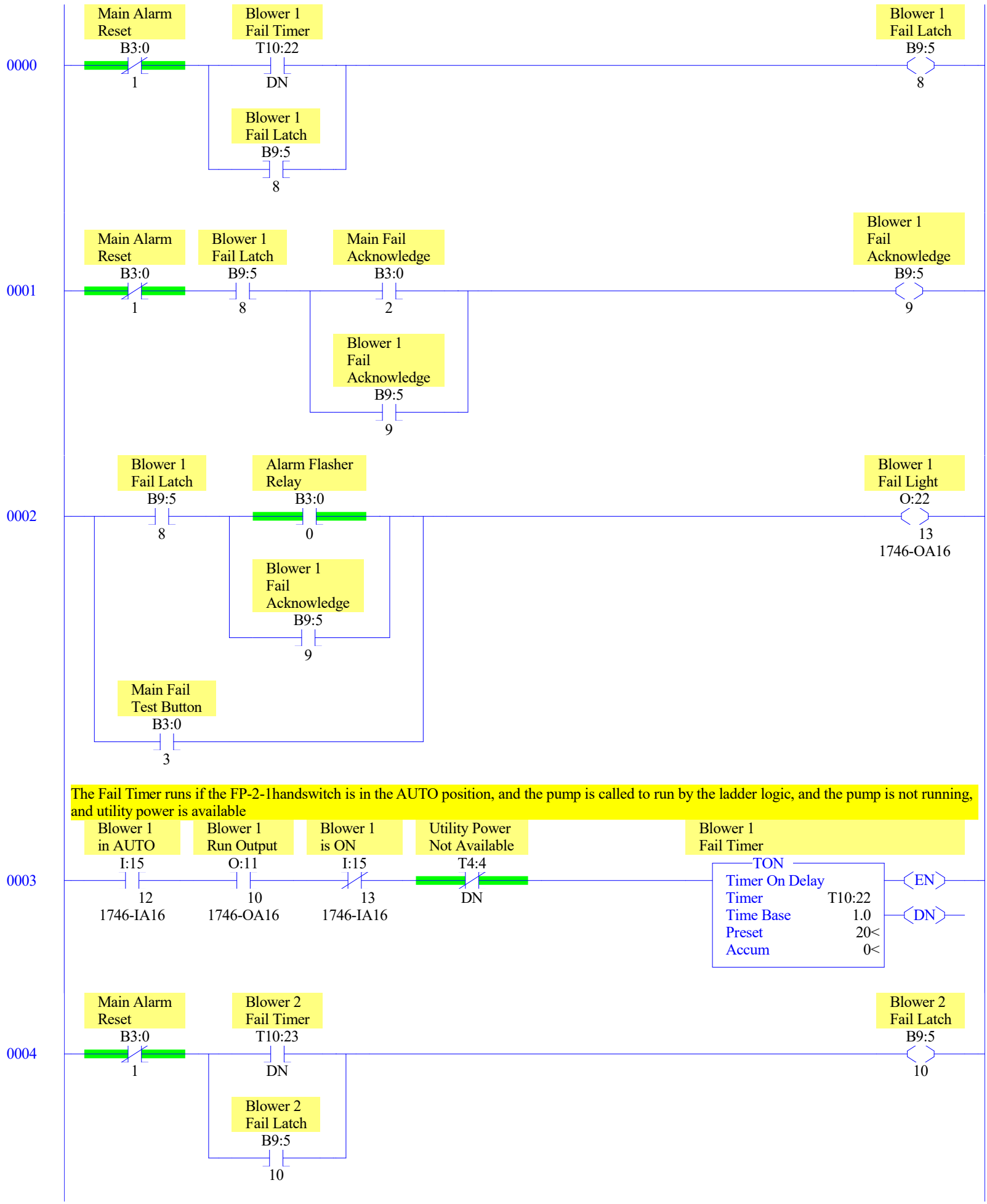

0008
Clarifier 2 High Torque Latch
B9:6
4
Alarm Flasher Relay
B3:0
0
Clarifier 2 High Torque Acknowledge
B9:6
5
Main Fail Test Button
B3:0
3
Clarifier 2 High Torque Light
O:22
11
1746-OA16
0009
Main Alarm Reset
B3:0
1
Clarifier 2 High High Torque
I:15
11
1746-IA16
Clarifier 2 High High Torque Latch
B9:6
6
Clarifier 2 High High Torque Latch
B9:6
6
0010
Main Alarm Reset
B3:0
1
Clarifier 2 High High Torque Latch
B9:6
6
Main Fail Acknowledge
B3:0
2
Clarifier 2 High High Torque Acknowledge
B9:6
7
Clarifier 2 High High Torque Acknowledge
B9:6
7
0011
Clarifier 2 High High Torque Latch
B9:6
6
Alarm Flasher Relay
B3:0
0
Clarifier 2 High High Torque Acknowledge
B9:6
7
Main Fail Test Button
B3:0
3
Clarifier 2 High High Torque Light
O:22
12
1746-OA16

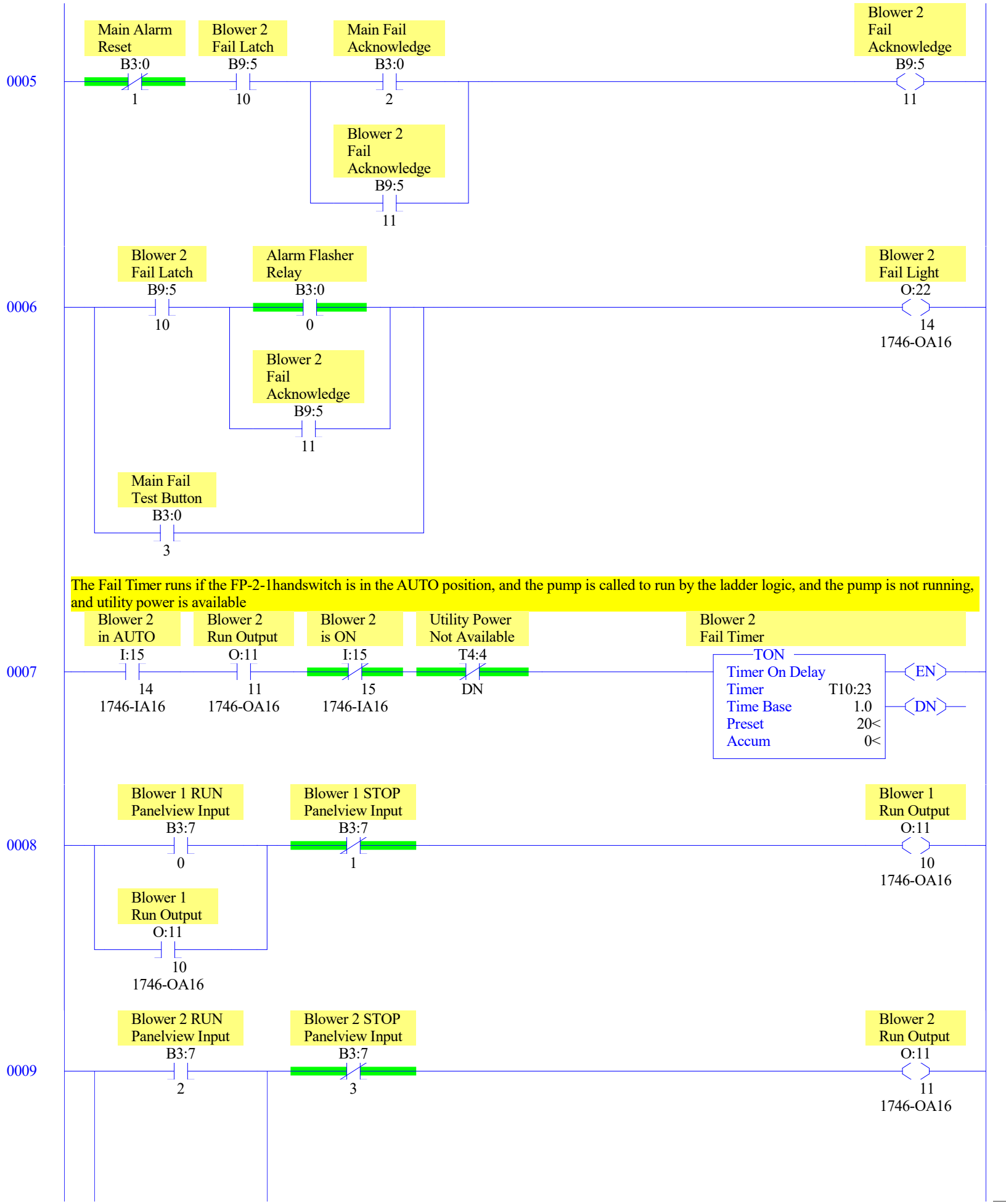
Returns to the MAIN ladder file.

0012 —— END ——

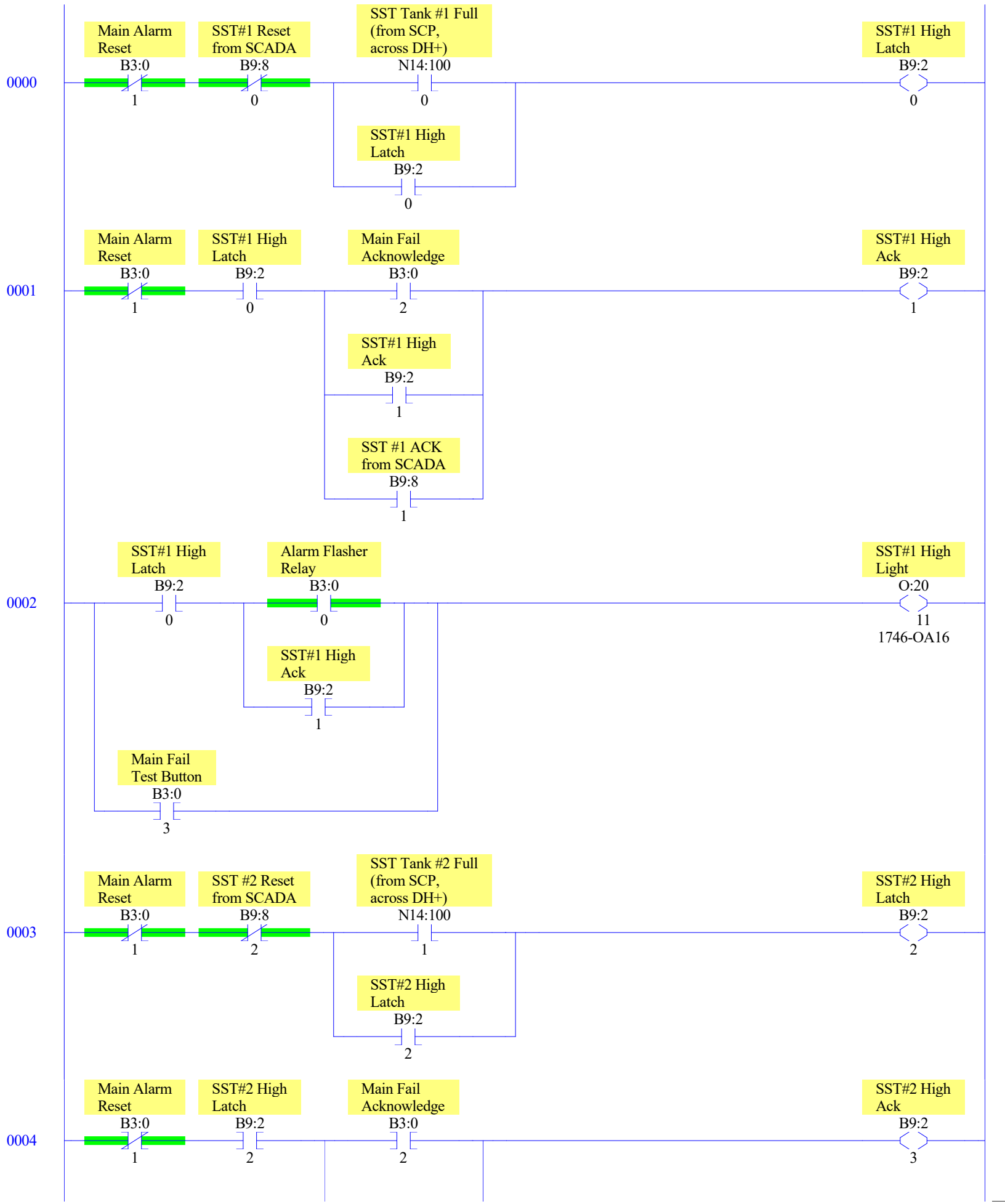
LAD 11 - --- Total Rungs in File = 1

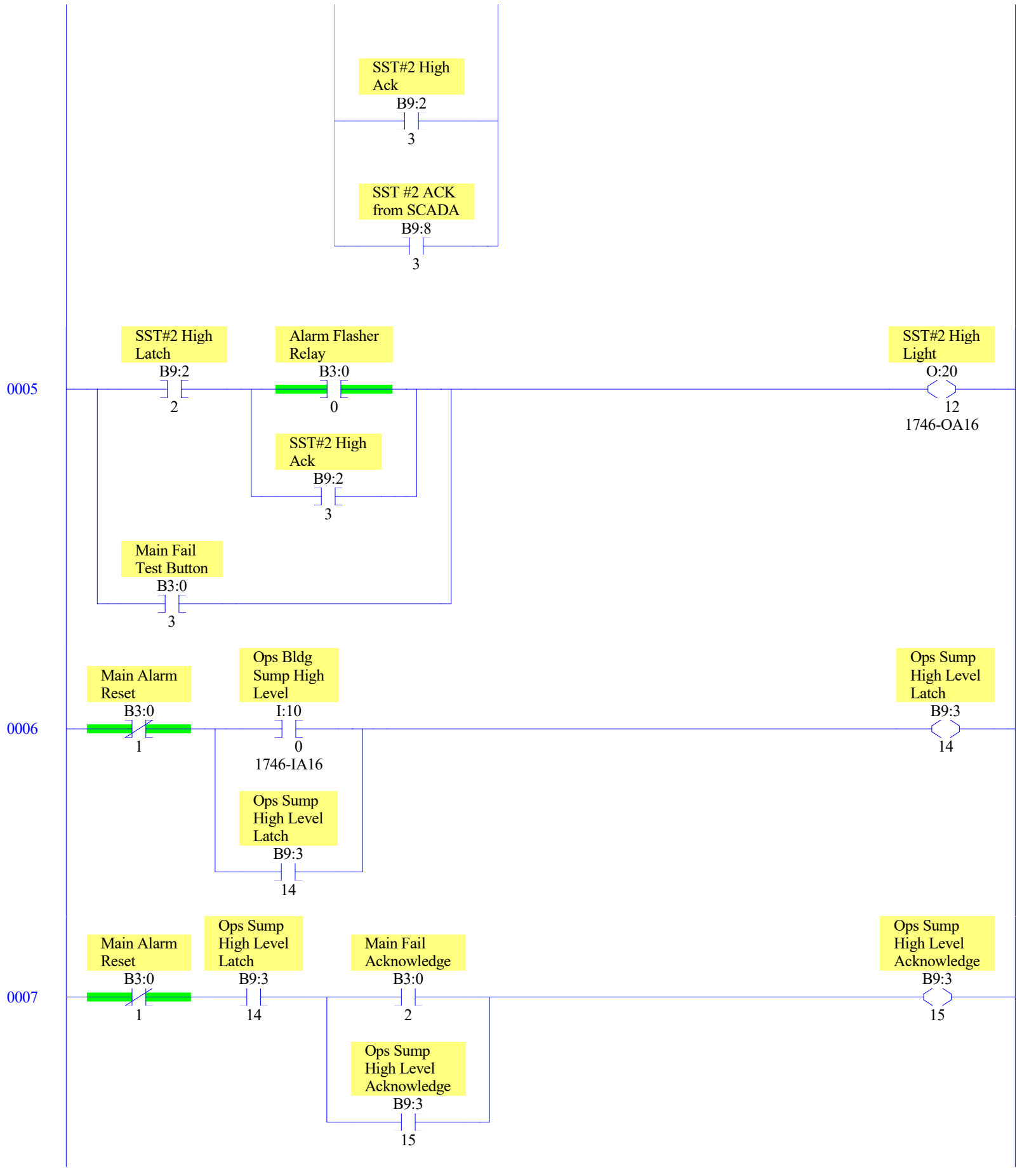


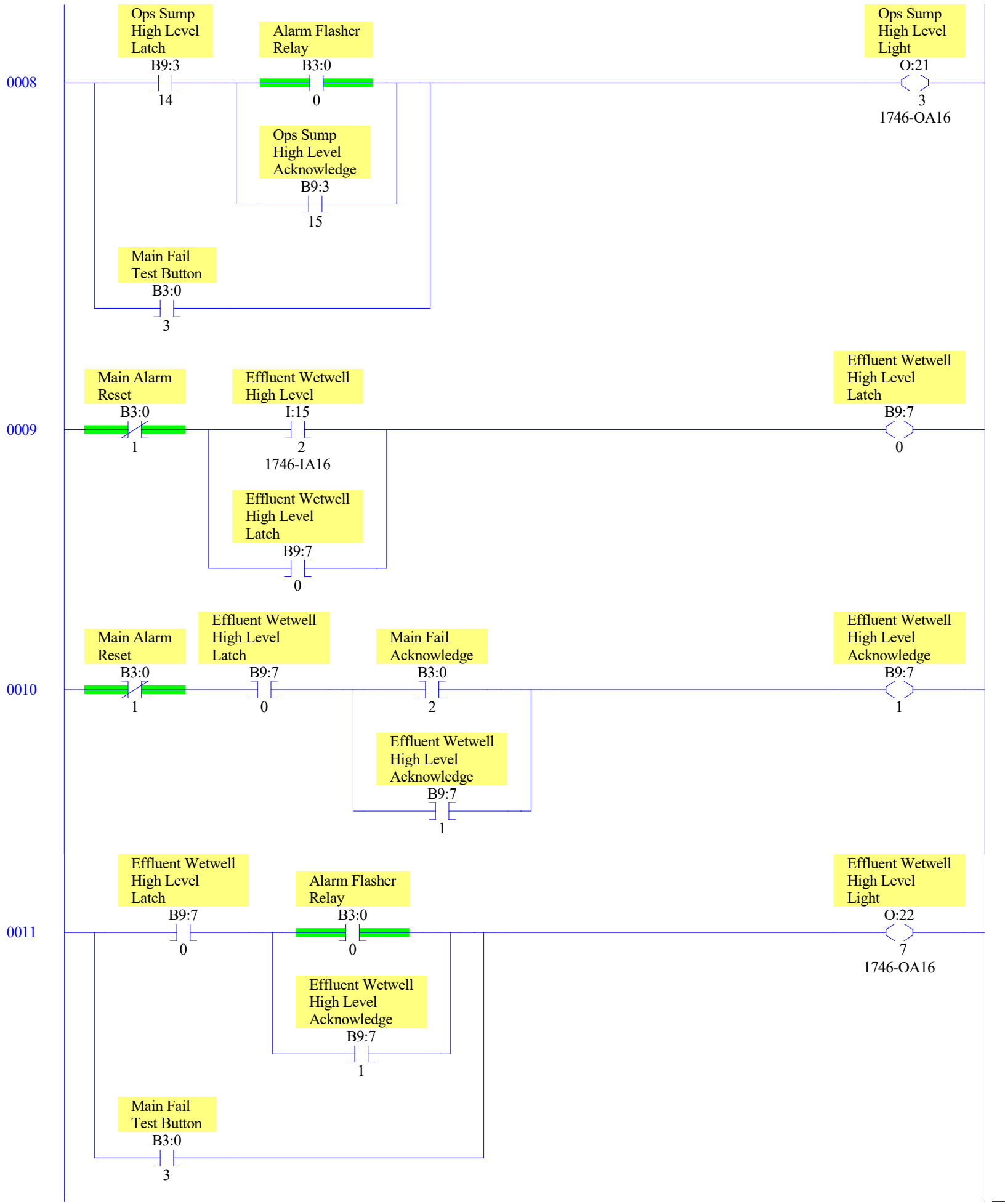

0000
Main Alarm Reset
B3:0
1
Blower 1 Fail Timer
T10:22
DN
Blower 1 Fail Latch
B9:5
8
Blower 1 Fail Latch
B9:5
8
0001
Main Alarm Reset
B3:0
1
Blower 1 Fail Latch
B9:5
8
Main Fail Acknowledge
B3:0
2
Blower 1 Fail Acknowledge
B9:5
9
Blower 1 Fail Acknowledge
B9:5
9
0002
Blower 1 Fail Latch
B9:5
8
Alarm Flasher Relay
B3:0
0
Blower 1 Fail Acknowledge
B9:5
9
Main Fail Test Button
B3:0
3
Blower 1 Fail Light
O:22
13
1746-OA16
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the pump is called to run by the ladder logic, and the pump is not running, and utility power is available
0003
Blower 1 in AUTO
I:15
12
1746-IA16
Blower 1 Run Output
O:11
10
1746-OA16
Blower 1 is ON
I:15
13
1746-IA16
Utility Power Not Available
T4:4
DN
Blower 1 Fail Timer
TON
Timer On Delay
Timer T10:22
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0004
Main Alarm Reset
B3:0
1
Blower 2 Fail Timer
T10:23
DN
Blower 2 Fail Latch
B9:5
10
Blower 2 Fail Latch
B9:5
10

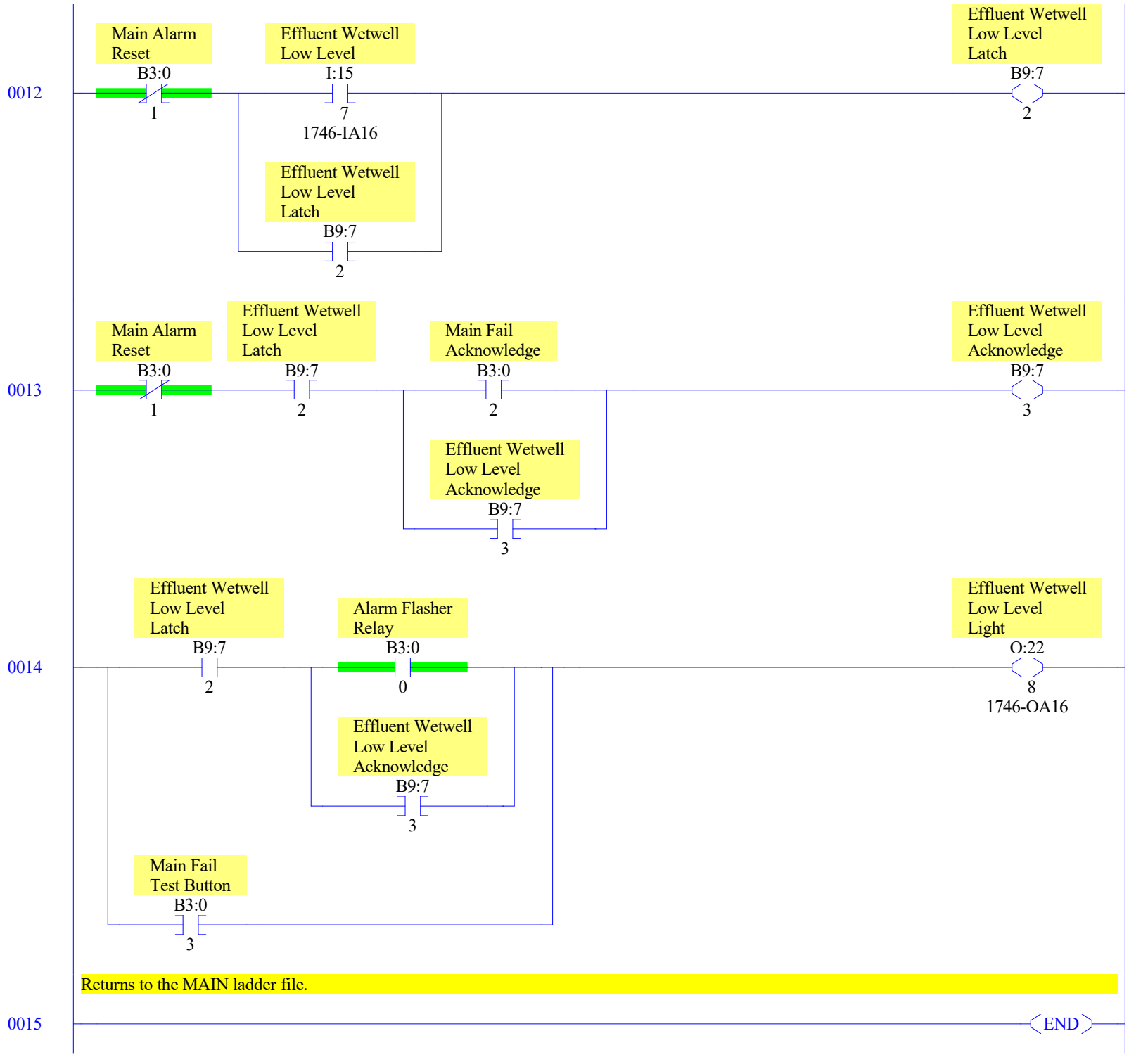

0005
Main Alarm Reset
B3:0
1
Blower 2 Fail Latch
B9:5
10
Main Fail Acknowledge
B3:0
2
Blower 2 Fail Acknowledge
B9:5
11
Blower 2 Fail Acknowledge
B9:5
11
0006
Blower 2 Fail Latch
B9:5
10
Alarm Flasher Relay
B3:0
0
Blower 2 Fail Acknowledge
B9:5
11
Main Fail Test Button
B3:0
3
Blower 2 Fail Light
O:22
14
1746-OA16
The Fail Timer runs if the FP-2-1handswitch is in the AUTO position, and the pump is called to run by the ladder logic, and the pump is not running, and utility power is available
0007
Blower 2 in AUTO
I:15
14
1746-IA16
Blower 2 Run Output
O:11
11
1746-OA16
Blower 2 is ON
I:15
15
1746-IA16
Utility Power Not Available
T4:4
DN
Blower 2 Fail Timer
TON
Timer On Delay
Timer T10:23
Time Base 1.0
Preset 20<
Accum 0<
EN
DN
0008
Blower 1 RUN Panelview Input
B3:7
0
Blower 1 STOP Panelview Input
B3:7
1
Blower 1 Run Output
O:11
10
1746-OA16
Blower 1 Run Output
O:11
10
1746-OA16
0009
Blower 2 RUN Panelview Input
B3:7
2
Blower 2 STOP Panelview Input
B3:7
3
Blower 2 Run Output
O:11
11
1746-OA16


