TECHNICAL SPECIFICATIONS FOR THE CONSTRUCTION OF THE

ARLINGTON EAST WATER RECLAMATION FACILITY RAS VALVE REPLACEMENT

BID SET

JEA PROJECT NO. 8005520

FEBRUARY 2020

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No. 69657
INSTRUMENTATION

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ARLINGTON EAST WATER RECLAMATION FACILITY

RAS VALVE REPLACEMENT

SECTION 00 01 10

TABLE OF CONTENTS

PROCUREMENT AND CONTRACTING REQUIREMENTS (SEE SOLICITATION PROVIDED BY JEA)

DIVISION 01 – GENERAL REQUIREMENTS

071419CB

DIVISION 02 – EXISTING CONDITIONS (NOT USED)

DIVISION 03 – CONCRETE (NOT USED)

DIVISION 04 – MASONRY (NOT USED)

DIVISION 05 – METALS (NOT USED)

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES (NOT USED)

DIVISION 07 – THERMAL AND MOISTURE PROTECTION (NOT USED)

DIVISION 08 – OPENINGS (NOT USED)

DIVISION 09 – FINISHES (NOT USED)

DIVISION 10 – SPECIALTIES (NOT USED)

DIVISION 12 – FURNISHINGS (NOT USED)

DIVISION 13 – SPECIAL CONSTRUCTION (NOT USED)

DIVISION 21 – FIRE SUPPRESSION (NOT USED)

DIVISION 22 – PLUMBING (NOT USED)

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) (NOT USED)

DIVISION 26 – ELECTRICAL (NOT USED)

DIVISION 27 – COMMUNICATIONS (NOT USED)

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY (NOT USED)

DIVISION 31 – EARTHWORK (NOT USED)

DIVISION 32 – EXTERIOR IMPROVEMENTS (NOT USED)

DIVISION 33 – UTILITIES (NOT USED)

DIVISION 35 – WATERWAY AND MARINE CONSTRUCTION (NOT USED)

DIVISION 40 – PROCESS INTERCONNECTIONS

Section	Title
40 61 13	Process Control System General Provisions
40 61 14	Preliminary Design Review
40 61 15	Process Control System Submittals
40 61 21	Process Control System Testing
40 61 21.72	Field Testing
40 61 21.73	Final Acceptance Test
40 61 26	Process Control System Training
40 61 93	Process Control System Input-Output List
40 61 96	Process Control Descriptions
40 68 00.13	Process Control Software (Modify Existing)

DIVISION 41 – MATERIAL PROCESSING AND HANDLING EQUIPMENT (NOT USED)

DIVISION 43 – PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT (NOT USED)

DIVISION 44 – POLLUTION AND WASTE CONTROL MANAGEMENT (NOT USED)

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT (NOT USED)

APPENDICES

Section	Title
A	Existing RAS Process Flow Diagram, Drawing M001
B	JEA Programming Standards (B-1 through B-5)

SECTION 01 11 00

SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Summary
2. Location and Description of Work
3. Construction Contracts, This Project
4. Construction Contracts, Other Projects
5. Work by Others
6. Work by Owner
7. Owner Furnished Equipment and Materials
8. Owner Assigned Procurement Contracts
9. Owner Pre-selected Equipment and Materials
10. Sequence and Progress of Work
11. Contractor's Use of Site
12. Easements and Rights-of-Way
13. Notices to Owners and Authorities of Properties Adjacent to the Work
14. Salvage of Equipment and Materials
15. Partial Utilization by Owner

1.02 LOCATION AND DESCRIPTION OF WORK

A. The Work is located at the following Site:

1. Arlington East WRF, 1555 Millcoe Rd, Jacksonville, FL

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B. The Work to be performed under this Contract includes, but is not limited to, constructing the Work described below and all appurtenances related to the Work. The Work shall be as follows:

1. Implement a functional control description for control of the eight RAS valves to automatically distribute RAS flow to each online aeration basin based on the weighted demand of one basin relative to all online basins. A most-open-valve algorithm will be included to keep the RAS valves as open as possible to minimize energy consumption.

C. The Work to be performed under this Contract shall be completed within twelve weeks of Notice to Proceed.

1.03 CONSTRUCTION CONTRACTS, THIS PROJECT

A. The documents under which the Project will be constructed are:

1. Work specified in Divisions 1 through 46 (inclusive) of the Specifications.

1.04 CONSTRUCTION CONTRACTS, OTHER PROJECTS

A. Secondary Clarifier Addition, Contractor: Ortega Industrial with C2i

B. Odor Control Improvements, Contractor: Brasfield & Gorrie

1.05 WORK BY OTHERS (NOT USED)

1.06 WORK BY OWNER

A. Owner will perform the following in connection with the Work: Operate all existing valves, gates, pumps, equipment, and appurtenances that will affect Owner's operation, unless otherwise specified or indicated.

1.07 OWNER-FURNISHED EQUIPMENT AND MATERIALS (NOT USED)

1.08 OWNER ASSIGNED PROCUREMENT DOCUMENTS (NOT USED)

1.09 OWNER PRE-SELECTED EQUIPMENT AND MATERIALS (NOT USED)

1.10 SEQUENCE AND PROGRESS OF WORK

A. Requirements for sequencing and coordinating with Owner's operations, including maintenance of plant operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 00 – Coordination with Owner's Operations.

1.11 CONTRACTOR'S USE OF SITE

A. Contractors' use of the Site shall be confined to the main control room for implementation of automated controls. Contractors shall share use of the Site with other contractors and others specified in this Section.

B. Contractor shall move stored products if they interfere with operations of Owner, other contractors, or others performing work for Owner.

1.12 EASEMENTS AND RIGHTS-OF-WAY

A. Confine construction operations to within Owner's property and the limits shown. Use care in placing construction tools, equipment, excavated materials, and products to be incorporated into the Work to avoid damaging property and interfering with traffic and plant operation.

1.13 NOTICES TO OWNERS AND AUTHORITIES OF PROPERTIES ADJACENT TO THE WORK (NOT USED)

1.14 SALVAGE OF EQUIPMENT AND MATERIALS

A. Existing equipment and materials removed and not shown or specified to be reused in the Work will be Contractor's property.

B. Existing equipment and material removed by Contractor shall not be reused in the Work, except where specified or indicated.

C. Carefully remove in manner to prevent damage to all equipment and materials specified or indicated to be salvaged and reused or to remain property of Owner. Store and protect salvaged items. Replace in kind or with new items equipment, materials, and components damaged in removal, storage, or handling through carelessness or improper procedures.

D. Contractor may furnish and install new items at no additional cost, with Engineer's approval, instead of those specified or indicated to be salvaged and reused, in which case such removed items will become Contractor's property.

1.15 PARTIAL UTILIZATION BY OWNER

A. Owner reserves the right to enter and use portions of the Work prior to Certificate of Substantial Completion is issued by Engineer.

B. Owner shall be responsible to prevent premature connections by private and public parties, persons or groups of persons, before Engineer issues Certificate of Substantial Completion for the portion of Work being partially utilized by Owner.

C. Contractor shall cooperate with Owner, Owner's agents, and Engineer to accelerate completion of Work designed for partial utilization by Owner in accordance with Contractor's progress schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 14 00

COORDINATION WITH OWNER'S OPERATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for coordinating with Owner's operations during the Work and included requirements for tie-ins and shutdowns necessary to complete the Work without impact on Owner's operations except as allowed in this Section.

2. Contractor shall provide labor, materials, tools, equipment and incidentals shown, specified and required to keep facility operational during the Work.

B. General Requirements:

1. Except for process interruptions specified in this Section, perform the Work such that Owner's facility remains in continuous operation during the Project. Schedule and conduct the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, or cause odors or other nuisances.

2. Work not specifically covered in this Section or in referenced Sections may, in general, be completed at any time during regular working hours in accordance with the General Conditions and Supplementary Conditions, subject to the requirements in this Section.