Blower 2
Run Output
O:11
11
1746-OA16
0010
END


0000
Main Alarm Reset
B3:0
1
SST#1 Reset from SCADA
B9:8
0
SST Tank #1 Full (from SCP, across DH+)
N14:100
0
SST#1 High Latch
B9:2
0
SST#1 High Latch
B9:2
0
0001
Main Alarm Reset
B3:0
1
SST#1 High Latch
B9:2
0
Main Fail Acknowledge
B3:0
2
SST#1 High Ack
B9:2
0
SST#1 High Ack
B9:2
1
SST #1 ACK from SCADA
B9:8
1
0002
SST#1 High Latch
B9:2
0
Alarm Flasher Relay
B3:0
0
SST#1 High Light
O:20
11
1746-OA16
SST#1 High Ack
B9:2
1
Main Fail Test Button
B3:0
3
0003
Main Alarm Reset
B3:0
1
SST #2 Reset from SCADA
B9:8
2
SST Tank #2 Full (from SCP, across DH+)
N14:100
1
SST#2 High Latch
B9:2
2
SST#2 High Latch
B9:2
2
0004
Main Alarm Reset
B3:0
1
SST#2 High Latch
B9:2
2
Main Fail Acknowledge
B3:0
2
SST#2 High Ack
B9:2
3


SST#2 High Ack
B9:2
3
SST #2 ACK from SCADA
B9:8
3
0005
SST#2 High Latch
B9:2
2
Alarm Flasher Relay
B3:0
0
SST#2 High Ack
B9:2
3
Main Fail Test Button
B3:0
3
SST#2 High Light
O:20
12
1746-OA16
0006
Main Alarm Reset
B3:0
1
Ops Bldg Sump High Level
I:10
0
1746-IA16
Ops Sump High Level Latch
B9:3
14
Ops Sump High Level Latch
B9:3
14
0007
Main Alarm Reset
B3:0
1
Ops Sump High Level Latch
B9:3
14
Main Fail Acknowledge
B3:0
2
Ops Sump High Level Acknowledge
B9:3
15
Ops Sump High Level Acknowledge
B9:3
15


0008
Ops Sump High Level Latch
B9:3
14
Alarm Flasher Relay
B3:0
0
Ops Sump High Level Acknowledge
B9:3
15
Main Fail Test Button
B3:0
3
Ops Sump High Level Light
O:21
3
1746-OA16
0009
Main Alarm Reset
B3:0
1
Effluent Wetwell High Level
I:15
2
1746-IA16
Effluent Wetwell High Level Latch
B9:7
0
Effluent Wetwell High Level Latch
B9:7
0
0010
Main Alarm Reset
B3:0
1
Effluent Wetwell High Level Latch
B9:7
0
Main Fail Acknowledge
B3:0
2
Effluent Wetwell High Level Acknowledge
B9:7
1
Effluent Wetwell High Level Acknowledge
B9:7
1
0011
Effluent Wetwell High Level Latch
B9:7
0
Alarm Flasher Relay
B3:0
0
Effluent Wetwell High Level Acknowledge
B9:7
1
Main Fail Test Button
B3:0
3
Effluent Wetwell High Level Light
O:22
7
1746-OA16


0012
Main Alarm Reset
B3:0
1
Effluent Wetwell Low Level
I:15
7
1746-IA16
Effluent Wetwell Low Level Latch
B9:7
2
Effluent Wetwell Low Level Latch
B9:7
2
0013
Main Alarm Reset
B3:0
1
Effluent Wetwell Low Level Latch
B9:7
2
Main Fail Acknowledge
B3:0
2
Effluent Wetwell Low Level Acknowledge
B9:7
3
Effluent Wetwell Low Level Acknowledge
B9:7
3
0014
Effluent Wetwell Low Level Latch
B9:7
2
Alarm Flasher Relay
B3:0
0
Effluent Wetwell Low Level Acknowledge
B9:7
3
Main Fail Test Button
B3:0
3
Effluent Wetwell Low Level Light
O:22
8
1746-OA16
Returns to the MAIN ladder file.
0015
END

This rung reads data from the SCP SLC 5/04. It gets the status of the Sludge Storage tanks HIGH and LOW level alarms.

0000

MSG
Read/Write Message
Type Peer-To-Peer
Read/Write Read
Target Device 500CPU
Local/Remote Local
Control Block N14:0
Control Block Length 14
Setup Screen <

EN
DN
ER

This rung controls the operation of the previous rung's MSG instruction. Without it, the message transfer function will overflow and crash, and the plant will overflow, killing the last living coral reef in North America.

0001

Error
N14:0
12

Done
N14:0
13

Enable
N14:0
U
15

Returns to the MAIN ladder file.

0002

END

Address/Symbol Database

Address	Symbol	Scope	Description	Sym Group	Dev. Code	ABV	BLW
	RAS_1	Global	RAS 1 Run Output				
B3:0			Alarm Flasher Relay				
B3:0/0			Alarm Flasher Relay				
B3:0/1			Main Alarm Reset				
B3:0/2			Main Fail Acknowledge				
B3:0/3			Main Fail Test Button				
B3:0/4			Reset AB-1 RAS Totalizer (from Panelview)				
B3:0/5			Reset AB-2 RAS Totalizer (from Panelview)				
B3:0/6			Increase Clarifier 1 Ratio				
B3:0/7			Decrease Clarifier 1 Ratio				
B3:0/8			RAS flowing to AB-1				
B3:0/9			Auto Run Output to WAS Pumps				
B3:0/10			Stop Wasting				
B3:0/11			Start Wasting				
B3:0/12			SST Tank Full				
B3:0/13			WAS Override				
B3:0/14			Halt Wasting				
B3:0/15			Wasting Done				
B3:1/0			Override Button				
B3:1/1			Reset Wasting Totalizer				
B3:1/2			Override Clear				
B3:2/0			CL2 LOW Latch				
B3:2/1			CL2 LOW Ack				
B3:2/2			CL2 LOW Light				
B3:2/3			CL2 LOW LOW Latch				
B3:2/4			CL2 LOW LOW Ack				
B3:3/0			W3 Pump Run LAG LAG				
B3:3/1			W3 Speed Auto Control				
B3:3/2			W1 Speed Auto Control				
B3:3/3			W1 Pump Run LAG				
B3:4/0			W3 Pump Run LAG				
B3:4/1			W3 #3 Ready				
B3:4/2			W3 #2 Ready				
B3:4/3			W3 #1 Ready				
B3:5/0			Aerator 1 Run LOW Panelview Input				
B3:5/1			Aerator 1 STOP Panelview Input				
B3:5/2			Aerator 1 Run HIGH Panelview Input				
B3:5/3			Aerator 2 Run LOW Panelview Input				
B3:5/4			Aerator 2 STOP Panelview Input				
B3:5/5			Aerator 2 Run HIGH Panelview Input				
B3:5/6			Aerator 3 Run LOW Panelview Input				
B3:5/7			Aerator 3 STOP Panelview Input				
B3:5/8			Aerator 3 Run HIGH Panelview Input				
B3:5/9			Aerator 4 Run LOW Panelview Input				
B3:5/10			Aerator 4 STOP Panelview Input				
B3:5/11			Aerator 4 Run HIGH Panelview Input				
B3:5/12			Aerator 5 Run LOW Panelview Input				
B3:5/13			Aerator 5 STOP Panelview Input				
B3:5/14			Aerator 5 Run HIGH Panelview Input				
B3:5/15			Aerator 6 Run LOW Panelview Input				
B3:6/0			Aerator 6 STOP Panelview Input				
B3:6/1			Aerator 6 Run HIGH Panelview Input				
B3:6/2			Aerator 7 Run LOW Panelview Input				
B3:6/3			Aerator 7 STOP Panelview Input				
B3:6/4			Aerator 7 Run HIGH Panelview Input				
B3:7/0			Blower 1 RUN Panelview Input				
B3:7/1			Blower 1 STOP Panelview Input				
B3:7/2			Blower 2 RUN Panelview Input				
B3:7/3			Blower 2 STOP Panelview Input				
B9:0/0			RAS 1 Fail Latch				
B9:0/1			RAS 1 Fail Ack				
B9:0/2			RAS 2 Fail Latch				
B9:0/3			RAS 2 Fail Ack				
B9:0/4			RAS 3 Fail Latch				
B9:0/5			RAS 3 Fail Ack				
B9:0/6			RAS 4 Fail Latch				
B9:0/7			RAS 4 Fail Ack				
B9:0/8			WAS 1 Fail Latch				
B9:0/9			WAS 1 Fail Ack				
B9:0/10			WAS 2 Fail Latch				
B9:0/11			WAS 2 Fail Ack				
B9:0/12			W3 1 Fail Latch				
B9:0/13			W3 1 Fail Ack				
B9:0/14			W3 2 Fail Latch				
B9:0/15			W3 2 Fail Ack				
B9:1/0			W3 3 Fail Latch				
B9:1/1			W3 3 Fail Ack				
B9:2/0			SST#1 High Latch				
B9:2/1			SST#1 High Ack				
B9:2/2			SST#2 High Latch				
B9:2/3			SST#2 High Ack				
B9:3/0			W1 1 Fail Latch				

Address/Symbol Database

Address	Symbol	Scope	Description	Sym Group	Dev. Code	ABV	BLW
B9:3/1			W1 1 Fail Acknowledge				
B9:3/2			W1 2 Fail Latch				
B9:3/3			W1 2 Fail Acknowledge				
B9:3/4			W1 Low Discharge Latch				
B9:3/5			W1 Low Discharge Acknowledge				
B9:3/6			W3 Low Discharge Latch				
B9:3/7			W3 Low Discharge Acknowledge				
B9:3/8			W3 High Discharge Latch				
B9:3/9			W3 High Discharge Acknowledge				
B9:3/10			W1 Low Suction Latch				
B9:3/11			W1 Low Suction Acknowledge				
B9:3/12			W1 High Discharge Latch				
B9:3/13			W1 High Discharge Acknowledge				
B9:3/14			Ops Sump High Level Latch				
B9:3/15			Ops Sump High Level Acknowledge				
B9:4/0			Aerator 1 Fail Latch				
B9:4/1			Aerator 1 Fail ACK				
B9:4/2			Aerator 2 Fail Latch				
B9:4/3			Aerator 2 Fail ACK				
B9:4/4			Aerator 3 Fail Latch				
B9:4/5			Aerator 3 Fail ACK				
B9:4/6			Aerator 4 Fail Latch				
B9:4/7			Aerator 4 Fail ACK				
B9:4/8			Aerator 5 Fail Latch				
B9:4/9			Aerator 5 Fail ACK				
B9:4/10			Aerator 6 Fail Latch				
B9:4/11			Aerator 6 Fail ACK				
B9:4/12			Aerator 7 Fail Latch				
B9:4/13			Aerator 7 Fail ACK				
B9:5/0			Scum Pump 1 Fail Latch				
B9:5/1			Scum Pump 1 Fail Acknowledge				
B9:5/2			Scum Pump 2 Fail Latch				
B9:5/3			Scum Pump 2 Fail Acknowledge				
B9:5/4			Scum Box 1 High Level Fail Latch				
B9:5/5			Scum Box 1 High Level Fail Ack				
B9:5/6			Scum Box 2 High Level Fail Latch				
B9:5/7			Scum Box 2 High Level Fail Ack				
B9:5/8			Blower 1 Fail Latch				
B9:5/9			Blower 1 Fail Acknowledge				
B9:5/10			Blower 2 Fail Latch				
B9:5/11			Blower 2 Fail Acknowledge				
B9:6/0			Clarifier 1 High Torque Latch				
B9:6/1			Clarifier 1 High Torque Acknowledge				
B9:6/2			Clarifier 1 High High Torque Latch				
B9:6/3			Clarifier 1 High High Torque Acknowledge				
B9:6/4			Clarifier 2 High Torque Latch				
B9:6/5			Clarifier 2 High Torque Acknowledge				
B9:6/6			Clarifier 2 High High Torque Latch				
B9:6/7			Clarifier 2 High High Torque Acknowledge				
B9:7/0			Effluent Wetwell High Level Latch				
B9:7/1			Effluent Wetwell High Level Acknowledge				
B9:7/2			Effluent Wetwell Low Level Latch				
B9:7/3			Effluent Wetwell Low Level Acknowledge				
B9:8/0			SST#1 Reset from SCADA				
B9:8/1			SST #1 ACK from SCADA				
B9:8/2			SST #2 Reset from SCADA				
B9:8/3			SST #2 ACK from SCADA				
C5:0			WAS 1 Totalizer Counter(x1000)				
C5:1			WAS 2 Totalizer Counter(x1000)				
F8:0			RAS Flow to AB-1 (0 - 0.0926 kgps)				
F8:1			RAS Flow to AB-2 (0 - 0.0926 kgps)				
F8:2			AB-1 RAS Flow (0 - 8 MGD) (for Panelview)				
F8:3			Total RAS Flow to AB-1 (x1000 gallons)				
F8:4			Total RAS Flow to AB-2 (x1000 gallons)				
F8:5			AB-2 RAS Flow (0 - 8 MGD) (for Panelview)				
F8:6			Panelview RAS Setpoint (0-8 MGD)				
F8:8			Scaled CL2 Residual (0-5 ppt)				
I:1.0			RAS Flow to AB-1				
I:1.1			RAS Flow to AB-2				
I:1.2			WAS 1 Flow				
I:1.3			WAS 2 Flow				
I:2.0			W3 Pressure (raw input)				
I:2.1			W1 Pressure (raw input)				
I:2.2			W1 Pressure				
I:2.3			pH Reading				
I:3.0			CL2 Residual				
I:3.1			Parshall Flow				
I:3.2			Influent Flow				
I:8/0			RAS 1 or 2 in Lead				
I:8/1			RAS 1 in Auto				
I:8/2			RAS 1 is On				
I:8/3			RAS 1 Fail Input				
I:8/4			RAS 2 in Auto				
I:8/5			RAS 2 is On				

Address/Symbol Database

Address	Symbol	Scope	Description	Sym Group	Dev. Code	ABV	BLW
I:8/6			RAS 2 Fail Input				
I:8/7			RAS 3 or 4 in Lead				
I:8/8			RAS 3 in Auto				
I:8/9			RAS 3 is On				
I:8/10			RAS 3 Fail Input				
I:8/11			RAS 4 in Auto				
I:8/12			RAS 4 is On				
I:8/13			RAS 4 Fail Input				
I:8/14			WAS 1 in Auto				
I:8/15			WAS 1 is On				
I:9/0			WAS 1 Fail Input				
I:9/1			WAS 2 in Auto				
I:9/2			WAS 2 is ON				
I:9/3			WAS 2 Fail Input				
I:9/4			W3 #1 is LEAD				
I:9/5			W3 #2 is LEAD				
I:9/6			W3 #3 is LEAD				
I:9/7			W3 2 in OFF				
I:9/8			W3 2 is On				
I:9/9			W3 2 Fail Input				
I:9/10			W3 3 in OFF				
I:9/11			W3 3 is On				
I:9/12			W3 3 Fail Input				
I:9/13			W3 1 in OFF				
I:9/14			W3 1 is On				
I:9/15			W3 1 Fail Input				
I:10/0			Ops Bldg Sump High Level				
I:10/1			W1 System Low Suction Pressure				
I:10/2			W1 System High Discharge Pressure				
I:10/3			W3 System Low Discharge Pressure				
I:10/4			W3 System High Discharge Pressure				
I:10/5			W1 System Low Discharge Pressure				
I:10/6			W1 #1 is LEAD				
I:10/7			W1 1 Fail Inputs				
I:10/8			W1 1 is ON				
I:10/9			W1 1 in AUTO				
I:10/10			W1 2 Fail Inputs				
I:10/11			W1 2 is ON				
I:10/12			W1 2 in AUTO				
I:10/13			Utility Power Available				
I:10/14			CL2 Residual LOW				
I:10/15			CL2 Residual LOW LOW				
I:14/0			Acknowledge Button				
I:14/1			Test Button				
I:14/2			Reset Button				
I:14/4			Scum Pump 1 in AUTO				
I:14/5			Scum Pump 1 is ON				
I:14/6			Scum Pump 1 Fail Input				
I:14/7			Scum Box 1 High Level				
I:14/8			Scum Box 1 Start Level				
I:14/9			Scum Box 1 Stop Level				
I:14/10			Scum Pump 2 in AUTO				
I:14/11			Scum Pump 2 is ON				
I:14/12			Scum Pump 2 Fail Input				
I:14/13			Scum Box 2 High Level				
I:14/14			Scum Box 2 Start Level				
I:14/15			Scum Box 2 Stop Level				
I:15/2			Effluent Wetwell High Level				
I:15/7			Effluent Wetwell Low Level				
I:15/8			Clarifier 1 High Torque				
I:15/9			Clarifier 1 High High Torque				
I:15/10			Clarifier 2 High Torque				
I:15/11			Clarifier 2 High High Torque				
I:15/12			Blower 1 in AUTO				
I:15/13			Blower 1 is ON				
I:15/14			Blower 2 in AUTO				
I:15/15			Blower 2 is ON				
I:18/4			Aerator 7 Fail Input from MCC				
I:18/5			Aerator 7 Running HIGH				
I:18/6			Aerator 7 Running LOW				
I:18/7			Aerator 7 in AUTO				
I:18/8			Aerator 6 Fail Input from MCC				
I:18/9			Aerator 6 Running HIGH				
I:18/10			Aerator 6 Running LOW				
I:18/11			Aerator 6 in AUTO				
I:18/12			Aerator 5 Fail Input from MCC				
I:18/13			Aerator 5 Running HIGH				
I:18/14			Aerator 5 Running LOW				
I:18/15			Aerator 5 in AUTO				
I:19/0			Aerator 4 Fail Input from MCC				
I:19/1			Aerator 4 Running HIGH				
I:19/2			Aerator 4 Running LOW				
I:19/3			Aerator 4 in AUTO				
I:19/4			Aerator 3 Fail Input from MCC				

Address/Symbol Database

Address	Symbol	Scope	Description	Sym Group	Dev. Code	ABV	BLW
I:19/5			Aerator 3 Running HIGH				
I:19/6			Aerator 3 Running LOW				
I:19/7			Aerator 3 in AUTO				
I:19/8			Aerator 2 Fail Input from MCC				
I:19/9			Aerator 2 Running HIGH				
I:19/10			Aerator 2 Running LOW				
I:19/11			Aerator 2 in AUTO				
I:19/12			Aerator 1 Fail Input from MCC				
I:19/13			Aerator 1 Running HIGH				
I:19/14			Aerator 1 Running LOW				
I:19/15			Aerator 1 in AUTO				
N7:0			Unscaled RAS Flow to AB 1 or 2 (3277 - 16384)				
N7:0/0			Unscaled RAS Flow to Basin				
N7:1			Clarifier 1/2 Ratio				
N7:2			RAS Flow From Clarifier 1 (Ratio from Panelview)				
N7:3			RAS Flow From Clarifier 2 (Ratio from Panelview)				
N7:4			Panelview Input for W3 Pressure				
N7:5			W3 Pressure (0-150 psi)				
N7:6			WAS 1 Flow (0-350 GPM)				
N7:7			WAS 1 Totalizer				
N7:8			WAS 2 Flow (0-462 GPM)				
N7:9			WAS 2 Totalizer				
N7:10			Wasting Totalizer				
N7:11			Wasting Target Value				
N7:12			Wasting Status Value				
N7:13							
N7:15			W3 LAG Start Frequency				
N7:16			W3 LAG Stop Frequency				
N7:17			W3 Manual Speed Control (0 - 100%)				
N7:18			W3 Percent Speed Output from PID Control				
N7:19			W1 Pressure (0-150 psi)				
N7:20			Panelview Input for W1 Pressure				
N7:21			W1 Percent Speed Output from PID Control				
N7:22			W1 Manual Speed Control (0 - 100%)				
N7:25			W1 VFD Frequency (20 - 60 Hz)				
N7:26			W3 VFD Frequency				
N11:0			RAS Pump Speed Control				
N11:2			RAS Flow Setpoint Input to PID Control (0-16383)				
N11:16			RAS PID Output (%)				
N11:28			Scaled Input for RAS PID Control (0 - 16383)				
N11:29			RAS PID Raw Output (0 - 16383)				
N11:30			RAS 3 and 4 Speed Control				
N11:58			Scaled Input for AB-2 RAS PID Control				
N12:2			W3 Pressure Setpoint Input to PID Control				
N12:28			Scaled Input for W3 PID Control (0 - 16383)				
N12:29			W3 PID Raw Output				
N13:2			W1 Pressure Setpoint Input to PID Control				
N13:28			Scaled Input for W1 PID Control (0 - 16383)				
N13:29			W1 PID Raw Output (0-16383)				
N14:0/12			Error				
N14:0/13			Done				
N14:0/15			Enable				
N14:100/0			SST Tank #1 Full (from SCP, across DH+)				
N14:100/1			SST Tank #2 Full (from SCP, across DH+)				
O:5.0			RAS 1 Speed Output (mA signal) (6242-31208)				
O:5/0			WAS 2 Fail Light				
O:5.1			RAS 2 Speed Output (mA signal) (6242-31208)				
O:5.2			RAS 3 Speed Output (mA signal) (6242-31208)				
O:5.3			RAS 4 Speed Output (mA signal) (6242-31208)				
O:6.0			W3 #1 Speed Output (4 - 20mA)				
O:6/0			W3 Pump Output Speed				
O:6.1			W3 #2 Speed Output (4 - 20mA)				
O:6.2			W3 #3 Speed Output (4 - 20mA)				
O:6.3			W1 #1 Speed Output (4 - 20mA)				
O:7.0			W1 #2 Speed Output (4 - 20mA)				
O:11/0			RAS 1 Run Output				
O:11/1			RAS 2 Run Output				
O:11/2			RAS 3 Run Output				
O:11/3			RAS 4 Run Output				
O:11/4			WAS 1 Run Output				
O:11/5			WAS 2 Run Output				
O:11/6			"Stopped Wasting" Output to LMP				
O:11/7			W3 1 Run Output				
O:11/8			W3 2 Run Output				
O:11/9			W3 3 Run Output				
O:11/10			Blower 1 Run Output				
O:11/11			Blower 2 Run Output				
O:11/12			Scum Pump 1 Run Output				
O:11/13			Scum Pump 2 Run Output				
O:11/14			Aerator 7 RUN HIGH				
O:11/15			W1 1 Run Output				
O:12/0			Aerator 7 RUN LOW				
O:12/1			Aerator 6 RUN HIGH				
O:12/2			Aerator 6 RUN LOW				