3. Coordinate process interruptions with Owner and Engineer.

4. Do not shut off or disconnect existing operating systems, unless approved by Engineer in writing. Operation of existing equipment will be by Owner unless otherwise specified or indicated. Where necessary for the Work, Contractor shall seal Owner-operated valves to prevent leakage that may affect the Work, Owner's operations, or both. Provide temporary watertight plugs, bulkheads, and line stops as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer/Owner.

C. Continuous Treatment Provision:

1. Federal regulations prohibit bypassing of untreated or partially treated wastewater or sewage during construction Work.

1.02 DEFINTIONS

A. A “shutdown” is when a portion of the normal operation of Owner’s facility, whether equipment, systems, piping, or conduit, has to be temporarily suspended or taken out of service to perform the Work.

B. A “process interruption” is when a portion of the normal operation of Owner’s facility, related to the network, SCADA, control system, etc. has to be temporarily suspended or taken out of service to perform the Work.

1.03 ADMINSTRATIVE REQUIREMENTS

A. Coordination:

1. Notify other contractors in advance of Work requiring coordination with Owner’s operations, to provide other contractors sufficient time for work included in their contracts that must be installed with or before Work specified in this Section.

B. Pre-Process Interruption Meeting: Contractor shall schedule and conduct one meeting with Owner and Engineer prior to scheduling a process interruption. Pre- Process Interruption Meeting(s) shall be scheduled at least 7 calendar days before Process Interruption occurs. Additional Process Interruption meetings may be scheduled and conducted at the request of the Contractor.

C. Sequencing:

1. Perform the Work in the specified sequence. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Stages specified in this Section are sequential in performance of the Work.

D. Scheduling:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. If Contractor’s operations cause an unscheduled interruption of Owner’s operations, immediately re-establish satisfactory operation for Owner.

3. Unscheduled interruptions of continued safe and satisfactory operation of Owner’s facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer’s opinion, Contractor did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

1.04 SUBMITTALS

A. Action/Informational Submittals:

1. Process Interruption Planning Submittal:

a. For each Process Interruption, submit an estimate of time required to accomplish the complete Process Interruption including time for Owner to take down and start up existing equipment, and written description of steps required to complete the Work associated with the shutdown.

b. Furnish submittal to Engineer at least thirty (14) days prior to proposed Process Interruption start date. Do not start Process Interruption until obtaining Engineer's acceptance of planning submittal.

2. Process Interruption Notification: After acceptance of planning submittal and prior to starting the Process Interruption, provide written notification to Owner and Engineer of date and time each shutdown is to start. Provide notification at least 72 hours in advance of each Process Interruption.

3. Substitute Sequence Submittal: When deviation from specified sequence is proposed, provide submittal explaining in detail the proposed sequence change and its effects, including evidence that Owner's operations will not be adversely affected by proposed change. List benefits of proposed sequence change, including benefits to Progress Schedule.

1.05 SITE CONDITIONS

A. General Constraints: New systems may be used by Owner after the specified field quality controls and testing are successfully completed .

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

1. Schedule and perform Process Interruptions for Monday through Thursday. Owner approval will be required for Process Interruptions on Friday, Saturday, and Sunday.

2. Electrical, Control, Communication, and Monitoring Systems:

a. Owner's existing SCADA system and fiber optic network shall remain functional, subject to the constraints herein.

b. Fiber optic communications and network connectivity to the Administration Building shall remain operational.

c. Unless Contractor elects to use existing fiber and/or temporary fiber, at his/her discretion, at least one communication path shall be in place at all times until substantial completion.

d. Each process area shall be permitted to have a single, non-concurrent, scheduled outage for the purpose of making PLC panel hardware modifications, loading the associated PLC logic, and its field testing/demonstration. Field testing and demonstration shall immediately follow modifications in an effort to keep scheduled shutdowns as short as possible.

1.06 SUGGESTED SEQUENCE OF WORK

A. Perform the Work in the specified sequence or as otherwise approved by Engineer. Certain phases or stages of the Work may require working 24-hour days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed sequence change, and with Engineer's acceptance. Stages specified in this Section are sequence-dependent.

1. Contractor shall submit preliminary I&C design information and meet with JEA and Engineer to review.

2. Contractor shall submit proposed PLC and HMI programming changes for JEA and Engineer to review.

3. Upon approval of proposed programming changes and completion of the RAS valve replacement (by JEA), Contractor shall implement the I&C changes on site and begin field testing.

4. Contractor shall maintain capability to revert to manual control of the valves at all times should there be problems with automatic controls.

5. Contractor shall conduct field testing of the new programming and make adjustments to the RAS valve controls and the RAS pump controls as necessary to ensure smooth stable operation of the system.

6. Contractor shall demonstrate the completed system to JEA and Engineer.

7. Contractor shall complete all I&C testing required for substantial completion.

8. Contractor shall complete a 30-day final acceptance test of the I&C with the RAS valves and RAS pumps running in automatic mode to achieve final completion.

1.07 TIE-INS (NOT USED)

1.08 SHUTDOWNS (NOT USED)

1.09 PROCESS INTERRUPTIONS

A. General:

1. Work that may interrupt normal operations shall be accomplished at times convenient to Owner.

2. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.

3. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's / Owner's opinion, Contractor did not conform to the requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in conducting the Work.

B. Treatment Process Shutdown and Site Access Constraints:

1. Owner shall have the following unit processes and equipment operational at all times during the Project, unless specified herein:

All equipment associated with the treatment of wastewater

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL (NOT USED)

3.02 DETAILED PROCESS INTERRUPTION REQUIREMENTS

A. Prior to Typical process interruption:

1. Obtain Engineer's acceptance of proposed process interruption planning submittal and process interruption notification submittal.

2. Submittal and approval of all shop drawings required.

3. Coordinate with plant operations on timing of process interruption and provide required notice to Owner.

4. Assist Owner in preparing to take systems temporarily out of service.

5. Coordinate other work to be performed simultaneously.

B. During Typical process interruption:

1. Owner will adjust system to account for equipment, tanks and basins out of service .

2. Install control strategy.

3. Verify operation of control strategy.

4. Following approval from Engineer and/or Owner, return system to operation with Owner.

C. Following Typical process interruption:

1. Verify functionality of system.

2. Verify operation of new systems.

3.03 PROPOSED SHUTDOWN SEQUENCE (NOT USED)

END OF SECTION

SECTION 01 20 00

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Items listed in this Section refer to and are the same pay items listed in the Bid Form and constitute all pay items for completing the Work.

2. Compensation for all services, items, materials, and equipment shall be include in prices stipulated for lump sum and unit price pay items listed in this Section and included in the Contract.

3. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, bonds, insurance, or other requirements of the General Conditions, Supplementary Conditions, General Requirements, and other requirements of the Contract Documents.

4. Each lump sum and unit bid price shall include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

B. Related Sections:

1. Payments to Contractor: Refer to JEA Solicitation.

2. Changes to Contract Price: Refer JEA Solicitation and Section 01 26.

3. Schedule of Values: Refer to JEA Solicitation and Section 01 29.

1.02 ENGINEER'S ESTIMATE OF QUANTITIES (NOT USED)

1.03 ADMINISTRATIVE REQUIREMENTS

A. Contractor shall include all additional Work items, services, goods, resources, and manpower necessary for installation of the Work to provide a completely functional system in accordance with the Contract Documents. Contractor shall include these costs associated with providing a completely functional system within the listed items on the Bid Form and as specified herein.

B. Bid Items:

1. Item 1: Mobilization/Demobilization:

a. Measurement and Payment: (Limited to 5% of Grand Total): Payment will be made at the aggregate sum price bid, which aggregate sum shall be full compensation for the CONTRACTOR's mobilization on site, including but not limited to bonds, insurance, permit fees scheduling, temporary facilities and all other activities necessary to prepare to complete the Contract work.

2. Item 2: All Work associated with the Programming and Implementation of the Arlington East Water Reclamation Facility RAS Valve Control to make it ready for operation:

   a. Measurement and Payment: Shall include, but not be limited to: instrumentation and system integration and all other work necessary for a complete and fully functioning system, as specified and show in the Contract Documents, whether specifically mentioned or implied, except that Work specifically included for payment under any other Bid Item.