Address/Symbol Database

Address	Symbol	Scope	Description	Sym Group	Dev. Code	ABV	BLW
O:12/3			Aerator 5 RUN HIGH				
O:12/4			Aerator 5 RUN LOW				
O:12/5			Aerator 4 RUN HIGH				
O:12/6			Aerator 4 RUN LOW				
O:12/7			Aerator 3 RUN HIGH				
O:12/8			Aerator 3 RUN LOW				
O:12/9			Aerator 2 RUN HIGH				
O:12/10			Aerator 2 RUN LOW				
O:12/11			Aerator 1 RUN HIGH				
O:12/12			Aerator 1 RUN LOW				
O:12/13			W1 2 Run Output				
O:12/14			Bleach Tote Valve CLOSE				
O:12/15			Common Fail Output				
O:20/0			RAS 1 Fail Light				
O:20/1			RAS 2 Fail Light				
O:20/2			RAS 3 Fail Light				
O:20/3			RAS 4 Fail Light				
O:20/4			WAS 1 Fail Light				
O:20/5			WAS 2 Fail Light				
O:20/6			W3 1 Fail Light				
O:20/7			W3 2 Fail Light				
O:20/8			W3 3 Fail Light				
O:20/9			W1 1 Fail Light				
O:20/10			W1 2 Fail Light				
O:20/11			SST#1 High Light				
O:20/12			SST#2 High Light				
O:20/13			Bleach Valve OPEN Light				
O:20/14			CL2 LOW Light				
O:20/15			CL2 LOW LOW Light				
O:21/0			Scum Box 1 High Level Light				
O:21/1			Scum Pump 1 Fail Light				
O:21/2			Scum Pump 2 Fail Light				
O:21/3			Ops Sump High Level Light				
O:21/4			Aerator 7 Fail Light Output				
O:21/5			Aerator 6 Fail Light Output				
O:21/6			Aerator 5 Fail Light Output				
O:21/7			Aerator 4 Fail Light Output				
O:21/8			Aerator 3 Fail Light Output				
O:21/9			Aerator 2 Fail Light Output				
O:21/10			Aerator 1 Fail Light Output				
O:21/11			W1 Low Suction Light				
O:21/12			W1 High Discharge Light				
O:21/13			W3 High Discharge Light				
O:21/14			W3 Low Discharge Light				
O:21/15			W1 Low Discharge Light				
O:22/7			Effluent Wetwell High Level Light				
O:22/8			Effluent Wetwell Low Level Light				
O:22/9			Clarifier 1 High Torque Light				
O:22/10			Clarifier 1 High High Torque Light				
O:22/11			Clarifier 2 High Torque Light				
O:22/12			Clarifier 2 High High Torque Light				
O:22/13			Blower 1 Fail Light				
O:22/14			Blower 2 Fail Light				
O:22/15			Scum Box 2 High Level Light				
O:23/14			Scum Pump 1 Run Output				
O:23/15			Scum Pump 2 Run Output				
S:0			Arithmetic Flags				
S:0/0			Processor Arithmetic Carry Flag				
S:0/1			Processor Arithmetic Underflow/ Overflow Flag				
S:0/2			Processor Arithmetic Zero Flag				
S:0/3			Processor Arithmetic Sign Flag				
S:1			Processor Mode Status/ Control				
S:1/0			Processor Mode Bit 0				
S:1/1			Processor Mode Bit 1				
S:1/2			Processor Mode Bit 2				
S:1/3			Processor Mode Bit 3				
S:1/4			Processor Mode Bit 4				
S:1/5			Forces Enabled				
S:1/6			Forces Present				
S:1/7			Comms Active				
S:1/8			Fault Override at Powerup				
S:1/9			Startup Protection Fault				
S:1/10			Load Memory Module on Memory Error				
S:1/11			Load Memory Module Always				
S:1/12			Load Memory Module and RUN				
S:1/13			Major Error Halted				
S:1/14			Access Denied				
S:1/15			First Pass				
S:2/0			STI Pending				
S:2/1			STI Enabled				
S:2/2			STI Executing				
S:2/3			Index Addressing File Range				
S:2/4			Saved with Debug Single Step				
S:2/5			DH-485 Incoming Command Pending				

Address/Symbol Database

Address	Symbol	Scope	Description	Sym Group	Dev. Code	ABV	BLW
S:2/6			DH-485 Message Reply Pending				
S:2/7			DH-485 Outgoing Message Command Pending				
S:2/15			Comms Servicing Selection				
S:3			Current Scan Time/ Watchdog Scan Time				
S:4			Time Base				
S:5/0			Overflow Trap				
S:5/2			Control Register Error				
S:5/3			Major Err Detected Executing UserFault Routine				
S:5/4			M0-M1 Referenced on Disabled Slot				
S:5/8			Memory Module Boot				
S:5/9			Memory Module Password Mismatch				
S:5/10			STI Overflow				
S:5/11			Battery Low				
S:6			Major Error Fault Code				
S:7			Suspend Code				
S:8			Suspend File				
S:9			Active Nodes				
S:10			Active Nodes				
S:11			I/O Slot Enables				
S:12			I/O Slot Enables				
S:13			Math Register				
S:14			Math Register				
S:15			Node Address/ Baud Rate				
S:16			Debug Single Step Rung				
S:17			Debug Single Step File				
S:18			Debug Single Step Breakpoint Rung				
S:19			Debug Single Step Breakpoint File				
S:20			Debug Fault/ Powerdown Rung				
S:21			Debug Fault/ Powerdown File				
S:22			Maximum Observed Scan Time				
S:23			Average Scan Time				
S:24			Index Register				
S:25			I/O Interrupt Pending				
S:26			I/O Interrupt Pending				
S:27			I/O Interrupt Enabled				
S:28			I/O Interrupt Enabled				
S:29			User Fault Routine File Number				
S:30			STI Setpoint				
S:31			STI File Number				
S:32			I/O Interrupt Executing				
S:33			Extended Proc Status Control Word				
S:33/0			Incoming Command Pending				
S:33/1			Message Reply Pending				
S:33/2			Outgoing Message Command Pending				
S:33/3			Selection Status User/DF1				
S:33/4			Communicat Active				
S:33/5			Communicat Servicing Selection				
S:33/6			Message Servicing Selection Channel 0				
S:33/7			Message Servicing Selection Channel 1				
S:33/8			Interrupt Latency Control Flag				
S:33/9			Scan Toggle Flag				
S:33/10			Discrete Input Interrupt Reconfigur Flag				
S:33/11			Online Edit Status				
S:33/12			Online Edit Status				
S:33/13			Scan Time Timebase Selection				
S:33/14			DTR Control Bit				
S:33/15			DTR Force Bit				
S:34			Pass-thru Disabled				
S:34/0			Pass-Thru Disabled Flag				
S:34/1			DH+ Active Node Table Enable Flag				
S:34/2			Floating Point Math Flag Disable,Fl				
S:35			Last 1 ms Scan Time				
S:36			Extended Minor Error Bits				
S:36/8			DII Lost				
S:36/9			STI Lost				
S:36/10			Memory Module Data File Overwrite Protection				
S:37			Clock Calendar Year				
S:38			Clock Calendar Month				
S:39			Clock Calendar Day				
S:40			Clock Calendar Hours				
S:41			Clock Calendar Minutes				
S:42			Clock Calendar Seconds				
S:43			STI Interrupt Time				
S:44			I/O Event Interrupt Time				
S:45			DII Interrupt Time				
S:46			Discrete Input Interrupt- File Number				
S:47			Discrete Input Interrupt- Slot Number				
S:48			Discrete Input Interrupt- Bit Mask				
S:49			Discrete Input Interrupt- Compare Value				
S:50			Processor Catalog Number				
S:51			Discrete Input Interrupt- Return Number				
S:52			Discrete Input Interrupt- Accumulat				
S:53			Reserved/ Clock Calendar Day of the Week				
S:55			Last DII Scan Time				

Address/Symbol Database

Address	Symbol	Scope	Description	Sym Group	Dev. Code	ABV	BLW
S:56			Maximum Observed DII Scan Time				
S:57			Operating System Catalog Number				
S:58			Operating System Series				
S:59			Operating System FRN				
S:61			Processor Series				
S:62			Processor Revision				
S:63			User Program Type				
S:64			User Program Functional Index				
S:65			User RAM Size				
S:66			Flash EEPROM Size				
S:67			Channel 0 Active Nodes				
S:68			Channel 0 Active Nodes				
S:69			Channel 0 Active Nodes				
S:70			Channel 0 Active Nodes				
S:71			Channel 0 Active Nodes				
S:72			Channel 0 Active Nodes				
S:73			Channel 0 Active Nodes				
S:74			Channel 0 Active Nodes				
S:75			Channel 0 Active Nodes				
S:76			Channel 0 Active Nodes				
S:77			Channel 0 Active Nodes				
S:78			Channel 0 Active Nodes				
S:79			Channel 0 Active Nodes				
S:80			Channel 0 Active Nodes				
S:81			Channel 0 Active Nodes				
S:82			Channel 0 Active Nodes				
S:83			DH+ Active Nodes				
S:84			DH+ Active Nodes				
S:85			DH+ Active Nodes				
S:86			DH+ Active Nodes				
T4:0			Alarm Flasher Timer				
T4:1			One-second Timer for Totalizers				
T4:2			AB-1 RAS Flow Indication (for Panelview)				
T4:3			AB-2 RAS Flow Indication (for Panelview)				
T4:4/DN			Utility Power Not Available				
T4:5			W3 LAG On Timer				
T4:6			W3 LAG Off Timer				
T4:7			W3 LAG LAG On Timer				
T4:8			RAS 1 Input Fail Timer				
T4:9			RAS 2 Input Fail Timer				
T4:10			RAS 3 Input Fail Timer				
T4:11			RAS 4 Input Fail Timer				
T4:12			W3 1 Input Fail Timer				
T4:13			W3 2 Input Fail Timer				
T4:14			W3 3 Input Fail Timer				
T4:15			W1 1 Input Fail Timer				
T4:16			W1 2 Input Fail Timer				
T4:17			W1 LAG ON Timer				
T4:18			W1 LAG Off Timer				
T10:0			RAS 1 Fail Timer				
T10:1			RAS 2 Fail Timer				
T10:1/DN			RAS 2 Fail Timer				
T10:2			RAS 3 Fail Timer				
T10:2/DN			RAS 3 Fail Timer				
T10:3			RAS 4 Fail Timer				
T10:3/DN			RAS 4 Fail Timer				
T10:4			WAS 1 Fail Timer				
T10:5			WAS 2 Fail timer				
T10:6			W3 1 Fail Timer				
T10:7			W3 2 Fail Timer				
T10:8			W3 3 Fail Timer				
T10:9			CL2 LOW Timer				
T10:10			CL2 LOW LOW Timer				
T10:11			W1 1 Fail Timer				
T10:12			W1 2 Fail Timer				
T10:13			Aerator 1 Fail Timer				
T10:14			Aerator 2 Fail Timer				
T10:15			Aerator 3 Fail Timer				
T10:16			Aerator 4 Fail Timer				
T10:17			Aerator 5 Fail Timer				
T10:18			Aerator 6 Fail Timer				
T10:19			Aerator 7 Fail Timer				
T10:20			Scum Pump 1 Fail Timer				
T10:21			Scum Pump 2 Fail Timer				
T10:22			Blower 1 Fail Timer				
T10:23			Blower 2 Fail Timer				

Instruction Comment Database

Address	Instruction	Description

Symbol Group Database

Group_Name	Description

Section 13562
FLOW INSTRUMENTS

PART 1 - GENERAL

1-1. SCOPE. The Flow Instrument Section covers the furnishing of flow instruments and accessories required for the Instrumentation and Control System as specified herein or as indicated on the Drawings.

Equipment and services provided under this section shall be subject to the Instrumentation and Control System section. This section shall be used and referenced only in conjunction with the Instrumentation and Control System section. Supplementing the Instrumentation and Control System section, instrument data, special requirements, and options are indicated on the Drawings.

1-2. DESIGN CRITERIA. Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by Contractor.

Primary elements shall derive any required power from the transmitter, unless otherwise indicated.

The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the Drawings. The instruments shall be installed at the locations indicated on the Drawings.

Where possible, each instrument shall be factory wet flow calibrated to the full scale flow range of the sensors or calibration ranges indicated on the Drawings. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. Calibration and configuration data shall be stored digitally in each device, including the instrument tag designation indicated on the Drawings.

1-3. SUBMITTALS. Submittals shall be made as specified in the Instrumentation and Control System section.

1-4. SHIPMENT, PROTECTION, AND STORAGE. Equipment provided under this section shall be shipped, protected, and stored as specified in the

Instrumentation and Control System section. Identification of packaging shall be as specified in the Instrumentation and Control System section.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs provide minimum device requirements. The Drawings shall be used to determine any additional instrument options, requirements, or service conditions.

2-1.01. Interconnecting Cable. For instruments where the primary element and transmitter are physically separated, interconnecting cable from the element to the transmitter shall be provided. The cable shall be the type approved by the instrument manufacturer for the intended purpose of interfacing the element to the transmitter. Length of cable shall be a minimum of three meters or as indicated on the Drawings. The interconnecting cable shall be provided in the length necessary for installation. Splices shall not be allowed in the installed cable.

2-1.02. Programming Device. For instruments that require a dedicated programming device for calibration, maintenance, or troubleshooting, one such programming device shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). The programming device shall include appropriate operation manuals and shall be included in the training requirements. For systems that allow the programming device functions to be implemented in software, running on a laptop computer, the software shall be provided instead of the programming device.

2-1.03. Configuration Software/Serial Interface. Devices indicated as requiring a serial interface shall be provided with all accessories required to properly communicate over the serial link. As a minimum, an appropriate cable shall be provided to allow the transmitter serial interface to be connected to a personal computer. One licensed copy of the diagnostic/interface software shall be provided for each Owner facility (quantity required shall be as indicated in the Instrumentation and Control System section). Software shall be capable of running under the Windows 10 operating system. If the software furnished performs the same functions as the programming device, specified elsewhere, then the programming device shall not be furnished.

2-2. FLOW INSTRUMENTATION.

2-2.01. Magnetic Flowmeters, Signal Converters, and Accessories.

2-2.01.01. Magnetic Flowmeter. The magnetic flowmeter shall be a completely obstructionless, in-line flowmeter with no constrictions in the flow of fluid through th

e meter. The meter shall consist of a metallic tube with flanged ends and with grounding rings. Flange diameter and bolt drilling pattern shall comply with ANSI/ASME B16.5 for line sizes from one-half inch to 24 inches or AWWA C207 for line sizes larger than 24 inches. Flange class ratings and meter maximum pressure ratings shall be compatible with the adjoining piping. Flangeless wafer insert style meters may be used for pipe sizes up to 6 inches, where compatible with adjacent piping flanges. Self-cleaning electrodes shall be provided for all meters used for sludge metering. Electrode and liner materials shall be fully compatible with the process fluid as approved by the Engineer. Each meter shall be factory wet flow calibrated to the sensors full flow capacity, at a facility, which is traceable to NIST or other standard acceptable to Engineer, and a copy of the calibration, report shall be submitted as part of the operation and maintenance manual submittal.

The meter shall be capable of standing empty for extended periods of time without damage to any components. The meter housing shall be of a splash-proof and drip-proof design.

Meters shall be Badger Meter “ModMAG M2000”, without exception.

2-2.01.02. Magnetic Flowmeter Signal Converters. Separately mounted, microprocessor-based signal converters shall be provided for the magnetic flowmeters. The signal converters shall include output damping, self-testing, built-in calibration capability, and an "empty pipe zero" contact input. The overall accuracy of the magnetic flowmeter transmitter and signal converter shall be ±0.5 percent of actual flow rate for full-scale settings of 3 to 30 fps. The meter manufacturer shall furnish the signal cable between the converter and the magnetic flowmeter. Signal cable shall be continuous and not spliced between the meter and the signal converter. The signal converter shall be housed in a corrosion-resistant, weatherproof NEMA Type 4X housing and shall be suitable for operation over an ambient temperature range of -30 to +140°F, and relative humidity of 10 to 100 percent. The converter shall have an analog output of 4-20 mA dc. The converter shall have a pulse output designed to operate a remote seven-digit totalizer and scaled so that the totalizer will operate for 60 days at 100 percent flow without repeating. Scaling factors shall be field adjustable and shall be selected to provide a totalizer multiplier of a power of 10. Transmitters tagged on the Drawings or specified to be of the indicating type shall contain a local indicator with a minimum four digit LCD type display, scaled to read in engineering units of flow.

Magnetic flowmeter systems shall provide zero flow stability by means of automatic zero adjustment of a DC excited metering circuit. Converters shall be capable of bi-directional flow measurement. Signal converters shall be of the same brand as the magnetic flowmeters.

The signal converter shall have a manually reset totalizer on the face of the enclosure.

The signal converter shall be diagnosed and recalibrated with the use of a hand-held communicator/calibrator device. One device shall be furnished for all converters provided by a single manufacturer.

PART 3 - EXECUTION

3-1. FIELD SERVICES. Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in the Instrumentation and Control System section.

Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. The System Supplier shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

End of Section

Section 13563

PRESSURE INSTRUMENTS

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of pressure gauges and accessories required as indicated on the Drawings.

Equipment and services provided under this section shall be subject to the Instrumentation and Control System section. This section shall be used and referenced only in conjunction with the Instrumentation and Control System section. Supplementing the Instrumentation and Control System section, instrument data, special requirements, and options are indicated on the Drawings.

1-2. DESIGN CRITERIA. Each device shall be a pre-assembled, packaged unit. Upon delivery to the work site, each device or system shall be ready for installation with only minor piping and electrical connections required by Contractor.

Where possible, each instrument shall be factory calibrated to the calibration ranges indicated in the Drawings.

1-3. SUBMITTALS. Submittals shall be made as specified in the Instrumentation and Control System section.

1-4. SHIPMENT, PROTECTION, AND STORAGE. Equipment provided under this section shall be shipped, protected, and stored in accordance with the requirements of the Instrumentation and Control System section. Identification of packaging shall be as described in the Instrumentation and Control System section.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs provide minimum device stipulations. The Drawings shall be used to determine any additional instrument options, requirements, or service conditions.

2-2. PRESSURE

2-2.01. Field-Mount Pressure Gauges. Pressure gauges shall be of the indicating dial type, with C-type phosphor bronze Bourdon tube; stainless steel rotary geared movement; phenolic or polypropylene open front turret case; adjustable pointer; stainless steel, phenolic, or polypropylene ring; and acrylic plastic or shatterproof glass window.

Gauge dial shall be 4-1/2 inch size, with white background and black markings. The units of measurement shall be indicated on the dial face. Subdivisions of the scale shall conform to the requirements of the governing standard. Pointer travel shall be not less than 200 degrees or more than 270 degrees of arc.

All stem-mounted gauges shall be provided with 1/2 inch NPT connections. Stem mounted gauges shall have an adjustable viewing angle to allow the gauge to be positioned for optimum viewing.

All pressure gauges shall measure in psi and all vacuum gauges in inches water. All gauges shall have a suitable range to give mid-scale readings under normal conditions. Gauge accuracy shall meet ASME B40.1 Grade 2A accuracy .

Where indicated on the Drawings, an annular diaphragm seal shall be provided for the respective gauge.

Gauges shall be installed at the locations indicated on the Drawings, with installation conforming to the installation detail. All gauges, snubbers, and diaphragm seals shall be installed in the vertical, upright position. Thread sealer, suitable for use with the associated process, shall be used in the assembly of threaded connections. All connections shall be free from leaks. Lines shall be purged of trapped air at gauge locations prior to installation of the gauge or diaphragm seal. Pressure gauges shall be ranged 0-50 PSI for both the WAS pumps and the RAS pumps.

Unless otherwise indicated, mounting and installation hardware shall be Type 316L stainless steel.

Pressure gauges shall be Ashcroft "1279 Duragauge", or equal.

PART 3 - EXECUTION

3-1. FIELD SERVICES. Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in the Instrumentation and Control System section.

Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. System Supplier shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

End of Section

Section 15010

VALVE INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of new valves and actuators purchased by Contractor as part of this Work.

Cleaning, disinfection, pressure and leakage testing, insulation, and pipe supports are covered in other sections.

The following specification sections are applicable to valves to be installed:

Title
Check Valves
Eccentric Plug Valves
Knife Gate Valves

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer1-2.01.

Coordination. When manufacturer's field services or installation check services are provided by the valve manufacturer, Contractor shall coordinate the services with the valve manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services.

Flanged, push-on, and grooved connections to valves including the bolts, nuts, and gaskets are covered in the appropriate pipe specification section. Valve ends shall match piping.

PART 2 - PRODUCTS - Not Applicable.

PART 3 - EXECUTION

3-1. INSPECTION. All valves and accessories shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and re-cleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3-2. INSTALLATION.

3-2.01. General. Valves shall be installed with sufficient clearance for proper operation of any external mechanisms, and with sufficient clearance to dismantle the valve for in-place maintenance. Installation shall be in accordance with the valve manufacturer's recommendations.

Unless otherwise indicated on the Drawings or specified, all valves installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the finish floor shall be installed with their operating stems vertical. Valves installed in horizontal runs of piping having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the finish floor shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems and operating handwheel shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems oriented to facilitate the most practicable operation, as reviewed by Engineer.

3-2.02. Installation Checks. When specified in the valve sections, the valve manufacturer will provide installation checks. For installation checks, the manufacturer's field representative will inspect the valve installation immediately following installation by Contractor. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to Owner.

3-2.03. AWWA Butterfly Valves. Not used

3-2.04. Check Valves.

3-2.04.01. Swing and Wafer Check Valves. Install valves oriented for the correct flow direction. Only valves designed for vertical installation shall be installed in vertical piping.

3-2.05. Plug Valves.

3 Eccentric Plug Valves. Eccentric plug valves shall be installed with the shaft horizontal and the plug in the upper half of the valve body. Valves in horizontal wastewater, sludge, or scum lines shall be installed with the seat on the upstream end. Valves in all vertical piping shall be installed with the seat at the upper end of the valve.

3-2.06. Resilient Seated Gate Valves. Valves shall be handled and installed in accordance with the recommendations set forth in the Appendices to ANSI/AWWA C509 and C515 and with the recommendations of the manufacturer.

3-3. VALVE ACTUATORS. Valve actuators and accessories shall be factory mounted on the valve, calibrated, and tested by the valve or actuator manufacturer.

3-4. FIELD QUALITY CONTROL.

3.4.01. Field Testing. After installation, all valves shall be tested in accordance with the Pipeline Pressure and Leakage Testing section.

3-4.01.01. Pressure Tests. Pressure testing shall be in accordance with the Pipeline Pressure and Leakage Testing section.

3-4.01.02. Leakage Tests. All valves shall be free from leaks. Each leak that is discovered within the functional acceptance test stipulated in the Commissioning section shall be repaired by and at the expense of Contractor. This requirement applies whether pressure testing is required or not.

End of Section

Section 15020
MISCELLANEOUS PIPING AND ACCESSORIES INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of piping and accessories as indicated on the Drawings for the following piping sections:

Section Title
Ductile Iron Pipe and Accessories

Contractor shall furnish all necessary jointing materials, coatings, and accessories that are specified herein.

Pipe supports and anchors shall be furnished by Contractor, and are covered in the Pipe Supports section.

1-2. GENERAL.

1-2.01. Coordination. Materials installed under this section shall be installed in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the manufacturer, unless exceptions are noted by Engineer.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete specifications, data, and catalog cuts or drawings shall be submitted in accordance with the Submittals Procedures section. Items requiring submittals shall include, but not be limited to, the following:

Watertight pipe sleeves.

Materials as specified herein.

1-3.02. Welder Certification. Not Used.

1-3.03. Spool Drawings. Spool drawings indicating the complete line, showing all welded and assembly items, except for insulation shoes or nonstress-relieved lines, shall be developed and submitted for the following services:

RAS Piping

WAS Piping

1-4. QUALITY ASSURANCE.

1-4.01. Welding and Brazing Qualifications. Not Used.

1-4.02. Tolerances. These tolerances apply to in-line items and connections for other lines.

The general dimension, such as face-to-face, face or end-to-end, face- or end-to center, and center-to-center shall be 1/8 inch.

The inclination of flange face from true in any direction shall not exceed 3/64 inch per foot.

Rotation of flange bolt holes shall not exceed 1/16 inch.

1-5. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

Plastic pipe, tubing, and fittings shall be stored between 40°F and 90°F.

1 Coated Pipe. Handling methods and equipment used shall prevent damage to the protective coating and shall include the use of end hooks, padded calipers, and nylon or similar fabric slings with spreader bars. Bare cables, chains, or metal bars shall not be used. Coated pipe shall be stored off the ground on wide, padded skids. Plastic-coated pipe shall be covered or otherwise protected from exposure to sunlight.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. Pipe, tubing, and fittings covered herein shall be installed in the services indicated in the various pipe sections.

2-2. MATERIALS.

Threaded Fittings

Anti-Seize Thread Lubricant	Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Never-Seez "Pure Nickel Special", or Permatex "Nickel Anti-Seize".
Teflon Thread Sealer	Paste type; Hercules "Real-tuff", John Crane "JC-30", or Permatex "Thread Sealant with Teflon".

Teflon Thread Tape	Hercules "Tape Dope" or John Crane "Thread-Tape".
Solvent Welded Fittings	
Solvent cement for PVC Systems	ASTM D2564.
Solvent cement for CPVC Systems	ASTM F493.
Sodium Hypochlorite, Sodium Hydroxide, and Sodium Bisulfite Service	IPS Corporation "Weld-On 724"
Primer for PVC Systems	ASTM F656.
Solder or Brazed Fittings	
Solder	Solid wire, ASTM B32, ANSI/NSF 61 certified, Alloy Grade Sb5, (95-5).
Soldering Flux	Paste type, ASTM B813.
Brazing Filler Metal	AWS A5.8, BCuP-5; Engelhard "Silvaloy 15", Goldsmith "GB-15", or Handy & Harman "Sil-Fos".
Brazing Flux	Paste type, Fed Spec O-F-499, Type B.
Insulating Fittings	
Threaded	Dielectric steel pipe nipple, ASTM A53, Schedule 40, polypropylene lined, zinc plated; Perfection Corp. "Clearflow Fittings".
Flanged	Epco "Dielectric Flange Unions" or Central Plastics "Insulating Flange Unions".
Watertight/Dusttight Pipe Sleeves	O-Z Electrical Manufacturing "Thruwall" and "Floor Seals", or Thunderline "Link-Seals"; with modular rubber sealing elements, nonmetallic pressure plates, and galvanized bolts.

Pipe Sleeve Sealant	Polysulfide or urethane, as specified in the Caulking section or as indicated on the Drawings.
Field Protective Coatings	

PART 3 - EXECUTION

3-1. INSPECTION. All piping components shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and recleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3-2. PREPARATION.

3-2.01. Field Measurement. Pipe shall be cut to measurements taken at the site, not from the Drawings. All necessary provisions shall be made in laying out piping to allow for expansion and contraction. Piping shall not obstruct openings or passageways. Pipes shall be held free of contact with building construction to avoid transmission of noise resulting from expansion.

3-3. INSTALLATION.

3-3.01. General. All instruments and specialty items shall be installed according to the manufacturer's instructions and with sufficient clearance and access for ease of operation and maintenance.

Flat faced wrenches and vises shall be used for copper tubing systems. Pipe wrenches and vises with toothed jaws will damage copper materials and shall not be used. Bends in soft temper tubing shall be shaped with bending tools.

3-3.02. Pipe Sleeves. Piping passing through concrete or masonry shall be installed through sleeves that have been installed before the concrete is placed or when masonry is laid. Pipe sleeves installed through floors with a special finish, such as ceramic or vinyl composition tile, shall be flush with the finished floor surface and shall be provided with nickel or chromium plated floor plates. Unless otherwise indicated on the Drawings, in all other locations where pipes pass through floors, pipe sleeves shall project not less than 1 inch nor more than 2 inches above the floor surface, with the projections uniform within each area. In the case of insulated pipes, the insulation shall extend through pipe sleeves. Where the Drawings indicate future installation of pipe, sleeves fitted with suitable plastic caps or plugs shall be provided.

Holes drilled with a suitable rotary drill will be considered instead of sleeves for piping which passes through interior walls and through floors with a special finish.

Unless otherwise indicated on the Drawings, all pipes passing through walls or slabs which have one side in contact with earth or exposed to the weather shall be sealed watertight with special rubber-gasketed sleeve and joint assemblies, or with sleeves and modular rubber sealing elements.

3-3.03. Pipe Joints. Pipe joints shall be carefully and neatly made in accordance with the indicated requirements.

3-3.03.01. Threaded. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs. Unless otherwise indicated, threaded joints shall be made up with teflon thread tape, thread sealer, or a suitable joint compound.

Threaded joints in plastic piping shall be made up with teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with teflon thread sealer and teflon thread tape applied to all male threads. Threaded joints in steel piping for chlorine service shall be made up with teflon thread tape or litharge and glycerine paste applied to all male threads.]

3-3.03.02. Compression. Not Used.

3-3.03.03. Flared. Ends of annealed copper tubing shall be cut square, and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as needed to produce leaktight connections.

3-3.03.04. Soldered and Brazed. Not Used.

3-3.03.05. Solvent Welded. Not Used.

3-3.03.06. Epoxy and Adhesive Bonded.Epoxy and adhesive bonded joints shall only be used for FRP pipe. All joint preparation, cutting, and jointing procedures shall comply with the pipe manufacturer's recommendations. Adhesive shall be mixed and applied in accordance with the manufacturer's recommendations. After joining, either the pipe or the fitting shall be rotated approximately one-half turn to uniformly distribute adhesive. A slight fillet of adhesive at the bond line is desirable, but all excess adhesive shall be wiped off immediately. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the curing period recommended by the manufacturer.

3-3.03.07. Heat Fusion Bonded. Heat fusion bonded joints shall be used for polyethylene pipe with socket and butt fusion fittings. All joint preparation, cutting, jointing equipment, and jointing procedures shall comply with the pipe ma

nufacturer's recommendations. The heating time, temperature, pressure applied to the joint during bonding, and cooling time shall consistently produce leaktight joints as strong as the pipe being joined.

3-3.03.08. Flanged. Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but shall not be torqued less than the minimum value required by the gasket manufacturer. Flange bolts shall not be so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly.

Flange bolt holes shall be oriented as follows, unless otherwise indicated on the spool drawings:

Vertical flange face:	Bolt holes to straddle the vertical centerlines.
Horizontal flange face:	Bolt holes shall be aligned with connecting pipe.

Pipe sealants, thread compounds, or other coatings shall not be applied to flange gaskets unless recommended by the gasket manufacturer for the specified service and approved by Engineer.

Welds at orifice flanges shall have internal surfaces ground smooth to the pipe wall.

Slip-on flanges shall be welded inside and outside. There shall be a distance of approximately 1/16 to 1/8 inch between the edge of the fillet weld and the face of the flange. The seal weld shall be applied so that the flange face shall be free of weld spatter and does not require refacing.

Flat-faced flanges shall be used when mating to Class 125 flanges. Full-face gaskets shall be used with flat-faced flanges and ring gaskets shall be used with raised faced flanges.

Weld neck flanges shall be used with butt-weld fittings. The bore of weld neck flanges shall match the pipe wall thickness.

Insulating joints connecting submerged (buried) piping to exposed piping shall be installed above the maximum water surface elevation and before the first pipe support not having coated anchor bolts or adhesive-bonded concrete anchors. All submerged (buried) metallic piping shall be isolated from the concrete reinforcement. Insulating flanges shall be tested for electrical isolation after installation and bolt-up but prior to introduction of conducting fluid.

3-3.03.09. Welded. Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.

Weld cross-sections shall be equal to or greater than the pipe wall thickness. Welds shall be smooth and continuous and shall have interior projections no greater than 1/16 inch [1.5 mm]. Backing strips or rings shall not be used except with specific prior review by Engineer as to use, material, and design. Root gap inserts that are completely melted and consumed in the weld bead are acceptable only when reviewed in advance by Engineer.

Stainless steel welding shall be inert gas tungsten arc (TIG) or the direct current, straight polarity, inert gas metal arc process (MIG).

Carbon steel welding shall be made by the shielded metal arc process.

For socket weld joints, fully engage the two pipe ends, then separate them by 1/16 inch prior to welding to all space for shrinkage.

3-3.03.10. Grooved Couplings. Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions, as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

3-3.03.11. Push-on. Gasket installation and other jointing procedures shall be in accordance with the recommendations of the manufacturer. Each spigot end shall be suitably beveled to facilitate assembly. All joint surfaces shall be lubricated with a heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean.

3-3.03.12. Rubber-Gasketed. Rubber joints for hub and spigot type cast iron soil pipe shall have plain spigot ends, without beads. Cut ends of all pipe shall be cut square, beveled, and all burrs shall be removed. Spigot ends shall be coated with a lubricant recommended by the gasket manufacturer and fully seated in the gasket. Clamps for hubless cast iron soil pipe shall be installed in accordance with the manufacturer's recommendations.

3-3.03.13. Other Pipe Joints. Coupled joints in tempered glass pipe, plastic joints in vitrified clay pipe, and other proprietary type joints shall be made in accordance with the manufacturer's recommendations and to the satisfaction of Engineer.

3-3.04. Pipe. Pipe shall be installed as specified, as indicated on the Drawings, or, in the absence of detail piping arrangement, in a manner acceptable to Engineer.

Piping shall be installed without springing or forcing the pipe in a manner which would induce stresses in the pipe, valves, or connecting equipment.

Piping shall be supported in conformance with the Pipe Supports section.

Piping shall be connected to equipment by flanges or unions as specified in the various piping sections. Piping connecting to equipment shall be supported by a pipe support and not by the equipment.

A union shall be provided within 2 feet of each threaded-end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping adjacent to devices or equipment which may require removal in the future and where required by the Drawings or the Specifications.

Water supply piping within structures shall be arranged, and facilities provided, for complete drainage. All piping serving metering equipment shall be uniformly graded so that air traps are eliminated and complete venting is provided.

Stuffing box leakage from water sealed pumps shall be piped to the nearest point of drainage collection.

Taps for pressure gauge connections on the suction and discharge of pumping units shall be provided with a nipple and a ball type shutoff valve.

Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.
In all piping, insulating fittings shall be provided to prevent contact of dissimilar metals, including but not limited to, contact of copper, brass, or bronze pipe, tubing, fittings, valves, or appurtenances, or stainless steel pipe, tubing, fittings, valves, or appurtenances with iron or steel pipe, fittings, valves, or appurtenances. Insulating fittings shall also be provided to prevent contact of copper, brass, or bronze pipe, tubing, fittings, valves or appurtenances with stainless steel pipe, tubing, fittings, valves, or appurtenances.

Branch connections in horizontal runs of steam, air, and gas piping shall be made from the top of the pipe.

Polyethylene piping shall be installed in accordance with the manufacturer's recommendations. A continuous 12 AWG THHN insulated copper tracer wire shall be placed 6 inches above all portions of the buried pipe, but no more than 18 inches below the ground surface. Where the pipe extends above grade, a 2 foot length of wire shall be coiled and attached to the pipe.
Piping adjacent to flow sensors shall be installed in accordance with the requirements of the manufacturer of the flow sensor and commonly accepted design practices of the appropriate straight pipe runs both upstream and downstream.

Drains required for operation are shown on the Drawings. However, vents at all high points and drains at all low points in the piping that are required for complete draining for pressure test may not be shown on these Drawings. Contractor shall add such items as found to be necessary during detail piping design and/or piping installation.

3-3.05. Reducers. Eccentric reducers shall be installed flat on the bottom for steam, condensate return and digester gas services.

3-3.06. Valves. Isolation valves provided with equipment and instruments shall be located in a manner which will allow ease of access and removal of the items to be isolated. Prior to soldering or brazing valves, teflon and elastomer seats and seals shall be removed to prevent damage.

3-4. PIPING ASSEMBLY.

3-4.01. General. Contractor shall only use labor that has been qualified by training and experience to capably perform the specified activities required to accomplish the work in a satisfactory manner

Any deviations from the Specifications or piping locations shown on the Drawings require prior review and approval by Engineer.

3-5. PROTECTIVE COATING.

Ductile Iron pipe field coatings shall be according to section 09940 – Protective Coatings.

Standard weight steel pipe in buried locations will have exterior surfaces protected with a shop applied plastic coating.

Where specified in the Miscellaneous Steel Pipe, Tubing, and Accessories section, extra strong steel pipe in buried locations will have exterior surfaces protected with a shop applied plastic coating or a shop applied tape wrap. Where not specified to be shop coated or wrapped in the Miscellaneous Steel Pipe, Tubing and Accessories section, a tape wrap shall be field applied. The exterior surfaces of all fittings, couplings, specials, and other portions of buried piping not protected with plastic coating shall be tape-wrapped in the field.

All surfaces to be tape-wrapped shall be thoroughly cleaned and primed in accordance with the tape manufacturer's recommendations immediately before wrapping. The tape shall be applied by two-ply (half-lap) wrapping or as needed to provide a total installed tape thickness of at least 60 mils [1.5 mm]. Joints in plastic-coated pipe shall be cleaned, primed, and tape-wrapped after installation.

Joints in galvanized steel piping in underground locations shall be field painted with two coats of coal tar epoxy coating.

3-5.01. Inspection. All shop-applied plastic coatings and tape wrap on pipe or fittings shall be inspected for holidays and other defects after receipt of the pipe or fitting on the job and immediately before installation. All field-applied tape wrap on pipe, joints, fittings, and valves shall be inspected for holidays and other defects following completion of wrapping. Inspection of plastic coatings after installation of the pipe or fitting in the trench shall be made where, in the opinion of Engineer, the coating may have been damaged during installation. Holidays and defects disclosed by inspection shall be repaired in accordance with the recommendations of the coating or tape wrap manufacturer, as applicable.

The inspection shall be made using an electrical holiday detector. The detector and inspection procedures shall conform to the requirements of Section 4.4 of ANSI/AWWA C209.

3-6. PRESSURE AND LEAKAGE TESTING. All specified tests shall be made by and at the expense of Contractor in the presence, and to the satisfaction of Engineer. Each piping system shall be tested for at least 1 hour with no loss of pressure. The Contractor shall coordinate this section with the Pipeline Pressure and Leakage Testing section. Ductile iron pipe shall be tested as indicated in the Ductile Iron Specification Section.

Leakage may be determined by loss-of-pressure, soap solution, chemical indicator, unless specified otherwise in other sections, or by other positive and accurate method acceptable to Engineer. All fixtures, devices, or accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected and the ends of the branch lines plugged or capped as needed during the testing.

Unless otherwise required by the applicable codes, drainage and venting systems shall be water tested. For water testing, the drainage and venting system shall be filled with water to the level of the highest vent stack. For air testing, the system shall be charged with air to a minimum pressure of 5 psig. Openings shall be plugged as necessary for either type of test. To be considered free of leaks, the system shall hold the water or air for 30 minutes without any drop in the water level or air pressure.

All necessary testing equipment and materials, including tools, appliances and devices, shall be furnished and all tests shall be made by and at the expense of Contractor. Contractor shall give Engineer 5 working days advanced notice of scheduled testing.

All joints in piping shall be tight and free of leaks. All joints which are found to leak, by observation or during any specified test, shall be repaired, and the tests repeated.

3-6.01. Air Pressure Tests. Not Used

3-7. CLEANING. The interior of all pipe, valves, and fittings shall be smooth, clean, and free of blisters, loose mill scale, sand, dirt, and other foreign matter when installed. Before being placed in service, the interior of all lines shall be thoroughly cleaned, to the satisfaction of Engineer.

Metal anhydrous ammonia, chlorine and sulfur dioxide piping shall be cleaned as recommended by the gas chemical feed system supplier. All surfaces which may come into contact with gas chemical shall be thoroughly dry and free of oil or grease before being placed in service. The recommended cleaning procedures shall be submitted for review in accordance with the Submittals section.

Tin-lined copper tubing for distribution of distilled water shall be flushed and cleaned with distilled water in accordance with the tubing manufacturer's recommendations.

3-8. ACCEPTANCE. Owner reserves the right to have any section of the piping system which he suspects may be faulty cut out of the system by Contractor for inspection and testing. Should the joint prove to be sound, Owner will reimburse Contractor on a time-and-material basis as specified in the Contract. Should the joint prove to be faulty, the destructive test will continue joint by joint in all directions until sound joints are found. Costs for replacement of faulty work and/or materials shall be the responsibility of Contractor.

End of Section

Section 15060

MISCELLANEOUS PIPING AND PIPE ACCESSORIES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of miscellaneous piping and pipe accessories. Miscellaneous piping shall be furnished complete with all fittings, flanges, unions, and other accessories specified herein.

1-2. SUBMITTALS.

1-2.01. Drawings and Data. Complete specifications, data and catalog cuts or drawings shall be submitted in accordance with the Submittals Procedures section. Submittals are required for all piping, fittings, gaskets, sleeves, and accessories, and shall include the following data:

Name of Manufacturer
Type and model
Construction materials, thickness, and finishes
Pressure and temperature ratings

Contractor shall obtain and submit a written statement from the gasket material manufacturer certifying that the gasket materials are compatible with the joints specified herein and are recommended for the specified field test pressures and service conditions.

1-3. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section. All materials shall be stored in a sheltered location above the ground, separated by type, and shall be supported to prevent sagging or bending.

PART 2 - PRODUCTS

2-1. MATERIALS. Miscellaneous piping materials shall be as specified herein.

2-1.01. Material Classification BR-1.

BR – Regular Weight Brass Pipe Gauge piping for hot/cold water. Gauge piping for seal water. Gauge piping for compressed air. Air release valve piping	Pipe Fittings	ASTM B43, red brass, seamless, regular weight. ANSI/ASME B16.15, Class 125.

2-1.02. Material Classification BR-2. Not used.

2-1.03. Material Classification HS-1. Not used.

2-1.04. Material Classification HS-2. Not used.

2-1.05. Material Classification TG-1. Not used.

2-1.06. Material Classification CRP-1. Not used.

2-1.07. Accessories. Accessories for the miscellaneous piping systems shall be as indicated.

Unions for brass pipe Fed Spec A-A-59617, Class 125.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section will be installed in accordance with the Miscellaneous Piping and Accessories Installation section.

End of Section

Section 15061

DUCTILE IRON PIPE

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of ductile iron pipe. Ductile iron pipe shall be furnished complete with all fittings, specials, adapters, closure pieces, blowoffs, outlets, caps and plugs, temporary bulkheads, access manholes, jointing materials, pipe hangers and supports, anchors, blocking, encasement, appurtenances, and accessories specified and indicated on the Drawings, and as required for proper installation and functioning of the piping.

The size, service, and locations of ductile iron pipelines are covered in the Ductile Iron Pipe Schedule.

Pipe hangers and supports, pressure and leakage testing, and cleaning and disinfection are covered in other sections.

1-2. GOVERNING STANDARDS. Except as modified or supplemented herein, all ductile iron pipe, fittings, and specials shall conform to the applicable requirements of the following standards and other standards named in this section:

ANSI/AWWA Standards	Title
C151	Ductile-Iron Pipe, Centrifugally Cast, For Water
C600	Installation of Ductile Iron Water Mains and Their Appurtenances
M41	Ductile Iron Pipe and Fittings - Manual of Water Supply Practices
C104	Cement Mortar Lining for Ductile Iron Pipe and Fittings
C105	Polyethylene Encasement for Ductile Iron Pipe Systems
C110	Ductile-Iron and Gray-Iron Fittings
C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C115	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
C153	Ductile-Iron Compact Fittings

1-3. PIPE MANUFACTURER AND FIELD SERVICES. All ductile iron pipe, fittings, specials, bolts, gaskets, other jointing materials, and appurtenances shall be fabricated, lined, coated, and furnished under the direction and management of one pipe manufacturer. The pipe manufacturer responsibilities, which shall include, at a minimum; coordinating and furnishing all pipe materials, gaskets, bolts, and other jointing materials, and pipe appurtenances (except for furnished coupled joints and other similar products by a specified manufacturer) for a complete piping system that meets the specified test pressures and service conditions; ensuring and certifying that all pipe, fittings, specials, and other pipe materials, pipe gaskets and bolts specified herein, are being manufactured in full accordance with the Contract Documents; preparing and submitting all submittal information and shop drawings; and making any corrections that may be required to submittal information and shop drawings.

The pipe manufacturer's minimum required experience qualifications shall include manufacture of interior plant piping of similar diameters of at least two water or wastewater plants with joints, linings, and coatings suitable for the same or higher pressure rating, of a diameter equal to or larger than the pipe to be provided, with joints, lining, and coating suitable for the same or higher pressure rating, which has performed satisfactorily for the past 5 years.

All ductile iron pipe shall be installed in accordance with the pipe manufacturer's recommendations.

1-4. SUBMITTALS. Drawings, details, specifications, and installation schedules covering all ductile iron pipe and accessories shall be submitted in accordance with the Submittals Procedures section. The drawings and data shall include, but shall not be limited to, the following:

Certification by manufacturer (affidavit of compliance) for each item furnished in accordance with the ANSI/AWWA Standards.

Restrained joints details.

Certification of gaskets by pipe manufacturer, certifying that gasket material is suitable for test pressures and services intended.

Certification of joint lubricant.

Certification of proof-of-design tests for joints, including restrained joints.

Certification of proof-of-design tests for welded-on outlets and experience documentation. Air test documentation for the welded-on outlets used for this project.

The method that the Contractor proposes to use for measuring deflection of pipe joints.

Submittal data shall clearly indicate the country of origin of pipe, fittings, flanges, restraining devices, and accessories. Certified copies of physical and chemical test results as outlined in ANSI/AWWA C151/A21.51 shall be submitted for the materials to be provided.

1-4.01. Emergency Repair Manual. Contractor shall submit an emergency repair manual prepared and furnished by the pipe manufacturer. The manual shall include procedures for handling emergency calls and repairs; a list of stock replacement pipe sections, closures, and other parts needed for emergency repairs; names and emergency telephone numbers of pipe manufacturer's engineering staff and factory-trained field service representatives who can be contacted day or night during an emergency; response and delivery times; and installation instructions for the materials and methods used in making repairs.

1-5. SPARE MATERIALS. (Not Used)

1-6. SHIPPING, HANDLING, AND STORAGE. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section, and as specified herein.

Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in handling and installing pipe and fittings shall not damage the pipe and fittings. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces. Unpadded hooks, wire brushes or other abrasive tools shall not be permitted to come into contact with polyethylene lining if such lining is specified.

Contractor-furnished pipe and fittings in which the lining has been damaged shall be replaced by and at the expense of Contractor. With the concurrence of Engineer, small and readily accessible damaged areas may be repaired.

Contractor shall repair any damage to pipe coatings and linings before the pipe is installed.

PART 2 - PRODUCTS

2-1. PIPE CLASS. The class of ductile iron pipe shall be as indicated in the following tablefor those services indicated in the Pipeline Schedule section. The specified class includes service allowance and casting allowance.

Pipe Size	ANSI/AWWA Pressure Class
inches	
64 thru 30	250
20 thru 14	250
12 and smaller	350

Pipe wall thickness for grooved and threaded end pipe shall be increased if necessary to comply with the following minimum thickness:

Pipe Size	Minimum Thickness Class	
inches	Threaded Ends (1)	Grooved Ends (2)
4-16	53	53
18	53	54
30-54	53	--

(1) Complies with ANSI/AWWA C115/A21.15 for minimum pipe wall thickness for threaded flanges.

(2) Complies with ANSI/AWWA C606 for grooved and shouldered joint ductile iron pipe.

2-2. MATERIALS.

Pipe	Ductile iron, ANSI/AWWA C151/A21.51

Gaskets – All Joint Types	Synthetic rubber unless otherwise specified; natural rubber will not be acceptable. All gaskets shall be furnished by the pipe manufacturer unless another manufacturer's product is indicated. Pipe manufacturer shall submit certificates of gasket suitability certifying that the gasket materials are compatible with the joints specified, are recommended for the specified field test pressure and service conditions. Gas and oil-resistant gaskets shall be made of Nitrile (NBR [Acrylonitrile Butadiene]) rubber. The name of the material shall be permanently marked or molded on the gasket. Gaskets shall also be certified as suitable where soils may be contaminated with gas and oil products.
Joint Lubricant	Vegetable-based lubricant recommended by the pipe manufacturer. Petroleum or animal-based lubricants will not be acceptable.
Fittings	ANSI/AWWA C110/A21.10 (except shorter laying lengths will be acceptable for U.S. Pipe), or ANSI/AWWA C153/A21.53, minimum working pressure rating as follows, unless indicated otherwise on the Drawings.

Fitting Size in.	Material	Type	Min. Working Pressure Rating, psi
4 to 24	DI	Flanged joints	250
30 to 48	DI	All joints	250

All fittings shall be ductile iron and suitable for the rated working pressure plus a surge or test pressure allowance of 100 psi or 1.5 times rated working pressure, whichever is less, without leakage or damage.

Flanged Joints	ANSI/AWWA C115/A21.15.
Flanges	

	Class 250 (Where identified on the Drawings)	Ductile iron, flat faced, with ANSI/ASME B16.1, Class 250 diameter and drilling.
	All Others	Ductile iron, Class 125, ANSI/AWWA C115/A21.15.
Flanges		All flanges shall be suitable for test pressure of 1.5 times rated pressure without leakage or damage.
Bolts		ASTM A307, chamfered or rounded ends projecting 1/4 to 1/2 inch beyond outer face of nut.
Nuts		ASTM A563, hexagonal, ANSI/ASME B18.2.2, heavy semifinished pattern.
Gaskets		ASTM D1330, Grade I rubber, full face type, 1/8 inch thick unless otherwise required by pipe manufacturer and accepted by Engineer. Pipe manufacturer shall submit certification of gaskets furnished as indicated above under Gaskets - All Joint Types.
Grooved-End Joints		AWWA C606.
Pipe Ends (rigid joints)		Grooved, with dimensions conforming to AWWA C606, Table 3.
Couplings (non-shouldered pipe)		Tyco/Grinnell "Figure 772," or Victaulic "Style 31."
Couplings (shouldered pipe)		Victaulic "Style 41" or "Style 44".
Restrained Flange Adapters		
Restrained (4 inch through 12 inch). Unless otherwise indicated on the Drawings, flanged coupling adapters shall be restrained.		EBAA Iron “Series 2100 Megaflange” or Romac “Style RFCA”
Flanged Coupling Adapters		
Restrained (4 inch through 12 inch). Unless otherwise indicated on the Drawings, flanged coupling adapters shall be restrained.		Smith-Blair "Type 912" or Romac "Style FCA501", with anchor studs of sufficient size and number to withstand test pressures.
Unrestrained (14 inch and larger)		Smith-Blair "Type 913" or Romac "Style FC400".
Dismantling Joints		

	Restrained (3 inch and larger). Unless otherwise indicated on the Drawings, dismantling joints shall be restrained.	Romac "DJ400"; Dresser "Style 131 Dismantling Joint" or Viking Johnson. For use in potable water systems, coating to be in accordance with NSF-61.
	Glass Lining	Two-coat system applied over blast-cleaned surface; ground and finish coats separately fired; finished lining thickness at least 10 mils, Mohs' Hardness 5 to 6 density as determined by ASTM D792; U.S. PipeFast Fabricators, Inc. "MEH 32" or "SG-14", or C&B Piping "CBGL911".
	Field Protective Coating	Per specification section 09940.
Anti-Seize Thread Lubricant		Jet-Lube "Nikal", John Crane "Thred Gard Nickel", Bostik/Never-Seez "Pure Nickel Special" or Permatex "Nickel Anti-Seize".

2-3. OUTLETS.