3. Item 3: Supplemental Work Authorization (SWA):

   a. The Owner will issue a written SWA to incorporate cost or schedule changes into the Contract. The SWA shall be used for increases and decreases in the Contract price, within the SWA amount set forth in the Bid, or to make changes in schedule for performance of the Work. An SWA work shall authorize the CONTRACTOR to perform changes in the Work. The CONTRACTOR shall not start on SWA work until the CONTRACTOR receives a fully authorized, written SWA form, signed by the appropriate JEA personnel – the CONTRACTOR shall not consider verbal statements as authorization to proceed with the changes. The CONTRACTOR should not expect that any SWAs will be issued. JEA shall have no obligation to pay for SWA work unless the same is performed pursuant to a written SWA form signed before the SWA work is commenced.

   b. The SWA for the Arlington East WRF RAS Valve Replacement project will be $8,000.

C. Alternate Bid Items: (NOT USED)

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. Section Includes:

1. General Conditions and Supplementary Conditions provision expansion, including the following:

a. Requests for interpretation.

b. Clarification notices

c. Field Orders

d. Work Change Directives

e. Proposal requests

f. Change Proposals

g. Change Orders

1.02 ADMINISTRATIVE REQUIREMENTS

A. Submit Contract modification documents to Engineer's contact person and address in the Contract Documents.

B. Retain at Contractor's office and at the Site complete copy of each Contract modification document and related documents, and Engineer's response.

1.03 REQUEST FOR INTERPRETATION

A. General:

1. Submit written or electronic requests for interpretation to Engineer. Contractor and Owner may submit requests for interpretation.

2. Submit request for interpretation to obtain clarification or interpretation of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents using requests for interpretation.

3. Do not submit request for interpretation when other form of communication is appropriate, such as submittals, requests for substitutions or "or equals", notices,

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ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action.

B. Procedure:

1. Submit one original (hard copy or electronic) of each request for interpretation. Submit each request for interpretation with separate letter of transmittal if hard copies are submitted.

2. Engineer will provide timely review of requests for interpretation. Allow sufficient time for review and response.

3. Engineer will maintain log of requests for interpretation. Copy of log will be provided upon request.

4. Engineer will provide written response to each request for interpretation. One copy of Engineer's response will be distributed to:

a. Contractor

b. Owner

c. Engineer

d. Owner's Site Representative (OSR)

C. If Engineer requests additional information to make an interpretation, provide information requested within ten (10) days, unless Engineer allows additional time, via correspondence referring to request for interpretation number.

D. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required, notify Engineer in writing before proceeding with the Work associated with the request for interpretation.

E. Submit each request for interpretation on a form acceptable to Engineer / Owner.

1. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number.

2. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail for engineer's response.

3. When applicable, request for interpretation shall include Contractor's recommended resolution.

1.04 CLARIFICATION NOTICES

A. General:

1. Clarification notices, when required, will be initiated and issued by Engineer.

2. Clarification notices do not change the Contract Price or Contract Times, and do not alter the Contract Documents.

3. Clarification notices will be issued as correspondence or using clarification notice form, with additional information as required.

B. Procedure:

1. Electronic copies of Clarification Notices will be maintained, stored, and distributed by electronic construction document management system.

2. If Contractor or Owner believes that a change in the Contract Price or the Contract Times or other change to the Contract is required, notify Engineer in writing before proceeding with the Work associated with clarification notice.

3. If clarification notice is unclear, submit request for interpretation.

1.05 FIELD ORDERS

A. General:

1. Field Orders, when required, will be initiated and issued by Engineer.

2. Field Orders authorize minor variations in the Work but do not change the Contract Price or Contract Times.

3. Field Orders will be in the form of Engineers Joint Contract Documents Committee (EJCDC) document C-942, “Field Order” or other Engineer’s accepted form.

4. Engineer will maintain a log of Field Orders issued.

B. Procedure.

1. Electronic copies of Field Orders will be maintained, stored, and distributed by electronic construction document management system.

2. If Contractor or Owner believes that a change in the Contract Price or the Contract Times or other change to the Contract is required, immediately notify Engineer in writing before proceeding with the Work associated with the Field Order.

3. If the Field Order is unclear, submit request for interpretation.

1.06 WORK CHANGE DIRECTIVE

A. General:

1. Work Change Directives, when required, order additions, deletions, or revisions to the Work.

2. Work Change Directives do not change the Contract Price or Contract Times but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

3. Work Change Directives will be in the form of EJCDC document C-940, “Work Change Directive” or other Engineer’s accepted form.

B. Procedure:

1. Three originals of Work Change Directive signed by Owner and Engineer will be furnished to Contractor, who shall promptly sign each original Work Change Directive and, within five days of receipt, return all originals to Engineer.

2. Original, signed Work Change Directives will be distributed as follows:

   a. Contractor: One original

   b. Owner: One original

   c. Engineer: One original

3. One hard copy of each Work Change Directive will be distributed to Owner’s Site Representative (OSR).

4. When required by Engineer, document for the Work performed under each separate Work Change Directive, for each day, the number and type of workers employed and hours worked; equipment used including manufacturer, model, and year of equipment, and number of hours; materials used, receipts for and descriptions of materials and equipment incorporated into the Work, invoices and labor and equipment breakdowns for Subcontractors and Suppliers, and other information required by Owner or Engineer, in a format acceptable to Engineer. Submit this documentation to Engineer as a Change Proposal.

1.07 PROPOSAL REQUESTS

A. General:

1. Proposal requests may be initiated by Engineer or Owner.

2. Proposal requests are for requesting the effect on the Contract Price and the Contract Times and other information relative to contemplated changes in the Work. Proposal requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.

3. Proposal requests will be furnished using the proposal request form included with this Section.

B. Procedure.

1. One copy of each signed proposal request will be furnished to Contractor with one copy each to:

a. Owner

b. Engineer

c. Owner's Site Representative (OSR)

2. Submit request for interpretation to clarify conflicts, errors, ambiguities, and discrepancies in proposal request.

3. Upon receipt of proposal request, Contractor shall prepare and submit a Change Proposal, in accordance with this Section, for the proposed Work described in the proposal request.

1.08 CHANGE PROPOSALS

A. General.

1. Submit written Change Proposal to Engineer in response to each proposal request, and when Contractor believes a change in the Contract Price or Contract Times or other change to the terms of the Contract is required.

B. Procedure.

1. Submit to Engineer one original and one copy of each Change Proposal with accompanying documentation, and simultaneously submit two copies to Owner. Submit each Change Proposal with separate letter of transmittal.

2. Engineer will review Change Proposal and either request additional information from Contractor or provide to Owner recommendation regarding approval of the Change Proposal.

3. When Engineer requests additional information to render a decision, submit required information within five days of receipt of Engineer's request, unless Engineer allows more time. Submit the required information via correspondence that refers to Change Proposal number.

4. Upon completing review, one copy of Engineer's written response, if any, will be distributed to:

    a. Contractor

    b. Owner

    c. Engineer

    d. Owner's Site Representative (OSR)

5. If Change Proposal is recommended for approval by Engineer and approved by Owner, a Change Order will be issued.

6. If parties do not agree on terms for the change, Owner or Contractor may file a Claim against the other, in accordance with the General Conditions and the Supplementary Conditions.

C. Each Change Proposal shall be submitted on a Change Proposal form acceptable to Engineer.

1. Number each Change Proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Proposal for the general contract for project named "Contract 23" would be, "Proposal No. 23-001".

2. In space provided on form:

    a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for Engineer's review and response. If a change item is submitted in response to proposal request, write in as scope, "In accordance with Change Proposal Request No." followed by the proposal request number. Provide written clarifications, if any, to scope of change.

    b. Provide justification for each proposed change. If change is in response to proposal request, write in as justification, "In accordance with Change Proposal Request No." followed by the proposal request number.

    c. List the total change in the Contract Price and Contract Times for each proposed change.

3. Unless otherwise directed by Engineer, attach to the Change Proposal detailed breakdowns of pricing (Cost of the Work and Contractor's fee) including:

    a. List of Work tasks to accomplish the change.

b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification.

c. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each.

d. Detailed breakdown of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier's written quotations.

e. Breakdowns of the Cost of the Work and fee for Subcontractors, including labor, construction equipment and machinery, and materials and equipment incorporated into the Work, other costs, and Subcontractor fees.

f. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions.

g. Other information required by Engineer.

h. Contractor's fees applied to eligible Contractor costs and eligible Subcontractor costs.

1.09 CHANGE ORDERS

A. General:

1. Change Orders will be recommended by Engineer and signed by Owner, and Contractor, to authorize additions, deletions, or revisions to the Work, or changes to the Contract Price or Contract Times.

2. Change Orders will be in the form of EJCDC document C-941, "Change Order" or other Owner's accepted form.

B. Procedure.

1. Five originals of each Change Order will be furnished to Contractor, who shall sign each original Change Order and return all originals to Engineer within five days of receipt.

2. Engineer will sign each original Change Order and forward them to Owner.

3. After approval and signature of all parties, three executed original copies will be returned to Engineer. Engineer will distribute as follows:

a. Contractor: One original

b. Owner: One original

c. Engineer: One original

4. One copy of each Change Order will be distributed to:

a. Owner's Site Representative (OSR)

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE

A. 2013 EJCDC Form C-942, Field Order

B. 2013 EJCDC Form C-940, Work Change Directive

C. 2013 EJCDC Form C-941, Change Order

END OF SECTION

Field Order No. _____

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

1) Contractor is hereby directed to promptly execute this Field Order, issued in accordance with General Conditions Paragraph 11.01, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference: _____ _____
Specification(s) Drawing(s) / Detail(s)

Description:

Attachments:

ISSUED:	RECEIVED:
By: _____	By: _____
Engineer (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____
Date: _____	Date: _____

Copy to: Owner

Work Change Directive No. _____

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

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments: [List documents supporting change]

Purpose for Work Change Directive:
Directive to proceed promptly with the Work described herein, prior to agreeing to changes on Contract Price and Contract Time, is issued due to: [check one or both of the following]

☐ Non-agreement on pricing of proposed change.

☐ Necessity to proceed for schedule or other Project reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price $ _____ [increase] [decrease].

Contract Time ____ days [increase] [decrease].

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price

☐ Cost of the Work ☐ Other

RECOMMENDED:	AUTHORIZED BY:	RECEIVED:
By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable)

By: _____ Date: _____

Title: _____

Change Order No. _____

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

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: [List documents supporting change]

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES [note changes in Milestones if applicable]
Original Contract Price: $	Original Contract Times: Substantial Completion: Ready for Final Payment: days or dates
[Increase] [Decrease] from previously approved Change Orders No. to No. : $	[Increase] [Decrease] from previously approved Change Orders No. to No. : Substantial Completion: Ready for Final Payment: days
Contract Price prior to this Change Order: $	Contract Times prior to this Change Order: Substantial Completion: Ready for Final Payment: days or dates
[Increase] [Decrease] of this Change Order: $	[Increase] [Decrease] of this Change Order: Substantial Completion: Ready for Final Payment: days or dates
Contract Price incorporating this Change Order: $	Contract Times with all approved Change Orders: Substantial Completion: Ready for Final Payment: days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____	By: _____	By: _____
Engineer (if required)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Title: _____	Title: _____	Title: _____
Date: _____	Date: _____	Date: _____

Approved Funding Agency (if required)

By: _____ Date: _____

Title: _____

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SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for preliminary and final Schedule of Values.

2. Schedule of Values and the Progress Schedule updates specified in Section 01 32 00 – Construction Progress Schedule, shall be basis for preparing each Application for Payment. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

1.02 ADMINSTRATIVE REQUIREMENTS

A. General Requirements:

1. Schedule of Values shall include breakdown of costs for materials and equipment, installation, and other costs used in preparing the Bid by Contractor and each Subcontractor. List purchase and delivery costs for materials and equipment for which Contractor may apply for payment as stored materials.

2. Include separate amounts for each Specification Section in the Contract Documents by structure, building, and work area.

3. Identify each line item with number corresponding to the associated Specification Section number. List sub-items of major products or systems, as appropriate or when requested by Engineer.

4. Include in Schedule of Values unit price payment items with their associated quantity. Provide in the Schedule of Values detailed breakdown of unit prices when required by Engineer.

5. Include in Schedule of Values itemized list of Work for each major part of the Contract, for each payment item specified in Section 01 20 00 – Measurement and Payment.

6. Sum of individual values shown on the Schedule of Values shall equal the total of associated payment item. Sum of payment item totals in the Schedule of Values shall equal the Contract Price.

032619

B. Specific Requirements:

1. Include in each line item a directly proportional amount of Contractor's overhead and profit. Do not include overhead and profit as separate item(s).

2. Include separate line item for each allowance, and for each unit price item

3. Include line item for bonds and insurance. Coordinate with Owner on limit according to Contract Price. This may be applied for in the first Application for Payment.

4. Include items for the General Conditions, permits (when applicable), construction Progress Schedule, and other items required by Engineer. Include such items in Applications for Payment on schedule accepted by Engineer and Owner

5. Line items for site maintenance such as dust control, compliance with storm water pollution prevention plans and permits, spill prevention control and countermeasures plans, and for construction photographic documentation; temporary utilities and temporary facilities, field offices, temporary controls, field engineering, and similar Work shall be included in the Schedule of Values and proportioned in Applications for Payment throughout duration of the Work.

6. Include separate line items under each appropriate payment item for mobilization and demobilization. Document for Engineer the activities included in mobilization and demobilization line items.

7. Costs for submittals, operations and maintenance manuals, field testing, and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by Engineer:

C. Preliminary Schedule of Values: Submit preliminary Schedule of Values to Engineer for initial review. Contractor shall incorporate Engineer's comments into the Schedule of Values and resubmit to Engineer. Engineer may require corrections and re-submittals until Schedule of Values is acceptable.

D. Time Frame for Submittals:

1. Submit preliminary Schedule of Values within ten days of date that the Contract Times commence running in accordance with the Notice to Proceed.

2. Submittal of the Schedule of Values shall be in accordance with the General Conditions. Engineer will not accept Applications for Payment without an acceptable Schedule of Values.

3. When required by Engineer, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.03 SUBMITTALS

A. Submit the following:

1. Seven copies of preliminary Schedule of Values.

2. Seven copies of Schedule of Values.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 29 76

PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Administrative and procedural requirements for progress payment to the Contractor by the Owner.

B. Related Sections:

1. Section 01 77 19 – Closeout Requirements.

1.02 ADMINSTRATIVE REQUIREMENTS

A. General: Contractor's request for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.

B. Procedure:

1. Review with Owner's Site Representative (OSR) quantities and the Work proposed for inclusion in each progress payment. Application for Payment shall cover only the Work and quantities recommended by the RPR/OSR.

2. Submit to Owner complete Application for Payment and other documents to accompany the Application for Payment as required by the Owner.

3. Owner will act on request for payment in accordance with the General Conditions and Supplementary Conditions.

C. Requirements:

1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.

2. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions. Legibly indicate on invoice or bill of sale the specific materials or equipment included in the payment request and corresponding bid/payment item number for each.

032619

3. Contractor's Affidavit is required for payment application and requests beginning with the second application for payment.

4. For payment requests that include payment for Work under an allowance, submit documentation acceptable to Owner of the authorization of allowance Work.

5. For payment requests (other than request for final payment) that include reduction or payment of retainage in an amount greater than that required in the Contract Documents, submit on form acceptable to Owner consent of surety to partial release or reduction of retainage.