2-4. JOINTS. Joints in buried and tunnel locations shall be mechanical or push-on type unless otherwise indicated on the Drawings or where required to connect to existing piping or to valves. Bells on wall castings and wall sleeves shall be mechanical joint type, with tapped holes for tie rods or stud bolts. All other joints shall be flanged unless otherwise indicated on the Drawings.

Certification of joint design shall be provided in accordance with ANSI/AWWA C111/A21.11, Performance Requirements, as modified herein. The joint test pressure shall be not less than 2 times the working pressure rating of the joint. The same certification and testing shall also be provided for restrained joints. For restrained joints, the piping shall not be blocked to prevent separation and the joint shall not leak or show evidence of failure. It is not necessary that such tests be made on pipe manufactured specifically for this project. Certified reports covering tests made on other pipe of the same size and design as specified herein and manufactured from materials of equivalent type and quality may be accepted as adequate proof of design. Any new proof-of-design testing to meet the requirements for this project shall be independently verified and the Owner shall be given the opportunity to witness the testing.

Unless otherwise indicated on the drawings or acceptable to the Engineer, field closure pieces shall be located away from the bends or dead ends beyond the length over which joints are to be restrained.

The length of pipe having restrained joints shall be as indicated on the drawings or specified. All vertical bends and eccentric reducers shall have restrained joints.

Where acceptable to Engineer, grooved couplings may be used instead of flanges, provided that rigid grooving is used to preclude longitudinal pipe movement and angular deflection at joints. Fittings, valves, and equipment installed using grooved couplings shall be adequately supported and blocked or restrained to prevent rotation.

2-4.01 Flanged Joints. Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

2-4.02. Flanged Coupling Adaptors. Flanged coupling adapters shall be provided for restrained couplings 12 inch and smaller where indicated on the Drawings and as specified herein. Unless indicated otherwise on the Drawings, all flange coupling adapters 12 inch and smaller shall be restrained. Flange coupling adapters 14 inch and larger may only be used in unrestrained pipe applications.

The inner and outer surfaces of couplings, except flange mating surfaces, shall be prepared for coating in accordance with instructions of the coating manufacturer and shall then be shop coated with liquid epoxy in accordance with ANSI/AWWA C210. The flange mating surfaces shall be cleaned and shop primed with universal primer.

2-4.03. Dismantling Joints. Dismantling joints shall be provided for restrained couplings 6 inch and larger piping where indicated on the Drawings and as specified herein. Dismantling joints shall comply with AWWA C219 and shall be restrained flange by flange couplings manufactured as a single unit. Unless otherwise indicated on the Drawings, dismantling joints shall be restrained.

The inner and outer surfaces of dismantling joints, except flange mating surfaces, shall be prepared for coating in accordance with instructions of the coating manufacturer and shall then be shop coated with liquid epoxy in accordance with ANSI/AWWA C210 and field coating shall be according to Protective Coatings Section. The flange mating surfaces shall be cleaned and shop primed with universal primer.]

2-4.04. Mechanical Couplings. The piping layout for mechanical couplings shall provide a space of at least 1/4 inch, but not more than 1 inch, between the pipe ends.

All surfaces, including the interior surfaces of the middle rings, shall be prepared for coating in accordance with instructions of the coating manufacturer and shall be shop coated with 16 mils liquid epoxy in accordance with ANSI/AWWA C210. Field coating shall be in accordance with the Protective Coatings Section.

A ductile iron pipe factory spacer shall be provided for the piping where indicated on the drawings. The spacer shall be shop lined and coated with 16 mils of liquid

epoxy. Piping surfaces within the coupling shall be shop coated with 16 mils of liquid epoxy.

Tie bolts shall be provided to restrain mechanical coupling connections where indicated on the Drawings. The connecting pipe shall be furnished with welded retainer rings as recommended by pipe manufacturer. The pipe manufacturer shall also coordinate the restrained connection with the pressure rating, length, and diameter dimensions of the mechanical coupling being furnished to assure proper clearance is provided for completing the restrained coupling installation.

2-4.05. Grooved-End Couplings. Grooved-end couplings shall not be used in the following applications: chemical service, except lime slurry piping, flammable liquid or flammable gas piping, compressed air or compressed gas piping operating at pressures above 25 psig, toxic gas piping, hot liquid with operating temperatures above 120°F, or steam piping.

2-5. REDUCERS. Reducers shall be eccentric or concentric as indicated on the Drawings. Reducers of eccentric pattern shall be installed with the straight side on top, so that no air traps are formed.

2-6. BLOWOFFS. Not used.

2-7. ACCESS OPENINGS. Not used

2-8. WALL AND FLOOR PIPES. Wall and floor pipes shall be installed where ductile iron pipes pass through concrete walls or floors, unless otherwise indicated on the Drawings.

Where a flange and mechanical joint pipe piece is to connect to a mechanical joint wall pipe or casting, the bolt holes in the bell of the wall pipe or casting shall straddle the top centerline of the horizontal pipe or casting and shall align with the bolt holes in the flange and mechanical joint piece. The top centerline shall be marked on the wall pipe or casting at the foundry or fabrication shop.

In vertical piping, the bolt holes of flanged and mechanical joint floor pipes or castings shall be aligned with the bolt holes of the flange or mechanical joint connecting piece. The required centerline alignment and orientation of the floor pipe or casting shall be marked on the floor pipe or casting at the foundry or fabrication shop.

2-9. WALL AND FLOOR SLEEVES. Not used.

2-10. SHOP COATING AND LINING. The interior of all pipe and fittings, unless noted otherwise, shall be glass lined.

Lining for pipe and fittings for wastewater facilities services shall be as specified below:

Service	Lining
All sludge piping	Glass.

Field coating shall be in accordance with the Protective Coating Section.

Glass-lined pipe buried or embedded in concrete shall be ductile iron with mechanical or push-on joints; glass-lined pipe installed in interior locations may be flanged ductile iron with flanged cast or ductile iron fittings. Where drilling or tapping of glass-lined pipe for 2-inch and smaller pipe connections is required, pre-manufactured welded on, threaded bosses shall be provided. Alternatively, the pipe manufacturer may pre-drill the pipe prior to installing glass lining and provide a tapping saddle.

The exterior surfaces of all pipe and fittings which will be exposed in both interior and exterior locations shall be shop primed. Flange faces shall be coated with a suitable rust-preventive compound. Exterior surfaces of all other pipe and fittings shall be coated with asphaltic coating.

PART 3 – EXECUTION

3-1. INSPECTION. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; pipe ends shall be examined with particular care. All defective pipe and fittings shall be removed from the site.

3-2. PROTECTION AND CLEANING. The interior of all pipe and fittings shall be thoroughly cleaned of all foreign material prior to installation and shall be kept clean until the work is completed. Before jointing, all joint contact surfaces shall be wire brushed if necessary and wiped clean.

Precautions shall be taken to prevent foreign material from entering the pipe during installation. Debris, tools, clothing, or other objects shall not be placed in or allowed to enter the pipe.

Whenever pipe laying is stopped, the open end of the pipe shall be closed to prevent entry of dirt, mud, rodents, and other material. All water in the trench shall be removed prior to removing the closure.

3-3. CUTTING PIPE. Cutting shall be done in a neat manner, without damage to the pipe or the lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the ends of the pipe shall be dressed with a file or a power grinder to remove all roughness and sharp edges. The cut ends of push-on joint pipe shall be suitably beveled.

All field cutting of existing gray cast iron pipe shall be done with mechanical pipe cutters, except where the use of mechanical cutters would be difficult or impracticable.

Ends of ductile iron pipe shall be cut with a portable guillotine saw, abrasive wheel, saw, milling cutter, or oxyacetylene torch. The use of hydraulic squeeze type cutters will not be acceptable. Field-cut holes for saddles shall be cut with mechanical cutters; oxyacetylene cutting will not be acceptable.

Contractor shall use factory prepared pipe ends unless a field cut is required for connections.

3-4. ALIGNMENT AND GRADE. Not used.

3-5. LAYING PIPE. Not used.

3-6. JOINTS.

Each joint, including restrained joints, shall be checked by Contractor as recommended by the pipe manufacturer to verify that the joint and the restraints are installed properly. Restrained joints shall be extended after they are assembled to minimize further take-up.

3-7. MECHANICAL JOINTS. Not used.

3-8. PUSH-ON JOINTS. Not Used.

3-9. FLANGED JOINTS. When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually in a crisscross pattern and at a uniform rate, to ensure uniform compression of the gasket around the entire flange. All flange joint bolting procedures shall be in accordance with the pipe manufacturer's recommendations.

Special care shall be taken when connecting piping to any pumping equipment to ensure that piping stresses are not transmitted to the pump flanges. All connecting piping shall be permanently supported to obtain accurate matching of bolt holes and uniform contact over the entire surface of flanges before any bolts are installed in the flanges.

Pump connection piping shall be free to move parallel to its longitudinal centerline while the bolts are being tightened. Each pump shall be leveled, aligned, and wedged into position which will fit the connecting piping, but shall

not be grouted until the initial fitting and alignment of the pipe, so that the pump may be shifted on its foundation if necessary to properly install the connecting piping. Each pump shall, however, be grouted before final bolting of the connecting piping.

After final alignment and bolting, the pump connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints. If any movement is observed, the piping shall be loosened and re-aligned as needed and then the flanges bolted back together. The flange bolts shall then be loosened and the process repeated until no movement is observed.

3-10. FLANGED COUPLING ADAPTERS. Flange coupling adapters shall be installed in accordance with the coupling manufacturer's recommendations. After the pipe is in place and bolted tight, the locations of holes for the anchor studs shall be determined and the pipe shall be field-drilled. Holes for anchor studs shall be drilled completely through the pipe wall. Hole diameter shall be not more than 1/8 inch larger than the diameter of the stud projection. Unless indicated on the Drawings, all flange coupling adapters shall be restrained.

3-11. DISMANTLING JOINTS. Dismantling joints shall be installed in accordance with the coupling manufacturer's recommendations.

3-12. MECHANICAL COUPLINGS. Mechanical couplings shall be installed in accordance with the coupling manufacturer's recommendations. A space of at least 1/4 inch, but not more than 1 inch, shall be left between the pipe ends. Pipe and coupling surfaces in contact with gaskets shall be clean and free from dirt and other foreign matter during assembly. All assembly bolts shall be uniformly tightened so that the coupling is free from leaks, and all parts of the coupling are square and symmetrical with the pipe. Following installation of the coupling, damaged areas of shop coatings on the pipe and coupling shall be repaired to the satisfaction of Engineer.

3-13. GROOVED-END JOINTS. Grooved joints with rigid type grooving shall be installed in accordance with the coupling manufacturer's recommendations. Completed joints shall be rigid and shall allow no angular deflection or longitudinal movement. Except for closure pieces, field grooving of pipe will not be acceptable.

3-14. GAS AND OIL-RESISTANT GASKETS. Not used.Not used.

3-15. CORROSION PROTECTION. Not used.

3-16. PROVISIONS FOR CATHODIC PROTECTION SYSTEMS. Not used.

3-17. CONNECTIONS WITH EXISTING PIPING. Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by Owner. Facilities shall be provided for proper dewatering and for disposal of all water removed from dewatered lines and excavations without damage to adjacent property.

Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing potable water piping. Trench water, mud, or other contaminating substances shall not be permitted to enter the lines. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then swabbed with, or dipped in, a 500 mg/L chlorine solution.

3-18. CONCRETE ENCASEMENT. Concrete encasement shall be installed where indicated on the Drawings. A pipe joint shall be provided within 12 inches [300 mm] of each end of the concrete encasement. Concrete and reinforcing steel shall be as specified in the Cast-in-Place Concrete section. All pipe to be encased shall be suitably supported and blocked in proper position, and shall be anchored to prevent flotation.

3-19. REACTION ANCHORAGE AND BLOCKING. Not used.

3-20. PRESSURE AND LEAKAGE TESTS.

After installation, pipe and fittings shall be subjected to a pressure test and a leakage test. The Contractor shall provide all necessary pumping equipment; piping connections between the piping and the nearest available source of test water; pressure gauges; and other equipment, materials, and facilities necessary for the tests. The minimum test pressure shall be 60 psi

All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed and replaced with new and acceptable materials, and the affected portion of the piping shall be retested by and at the expense of Contractor.

All joints shall be watertight and free from visible leaks. Any visible leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.

3-21. CLEANING AND DISINFECTION. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean of any foreign matter until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

End of Section

Schedule 15061

Ductile Iron Pipe Schedule

Size in.	Location and Service	ANSI/AWWA Class	Lining Material
4	Pump Room, WAS	350	GLDIP
6	Pump Room, WAS	350	GLDIP
12	Pump Room, RAS	250	GLDIP
18	Pump Room, RAS	250	GLDIP
24	Pump Room, RAS	250	GLDIP

End of Document

Section 15093

CHECK VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of check valves as specified herein and as shown on the Drawings.

Piping, pipe supports, insulation, and accessories that are not an integral part of the valves or are not specified herein are covered in other sections.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Temporary Number Plates. Not used.

1-2.03. Identification. Valves specified herein shall be tagged in accordance with the Equipment and Valve Identification section.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the Submittals Procedures section. Included in the submittal shall be drawings by the valve manufacturer to indicate the position of the valve actuator and valve shaft.

PART 2 – PRODUCTS

2-1. CONSTRUCTION.

2-1.01. Valves VC-1. Not used.

2-1.02. Valves VC-2. For replacement of existing wafer check valves, where installation is feasible based on available laying length and pending Engineer's approval. This type of valve shall be provided at not extra cost to Owner.

VC Water, sludge, liquid service, or sump pump discharge Threaded ends 2 inch [25 mm] or smaller pipe	Rating Code Type Body/Bonnet Trim Seat Disc Hinge Pins End Connection Temp. Limitations Manufacturers	Class 125 AWWA C508 Horizontal swing, threaded bonnet ASTM B62 bronze Bronze, regrinding Bronze Manufacturer's standard Threaded -20 to 212°F [-29 to 100°C] Stockham "B-321", Walworth "Fig 3406"

2-1.03. Valves VC-3. Not used.

2-1.04. Valves VC-4. Not used.

2-1.05. Valves VC-5. Not used.

2-1.06. Valves VC-6. Not used.

2-1.07. Valves VC-7. Not used.

2-1.08. Valves VC-8. Not used.

VC	Rating	Class 125
	Type	Single disc wafer
Low pressure clear water service	Body	ASTM A126, Class B, cast iron
	Trim	
	Seat Ring	Buna-N
	Disc	ASTM B148 Alloy 952, aluminum bronze
3 through 12 inch pipe	Springs/Hinge Pins/Stops	Stainless steel
	Bearings	Teflon
	End Connection	Plain, installed between ASME B16.1, Class 125, flat faced flanges
	Temp. Limitations	-20 to 225°F intermittent, 0 to 180°F continuous
	Manufacturers	"TITAN CV31-DI" "DeZurik/Hilton H-920" "TECHNO"

2-1.09. Valves VC-9. Not used.

2-1.10. Valves VC-10. For replacement of existing wafer check valves, where installation is feasible based on available laying length and pending Engineer's approval. This type of valve shall be provided at not extra cost to Owner.

VC -10	Rating	Class 125
	Code	AWWA C508
Wastewater pump discharge service	Type	Horizontal swing, bolted bonnet
	Body	ASTM A126 Class B cast iron
	Trim	
	Seat Ring	ASTM B763 Alloy 84400 bronze
	Disc	ASTM A126 Class B cast iron
6 inch and larger pipe	Hinge Pins	Stainless steel
	Bearings	Bronze bushings
	Cover Gasket	Manufacturer's standard
	End Connection	Flanged, ASME B16.1, Class 125, flat faced
	Temp. Limitations	-20 to 212°F
	Valve Operator	External spring or weighted lever
	Manufacturers	American Flow Control "52 SC", M&H "Style 259-02", Mueller "A2600-6-01 or 6-02"

2-1.11. Valves VC-11.

VC	Rating	Class 125
	Type	Single disc wafer
Low pressure clear water service	Body	ASTM A126, Class B, cast iron or ductile iron
	Trim	
	Seat Ring	Buna-N
14 inch and larger pipe	Disc	ASTM B148 Alloy 952, aluminum bronze
	Springs/Hinge Pins/Stops	Stainless steel
	Bearings	Teflon
	End Connection	Plain, installed between ASME B16.1, Class 125, flat faced flanges
	Temp. Limitations	--20 to 225°F intermittent, 0 to 180°F continuous
	Manufacturers	Marlin “Wafer Check 125HZNSF”, “Duo-Chek II Figure 12HMP”, Apco Valve and Primer “9000AR1F”

2-1.12. Valves VC-12. Not used.

2-1.13. Valves VC-13. Not used.

2-1.14. Valves VC-14. Not used.

2-1.15. Valves VC-15. Not used.

2-1.16. Valves VC-16. Not used.

2-1.18. Valves VC-18. Not used.

2-1.19. Valves VC-19. Not used.

2-1.20. Shop Coatings. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop coated for corrosion protection. The valve manufacturer’s standard coating will be acceptable, provided it is functionally equivalent to the specified coating per Coating Systems Section .

Coating Materials

Epoxy Enamel (for liquid service)	See Coating System Section and data sheet Attachment 13S3.

Rust-Preventive Compound	As recommended by the manufacturer.

Surfaces To Be Coated

Unfinished Surfaces	
Interior Surfaces	
Liquid Service	Epoxy enamel.
Exterior Surfaces	Universal primer.
Polished or Machined Surfaces	Rust-preventive compound.
Actuators and Accessories	Universal primer.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials furnished under this section shall be installed in accordance with Valve Installation section.

End of Section

Section 15102

ECCENTRIC PLUG VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing all eccentric plug valves as required by the Work. Plug valves shall be furnished complete with actuators and accessories as specified herein and as specified in the Valve and Gate Actuators section.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If the requirements in this section are different from those in the General Equipment Stipulations, the requirements in the section shall take precedence.

1.2.02. Governing Standard. Except as modified or supplemented herein, all eccentric plug valves and manual actuators shall conform to the applicable requirements of ANSI/AWWA C517.

1-2.03. Marking. Each valve shall be marked with the manufacturer's name, valve size, and pressure rating, and the country of origin of the body casting. All markings shall be cast on the exterior surface of the valve body. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the valve body.

1-2.04. Temporary Number Plates.

1-2.05. Identification. Eccentric plug valves shall be identified in accordance with the Equipment and Valve Identification section.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the Submittals Procedures section.

PART 2 - PRODUCTS

2-1. ACCEPTABLE PRODUCTS. Eccentric plug valves furnished under this section shall be manufactured by DeZurik, Pratt, Milliken, Val-Matic, Clow, or Victaulic, Owner-accepted equal.

2-2. MATERIALS. Materials used in the manufacture of eccentric plug valves shall be as indicated:

Body	Cast iron, ASTM A126, Class B; or ductile iron, ASTM A536, Grade 65-45-12.
Plug	Cast iron, ASTM A126, Class B; or ductile iron, ASTM A536, Grade 65-45-12.
Plug Facing	Chloroprene, Neoprene or Buna-N, 70 Type A durometer hardness in accordance with ASTM D2240.
Body Seat	Welded nickel overlay.
Upper and Lower Trunnion Bearings	Sleeve type; stainless steel or bronze.
Upper Thrust Bearing	TFE, Nylatron, or Delrin.
Stem Seal	V-type packing or U-cups, Buna-N or TFE.

The following are acceptable shop coatings.

Epoxy

For Liquid Service other than in potable water facilities	See Coating Systems Section and data sheet Attachment 13S3.

2-3. VALVE CONSTRUCTION.

2-3.01. Valve Body. The valve port area of each valve shall be at least 80 percent of the cross section of the connecting piping for 20 inch and smaller valves and 70 percent for 24 inch and larger valves. Valves shall provide tight shutoff at the rated pressure from either direction. An adjustable closed position plug stop shall be provided.
Each valve body shall be plainly marked to indicate the seat end. The actual length of 10 inch and smaller valves shall be within plus or minus 1/16 inch of the

theoretical length. The actual length of 12 inch and larger valves shall be within plus or minus 1/8 inch of the theoretical length.
Valve ends shall be compatible with connecting piping. All valves shall have flanged, grooved or mechanical joint ends as indicated on the Drawings. Flange diameter and drilling shall conform to ANSI B16.1, Class 125. Flanges shall be flat faced and finished to true plane surfaces within a tolerance limit of 0.005 inch. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per foot of flange diameter. Grooved end dimensions shall conform to ANSI/AWWA C606, Table 5, for rigid joints. When grooved end valves are to be installed in flanged piping, two flange adapters compatible with the connecting piping shall be provided with each valve. Mechanical joint ends shall conform to ANSI/AWWA C111/A21.11.
2-3.02. Plug. The plug shall be of one-piece construction and shall have a cylindrical or spherical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and the body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. Plug surfaces shall be faced with a resilient material.

2-3.03. Seats. Seats shall be cast in the body and shall have raised, welded-in nickel overlay not less than 0.050 inch thick on all surfaces in contact with the plug face. The overlay shall be at least 90 percent nickel and have a Brinell hardness of 200 or greater.

2-3.04. Stem Seals. The valve shaft shall be sealed by U-cups or by at least four self-adjusting chevron type packing rings.
2-3.05. Working Pressure. Valves shall be rated for a minimum working pressure as specified below, except where otherwise indicated .

Size in inches	Pressure Rating in psi
3 to 12	175
14 to 72	150

2-4. VALVE ACTUATORS. Requirements for valve actuators shall be as specified herein and as specified in the Valve and Gate Actuators section. Valve actuators types shall be manual.

Geared actuators shall be used for manually operated valves in the following applications:

a. For all 4 inch and larger buried valves.

b. For all 8 inch and larger valves.

c. For all 6 inch and larger valves in throttling or free discharge applications.

d. For all 6 inch and larger valves where the unseating pressure exceeds 25 psi.

e. For all chainwheel operated valves.

Geared actuators for plug valves unless otherwise specified or shall be rated for a differential pressure across the valve, on the seating side, of 100 psi for 6 inch to 8 inch valves, 50 psi for 10 inch and larger valves, and 25 psi for gas service valves and a maximum flow of 8 ft/s.

2-5. SHOP PAINTING. All interior and exterior ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valves and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting per Section 09940.

Surfaces shall be painted as follows:

Unfinished Surfaces	
Interior Surfaces	
For Liquid Service	Epoxy.
Exterior Surfaces	Epoxy.
Polished or Machined Surfaces	Rust-preventive compound.

Interior epoxy coatings shall comply with ANSI/AWWA C550 and shall be free of holidays.The total dry film thickness of shop-applied coatings shall be not less than:

Type of Coating	Minimum Dry Film Thickness
Epoxy	10 mils
Universal Primer	3 mils

2-6. ACCESSORIES. Requirements for extension stems and stem guides, position indicators, floor boxes, operating stands, and valve boxes shall be as indicated on the Drawings andas specified in the Valve and Gate Actuators sect

ion.

2-7. TESTING. Except as modified herein, eccentric plug valves shall be tested in accordance with Section 5 of the governing standard. Each valve shall be performance tested in accordance with Section 5.2 of the governing standard. The leakage test shall be applied to the seating face of the plug (tending to unseat the plug) at the rated pressure of the valve.

Each valve shall be leaktight in both directions when closed by the actuator with the maximum differential pressure applied to the plug as specified herein.

PART 3 - EXECUTION

3-1. INSTALLATION. Valves shall be installed in accordance with Valve Installation section.

3-1.01. Installation Check. An installation check by an authorize representative of the manufacturer is not required.End of Section

Section 15108

AIR VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing air valves as required by the Work, and as indicated in the Drawings.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are accepted by the Engineer.
Valves shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standard. Except as modified or supplemented herein, all valves furnished under this section shall conform to the applicable performance requirements of ANSI/AWWA C512.

1-2.03. Identification. Air valves shall be tagged in accordance with the Equipment and Valve Identification section.

1-3. SUBMITTALS. Complete assembly drawings, together with detailed specifications and data covering materials used and accessories forming a part of the valves furnished, shall be submitted in accordance with the Submittals Procedures section.

PART 2 - PRODUCTS

2-1. CONSTRUCTION.

Air release valves for wastewater applications with operating pressures of 300 psi or less shall be Apco/Valve and Primer “No. 400 or 450”, Multiplex “Crispin S Series”, ARI “No. S-020”, or Val-Matic “VM-48A or 49A”.

2-2. MATERIALS. Except as modified or supplemented herein, materials of construction shall comply with the governing standard.

Valve Trim	Bronze or austenitic stainless steel or polymer materials. Valve trim for valves in wastewater service shall be austenitic stainless steel.
Float	Austenitic stainless steel, polycarbonate, or foamed polypropylene.
Shop Coatings	
Epoxy (NSF-61 Certified)	PPG Amercoat “Amerlock 400 High Solids Epoxy”, Carboline “Carboguard 891”, Sherwin-Williams "Macropoxy 646NSF" or Tnemec “Series N140 Pota-Pox Plus”.
Epoxy	PPG Amercoat “Amercoat 385 Epoxy”, Carboline “Carboguard 890”, Sherwin-Williams "Macropoxy 646" or Tnemec “Series N69 Hi-Build Epoxoline II”.
Rust-Preventive Compound	As recommended by manufacturer.