D. Requirements for request for final payment are in the General Conditions, as modified by the Supplementary Conditions, and Section 01 77 19 – Closeout Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pre-Construction Meeting:

a. Purpose of conference is to designate responsible personnel, establish working relationships, discuss preliminary schedules submitted by Contractor, and review administrative and procedural requirements for the Project. Matters requiring coordination will be discussed and procedures for handling such matters will be established.

b. Date, Time and Location: Conference will be held after execution of the Contract and before Work starts at the Site. Engineer will establish the date, time, and location of conference and notify the interested and involved parties.

2. Progress Meetings:

a. Progress meetings will be held throughout the Project. Contractor shall attend each progress meeting prepared to discuss in detail all items on the agenda.

b. Owner will preside at progress meetings and will prepare and distribute minutes of progress meetings to all meeting participants and others as requested.

c. Date, Time and Location:

1) Regular Meetings: Every month on a day and time agreeable to Owner, Engineer, and Contractor.

2) Administration Building Conference room at the Site or other location mutually agreed upon by Owner, Contractor, and Engineer.

d. Additional meetings may be conducted as progress of Work requires at a mutually agreed date, time and location.

032619

1.02 ADMINSTRATIVE REQUIREMENTS

A. Pre-Construction Meeting:

1. Contractor shall provide pre-construction meeting submittals with sufficient number of copies for each attendee:

2. Required Attendees:

    a. Contractor

        1) Project manager

        2) Site superintendent

        3) Safety representative

        4) Major Subcontractors

    b. Owner

    c. Engineer

    d. Owner's Site Representative (OSR)

    e. Representatives of governmental or other regulatory agencies, as necessary

3. Contractor shall prepare and submit a health and safety plan, including confined space entry plan if necessary, as specified in this Section prior to the pre-construction meeting.

4. Agenda, minimum:

    a. Procedural requirements:

        1) Designation of responsible personnel

        2) Use of Site and Owner's requirements, including general regards for community relations

        3) Delivery of materials and equipment to the Site

        4) Safety and first aid procedures

        5) Confined space entry plan, if necessary

        6) Security procedures

        7) Housekeeping procedures

    b. Administrative requirements:

        1) Distribution of Contract Documents

2) Shop Drawing submittal procedures

3) Maintaining record documents at the Site

4) Contract modification procedures

5) Processing of Payment Application

c. Site mobilization requirements:

1) Working hours, overtime, and holidays

2) Field offices, trailers, and staging areas

3) Temporary facilities and utilities, including usage and coordination

4) Temporary controls, such as sediment and erosion control, noise, dust, storm water, and other measures

5) Access to Site, access roads, and parking for construction vehicles

6) Protection of traffic and existing property, including site barriers and temporary fencing

7) Security

8) Storage of materials and equipment

9) Reference points and benchmarks, surveys and layouts

10) Site maintenance during the project, including cleaning and removal of trash and debris

11) Site restoration

d. Schedules

1) Preliminary construction schedule

2) Critical work sequencing

3) Preliminary Shop Drawing submittal schedule

4) Preliminary Schedule of Values

B. Progress Meetings:

1. Progress meetings frequency shall be conducted as specified in this Section, unless modified and agreed upon by Owner, Contractor, and Engineer. Additional meetings may be conducted as progress of Work requires.

2. Contractor shall provide submittals specified in this Section prior to each progress meeting.

3. Attendance:

    a. Contractor, including project manager, site superintendent, safety representative, and representatives of Subcontractors and Suppliers as required.

    b. Engineer, including project manager (or designated representative), others as required by Engineer.

    c. Owner, including Owner's Site Representative.

    d. Subcontractors, only with Engineer's approval or request, as required in the agenda.

4. Agenda, minimum:

    a. Review of progress since the previous progress meeting.

    b. Planned progress through next 30 – 60 days.

    c. Review of Progress Schedule

        1) Contract Times, including Milestones (if any)

        2) Critical path.

        3) Schedules for fabrication and delivery of materials and equipment.

        4) Corrective measures, if required.

    d. Submittals:

        1) Review of status of critical submittals.

        2) Review revisions to schedule of submittals.

    e. Contract Modifications:

        1) Requests for interpretation

        2) Clarification notices

3) Field Orders

4) Proposal requests

5) Change Proposals

6) Work Change Directives.

7) Change Orders.

8) Claims.

f. Applications for progress payments.

g. Problems, conflicts, and observations.

h. Quality standards, testing, and inspections.

i. Coordination between parties.

j. Site management issues, including access, security, maintenance and protection of traffic, maintenance, cleaning, and other Site issues.

k. Safety.

l. Permits.

m. Record documents status.

n. Punch list status, as applicable.

o. Other business.

1.03 SUBMITTALS

A. Pre-Construction Meeting Submittals:

1. Prior to the conference, submit the following preliminary schedules in accordance with the General Conditions:

1) Progress schedule

2) Schedule of submittals

3) Schedule of values

2. Contractor’s safety and first aid procedures.

3. Confined space entry plan.

4. List of emergency contact information

B. Progress Meeting Submittals:

1. List of Work accomplished since the previous progress meeting.

2. Up-to-date Progress Schedule.

3. Up-to-date Schedule of Submittals.

4. Detailed “look-ahead” schedule of Work planned through the next progress meeting, with specific starting and ending dates for each activity, including shutdowns, deliveries of important materials and equipment, Milestones (if any), and important activities affecting the Owner, Project, and Site.

5. When applicable, list of upcoming, planned time off (with dates) for personnel with significant roles on the Project, and the designated contact person in their absence.

1.04 EMERGENCY CONTACT INFORMATION

A. Contractor shall provide list of emergency contact information for 24-hour use throughout the Project. Emergency contact information shall be updated and kept current throughout the Project. If personnel or contact information change, provide updated emergency contact information list at the next progress meeting.

B. Contractor’s list of emergency contact information shall include:

1. Contractor’s project manager’s office, field office, cellular, and home telephone numbers.

2. Contractor’s Site superintendent’s office, field office, cellular, and home telephone numbers.

3. Contractor’s foreman’s field office, cellular (if available), and home telephone numbers.

4. Major Subcontractors’ and Suppliers’ office, cellular, and home telephone numbers of project manager and foreman (when applicable).

C. Additional Emergency Contact Information:

1. Owner’s Project Manager: office, cellular, and home telephone numbers.

2. Owner’s central 24-hour emergency telephone number.

3. Engineer’s project engineer’s office, cellular, and home telephone numbers.

4. Owner's Site Representative's office, field office, cellular, and home telephone numbers.

5. Emergency telephone numbers, including: "Emergency: Dial 911", and seven-digit telephone numbers for the hospital, ambulance, police, and fire department nearest to the Site. Provide names of each of these institutions.

6. Other involved entities as applicable.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 00
CONSTRUCTION PROGRESS SCHEDULE

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall prepare and submit Progress Schedules and related documents in accordance with the Solicitation, general JEA standards and this Section, unless otherwise accepted by Owner.

1. Maintain and update Progress Schedules and related documents.

2. Progress Schedule shall be a Critical Path Method (CPM) Progress Schedule.

B. Owner's acceptance of the Progress Schedule or related documents, and comments or opinions concerning activities in the Progress Schedule and related documents shall not control independent judgment of Contractor concerning means, methods, techniques, sequences and procedures of construction, unless the associated means, method, technique, sequence, or procedure is directed by the Contract Documents. Contractor is solely responsible for complying with the Contract Times.

1.02 REFERENCES

A. Definitions:

1. Activity: An element of the construction work that has the following specific characteristics: consumes time, consumes resources, has a definable start and finish, is assignable, and is measurable.

2. Constraint: An imposed date on the Progress Schedule or an imposed tie between Activities. The Contract Times are Constraints.

3. CPM Progress Schedule: Computerized Progress Schedule in Critical Path Method (CPM) format which accounts for the entire Work, defines the interrelationships between elements of the Work, reflects the uncompleted Work, and indicates the sequence with which the Work has been completed, indicates the sequence in which uncompleted Work will be completed, and indicates the duration of each Activity.

4. Critical Path: The continuous chain of Activities with the longest duration for completion within the Contract Times.

5. Early Start: The earliest possible date an Activity can start according to the assigned relationships among Activities.

032619

6. Early Finish: The earliest date an Activity can finish according to the assigned relationships among the Activities.

7. Late Finish: The latest date an Activity can finish without extending the Contract Times.

8. Late Start: The latest date an Activity can start without extending the Contract Times.

9. Float: The time difference between the calculated duration of the Activity chain and the Critical Path.

10. Total Float: The total number of days that an Activity (or chain of Activities) can be delayed without affecting the Contract Times.

11. Network Diagram: A time-scaled logic diagram depicting the durations and relationships of the Activities.

12. Work Areas, Area, or System: A logical breakdown of the Project elements or a group of Activities which, when collectively assembled, are readily identifiable on the Project (for example, yard piping, a structure or building, a treatment process, or other logical grouping).

1.03 ADMINSTRATIVE REQUIREMENTS

A. Initial Progress Schedule:

1. Type and Organization of Progress Schedules:

   a. Prepare one Progress Schedule covering the entire Project using scheduling software that is acceptable to Owner.

   b. Sheet Size: 11” by 17”, unless otherwise accepted by Owner.

2. Preliminary Progress Schedule:

   a. Contractor shall submit to Engineer and Owner the preliminary Progress Schedule, in accordance with Owner standards, 10 days prior to the Preconstruction Meeting.

   b. Submit 3 copies of preliminary Progress Schedule and associated reports and schedule-related documents to accompany the preliminary Progress Schedule, in accordance with the Submittals Article of this Section. Submit in accordance with Section 01 33 00 – Submittal Procedures, unless otherwise required in the instruction to bidders.

3. Initial Acceptance of Progress Schedule:

a. At least 10 days before submission of the first Application for Payment, Contractor shall schedule a conference at the Site for review of the preliminary Progress Schedule.

1) Attendees shall include Contractor, Owner and others as required.

2) Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the Progress Schedule.

3) Owner reserves the right to not make progress payment to Contractor until acceptable Progress Schedule and other reports and schedule-related documents required are submitted to Owner.

b. Submit 3 copies each of acceptable Progress Schedule with reports, and other schedule-related documents required to accompany the initial acceptable Progress Schedule, in accordance with JEA standards.

c. Initially-accepted Progress Schedule shall be identified as the baseline Progress Schedule.

B. Progress Schedule Updates:

1. Update the Progress Schedule each month. If during progress of the Work events develop that necessitate changes in the initially accepted Progress Schedule (i.e., baseline Progress Schedule), identify updated Progress Schedules sequentially.

2. The update to the Progress Schedule shall be based on retained logic. Progress override logic is not allowed.

3. Required scheduling software, and schedule organization, format, and content for updated Progress Schedules are identical to that required in this Section for initial Progress Schedules.

4. Submit to Engineer 3 hard copies and an electronic copy of the updated Progress Schedule and other schedule-related reports and documents required.

1.04 NETWORK DIAGRAMS (PERT CHARTS) (NOT USED)

1.05 TIME IMPACT ANALYSIS (NOT USED)

1.06 RECOVERY SCHEDULES

A. General:

1. When updated Progress Schedule indicates that the ability to comply with the Contract Times falls 30 or more days behind schedule, and there is no excusable delay, Change Order, or Work Change Directive to support an extension of the Contract Times, Contractor shall prepare and submit a Progress Schedule demonstrating Contractor's plan to accelerate the Project to achieve compliance with the Contract Times (i.e., "recovery schedule") for Owner's acceptance.

2. Submit recovery schedule within 14 days after submittal of updated Progress Schedule where need for recovery schedule is indicated.

B. Implementation of Recovery Schedule:

1. At no additional cost to Owner, Contractor shall do one or more of the following:

a. Furnish additional labor and construction equipment

b. Employ additional work shifts

c. Expedite procurement of materials and equipment to be incorporated into the Work

d. Other measures necessary to complete the Work within the Contract Times.

2. Upon acceptance of recovery schedule by Owner, incorporate recovery schedule into the next Progress Schedule update.

C. Lack of Action: Contractor's refusal, failure or neglect to submit a recovery schedule, shall constitute reasonable evidence that Contractor is not prosecuting the Work or separable part thereof with the diligence that will ensure completion within the Contract Times. Such lack of action shall constitute sufficient basis for Owner to exercise remedies available to Owner under the Contract Documents

1.07 SUBMITTALS

A. Action/Informational Submittals:

1. Initial Progress Schedules:

a. Preliminary Progress Schedule.

b. Acceptable Progress Schedule.

2. Progress Schedule Updates:

a. Progress Schedule updates shall comply with JEA standards, and shall include updated Progress Schedule and necessary reports when relationships among Activities are changed.

b. Submit updated Progress Schedule at each progress meeting. If a Progress Schedule remains unchanged from one progress meeting to the next, submit a written statement to that effect.

3. Recovery Schedule: Submit in accordance with this Section.

4. Qualifications: Progress Schedule preparer, and other personnel that will assist Progress Schedule preparer in preparing and maintaining the Progress Schedule.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contractor shall provide submittals in accordance with the Solicitation, and this Section.

2. Contractor is responsible for dimensions to be confirmed and corrected at the Site, for information pertaining solely to the fabrication processes and to techniques of construction, and for coordinating the work of all trades. Contractor's signature of submittal's stamp and letter of transmittal shall be Contractor's representation that Contractor has met his obligations under the Contract Documents relative to that submittal.

B. Related Sections:

1. Section 01 25 00 – Substitution Procedures.

2. Section 01 78 23 – Operation and Maintenance Data.

3. Section 01 78 39 – Project Record Documents.

1.02 REFERENCES

A. Types of Submittals: When type of submittal is not specified and is not specified in this Section, Engineer will determine type of submittal.

1. Action/Informational Submittals:

a. Shop Drawings.

b. Product data.

c. Delegated design submittals in accordance with the General Conditions and as modified by the Supplemental Conditions.

d. Samples.

e. Testing plans, procedures, and testing limitations.

f. Design data not sealed and signed by a design professional retained by Contractor, Subcontractor, or Supplier.

g. Pre-construction test and evaluation reports, such as reports on pilot testing, subsurface investigations, potential Hazardous Environmental Condition, and similar reports.

h. Supplier instructions, including installation data, and instructions for handling, starting-up, and troubleshooting.

i. Sustainable design submittals (other than sustainable design closeout documentation).

j. Lesson plans for training and instruction of Owner's personnel.

2. Closeout Submittals:

a. Maintenance contracts.

b. Operations and maintenance data.

c. Bonds, such as maintenance bonds and bonds for a specific product or system.

d. Warranty documentation.

e. Record documentation.

f. Sustainable design closeout documentation.

g. Software.

3. Maintenance Material Submittals:

a. Maintenance materials schedule and checklist.

b. Spare parts.

c. Extra stock materials.

d. Tools.

4. Quality Assurance Submittals:

a. Performance affidavits.

032619

b. Certificates.

c. Source quality control submittals (other than testing plans, procedures, and testing limitations), including results of shop testing.

d. Field or Site quality control submittals (other than testing plans, procedures, and testing limitations), including results of operating and acceptability tests at the Site.

e. Supplier reports.

f. Special procedure submittals, including health and safety plans and other procedural submittals.

g. Qualifications statements.

1.03 ADMINSTRATIVE REQUIREMENTS

A. Submittal Requirements:

1. Contractor shall submit electronic copy of submittals for Engineer's review electronically (preferably via a Document Management Software or Sharepoint / Projectwise platform), unless otherwise specified in individual Specification Sections. Acceptable electronic formats are Adobe PDF, Microsoft Word, Autodesk DWF and AutoCAD.

2. Submittal shall be accompanied by letter of transmittal containing date, project title, Contractor's name, number and title of submittal, list of relevant Specification Sections, notification of deviations from Contract Documents, and other material required for Engineer's review.