2-3. SHOP PAINTING. All interior and exterior ferrous metal surfaces, except stainless steel components, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field coating. Field painting is covered in the Protective Coatings section.

Surfaces shall be painted as indicated:

Interior Surfaces of Valves in Wastewater Applications	Epoxy per section 09940
Exterior Surfaces of Valves To Be Installed in Manholes or Valve Vaults	Epoxy. section 09940
Exterior Surfaces of All Other Valves	Universal primer.
Polished or Machined Surfaces	Rust-preventive compound.

Interior coatings for all valves shall be free of holidays. The total dry film thickness of shop-applied coatings shall be not less than:

Type of Coating	Minimum Dry Film Thickness
Epoxy	10 mils [250 µm]
Universal Primer	3 mils [75 µm]

2-4. SHUTOFF VALVES. A shutoff valve shall be provided in the piping leading to each air valve. Shutoff valves 2 inches and smaller shall be ball valves as specified in the Miscellaneous Ball Valves section. Shutoff valves 3 inches and larger for wastewater service shall be eccentric plug valves as specified in the Eccentric Plug Valve section.

PART 3 - EXECUTION

3-1. INSTALLATION. Air release and combination air valves shall be installed in accordance with the Valve Installation section.

End of Section

Section 15110

KNIFE GATE VALVES

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing bi-directional resilient seat knife gate valves complete with actuators and accessories as specified herein and as specified in Section 15180-Valve and Gate Actuators.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all equipment and materials furnished under this section.

1.2.02. Governing Standard. Except as modified or supplemented herein, all knife gate valves shall conform to the applicable requirements of ANSI/AWWA C520.

1-2.03. Marking. Each valve shall be marked with the manufacturer's name, valve size, and pressure rating, and the country of origin of the body casting. All markings shall be cast on the exterior surface of the valve body. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the valve body.

1-2.04. Temporary Number Plates. Not Used.
1-2.05. Permanent Number Plates. All knife gate valves shall be provided with a permanent number plate as required by the Equipment and Valve Identification section. The location of number plates and the method of fastening shall be acceptable to Engineer. Numerals shall be at least 1 inch high and shall be black baked enamel on anodized aluminum plate

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted in accordance with the Submittals section.

Certified copies of proof-of-design statement for tests described in Section 5.2 of governing standard stating that tests were performed and were successfully met shall be submitted to Engineer before the valves are shipped.
1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Shipping section. Handling and storage shall be in accordance with the Handling and Storage section.

PART 2 - PRODUCTS

2-1. ACCEPTABLE PRODUCTS. Knife gate valves furnished under this section shall be Dezurik, Pratt, or approved equal.

2-2. MATERIALS. Materials used in the manufacture of bi-directional resilient seat knife gate valves shall be as indicated:

Body	Cast 304 stainless steel, ASTM A351 Grade CF8.
Seat and O-ring	Type 316 stainless steel seat ring with Viton resilient seat material.
Gate	316 Stainless Steel finished to 32 RMS
Yoke	Cast or fabricated 304 or 316 Stainless Steel;
Stem	316 Stainless Steel
Packing	PTFE.
Packing Gland	304 or 316 Stainless Steel
Nuts, Bolts, and Hardware	316 Stainless Steel

The following are acceptable shop coatings.

Epoxy	
For Liquid Service	PPG Amercoat “Amercoat 385 Epoxy”, Carboline “Carboguard 890”, or Tnemec “Series N69 Hi-Build Epoxoline II”.

2-3. VALVE CONSTRUCTION.

2-3.01. Valve Body. The valve shall be designed to be drip tight to the rated pressure in in both directions from 0 to 30 psi.

All valves shall have flanged ends. Flange diameter and drilling shall conform to ANSI B16.1, Class 125. Flanges shall be flat faced and finished to true plane surfaces within a tolerance limit of 0.005 inch. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per footof flange diameter.

2-3.02. Gate Seals. The gate shall be sealed against the valve body with packing rings. The packing shall be held in place by a packing gland, which shall be held in place by spring assisted bolts.

As an alternative, if it is the manufacturer's standard, the gate may be sealed against the body of the valve using a transverse seal. The seal shall be constructed of resilient material, shall be repackable, and shall be complete with UHMW polyethylene scraper blade.

Bi-directional valves shall incorporate a double seat design and be leak free with flow in either direction.

2-3.03. Valve Stems. Valve stems shall be fabricated of AISI Type 304 or 316 stainless steel and shall have single-lead threads. Stems to be supported to reach the operating elevation as shown in the drawings.

2-3.04. Yoke. A grease fitting on the yoke sleeve shall be provided. Yoke supports are to be provided to reach the operating elevation shown in the drawings.

2-4. VALVE ACTUATORS. Requirements for valve actuators shall be as specified herein and as specified in the Valve and Gate Actuators section. Valve actuators shall be manual types. Geared actuators shall be used for manually operated valves.Geared actuators for knife gate valves shall be rated for a differential pressure across the valve, on the seating side, of 100 psi for 8 inch and smaller valves, 50 psi for 10 inch and larger valves, and 25 psi for gas service valves.

2-5. SHOP PAINTING. All interior and exterior ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valves and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

Surfaces shall be painted as follows:

Unfinished Surfaces	
Interior Surfaces	
For Liquid Service	Epoxy.
Exterior Surfaces of All Other Valves	Universal primer.
Polished or Machined Surfaces	Rust-preventive compound.

Interior epoxy coatings shall comply with AWWA C550 and shall be free of holidays. The total dry film thickness of shop-applied coatings shall be not less than:

Type of Coating	Minimum Dry Film Thickness
Epoxy	10 mils
Universal Primer	3 mils
Fusion Bonded Epoxy	10 mils

2-6. ACCESSORIES. Requirements for extension stems and stem guides, position indicators, floor boxes, operating stands, and valve boxes shall be as specified in Section 15180-Valve and Gate Actuators.

2-7. TESTING. Each valve shall be performance tested in accordance with Section 5.1 of the governing standard. Performance test, hydrostatic test, seat test, and high-pressure test shall be performed on each valve in accordance with the governing standard. An affidavit of compliance shall be submitted.

PART 3 - EXECUTION

3-1. INSTALLATION. Valves will be installed in accordance with the Valve Installation section.

3-1.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation and shall revisit the job site as often as necessary until any problems are corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping and appurtenances;

and has been operated under full load conditions and that it has operated satisfactorily.

All costs for these services shall be included in the contract price for the number of days and round trips to the site as required.

End of Section

Section 15140
PIPE SUPPORTS

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of pipe hangers, brackets, supports, bracing, anchorage, and the design for the pipe support system for pipes 12 inches and smaller. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories. This section also covers the spacing of expansion joints in pipes 12 inches in diameter and smaller. Expansion joint products and materials are covered in the respective piping sections.

This section covers pipe supports for the following pipe materials:

Ductile iron

1-2. GENERAL. Contractor shall provide pipe supports, anchors, flexible couplings, and expansion joints for all piping systems. The Drawings indicate pipe supports, anchors, flexible couplings, and expansion joints for pipes larger than 12 inches in diameter, and in special cases for pipes that are 12 inches and smaller. Contractor shall design anchors, pipe supports, expansion joints, and flexible couplings not already shown on the Drawings, in accordance with the requirements specified herein.

Contractor's design shall include pipe supports, bracing, and anchorage adjacent to expansion joints, couplings, valves, in-line devices, equipment, wyes and tees, or changes in direction as required for dismantling piping, removing valves or other in-line devices, disconnecting piping from equipment, and pipe support, in addition to supports in accordance with the maximum spacing specified herein. The pipe support system design by Contractor shall rigidly support pipe so there is no visible movement or visible sagging between supports. The system shall comply with specified piping code requirements.

Contractor shall not delete or relocate the supports, expansion joints, or couplings indicated on the Drawings without written approval of Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all supports furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-3. SUBMITTALS. Complete data, catalog information, and drawings covering fabricated pipe supports, fabricated inserts, and stainless steel, galvanized, and

copper-plated and plastic-coated pipe supports shall be submitted in accordance with the Submittals Procedures section.

Data shall include a listing of the intended use and general location of each item submitted.

When a wind and/or seismic design is required, Contractor shall submit confirmation of compliance with the Meteorological and Seismic Design Criteria section.

PART 2 - PRODUCTS

2-1. MATERIALS. Unless otherwise indicated, all pipe supports shall comply with ANSI/MSS SP-58 and MSS SP-69. Materials of construction for fabricated steel supports are covered in the Structural and Miscellaneous Metals section. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

Unless otherwise specified or indicated on the Drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with manufacturer's standard finish.

Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

Pipe supports shall be manufactured for the sizes and types of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item. Continuously threaded rod is not acceptable for hanger rods over 12 inches in length.

Unless accepted by Engineer, the use of supports which rely on stressed thermoplastic components to support the pipe will not be permitted.

Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated. Supports for brass or copper pipe or tubing shall be copper plated or plastic coated.

Pipe support types and application shall comply with Table 1.

2-2. WIND AND SEISMIC LOADS. Wind and seismic loads for worst case conditions of either full, partially full, or empty pipes shall be considered in the design. Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

PART 3 - EXECUTION

3-1. APPLICATION. Fastening of supports to existing concrete and masonry shall be in accordance with the Anchorage in Concrete and Masonry section.

Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as specified to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as needed to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellows type expansion joints may be located adjacent to the joint.

When expansion joints are required, pipe guides shall be provided adjacent to bellows type expansion joints. Guides will not be required where mechanical couplings are permitted as expansion joints. Guides shall be located on both sides of expansion joints, except where anchors are adjacent to the joint. Unless otherwise indicated on the Drawings, one guide shall be within four pipe diameters from the joint and a second guide within 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for anchoring pipe against longitudinal forces. Pipe guides shall be provided at locations as recommended by the manufacturer.

Pipe supports for insulated cold piping systems shall be sized for the outside diameter of the insulated pipe, and an insulation protection shield shall be installed between the support and the insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields for piping larger than 2 inches or when needed to prevent crushing of the insulation. Inserts shall be of the same thickness as the adjacent insulation and shall be vapor sealed.

3-2. TYPES OF SUPPORTS. The products for pipe supports shall be as indicated in Table 1 for the specified type and size of support. Where stainless steel is specified for pipe supports but is not available from the name suppliers for the model specified in Table 1, Contractor shall provide a heavier duty support that is available in stainless steel.

TABLE 1 - TYPES OF SUPPORTS

Description and Service	MSS SP 69 Type (Note 1)	Specification
Hangers		
2-1/2 inch and smaller pipe		

TABLE 1 - TYPES OF SUPPORTS

Description and Service	MSS SP 69 Type (Note 1)	Specification
Other services		
J-style	5	B-Line "B3690", Anvil "67", Unistrut "J Hanger", or Piping Technology & Products Fig. 67.
Clevis	1	B-Line "B3104", Anvil "260", or Piping Technology & Products Fig 83.
3 Through 12 inch pipe (Note 3)		
For uninsulated cold piping		
Clamp	4	B-Line "3140", Anvil "212", or Piping Technology & Products Fig. 50.
Clevis	1	B-Line "B3100", Anvil "260", or Piping Technology & Products Fig 83.
Other services		
Clevis	1	B-Line "B3100" or Anvil "260" for steel pipe; B-Line "B3102", Anvil "590", or Piping Technology & Products Fig. 83 C. L. for cast iron pipe.
Side Beam Bracket	34	B-Line "B3062", Anvil "202", or Piping Technology & Products Fig. 20L.
Wall Supports and Frames, Steel, 12 inch and smaller pipe (Note 2)		
Brackets	32	B-Line "B3066", Anvil "195", or Piping Technology & Products Fig. 76.
	33	B-Line "B3067", Anvil "199", or Piping Technology & Products Fig. 76.
Prefabricated channels (Unistrut)	--	12 ga , galv, 1-5/8 inches , with suitable brackets and pipe clamps.

TABLE 1 - TYPES OF SUPPORTS

Description and Service	MSS SP 69 Type (Note 1)	Specification
Offset pipe clamp, 1-1/2 inch and smaller pipe	--	Galv, 1-1/4 by 3/16 inch steel, with 3/8 inch bolts.
Offset pipe clamp, 2 to 3-1/2 inch pipe	--	Galv, 1-1/4 by 1/4 inch steel, with 3/8 inch bolts.
Floor Supports, Steel or Cast Iron		
6 inch and smaller pipe	37 (with base)	B-Line "B3090", Anvil "259" or Piping Technology & Products Fig. 48.
8 through 12 inch pipe	38	B-Line "B3093", Anvil "264" or Piping Technology & Products Fig. 46.
Pipe Alignment Guides	--	B-Line "B3281" through "B3287", Anvil "255", or Piping Technology & Products Fig. 6.
Turnbuckles Steel	13	B-Line "B3202", Anvil "230", or Piping Technology & Products Fig. 30.
Hanger Rods, Carbon Steel, Threaded Both Ends, 3/8 inch minimum size	--	B-Line "B3205", Anvil "140", or Piping Technology & Products Fig. 128.
Weldless Eye Nut, steel	17	B-Line "B3200", Anvil "290", or Piping Technology & Products Fig. 40.

3-3. SUPPORT SPACINGS. Pipe supports and expansion joints shall be spaced in accordance with Tables 2. The types of pipes to be supported are as specified herein. Table 2 covers spacings for the standard operating conditions specified for each pipe material. Spacing in the tables is the maximum spacing considering gravity loads. Where Contractor's design includes lateral and longitudinal forces due to seismic loads, wind loads, and other forces, the spacing requirement may be less than that indicated in the tables.

TABLE 2 – MAXIMUM PIPE SUPPORT SPACING AT STANDARD TEMPERATURES AND SERVICES

Type of Pipe	Pipe Support Max Spacing feet	Max Run Without Expansion Joint, Loop, or Bend (Note 1) feet	Expansion Joint Max Spacing (Note 2) feet	Type of Expansion Joints
Ductile iron	15	80	80	Note 6
Ductile iron, glass-lined	12	80	80	Note 6

Table 2 Notes:

1. Unless otherwise acceptable to Engineer, an expansion joint shall be provided in each straight run of pipe having an overall length between loops or bends exceeding the maximum run specified herein.
2. Unless otherwise acceptable to Engineer, the spacing between expansion joints in any straight pipe run shall not exceed the maximum spacing specified herein.
3. Expansion joint fittings are specified in the respective piping sections.
4. At least two properly padded supports for each pipe section.
5. At least one support for each pipe section.
6. Expansion joints shall be mechanical couplings.
7. No expansion joints are required.
8. Supports for 5 and 10 foot long pipe sections shall be located within 18 inches of each joint. Supports shall be positioned to maintain the piping alignment and to prevent the piping from sagging.

9 References to specific gravity refer to liquid specific gravity and are referenced to water which is assumed to have a specific gravity of 1.0.

3-4. INSTALLATION.

3-4.01. General. All piping shall be supported in a manner which will prevent undue stress on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, and adjacent to flexible couplings. Pipe supports and hangers shall not be installed in equipment access areas.

Where horizontal piping is arranged with two or more parallel lines, trapeze hangers may be used in lieu of individual hangers. Trapeze assembly shall consist of structure attachments as previously specified with rod size dependent

upon total weight supported. Spacing of assemblies shall be determined by the minimum pipe size included in the group supported. Trapeze horizontal assemblies shall be structural angle or channel section of sufficient size to prevent measurable sag between rods when pipes are full. All lines shall be attached to the horizontal with intermediate pipe guides and U-bolts or one-hole clamps. Pre-engineered support equipment may be used when selected and installed in accordance with the manufacturer's recommendations.

Where copper pipe is installed on a support system of dissimilar metal with other pipes, the copper pipe shall be galvanically isolated from the support using Neoprene strips or other material acceptable to Engineer.

No piping shall be supported from the pipe above.

Horizontal piping hanger support rods shall attach to steel beams with center-loading I-clamps, or welded beam clips. Hanger support rods shall attach to concrete slabs or beams with inserts.

Anchorage shall be provided to resist both lateral and longitudinal seismic forces.

3-4.02. Inserts. Concrete inserts or anchor bolts shall be used to support piping from new cast-in-place concrete. Fastening of supports to existing concrete and masonry shall be in accordance with the Anchorage in Concrete and Masonry section. Reference building structural concrete Drawings for concrete inserts. When not provided as part of the building concrete structure, provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

Where concrete slabs form finished ceilings, provide inserts flush with the slab surface.

Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab. NDE (Non-Destructive Evaluation) shall be used to locate existing reinforcing before drilling.

3-4.03. Pipe Hangers and Supports. Install hangers to provide a minimum 1/2 inch space between finished covering and adjacent work.

A hanger shall be placed within 18 inches of each horizontal elbow, and on both sides of all piping accessories and valves weighing 20 lbs or more.

Hangers shall have 1-1/2 inches minimum vertical adjustment.

Support horizontal cast iron, ductile iron and no-hub piping systems adjacent to each joint.

Support vertical piping at every floor using riser clamps.

Support riser piping independently of connected horizontal piping.

Hanger and hanger components shall be sized specifically for the pipe size it is to be used on.

3-5. PLACEMENT. The maximum spacing for pipe supports and expansion joints shall be as indicated in Tables 2.

Rubber hose and flexible tubing shall be provided with continuous angle or channel support.

Unless otherwise indicated on the Drawings or acceptable to Engineer, piping shall be supported approximately 1-1/2 inches out from the face of walls and at least 3 inches below ceilings.

End of Section

Section 15180

VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing manual and powered valve actuators and accessories as specified herein.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with Drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Actuators shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Governing Standards. Except as modified or supplemented herein, cylinder and vane type actuators shall conform to applicable requirements of ANSI/AWWA C541.

Except as modified or supplemented herein, actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.

1-2.03. Power Supply. Not used.

1-2.04. Marking. Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.

1-2.05. Temporary Number Plates. Each actuator shall be factory tagged or marked to identify the actuator and the applicable valve or gate by number or service as indicated in the valve or gate schedule.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted in accordance with the Submittal Procedures section. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS.

2-1.01. General. Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve section.

Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material.

2-1.02. Valve Actuators. Each actuator shall be designed to open or close the valve under all operating conditions.

Valve actuators shall be provided and adjusted by the valve manufacturer. Actuator mounting arrangements and positions shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the Drawings or directed by Engineer.

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of the applicable governing standard(s).

2-3. VALVE MANUAL ACTUATORS.

2 General. Manual actuators of the types listed in the valve specifications shall be provided by the valve manufacturer.

Unless otherwise indicated or specified, each geared manual actuator shall be equipped with an operating handwheel.

The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body or actuator shall have cast thereon the word "Open" and an arrow indicating the direction to open.

The housing of traveling-nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.

Each actuator shall be designed so that shaft seal leakage cannot enter the actuator housing.

Valves for throttling service shall be equipped with an infinitely variable locking device or a totally enclosed gear actuator.

Actuators shall produce the required torque with a maximum pull of 80 lbs on the lever, handwheel, or chain. Actuator components shall withstand, without damage, a pull of 200 lbs on the handwheel or chainwheel or an input of 300 foot-lbs on the operating nut.

2-3.02. Handwheels. Handwheel diameters shall be at least 8 inches but not more than 24 inches for 30 inch and smaller valves and not more than 30 inches for 36 inch and larger valves.

2-3.03. Chainwheels. All valves with center lines more than 7'-6" above the floor shall be provided with chainwheels and operating chains. All new valves replacing existing valves with chainwheels shall also be provided with chainwheels. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized or zinc plated carbon steel and shall be looped to extend to within 4 feet of the floor below the valve.

2-3.04. Levers. Levers shall be capable of being locked in at least five intermediate positions between fully open and fully closed. In any building or structure containing lever operated valves, at least two operating levers shall be provided for each size and type of lever operated valve.

2-3.05. Chain Levers. Suitable actuator extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized carbon steel and shall be looped to extend to within 4 feet of the floor below the valve.

2-4 ACTUATOR ACCESSORIES.

2-4.01. Position Indicators. Unless otherwise specified, each valve actuator shall be provided with a position indicator to display the position of the plug or disc relative to the body seat opening.

For quarter turn plug, ball, or cone type valves installed in interior locations, the indicating pointer shall be mounted on the outer end of the valve operating shaft extension and shall operate over an indicating scale on the operating mechanism cover. Where the shaft passes through the cover, a suitable stuffing box or other seal shall be provided to prevent the entrance of water.

2-5. SHOP PAINTING. All ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

The following surfaces shall be painted:

Polished or Machined Surfaces	Rust-preventive compound.
Other Surfaces	Epoxy.
Actuators and Accessories	Universal primer.

PART 3 - EXECUTION

3-1. INSTALLATION. Actuators will be installed on the valves in accordance with the Valve Installation section.

End of Section

Section 16050

ELECTRICAL

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of all equipment and materials needed for the electrical requirements of this Contract. It also covers conduit, wiring, and terminations for electrical equipment installed under Electrical Equipment Installation section.

This section covers the installation and interconnection of electrical equipment furnished under other sections, except electrical items designated to be installed under those sections.
1-2. GENERAL. Electrical apparatus on all equipment shall be installed complete and placed in readiness for proper operation.

Electrical materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all equipment provided under this section. If requirements in this section differ from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence

1-2.02. Seismic Design Requirements. Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

1-2.03. Coordination. Electrical work shall conform to the construction schedule and the progress of other trades.

1-2.04. Anchor Bolts and Expansion Anchors. All anchor bolts, nuts, washers, and expansion anchors shall comply with Anchorage in Concrete and Masonry section, except smaller than 3/4 inch [19 mm] will be permitted to match NEMA standard size bolt holes on motors and electrical equipment.

1-2.05. Drawings. Supplementing this section, the Drawings indicate locations of equipment and enclosures and provide one-line and schematic diagrams regarding the connection and interaction with other equipment.

1-3. CODES AND PERMITS. All work shall be performed and materials shall be furnished in accordance with the NEC - National Electrical Code, the NESC - National Electrical Safety Code, and the following standards where applicable:

AEIC	The Association of Edison Illuminating Companies
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
Fed Spec	Federal Specification
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
NEIS	National Electrical Installation Standards
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters' Laboratories

Equipment covered by this section shall be listed by UL, or by a nationally recognized third party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor.

1-4. SEISMIC DESIGN REQUIREMENT.

1-4.01. Seismic Design Requirements. Submit confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section.

1-5. IDENTIFICATION.

1-5.01. Conduit. Conduits in manholes, handholes, building entrance pull boxes, junction boxes, and equipment shall be provided with identification tags. Identification tags shall be 19 gage [1 mm thick] stainless steel, with 1/2 inch [13 mm] stamped letters and numbers as indicated on the Drawings. Identification tags shall be attached to conduits with nylon tie wraps and shall be positioned to be readily visible.

1-5.02. Conductors. All conductors in power, control, and instrumentation circuits shall be identified and color coded as described herein.

1-5.02.01. Conductor Identification Number. Except for lighting and receptacle circuits, each individual conductor in power, control, and instrumentation circuits shall be provided with wire identification markers at the point of termination.

The wire markers shall be of the heat-shrinkable tube type, with custom typed identification numbers.

The wire numbers shall be as indicated on the equipment manufacturer's drawings.

The wire markers shall be positioned to be readily visible for inspection.

1-5.02.02. Conductor Color Coding. Power conductors shall be color coded as indicated below. For conductors 6 AWG and smaller, the color coding shall be the insulation finish color. For sizes larger than 6 AWG, the color coding may be by marking tape. The equipment grounding conductor shall be green or green with one or more yellow stripes if the conductor is insulated.

The following color coding system shall be used:

125 V DC — black (negative) and red (positive)
120/240 V, single-phase — black, red, and white
120/208 V, three-phase — black, red, blue, and white
120/240 V, three-phase — black, orange, blue, and white
277/480 V, three-phase — brown, orange, yellow, and gray

Where 120/240 and 120/208 volt systems share the same conduit or enclosure, the neutral for either the 120/240 volt system or the 208 volt system shall be white with a permanent identifiable violet stripe.

Control and instrumentation circuit conductors shall be color coded as indicated in the Cable Data Figures at the end of this section.

1-5.03. Motor Starters. Motor starters shall be provided with nameplates identifying the related equipment. Pilot controls and indicating lights shall have engraved or etched legends ("start", "stop", etc.) as indicated on the Drawings. Nameplates shall be laminated black-over-white plastic, with 1/8 inch [3 mm] engraved letters, and shall be securely fastened to the motor starters.

1-5.04. Control Stations. Control stations shall be provided with nameplates identifying the related equipment. Pilot controls and indicating lights shall have engraved or etched legends ("start", "stop", etc.) as indicated on the Drawings. Nameplates shall be laminated black-over-white plastic, with 1/8 inch [3 mm] engraved letters, and shall be securely fastened to the control stations.

1-5.05. Circuit Breakers. Circuit breakers shall be provided with nameplates identifying related equipment. Nameplates shall be laminated black-over-white plastic, with 1/8 inch [3 mm] engraved letters, and shall be securely fastened to the circuit breakers.

1-5.06. Disconnect Switches. All switches shall have front cover-mounted permanent nameplates that include switch type, manufacturer's name and catalog number, and horsepower [kW] rating. An additional nameplate, engraved or etched, laminated black-over-white plastic, with 1/8 inch [3 mm] letters, shall be provided to identify the associated equipment. Both nameplates shall be securely fastened to the enclosure.

1-5.07. Arc Flash Hazard Labels. Lighting panels, power panels, power centers, switchgear, switchboards, motor control centers, motor control line ups, transfer switches, industrial control panels, variable frequency drives, fused switches, meter socket enclosures, and other electrical equipment likely to be worked on energized shall be provided with permanent labels warning the risk of arc flash and shock hazard. Labels shall be designed in accordance with ANSI Z535.4 and shall include the following:

WARNING
Arc Flash and Shock Hazard

Appropriate personal protection equipment (PPE) required. SEE NFPA 70E.
Equipment must be accessed by qualified personnel only.
Turn off all power sources prior to working on or inside equipment.

1-6. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the work performed by the Contractor, shall be submitted in accordance with the Submittal Procedures section. The drawings and data shall include, but shall not be limited to, the following:

Drawings and data.
Operating manuals.
Samples.
Test reports
Studies

1-6.01. Submittal Identification. Information covering all materials and equipment shall be submitted for review in accordance with the Submittal Procedures section. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment as follows:

a. Lamp fixture descriptive sheets shall show the fixture schedule letter, number, or symbol for which the sheet applies.

b. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies.

c. Sheets or drawings covering more than the item being considered shall have all inapplicable information crossed out.

d. A suitable notation shall identify equipment and materials descriptive literature not readily cross-referenced with the Drawings or Specifications.

e. Schematics and connection diagrams for all electrical equipment shall be submitted for review. A manufacturer's standard connection diagram or schematic showing more than one scheme of connection will not be accepted, unless it is clearly marked to show the intended connections.

Contractor shall submit the name and qualifications of the Engineering and Testing Services firm proposed to perform the protective device study and the on-site testing.

Within 90 days after the Notice to Proceed, Contractor shall furnish a submittal for all types of cable and conduit to be provided. The submittal shall include the cable manufacturer and type, and sufficient data to indicate that the cable and conduit meet the specified requirements.

In addition to the complete specifications and descriptive literature, a sample of the largest size of each type of cable shall be submitted for review before installation. Each sample shall include legible and complete surface printing of the cable identification.

1-6.02. Seismic Design Requirements. Submitted confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section.

1-7. PROTECTION AND STORAGE. During construction, the insulation on all electrical equipment shall be protected against absorption of moisture, and metallic components shall be protected against corrosion by strip heaters, lamps, or other suitable means. This protection shall be provided immediately upon receipt of the equipment and shall be maintained continuously.

PART 2 - PRODUCTS

2-1. POWER SERVICE ENTRANCE. Not used.

2-2. TELEPHONE SERVICE ENTRANCE. Not used.

2-3. CABLE. All cables of each type (such as lighting cable or 600 volt power cable) shall be from the same manufacturer.

All types of cable shall conform to the Cable Data Figures at the end of this section and as described herein.

2-3.01. Lighting Cable. Not used.

2-3.02. 600 Volt Power Cable. Cable in power, control, indication, and alarm circuits operating at 600 volts or less, except where lighting, multiconductor control, and instrument cables are required, shall be 600 volt (Figure 2-16050 XHHW-2) power cable.

2-3.03. Instrument Cable. Cable for electronic circuits to instrumentation, metering, and other signaling and control equipment shall be two- or three-conductor instrument cable twisted for magnetic noise rejection and protected from electrostatic noise by a total coverage shield. Types of instrument cables shall be (Figure 4-16050 single pair).

2.3.04. Multiconductor Control Cable. Not used.

2-3.05. Medium Voltage Power Cable. Not used.

2-3.06. Tray Cable. Not used.

2-4. RACEWAY. Conduit and cable tray shall be as described in the following paragraphs:

2-4.01. Rigid Steel Conduit. Rigid steel conduit shall be heavy wall, hot-dip galvanized, shall conform to NEMA C80.1, and shall be manufactured in accordance with UL 6.

2-4.02. Intermediate Metal Conduit (IMC). Not used.

2-4.03. Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moistureproof polyvinyl chloride jacket, and shall be UL labeled.

2-4.04. Utility (PVC) Duct. Not used.

2-4.05. Rigid Nonmetallic (PVC) Conduit. PVC conduit shall be heavy wall, Schedule 40 and 80, UL labeled for aboveground and underground uses, and shall conform to NEMA TC-2 and UL 651.

2-4.06. PVC-Coated Rigid Steel Conduit. Not used.

2-4.07. Electrical Metallic Tubing (EMT). Not used.

2-4.08. Rigid Aluminum Conduit (RAC). Not used.

2-5. WIRING DEVICES, BOXES, AND FITTINGS. Concealed conduit systems shall have flush-mounted switches and convenience outlets. Exposed conduit systems shall have surface-mounted switches and convenience outlets.

2-5.01. Conduit Boxes and Fittings.

a. Aluminum boxes and fittings manufactured by Crouse-Hinds, Appleton, or O Z Gedney shall be installed.

e. Hub arrangements on threaded fittings shall be the most appropriate for the conduit arrangement to avoid unnecessary bends and fittings.

2-5.02. Device Plates.

a. Galvanized or cadmium-plated device plates shall be used on surface mounted outlet boxes where weatherproof plates are not required.

b. Device plates on flush mounted outlet boxes where weatherproof plates are not required shall be AISI Type 302 stainless steel, Eaton "93000 series", Hubbell "S series", or Leviton "840nn-40 series"; nylon or polycarbonate, Eaton "5000 series", Hubbell "Pn series", or Leviton "807nn-I series".

c. Device plate mounting hardware shall be countersunk and finished to match the plate.

d. Device plates for switches outdoors or indicated as weatherproof shall have provisions for padlocking switches "On" and "Off", and shall be Appleton "FSK-1VS", Crouse-Hinds "DS185" or O Z Gedney "FS-1-WSCA".

e. Device plates for receptacles indicated as weatherproof shall be Appleton "FSK-WRD", Crouse-Hinds "WLRD1", or O Z Gedney "FS-1-WDCA.

f. Flush-mounted, weatherproof plates shall be provided with adapter plates, Appleton "FSK-SBA" or Crouse-Hinds "FS031".

g. Device plates for ground fault interrupter receptacles indicated to be weatherproof shall be Appleton "FSK-WGFI", Eaton "S966", or O Z Gedney "FS-1-GFCA".

h. Receptacle covers outdoors or otherwise indicated to be weatherproof while in-use shall be die cast aluminum and shall include a padlock eye. Covers for standard convenience outlets shall be Hubbell “WP8M” or Thomas and Betts Red Dot “CKMUV”. Covers for ground fault interrupter receptacles shall be Hubbell “WP26M” or Thomas and Betts Red Dot “CKMUV”.

i. Engraved device plates, where required, shall be manufactured by Leviton, or equal.

j. Device plates on PVC conduit fittings shall be Carlon "E98 Series" or Cantex "513300 Series".

2-5.03. Wall Switches. Not used.

2-5.04. Receptacles. Not used.

2-5.05. Special Outlets. Not used.

2-6. JUNCTION BOXES, PULL BOXES, AND WIRING GUTTERS. Indoor boxes (larger than switch, receptacle, or fixture type) and gutters shall be constructed of sheet steel, shall be galvanized after fabrication, and shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts.

Indoor boxes and gutters in corrosive areas indicated on the Drawings and outdoor boxes and gutters shall be NEMA Type 4X, ABS or stainless steel and shall be rigidly supported by PVC-coated or stainless steel framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

Bolt-on junction box covers 3 feet [900 mm] square or larger, or heavier than 25 lbs [11 kg], shall have rigid handles. Covers larger than 3 by 4 feet [900 by 1200 mm] shall be split.

Where indicated on the Drawings, junction and pull boxes with a removable side opposite the underground conduits shall be provided over building ends of underground conduit banks. Boxes shall be sized in accordance with the National Electrical Code, including space for full size continuations of all underground conduits not originally continued. Conduit arrangement shall leave maximum space for future conduits.

2-7. LIGHTING FIXTURES. Not used.

2-8. LIGHTING PANELS. Not used.

2-9. POWER PANELS. Not used.
2-10. SURGE PROTECTIVE DEVICES. Not used.

2-11. SEPARATELY ENCLOSED MOTOR STARTERS. Not used.

2-12. SEPARATELY ENCLOSED MANUAL STARTERS. Not used.

2-13. CONTROL STATIONS. Not used.

2-14. SEPARATELY ENCLOSED CIRCUIT BREAKERS. Not used.

2-15. DISCONNECT SWITCHES. Not used.

2-16. LIGHTING AND AUXILIARY POWER TRANSFORMERS. Not used.

2-17. POWER CENTERS. Not used.

2-18. POWER FACTOR CORRECTION CAPACITORS. Not used.

2-19. LIGHTING CONTACTORS. Not used.

2-20. PHOTOELECTRIC CONTROLS. Not used.

2-21. RELAY ENCLOSURES. Not used.

2-22. ALARM HORN AND BEACON. Not used.

2-23. HEAT-TRACED PIPING. Not used.

2-24. DOOR ENTRY SWITCHES. Not used.

2-25. MCC RETROFIT CIRCUIT BREAKERS AND STARTERS. New circuit breakers and starters for 6MCC4A/4B and 6MCC7 shall be compatible with the existing Westinghouse series 2100 motor control centers. The new circuit breakers and starters shall be of the sizes shown in the Drawings.

PART 3 - EXECUTION

3-1. INSTALLATION, TESTING, AND COMMISSIONING. All material, equipment, and components specified herein shall be installed, tested, and commissioned for operation in compliance with NECA 1000 – NEIS Specification

System. Where required in NECA 1000, testing and commissioning procedures shall be followed prior to energizing equipment.

3-2. ARC FLASH HAZARD ANALYSIS. Not used. *NNo*

3-2.01. Arc Flash Analysis Software. Not used.

3-2.02. Arc Flash Hazard Report.

3-2.03. Arc Flash Labeling. Contractor shall furnish and install arc flash labels on the applicable electrical equipment. The label template shall be subject to review and acceptance by Engineer. Labels shall include, at a minimum, the nominal system voltage and equipment name.

3-3. PROTECTIVE DEVICE STUDY. Contractor shall commission a short circuit study and protective device study of relays, fuses, circuit breakers, and all other protective devices and shall submit a coordination and protective device settings report as specified herein. The study shall be in compliance with IEEE 242 and include the entire distribution system, including any and all existing power distribution components which will impact the results of the protective device study, starting with the smallest – 480 volt, 3 phase, 60 Hz – circuit protective device on the load end, to the nearest protective device on the power company's line side. Where existing electrical distribution system components are part of the study, the Contractor shall field verify and report the respective ratings and settings of each device as found as a prerequisite to the study analysis being performed. Protective device settings shall be selected to provide selective coordination to the maximum extent possible for equipment protection and device coordination while balancing the goal to reduce the calculated incident energy to the greatest extent possible.

Contractor shall be responsible for and shall ensure that all relays, protective devices and circuit breakers shown on the Drawings and Specifications are sized and set according to the study results.

The study shall include, but shall not be limited to, the following:

Color-coded printouts of coordination curves prepared with calculation software.

A tabulation of all protective relay and circuit breaker trip settings and recommended sizes and types of medium-voltage fuses.

3-4. POWER AND SERVICE ENTRANCE INSTALLATION. Not used....
3-5. TELECOMMUNICATIONS SERVICE ENTRANCE INSTALLATION. Not used.

3-6. CABLE INSTALLATION.

3-6.01. General. Except as otherwise specified or indicated on the Drawings, cable shall be installed according to the following procedures, taking care to protect the cable and to avoid kinking the conductors, cutting or puncturing the jacket, contamination by oil or grease, or any other damage. Circuits to supply electric power and control to equipment and devices, communication and signal circuits as indicated on the one-line diagrams shall be installed continuous and may not be spliced unless approved by the Engineer.

a. Stranded conductor cable shall be terminated by lugs or pressure type connectors. Wrapping stranded cables around screw type terminals is not acceptable.

b. Stranded conductor cable shall be spliced by crimp type connectors. Twist-on wire connectors may only be used for splicing solid cable and for terminations at lighting fixtures.

c. Splices may be made only at readily accessible locations.

d. Cable terminations and splices shall be made as recommended by the cable manufacturer for the particular cable and service conditions.

e. Cable shall not be pulled tight against bushings nor pressed heavily against enclosures.

f. Cable-pulling lubricant shall be compatible with all cable jackets; shall not contain wax, grease, or silicone; and shall be Polywater "Type J".

g. Where necessary to prevent heavy loading on cable connections, in vertical risers, the cable shall be supported by Kellems, or equal, woven grips.

h. Spare cable ends shall be taped, coiled, and identified.

i. Cables shall not be bent to a radius less than the minimum recommended by the manufacturer. For cables rated higher than 600 volts, the minimum radius shall be 8 diameters for nonshielded cable and 12 diameters for shielded cable.

j. All cables in one conduit, over 1 foot long, or with any bends, shall be pulled in or out simultaneously.

k. Circuits to supply electric power and control to equipment and devices are indicated on the one-line diagrams. Conductors in designated numbers and sizes shall be installed in conduit of designated size. Circuits shall not be combined to reduce conduit requirements unless acceptable to Engineer.

l. Instrument cable shields and drain wires shall be continuous over the entire length of the circuit and grounded at one end only. In general, the field end of the shield shall be ungrounded. At the ungrounded termination of the circuit, the shield and drain wire shall be insulated by taping to prevent grounding.

3-6.02. Underground Cable Pulling Procedure. Not used.
3-6.03. Medium-Voltage Cable Insulation Test. Not used.

3-7. RACEWAY INSTALLATION. Contractor shall be responsible for routing all raceway. This shall include all conduits indicated on the one-lines, riser diagrams, and home-runs shown on the plan Drawings. Conduits shall be routed as defined in these Specifications. Where conduit routing is shown on plans, it shall be considered a general guideline and shall be field verified to avoid interferences.

Except as otherwise specified or indicated on the Drawings, conduit installation and identification shall be completed according to the following procedures.

3-7.01. Installation of Interior and Exposed Exterior Conduit. This section covers the installation of conduit inside structures, above and below grade, and in exposed outdoor locations. In general, conduit inside structures shall be concealed. Large conduit and conduit stubs may be exposed unless otherwise specified or indicated on the Drawings. No conduit shall be exposed in water chambers unless so indicated on the Drawings.

Unless otherwise indicated on the Drawings, Contractor shall be responsible for routing the conduit to meet the following installation requirements:

a. Conduit installed in all exposed indoor locations, except corrosive areas indicated on the Drawings, and in floor slabs, walls, and ceilings of hazardous (classified) locations, shall be rigid steel. Exposed conduit shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts.

b. Conduit installed in floor slabs and walls in non-hazardous locations shall be rigid Schedule 40 PVC.

c. Conduit installed in all exposed outdoor locations shall be PVC-coated rigid steel, rigidly supported by PVC-coated framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

d. Final connections to dry type transformers, to motors without flexible cords, and to other equipment with rotating or moving parts shall be liquidtight flexible metal conduit with watertight

connectors installed without sharp bends and in the minimum lengths required for the application, but not longer than 6 feet unless otherwise acceptable to Engineer.

e. Terminations and connections of rigid steel and intermediate metal conduit shall be taper threaded. Conduits shall be reamed free of burrs and shall be terminated with conduit bushings.

f. Exposed conduit shall be installed either parallel or perpendicular to structural members and surfaces.

g. Two or more conduits in the same general routing shall be parallel, with symmetrical bends.

h. Conduits shall be at least 6 inches from high temperature piping, ducts, and flues.

i. Conduit installed in corrosive chemical feed and storage areas as indicated by Area Type on the Drawings shall be rigid Schedule 80 PVC. Exposed conduit in corrosive areas shall be supported by FRP framing materials with stainless steel hardware, including nuts and bolts.

j. Rigid Schedule 40 and 80 PVC conduit shall have supports and provisions for expansion as required by NEC Article 352.

k. Metallic conduit connections to sheet metal enclosures shall be securely fastened by locknuts inside and outside.

l. Rigid Schedule 40 and 80 PVC conduit shall be secured to sheet metal device boxes using a male terminal adapter with a locknut inside or by using a box adapter inserted through the knockout and cemented into a coupling.

m. Conduits in walls or slabs, which have reinforcement in both faces, shall be installed between the reinforcing steel. In slabs with only a single layer of reinforcing steel, conduits shall be placed under the reinforcement. Conduits larger than 1/3 of the slab thickness shall be concrete encased under the slab.

n. Conduits that cross structural joints where structural movement is allowed shall be fitted with concretetight and watertight expansion/deflection couplings, suitable for use with metallic conduits and rigid Schedule 40 or 80 PVC conduits. The couplings shall be Appleton Type DF, Crouse-Hinds Type XD, or O-Z Type DX.

o. Conduit shall be clear of structural openings and indicated future openings.

p. Conduits through roofs or metal walls shall be flashed and sealed watertight.

q. Conduit installed through any openings cut into non-fire rated concrete or masonry structure elements shall be neatly grouted. Conduit penetrations of fire rated structure elements shall be sealed in a manner that maintains the fire rating as indicated on the Architectural Drawings.

r. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.

s. Exposed conduit stubs for future use shall be terminated with galvanized pipe caps.

t. Concealed conduit for future use shall be terminated in equipment or fitted with couplings plugged flush with structural surfaces.

u. Where the Drawings indicate future duplication of equipment wired hereunder, concealed portions of conduits for future equipment shall be provided.

v. Horizontal conduit shall be installed to allow at least 7 feet of headroom, except along structures, piping, and equipment or in other areas where headroom cannot be maintained.

w. Conduit shall not be routed across the surface of a floor, roof, or walkway unless approved by Engineer.

x. PVC-coated rigid steel conduit shall be threaded and installed as recommended by the conduit manufacturer's installation procedure using appropriate tools.

y. All conduits that enter enclosures shall be terminated with acceptable fittings that will not affect the NEMA rating of the enclosure.

z. Conduit which turns out of concrete slabs or walls, shall be connected to a 90 degree elbow of PVC-coated rigid steel conduit before it emerges. Conduits shall have PVC-coated rigid steel coupling embedded a minimum of 3 inches when emerging from slabs or walls and the coupling shall extend 2 inches from the wall.

ab. Power conductors to and from variable frequency drives shall be installed in steel conduit.

3-7.02. Underground Conduit Installation. Not used.3-7.03. Sealing of Conduits. After cable has been installed and connected, conduit ends shall be sealed by forcing nonhardening sealing compound into the conduits to a depth at least equal to the conduit diameter. This method shall be used for sealing all conduits at handholes, manholes, and building entrance

junction boxes, and for 1 inch [25 mm] and larger conduit connections to equipment.

Conduits entering chlorine feed and storage rooms shall be sealed in a junction box or conduit body adjacent to the point of entrance.

Conduits entering hazardous (classified) areas and submersible or explosion proof enclosures shall have Appleton "Type ESU" or Crouse-Hinds "EYS" sealing fittings with sealing compound.

3-7.04. Reuse of Existing Conduits. Existing conduits shall not be reused.
3-7.05. Cable Tray Installation. Cable tray shall be installed per NEMA VE 2, NEC and manufacturers installation instructions and as indicated on the drawings. Exact cable tray mounting height and location shall be coordinated by the Contractor with other equipment and structures to avoid interferences.

3-8. WIRING DEVICES, BOXES, AND FITTINGS INSTALLATION. Metallic and nonmetallic conduit boxes and fittings shall be installed in the following locations:

3-8.01. Conduit Boxes and Fittings.

a. Galvanized or cadmium plated, threaded, malleable iron boxes and fittings shall be installed in concrete walls, ceilings, and floors; in the outdoor faces of masonry walls; and in all locations where weatherproof device covers are required. These boxes and fittings shall also be installed in exposed rigid steel and intermediate metal conduit systems.

b. Galvanized or cadmium plated sheet steel boxes shall be installed in the indoor faces of masonry walls, in interior partition walls, and in joist supported ceilings.

c. Rigid PVC device boxes shall be installed in exposed nonmetallic conduit systems.

d. PVC coated boxes and fittings shall be installed in PVC coated conduit systems.

3-8.02. Device Plates. Not used.

3-8.03. Wall Switches. Not used.

3-8.04. Receptacles. Not used.

3-8.05. Special Outlets. Not used.

3-9. EQUIPMENT INSTALLATION. Except as otherwise specified or indicated on the Drawings, the following procedures shall be used in performing electrical work.

3-9.01. Setting of Equipment. All equipment, boxes, and gutters shall be installed level and plumb. Boxes, equipment enclosures, metal raceways, and similar items mounted on water- or earth-bearing walls shall be separated from the wall by at least 1/4 inch [6 mm] thick corrosion-resistant spacers. Where boxes, enclosures, and raceways are installed at locations where walls are not suitable or available for mounting, concrete equipment pads, framing material, and associated hardware shall be provided.

3-9.02. Sealing of Equipment. All outdoor substation, switchgear, motor control center, and similar equipment shall be permanently sealed at the base, and all openings into equipment shall be screened or sealed with concrete grout to keep out rodents and insects the size of wasps and mud daubers. Small cracks and openings shall be sealed from inside with silicone sealant, Dow-Corning "795" or General Electric "SCS1200".

3-10. GROUNDING.

3-10.01. General. The electrical system and equipment shall be grounded in compliance with the National Electrical Code and the following requirements:

a. All ground conductors shall be at least 12 AWG [4 mm^2] soft drawn copper cable or bar, bare or green-insulated in accordance with the National Electrical Code.

b. All powered equipment, including lighting fixtures and receptacles, shall be grounded by a copper ground conductor in addition to the conduit connection.

c. Ground connections to equipment and ground buses shall be made with copper or high conductivity copper alloy ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be made with irreversible high-compression type lugs inserted under permanent assembly bolts or under new bolts drilled and inserted through enclosures, other than explosion proof enclosures, or by grounding locknuts or bushings. Ground cable connections to anchor bolts; against gaskets, paint, or varnish; or on bolts holding removable access covers will not be acceptable.

d. Ground conductors shall be routed as directly as possible, avoiding unnecessary bends. Ground conductor installations for equipment ground connections to the grounding system shall have turns with minimum bend radii of 12 inches.

e. The grounding system shall be bonded to the station piping by connecting to the first flange inside the building, on either a suction or discharge pipe, with a copper bar or strap. The flange shall be drilled and tapped to provide a bolted connection.

3-10.02. Grounding System Resistance. The ground system resistance shall comply with National Electrical Code.

3-10.03. Grounding System Testing. The grounding system of each new building or structure and each existing building or structure indicated below, shall be tested to determine the resistance to earth. Testing shall be performed by an independent electrical or grounding system testing organization. Testing shall be completed after not less than three full days without precipitation and without any other moistening or chemical treatment of the soil.

3-10.03.01. New Grounding Systems. Not used.

3.10.03.02. Existing Grounding Systems. Grounding systems of each existing building or structure indicated shall be tested for resistance to earth.

Existing building(s) or structure(s) to be tested	Pump Room (in Ops BLDG.)

Where existing grounding systems can be isolated from the building power service or utility power service a three-point fall of potential test shall be completed as indicated above. Where isolation of the building grounding system is not practical, a clamp-on resistance test will be an acceptable alternative. Clamp-on resistance testing shall be completed utilizing a ground resistance tester specifically designed for clamp on resistance testing, such as the AEMC "Model 3711". Clamp-on resistance measurements shall be taken at the service side of the service entrance neutral, upstream of the neutral to ground bonding connection to ensure a single path between the grounding system and the utility reference.

3.10.03.03. Grounding System Test Report. A report certified by the testing organization shall be prepared and submitted in accordance with the Submittal Procedures section. The final report shall include complete testing results for each building or structure, graphical representation of the test point results for the three-point fall of potential method, and complete observations of all site weather conditions and other environmental conditions that may affect the test results.

Final acceptance of the results reported shall be subject to the review and approval of Engineer.

3-11. LIGHTING FIXTURE INSTALLATION. Not used.

3-12. POWER FACTOR CORRECTION CAPACITOR INSTALLATION. Not used.

3-13. HEAT-TRACED PIPING INSTALLATION. Not used

3-14. MODIFICATIONS TO EXISTING EQUIPMENT. Modifications to existing equipment shall be completed as specified herein and indicated on the Drawings. All existing facilities shall be kept in service during construction. Temporary power or relocation of existing power and control wiring, equipment, and devices shall be provided as required during construction. Coordination and timing of outages shall be as specified in other sections of these Specifications. Electrical power interruptions will only be allowed where agreed upon in advance with Owner, and scheduling at times of low demand may be required.

3-14.01. Demolition. Unless otherwise specified or indicated on the Drawings, all cable and all exposed conduit for power and control signals of equipment indicated to be removed shall be demolished. Conduit supports and electrical equipment mounting hardware shall be removed, and holes or damage remaining shall be grouted or sealed flush. Conduit partially concealed shall be removed where exposed, and plugged with expanding grout flush with the floor or wall. Repairs shall be refinished to match the existing surrounding surfaces. Demolished equipment shall be discarded or salvaged as indicated on the Drawings and as specified in other sections of these Specifications.

End of Section

STANDARD SPECIFICATIONS

REFERENCE: ICEA S-95-658 (NEMA WC 70).

CONDUCTOR: Concentric-lay, uncoated copper; strand Class B. Wet/dry maximum operating temperature 90°C.