B. Scheduling:

1. Provide submittals well in advance of need for the material or equipment, or procedure (as applicable), in the Work and with ample time required for delivery of material or equipment and to implement procedures following Engineer's approval or acceptance of the associated submittal. Work covered by a submittal will not be included in progress payments until approval or acceptance of related submittals has been obtained in accordance with the Contract Documents.

2. Submittals shall be provided by Contractor with at least 20 working days for review and processing.

1.04 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals, as specified in this Section:

1. Timing:

a. Provide submittal within time frames specified in the Contract Documents.

b. Provide updated Schedule of Submittals with each submittal of the updated Progress Schedule.

2. Content: In accordance with the General Conditions as modified by the Supplementary Conditions, and this Section. Requirements for content of preliminary Schedule of Submittals and subsequent submittals of the Schedule of Submittals are identical.

   a. Identify submittals required in the Contract Documents. Updates of Schedule of Submittals shall show scheduled dates and actual dates for completed tasks. Indicate submittals that are on the Project's critical path.

   b. Indicate the following for each submittal:

      1) Date when submittals are requested and received from Supplier.

      2) Date when certification is received from Supplier and when submitted to Engineer.

      3) Date when submittals are submitted to Engineer and returned with disposition from Engineer.

      4) Date when submittals are revised by Supplier and submitted to Engineer.

      5) Date when submittals are returned with "Furnish as Submitted" (FAS) or "Furnish as Corrected" (FAC) disposition from Engineer.

      6) Date when approved submittals are returned to Supplier.

      7) Date of Supplier scheduled delivery of equipment and material.

      8) Date of actual delivery of equipment and material.

      9) Whether submittal will be for a substitution or "equal". Procedures for substitutions and "or equals" are specified in the General Conditions and the Section 01 25 00 – Substitution Procedures.

      10) For submittals for materials or equipment, date by which material or equipment must be at the Site to avoid delaying the Work and to avoid delaying the work of other contractors.

3. Prepare Schedule of Submittals using same software, and in same format, specified for Progress Schedules.

4. Coordinate Schedule of Submittals with the Progress Schedule.

5. Schedule of Submittals that is not compatible with the Progress Schedule, or that does not indicate submittals on the Project's critical path, or that places extraordinary demands on Engineer for time and resources, is unacceptable. Do not include submittals not required by the Contract Documents.

6. In preparing Schedule of Submittals:

    a. Considering the nature and complexity of each submittal, allow sufficient time for review and revision.

    b. Reasonable time shall be allowed for: Engineer's review and processing of submittals, for submittals to be revised and resubmitted, and for returning submittals to Contractor.

    c. Identify and accordingly schedule submittals that are expected to have long anticipated review times.

1.05 ACTION/INFORMATIONAL SUBMITTALS

A. Provide the following Submittals in accordance with the individual Specification Sections, including, but not limited to, the following:

1. Product Data:

    a. Catalog cut-sheets

    b. Descriptive bulletins/brochures/specifications

    c. Material of construction data, including details on all components including applicable ASTM designations.

    d. Lifting, erection, installation, and adjustment instructions, and recommendations.

    e. Finish/treatment data, including interior and exterior shop coating systems.

    f. Equipment/material weight/loading data, including total uncrated weight of the equipment plus the approximate weight of shipped materials. Support locations and loads that will be transmitted to bases and foundations following installation. Size, placement, and embedment requirements of anchor bolts.

    g. Complete information regarding location, type, size, and length of all field welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.

h. Motor data, equipment and motor protective devices, and interconnection diagrams.

i. Engineering design data, calculations and system analyses

j. Digital system documentation

k. Operating sequence descriptions

l. Software/programming documentation

m. Manufacturer’s instructions

2. Shop Drawings:

a. Equipment and material layout drawings, including panel layout drawings.

b. System schematics and diagrams including, but not limited to, piping systems; HVAC and ventilation systems; process equipment systems; electrical operating systems; wiring diagrams; controls, alarm and communication systems.

c. Layout and installation drawings (interior and exterior) for all pipes, valves, fittings, sewers, drains, heating and ventilation ducts, all electrical, heating, ventilating and other conduits, plumbing lines, electrical cable trays, lighting fixture layouts, and circuiting, instrumentation, interconnection wiring diagrams, communications, power supply, alarm circuits, etc.

d. Layout and installation drawings shall show connections to structures, equipment, sleeves, valves, fittings, etc.

e. Drawings shall show the location and type of all supports, hangers, foundations, etc., and the required clearances to operate valves, equipment, etc.

f. Drawings for pipes, ducts, conduits, etc., shall show all 3 inch and larger electrical conduits and pressure piping, electrical cable trays, heating and ventilation ducts or pipes, structure, manholes or any other feature within four (4) feet (measured as the clear dimension) from the pipe duct, conduit, etc., for which the profile is drawn.

g. Equipment and material schedules.

3. Delegated design submittals, which include documents prepared, sealed, and signed by a design professional retained by Contractor, Subcontractor, or Supplier for materials and equipment to be incorporated into the completed Work. Delegated design submittals do not include submittals related to temporary

construction unless specified otherwise in the related Specification Section. Delegated design submittals include: design drawings, design data including calculations, specifications, certifications, and other submittals prepared by such design professional.

B. Samples:

1. General Requirements:

a. Conform submittal of Samples to the General Conditions as modified by the Supplementary Conditions, this Section, and the Specification Section in which the Sample is specified.

b. Furnish at the same time Samples and submittals that are related to the same unit of Work or Specification Section. Engineer will not review submittals without associated Samples and will not review Samples without associated submittals.

c. Samples shall clearly illustrate functional characteristics of product, all related parts and attachments, and full range of color, texture, pattern, and material.

2. Submittal Requirements:

a. Securely label or tag Samples with submittal identification number. Label or tag shall not cover, conceal, or alter appearance or features of Sample. Label or tag shall not be separated from the Sample.

b. Submit number of Samples required in Specifications. If number of Samples is not specified in the associated Specification Section, provide at least one identical Samples of each item required for Engineer's approval. If Contractor requires Sample(s) for Contractor's use, notify Engineer in writing and provide additional Sample(s). Contractor is responsible for furnishing, shipping, and transporting additional Samples.

c. Deliver one Sample to Engineer's field office at the Site. Deliver balance of Samples to location directed by Engineer.

1.06 CLOSEOUT SUBMITTALS

A. Provide the following Closeout Submittals in accordance with the individual Specification Sections, including, but not limited to, the following:

1. Maintenance contracts

2. Bonds for specific products or systems

3. Warranty documentation

4. Sustainable design closeout documentation.

5. Software programming and documentation.

B. On documents such as maintenance contracts and bonds, include on each document furnished original signature of entity issuing the document.

C. Operations and Maintenance Data: Submit in accordance with Section 01 78 23 – Operations and Maintenance Data.

D. Record Documentation: Submit in accordance with Section 01 78 39 – Project Record Documents.

E. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. For spare parts, extra stock materials, and tools, submit quantity of items specified in associated Specification Section.

B. Disposition: Dispositions and meanings are the same as specified for Informational Submittals.

1.08 CONTRACTOR'S RESPONSIBILITIES

A. Contractor shall review, coordinate, and verify submittals with Subcontractors, Manufacturers, and Suppliers, including field measurements at Site, in accordance with the General Conditions and as modified by Supplemental Conditions prior to submitting material for Engineer's review.

B. Contractor shall provide Contractor's stamp of approval certifying submittal material has been reviewed and conform to the Contract Documents prior to submitting material for Engineer's review.

C. Contractor shall provide written notice of deviations or variations that submittal may have with the Contract Documents.

D. Contractor shall provide bound, dated, labeled, tabulated, and consecutively numbered submittals as specified in the individual Specification Section. Label shall contain the following:

1. Specification Section.

2. Referenced Drawing number.

3. Subcontractor or Supplier name.

4. Type of equipment and/or materials.

E. Contractor shall perform the following after receiving Engineer's review disposition:

1. Order, fabricate, or ship equipment and materials included in the submittal (pending Engineer's review of source quality control submittals) with the following disposition:

a. "Furnish as Submitted" (FAS).

b. "Furnish as Corrected" (FAC).

c. "Furnish as Corrected – Confirm" (FACC), only portions of Work that do not require resubmittal for Engineer's review.