INSULATION: Cross-linked thermosetting polyethylene, ICEA S-95-658, Paragraph 3.6.

SHIELD: None.

JACKET: None.

FACTORY TESTS: Cable shall meet the requirements of ICEA S-95-658.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	mm^2		in.	μm	in.	mm
14	2.5	7	0.030	760	0.17	4.32
12	4.0	7	0.030	760	0.19	4.83
10	6.0	7	0.030	760	0.21	5.33
8	10.0	7	0.045	1140	0.27	6.86
6	16.0	7	0.045	1140	0.31	7.87
4	25.0	7	0.045	1140	0.36	9.14
2	35.0	7	0.045	1140	0.42	10.67
1	40.0	19	0.055	1400	0.48	12.19
1/0	50.0	19	0.055	1400	0.52	13.21
2/0	70.0	19	0.055	1400	0.57	14.48
4/0	95.0	19	0.055	1400	0.68	17.27
250	120.0	37	0.065	1650	0.75	19.05
350	185.0	37	0.065	1650	0.85	21.59
500	300.0	37	0.065	1650	0.98	24.89
750	400.0	61	0.080	2030	1.22	31.00
1,000	500.0	61	0.080	2030	1.37	34.80

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, XLP, XHHW-2, conductor size, and voltage class.

600 Volt, Single Conductor Lighting/Power Cable (600-1-XLP-NONE-XHHW-2)

BLACK & VEATCH	Cable Data	Figure 2-16050

STANDARD SPECIFICATIONS

REFERENCE: UL 66, UL 1277.

CONDUCTOR: 16 AWG (1.5 mm^2), 7-strand, concentric-lay, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, not less than 15 mils (380 μm) average thickness; 13 mils (330 μm) minimum thickness, UL 66, Type TFN.

LAY: Twisted pair with 1-1/2 inch to 3 inch (38.10 mm - 63.5 mm) lay.

SHIELD: Cable assembly, combination aluminum-polyester tape and 7-strand, 20 AWG (0.5 mm^2) minimum size, tinned copper drain wire, shield applied to achieve 100 percent cover over insulated conductors.

JACKET: Conductor: Nylon, 4 mils (100 μm) minimum thickness, UL 66.

Cable assembly: Black, flame-retardant polyvinyl chloride, UL 1277, applied over tape-wrapped cable core.

CONDUCTOR IDENTIFICATION: One conductor black, one conductor white.

FACTORY TESTS: Insulated conductors shall meet the requirements of UL 66 for Type TFN. Assembly jacket shall meet the requirements of UL 1277. Cable shall meet the vertical-tray flame test requirements of UL 1277.

Cable Details

	Assembly Jacket Thickness*		**Maximum Outside Diameter**	
	in.	**μm**	**in.**	**mm**
Single Pair	0.045	1140	0.34	8.64

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 80 percent of the value indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, Type TC, Type TFN, conductor size, single pair, and voltage class.

600 Volt, Single Pair, Shielded Instrument Cable (600-SINGLE-PAIR-SH-INSTR)

BLACK & VEATCH	**Cable Data**	**Figure 4-16050**

Section 16100

ELECTRICAL EQUIPMENT INSTALLATION

PART 1 – GENERAL

1-1. SCOPE. This section covers the installation of electrical equipment.

1-2. GENERAL. Equipment specified to be installed under this section shall be erected, and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

The electrical equipment identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least 14 days prior to the need for manufacturer's field services furnished by others.

Submittals for equipment furnished under the original procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Delivery. When sills are required for electrical equipment, they shall be shipped ahead of the scheduled equipment delivery to permit installation before concrete is placed.

1-3.02. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with Product Storage and Handling Requirements section, and in accordance with manufacturer's written instructions, until installed in the Work. Equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on earth or grass surfaces or come into contact with earth or grass. Contractor shall keep the equipment clean and dry at all times. Openings shall be plugged or capped (or otherwise sealed by packaging) during temporary storage.

1-3.03. Handling. Electrical equipment shall be moved by lifting, jacking, or skidding on rollers as described in the manufacturer's instructions. Special lifting harness or apparatus shall be used when required. Lifting and jacking points shall be used when identified on the equipment. Contractor shall have required unloading equipment on site to perform unloading work on the date of equipment delivery.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3-1. INSTALLATION, TESTING, AND COMMISSIONING. All installation work shall be in accordance with manufacturer's written instructions.

All material, equipment, and components specified to be installed according to this section shall be installed, tested, and commissioned for operation in compliance with NECA 1000 – NEIS Specification System. Where required in NECA 1000, testing and commissioning procedures shall be followed prior to energizing equipment.

Electrical equipment cubicles and vertical sections shall be installed plumb and level. Draw-out equipment carriages, circuit breakers, and other removable components shall operate free and easy without binding or distortion.

Unless otherwise indicated or specified, all indoor floor-mounted electrical equipment and control cabinets shall be installed on concrete equipment pads four inches [102 mm] in height.

Indoor metalclad switchgear shall be bolted to steel floor channels which are installed level and flush with the top of the concrete floor or equipment pad.

Outdoor metalclad switchgear and interrupter gear with integral floor channels or beams shall be secured to concrete pads with anchor bolts and clips.

Motor control centers with integral floor sills shall be secured to concrete floors or equipment pads with anchor bolts.

Adequate bracing shall be provided for seismic forces. The bracing shall be designed to meet the requirements of the Meteorological and Seismic Design Criteria section.

3-1.01. Cleaning. All deposits of oil, grease, mud, dirt or debris shall be cleaned from the electrical equipment following installation and field wiring. A detergent

water-based solution, or other liquid cleaners not harmful to material or equipment finishes, shall be used as recommended by the manufacturer.

End of Section

Section 16150

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1-1. SCOPE. This section covers pulse width modulated (PWM) type variable frequency drives (VFD) for the RAS pumps located in the Pump Room as shown in the drawings. VFD shall meet the design conditions and features specified herein.

Driven equipment specification number.	11150	11150	11150	11150
Unit designations.	VFD 4-1-1	VFD 4-1-2	VFD 4-1-3	VFD 4-1-4

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Equipment provided under this section shall be fabricated as specified in this section and as shown on the schematics and one line diagrams on the Drawings.

Unless otherwise indicated on the Drawings, one variable frequency drive, complete with all required control components, shall be furnished for each motor.

VFD shall be designed, manufactured, supplied, and warranted as a complete system by the VFD manufacturer. Fabrication and assembly of the drive system not directly controlled by the VFD manufacturer will not be acceptable.

1-2.01. Coordination. The design of the variable frequency drive shall be coordinated with the driven equipment. Contractor shall be responsible for coordinating the collection of data and the design effort to limit harmonics to the levels specified. The manufacturer of the driven equipment shall be responsible for furnishing the variable frequency drive. Contractor shall be responsible for coordinating variable frequency drive equipment amongst the driven equipment suppliers to ensure all drives are a product of the same manufacturer.

Contractor shall field verify all existing communication and control wiring between the existing PLC FP-2-1 and the four existing RAS pumps VFDs. The configuration and all functions of the new drives should match that of

the existing drives. Existing VFDs are Allen-Bradley model 1336 II. Contractor shall coordinate with owner and with drives' manufacturer to finish the development of the VFD schematics.

1-2.02. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all equipment furnished under this section. If requirements in this section differ from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence.

1-2.03. Seismic Design Requirements. Seismic design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section.

1-2.04. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values. The supplier shall review the Drawings, the manufacturer's layout drawings and installation requirements, and make any modifications required for proper installation subject to acceptance by Engineer.

1-2.05. Workmanship and Materials. Equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with applicable governing standards. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

1-2.06. Governing Standards. The variable frequency drive shall be designed, constructed, and tested in accordance with the applicable standards of NEMA, ANSI, UL, and IEEE, and shall be designed for installation in accordance with the NFPA 70.

The equipment covered by this section shall be listed by UL or a nationally recognized third-party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor. In the event no third-party testing laboratory provides the required listing, an independent test shall be conducted at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure to Engineer.

1-2.07. Nameplates. Nameplates with the description and designation of each control or indicating device shall be provided. Unless specified otherwise, each drive enclosure shall be provided with a nameplate bearing the unit designation as indicated above. Nameplates shall be white on black laminated phenolic material of suitable size, and shall be engraved with 3/8 inch [10 mm] high letters for the drive designation and 3/16 inch [5 mm] letters for other information. The engraving shall extend through the white exterior lamination to the black center.

Each control device and each control wire terminal block connection inside the enclosure shall be identified with permanent nameplates or painted legends to match the identification on the manufacturer's wiring diagram.

1-3. DESCRIPTION. The VFD shall produce an adjustable ac voltage/frequency output and shall be equipped with an output voltage regulator to maintain correct output V/Hz despite incoming voltage variations.

1-3.01. Six-Pulse Drives. Drives for motors rated below 100 horsepower, shall be of the pulse-width modulated type and shall consist of a full-wave diode or gated-open SCR bridge. The rectifier shall convert incoming fixed voltage and fixed frequency to a fixed dc voltage. The pulse-width modulation technology shall be of the space vector type, implemented in a microprocessor that generates a sine-coded output voltage.

The drive inverter output shall be generated by insulated gate bipolar transistors (IGBT) which shall be controlled by six identical base driver circuits. The drive shall not induce excessive power losses in the motor. The worst case RMS motor line current measured at rated speed, torque, and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.

1-3.02. Eighteen-Pulse Drives and Active Front End Drives. Not used.

1-4. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the drive shall be submitted in accordance with the Submittal Procedures section. The drawings and data shall include, but shall not be limited to, the following:

a. Name of manufacturer.
b. Types and model numbers.
c. Rated drive input kVA and output kVA.
d. Percent efficiency at 100 percent speed and 60 percent speed.
e. Maximum Btu [kJ] heat release data and verification of the drive cooling requirements.

f. Total weight and lifting instructions, height, mounting, and floor space required.
g. Panel interior and front and side exterior view details showing maximum overall dimensions of all transformer, bypass contactor, ac line filter, ac line reactor, and drive compartments.
h. Schematics, including all interlocks.
I. Wiring diagrams, including all internal and external devices and terminal blocks.
j. Locations and sizes of electrical connections, ground terminations, and shielded wires.
k. List of diagnostic indicators.
l. List of fault and failure conditions that the drive can recognize and indicate for simultaneous occurrence.
m. List of standard features and options.
n. List of spare parts to be furnished.
o. Input line protection model numbers and manufacturer's data sheets.
p. Output filter model number and manufacturer's data sheets.
q. UL 508C Certificate of Compliance for short circuit current rating.
r. Submit confirmation of compliance with the requirements of the Meteorological and Seismic Design Criteria section.
s. Not used.
t. Harmonic calculations by the drive manufacturer at the points of analysis. Detailed drawings and information showing how protection is applied to comply with harmonic limits.

1-5. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied. Operation and maintenance manuals shall be submitted in accordance with the Submittal Procedures section.

Operation and maintenance manuals shall include the following:

a. Manufacturer's operation and maintenance manual for each size of variable frequency drive.
b. Manufacturer's standard manuals for each size and type of bypass contactor, transformer, line reactor, and filter.
c. Schematics, wiring diagrams, and panel drawings in conformance with construction record.
d. Model numbers and up-to-date cost data for spare parts.
e. Troubleshooting procedures, with a cross-reference between symptoms and corrective recommendations.
f. Connection data to permit removal and installation of recommended smallest field-replaceable parts.

g. Information on testing of power supplies and printed circuit boards and an explanation of the drive diagnostics.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-6. SPARE PARTS. The drive manufacturer shall provide spare parts for each type and size of drive supplied. The spare parts shall include at least one complete set of all plug-in components for each size and type of drive, and shall include the following:

Power fuses

Control fuses

Indicating lights

Rectifier power semiconductors

Inverter power semiconductors

One of each type printed circuit board and gate firing board

Other field-replaceable component parts

Spare parts shall be suitably packaged, as specified herein, with labels indicating the contents of each package. Spare parts shall be delivered to Owner as directed.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS. All drives shall be pulse-width modulated type, as manufactured by Rockwell Automation without exception. The products of other manufacturers will not be acceptable.

All variable frequency drives shall be a product of the same manufacturer.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS.

2-2.01. Performance. The variable frequency drive controller shall be of sufficient capacity and shall produce a quality output waveform for stepless motor control from 10 to 100 percent of base speed. The variable frequency drive shall be suitable for loads and shall have voltage ratings as follows:

Unit designations	VFD 4-1-1, VFD 4-1-2, VFD 4-1-3 VFD 4-1-4
Load type	Constant torque

Input voltage 480 volt, 3 phase

The variable frequency drive shall be suitable for operation at an elevation below 3300 ft [1000 m], and shall meet the following ratings and parameters:

Input frequency	60 Hz
Input voltage and frequency variation	±10 percent voltage variation, ±2 Hz; imbalance, 2 percent maximum. Continued operation with additional momentary 25 percent voltage dip of 0.5 second duration from nominal input voltage level.
Minimum drive efficiency	95 percent at 100 percent speed, 90 percent at 60 percent speed.
Ambient temperature	0 to 40°C.
Relative Humidity	0 to 95 percent non-condensing.
Displacement Power Factor	95 percent or higher throughout the entire operating speed range, measured at drive input terminals.
Drive service factor	1.0.
Overcurrent capability	110 percent for 1 minute for variable torque; 150 percent for 1 minute for constant torque.
Volts/Hz ratio	Voltage varies as the square of frequency over the entire range of the unit for variable torque drives, linear over the entire range of the unit for constant torque drives; except under voltage boost condition.
Acceleration/deceleration time	Adjustable over a range that meets the requirements of the drive equipment.
Output speed regulation	0.5 percent.
Output frequency stability	0.5 percent of nominal.

2-2.02. Adjustments. The following drive adjustments shall be provided:

Maximum speed.

Minimum speed.

Linear acceleration time.

Linear deceleration time.

Volts/Hz ratio; linear, squared, and automatic settings.

Voltage boost.

Process follower gain, offset, and bias.

Torque limit.

Critical frequency avoidance with adjustable bandwidth.

2-2.03. Fault Protection. Design of the power circuit shall include provisions for protection against fault conditions as follows.

2-2.03.01. Input Protection.

The drive assembly shall be UL 508C listed. A UL Certificate of Compliance shall be submitted to confirm product compliance with UL 508C and to indicate the short circuit current rating. The short circuit current rating shall meet or exceed the available short circuit current indicated on the Drawings.

Solid state instantaneous overcurrent trip set at 180 percent.

Adjustable overvoltage and undervoltage protection with automatic restart.

Phase loss and reverse phase trip with manual restart.

2-2.03.02. Internal Protection.

AC line, phase-to-phase transient voltage surge suppression utilizing metal oxide varistors. Drive shall meet the requirements of IEEE C62.41.

Power device snubbers.

Power devices rated 2.5 times line voltage.

Instantaneous overcurrent.

Static overspeed (overfrequency) protection.

DC bus overvoltage trip.

Components and labeling that comply with UL 508 requirements. Drives shall be equipped with an automatic discharge circuit to deplete the charge on the DC capacitor bank to less than 50 volts within 60 seconds after main input power is removed. Labels indicating derivative voltage sources and required wait time for servicing after power removal shall be placed on all applicable enclosures.

Individual transistor overtemperature and overcurrent protection.

Control logic circuit malfunction indication.

2-2.03.03. Output Protection.

Inverse-time motor overload protection adjustable from 10 percent to 100 percent.

Overvoltage protection.

Overfrequency protection.

Short circuit protection (three phase, phase to phase, and ground fault protection).

Protection against opening or shorting of motor leads.

Static overspeed protection.

Stall protection on overload with inverse time overcurrent trip, adjustable current limit from 10 percent to 120 percent.

2-2.04. Harmonic Distortion Abatement. Not used N

2-3. CONSTRUCTION. Construction requirements shall be as follows and as specified below:

Unit designations	VFD 4-1-1, VFD 4-1-2, VFD 4-1-3, VFD 4-1-4
Cable entry	Top
Cable exit	Top
Enclosure type	NEMA Type 4X with fans, filters, and gasketed doors
Maximum drive dimensions	34” Wide 15” Deep 84” High

Adequate bracing shall be provided for seismic forces. The bracing shall be designed to meet the requirements of the Meteorological and Seismic Design Criteria section.

2-3.01. Fabrication and Assembly. The variable frequency drive system shall be shop assembled in a single enclosure using interchangeable plug-in printed circuit boards and power conversion components wherever possible. Shop assembly shall be performed by the drive manufacturer, or a manufacturer approved assembly center under the direction and control of the drive manufacturer; systems fabricated, assembled, and supplied in whole or in part by parties other than the drive manufacturer will not be acceptable. Changes to the drive manufacturer's product by a distributor or system integrator are not allowed.

Input line reactors, fuses, circuit breakers, and filters, where required, shall be mounted within the drive enclosure, without exception. Isolation/voltage matching transformers, where required, may be enclosed separately from the remaining drive equipment.

The variable frequency drive system shall be designed to fit in the space indicated on the Drawings.

2-3.02. Wiring. Internal cabinet wiring shall be neatly installed in wireways or with wire ties where wireways are not practical. Where wireway is used, they are to be mounted to the panel surface with a continuous run of 3M brand, or equal, industrial two-sided adhesive strip. For 12 AWG wire sizes and smaller, and in bundles of six or less, wire tie-down square mounting straps shall be permitted. Tie-down mounts shall be installed at 8” increments or less. All mounting surfaces shall be pre-cleaned with isopropyl alcohol to ensure proper adhesion over the life of the equipment.

Terminal blocks shall be non-brittle, interlocking, track-mounted type, complete with a marking strip, covers, and pressure connectors. Screw terminals will not be acceptable. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. In freestanding panels, 8 inches [200 mm] of clearance shall be provided between terminals and the panel base for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Terminals shall be labeled to agree with the identification on the submittal drawings. Each control loop or system shall be individually fused, clearly labeled, and located for ease of maintenance.

All grounding wires shall be attached to the sheet metal enclosure with a ring tongue terminal. The surface of the sheet metal shall be prepared to ensure good conductivity and corrosion protection.

Wires shall not be kinked or spliced and shall be color coded or marked on both ends. The markings or color coding shall agree with the submittal drawings.

With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for at least 600 volts, with a moisture-resistant and flame-retardant covering rated for at least 90°C.

2-3.03. Enclosures. The drive shall consist of factory mounted and wired components within an enclosure, arranged so no electrically live components, terminals, or conductors are accessible on the front panel or door when the enclosure door is open.

The complete drive package, including accessories, shall fit into the space indicated on the Drawings.

Freestanding panels shall be suitable for mounting on a concrete pad and shall include provisions for anchoring to the supporting structure. Suitable lifting facilities shall be provided for handling and shipment.

Relays, terminals, and special devices inside the control enclosure shall have permanent markings to match the identification on the manufacturer's wiring diagrams.

2-3.04. Printed Circuit Boards. All plug-in type boards shall be mechanically held at the circuit board connector. Compression fit only at the connector will not be acceptable.

2-3.05. Shop Painting. All iron and steel surfaces, except machined surfaces and stainless steel, shall be shop cleaned in accordance with the coating manufacturer's recommendations, and finished with the drive manufacturer's standard coating. Finish color shall be manufacturer’s standard color. Dry film thickness of the finish coat shall be at least 4 mils [100 µm]. Field painting, other than touch up, will not be required. A sufficient quantity of additional coating material and thinner shall be furnished for field touch up of damaged coatings.

2-4. OPTIONAL EQUIPMENT.

2-4.01. Bypass Switch. Not used.

2-4.02. AC Line Reactors. Each six-pulse VFD, where isolation/voltage matching transformers are not used, shall be supplied with an input ac line reactor. AC line reactors shall be designed to address performance issues of

NEMA MG1-20.55 and to provide proper transient protection of the VFD input power devices. AC line reactors shall be factory mounted and wired within the VFD enclosure. AC line reactors shall be K-rated per IEEE C57-110 and shall be TCI Model KLR, or equal.

2-4.03. Harmonic Filters. Not used.
2-4.04. Isolation/Voltage Matching Transformers. Not used.

2-4.05. Power Factor Correction Capacitors. Not used.

2-4.06. Output dV/dt Filters. Not used.

2-5. CONTROLS.

2-5.01. Features. Each drive shall include the following features in addition to those indicated on the Drawings:

a. A door mounted membrane keypad with integral two-line, 24 character minimum LCD display that is capable of controlling the VFD and setting drive parameters. The keypad module shall be programmed with factory set drive parameters in nonvolatile EEPROM or FLASH memory and shall be resettable in the field through the keypad.
b. Control switches and pilot lights shall be provided as indicated on the schematic diagrams. Manual-automatic and start-stop controls included as features of the drive keypad shall be password protected or disabled to prevent override of control switches and safety interlocks shown on the schematic diagrams.
c. Control switches and pilot lights shall be 30.5 mm heavy-duty, oiltight construction. Pilot lights shall be full voltage type with LED lamps.
d. Microprocessor-based regulator. Nonvolatile memory modules shall have a useful life of at least 20 years without requiring battery or module replacement.
e. Input thermal-magnetic molded-case circuit breaker disconnect with interrupting capacity rated in RMS symmetrical amperes as required, and labeled in accordance with UL standard 489. The disconnect shall be mounted inside the controller enclosure and shall have door interlocks and a handle with provisions for padlocking in the "Off" position.
f. Manual speed adjustment.
g. Indications of power "On", drive "Run", and drive "Fault". Indication of these parameters shall be provided by full voltage type LED pilot

lights. Lamps shall be easily replaceable from the front of the indicating light.

h. Elapsed time meter.

i. Speed indication - calibrated in percent rpm.

j. Control circuits of not more than 115 volts supplied by internal control power transformers. Control power transformers shall have additional capacity as required by external devices indicated on the Drawings. Control power transformers shall be equipped with two primary leads fused, one secondary lead fused, and one secondary lead grounded.

k. Automatic controller shutdown on overcurrent, overvoltage, undervoltage, motor overtemperature and other drive fault conditions. Controller shutdown shall be manually reset type. Terminals shall be provided for control wiring from motor temperature switches, or a motor protection relay located in the drive enclosure.

l. Diagnostic indicators that pinpoint failure and fault conditions. Indicators shall be manually reset to restore operation after abnormal shutdown.

m. Accept a remote 4-20 mA speed control signal.

n. Process control output for remote 4-20 mA speed indication, rated 0 to 100 percent speed.

o. Spare interlock contacts rated 5 amperes at 120 volts ac, wired separately to the unit terminal board. One NO and one NC isolated spare interlock shall be furnished with each drive. Additional interlock contacts shall be provided as indicated on the Drawings.

p. Drive fault and run status contacts for remote indication, rated 5 amperes at 120 volts ac.

q. Speed droop feature, which reduces the speed of the drive on transient overloads. The drive shall return to set speed after the transient is removed. If the acceleration or deceleration rates are too rapid for the moment of inertia of the load, the drive shall automatically compensate to prevent drive trip.

r. Individual adjustable speed profile settings for start, stop, entry, slope, and minimum and maximum speed points.

s. Coast, controlled ramp, or dc injection selectable modes of stopping.

t. Not used.

u. Adjustable PWM carrier frequency. The inverter output section shall be provided with adjustable PWM carrier frequency from 500 Hz to at least 8 kHz.

2-5.02. Diagnostics. Diagnostic indicators on the face of the drive shall display the type of fault responsible for drive shutdown, warning, or failure. If two or

more faults occur simultaneously, the diagnostic segment shall record or indicate each condition. The drive shall be capable of storing 6 events.

2-5.03. Motor Protection Relay. Not used.

2-6. TESTING. All power switching components shall be pre-run under anticipated operating temperature and load conditions. Any alternative testing procedures shall be submitted and pre-approved before proceeding.

2-6.01. Factory Testing. After the drive system has been assembled at the manufacturer's facility, it shall be tested for at least 4 hours before it is shipped. The complete drive system, including all peripherals, shall be factory tested under simulated operating conditions, including normal operating sequences and fault conditions. Contact closure inputs and simulated driven-outputs shall be connected to the system input/output modules.

A test report summary indicating satisfactory final test results shall be submitted to Engineer before shipment of the equipment.

PART 3 - EXECUTION

3-1. INSTALLATION. Installation shall be in accordance with Electrical Equipment Installation section.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, set all relays in accordance with the settings designated in the coordination study, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Commissioning Requirements section, and shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

3-2.02. Installation Supervision. The equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation. Such services shall be included in the Contract price.

Manufacturers' installation supervisor shall observe, instruct, guide, and direct the installing Contractor's erection or installation procedures. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.

All costs for these services shall be included in the Contract Price. Contractor shall include a minimum of three day(s) and three trip(s) to the site.

3-3. FIELD HARMONIC DISTORTION TEST. Not used.
N
NO
No
3-4. TRAINING. The manufacturer's representative shall provide training of Owner's personnel as described in the Demonstration and Training specification. All costs for training services shall be included in the Contract Price.

Up to four employees of Owner, shall be trained in the proper operation, troubleshooting, and maintenance of the equipment. Training shall be conducted by a qualified representative, and shall consist of combined classroom and hands-on instruction. Training shall be conducted at a place and time mutually agreeable to Owner and the drive manufacturer.

Contractor shall include a minimum of three day(s) and three trip(s) to the site.

End of Section