2. Resubmittal requirements:

a. Partial resubmittal of "Furnish as Corrected – Confirm" (FACC) returned dispositions, until Engineer's disposition is either "Furnish as Submitted" (FAS) or "Furnish as Corrected" (FAC).

b. Full resubmittal of material with Engineer's disposition of "Revise and Resubmit" (R&R), until Engineer's disposition is "Furnish as Submitted" (FAS), "Furnish as Corrected" (FAC), or "Furnish as Corrected – Confirm" (FACC) that requires a partial resubmittal.

c. Contractor shall be responsible for Engineer's charges to Owner if submittals are not approved within the number of specified submittals in accordance with the General Conditions. Engineer's charges shall include, but not limited to, additional review effort, meetings, and conference calls with Contractor, Subcontractor, or Supplier.

1.09 ENGINEER'S REVIEW

A. Engineer's review of the Contractor's submittal shall not relieve Contractor's responsibility under the Contract Document in accordance with the Solicitation. An acceptance of a submittal shall be intended to mean the Engineer does not have specific objection to the submitted material, subject to conformance with the Contract Drawings and Specifications.

B. Engineer's review of Contractor's submittal shall be confined to general arrangement and compliance with the Contract Documents, and shall not be for the purpose of checking dimensions, weights, clearances, fittings, tolerances, interferences, coordination of Subcontractor work, etc.

C. Review Dispositions:

1. “Furnish as Submitted” (FAS) – No exceptions are taken.

2. “Furnish as Corrected” (FAC) – Minor corrections are noted for Contractor’s correction.

3. “Furnish as Corrected – Confirm” (FACC) – Corrections are noted and partial resubmittal shall be made as noted.

4. “Revise and Resubmit” (R&R) – Corrections are noted and complete resubmittal shall be made. Submittal does not conform to applicable requirements of the Contract Documents and is not acceptable. Revise submittal and re-submit to indicate acceptability and conformance with the Contract Documents.

5. “Receipt Acknowledged” (RA) –

   a. Information included in submittal conforms to the applicable requirements of the Contract Documents and is acceptable. No further action by Contractor is required relative to this submittal, and the Work covered by the submittal may proceed, and products with submittals with this disposition may be shipped or operated, as applicable.

   b. Information included in submittal is for Project record purposes and does not require Engineer’s review or approval.

6. “Rejected” (R) – Information included in submittal does not conform to the applicable requirements of the Contract Documents and is unacceptable. Contractor shall submit products and materials as specified in the Contract Documents or provide required information for substitution as specified in the Contract Documents for consideration by Engineer.

D. Electronic Submittal Return to Contractor: Electronic submittals shall be returned electronically with dispositions provided.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 00

REFERENCES

PART 1 – GENERAL

1.01 SUMMARY

A. Definitions and terminology applicable to all the Contract Documents are included in the General Conditions and Supplementary Conditions.

1.02 REFERENCES

A. Abbreviations and Acronyms: Common abbreviations that may be found in the Contract Documents are listed below:

alternating current	a-c
ampere	A
Architectural Barriers Act	ABA
Americans with Disabilities Act	ADA
Americans with Disabilities Act Accessibility Guidelines	ADAAG
ante meridian	a.m.
average	avg
biochemical oxygen demand	BOD
brake horsepower	bhp
British thermal unit	Btu
Centigrade (or Celsius)	C
chlorinated polyvinyl chloride	CPVC
Code of Federal Regulations	CFR
cubic inch	cu in
cubic foot	cu ft
cubic yard	cdu yd, or CY
cubic feet per minute	cfm
cubic feet per second	cfs

degree Centigrade (or Celsius)	degrees C or ^{o}C
degrees Fahrenheit	degrees F or ^{o}F
diameter	dia
direct current	d-c
dollars	$
each	ea
efficiency	eff
Fahrenheit	F
feet	ft
feet per hour	fph
feet per minute	fpm
feet per second	fps
figure	Fig
flange	flg
foot-pound	ft-lb
gallon	gal
gallons per hour	gph
gallons per minute	gpm
gallons per second	gps
gram	g
grams per liter	g/L
Hertz	Hz
horsepower	hp or HP
hour	hr
human-machine interface	HMI
inch	in.
inches water gage	in. w.g.
inch-pound	in.-lb
inside diameter	ID

iron pipe size	IPS
thousand pounds	kips
thousand pounds per square inch	ksi
kilovolt-ampere	kva
kilowatt	kw
linear foot	lin ft or LF
liter	L
maximum	max
mercury	Hg
milligram	mg
milligrams per liter	mg/l or mg/L
milliliter	ml
millimeter	mm
million gallons per day	mgd or MGD
million gallons	MG
minimum	min
national pipe threads	NPT
net positive suction head	NPSH
net positive suction head available	NPSHA
net positive suction head required	NPSHR
nominal pipe size	NPS
number	no.
operator interface terminal	OIT
ounce	oz
ounce-force	ozf
outside diameter	OD
parts per hundred	pph
parts per million	ppm
parts per billion	ppb

polyvinyl chloride	PVC
post meridian	p.m.
pound	lb
pounds per square inch	psi
pounds per square inch absolute	psia
pounds per square inch gauge	psig
pounds per square foot	psf
process control system	PCS
programmable logic controller	PLC
revolutions per minute	rpm
second	sec
specific gravity	sp gr or SG
square	sq
square foot	sq ft or sf
square inch	sq in.
square yard	sq yd or SY
standard	std
standard cubic feet per minute	scfm
total dynamic head	TDH

B. Definitions: Terminology used in the Specifications includes:

1. “Indicated” refers to graphic representations, notes, or schedules on the Drawings, or to other paragraphs or schedules in the Specifications and similar locations in the Contract Documents.

2. “Shown”, “noted”, “scheduled”, and “specified” are used to help the user locate the reference without limitation on the location.

3. “Installer”, “applicator”, or “erector” is Contractor or another entity engaged by Contractor, either as an employee or subcontractor, to perform a particular construction activity, including installation, erection, application or similar Work. Installers shall be experienced in the Work that installer is engaged to perform.

4. “Experienced”, when used with the term “installer” means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; being familiar with Laws and Regulations; and having complied with requirements of authorities having jurisdiction, and complying with requirements of the Supplier of the material or equipment being installed.

5. Trades: Use of a term such as “carpentry” does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as “carpenter”, unless otherwise indicated in the Contract Documents or required by Laws or Regulations. Such terminology also does not imply that specified requirements apply exclusively to trade personnel of the corresponding generic name.

6. “Assigned specialists” and similar terms: Certain Sections of the Specifications require that specific construction activities be performed by specialists recognized as experts in those operations. Engage said specialists for those activities, and their engagement is a requirement over which Contractor has no option. These requirements do not conflict with enforcement of building codes and other Laws and Regulations. Also, such requirements are not intended to interfere with local trade union jurisdictional settlements and similar conventions. Such assignments shall not relieve Contractor of responsibility for complying with the requirements of the Contract Documents.

C. Reference Standards:

1. Refer to Solicitation, relative to reference standards and resolving discrepancies between reference standards and the Contract Documents. Provisions of reference standards are in effect in accordance with the Specifications.

2. Copies of Standards: Each entity engaged in the Work shall be familiar with reference standards applicable to its construction activity. Copies of applicable reference standards are not bound with the Contract Documents. Where reference standards are needed for a construction activity, obtain copies of standards from the publication source.

3. Abbreviations and Names: Where reference standards, specifications, codes, manuals, Laws or Regulations, or other published data of international, national, regional or local organizations are referred to in the Contract Documents, the organization issuing the standard may be referred to by their acronym or abbreviation only.

4. Following acronyms or abbreviations that may appear in the Contract Documents shall have the meanings indicated below. Listing is alphabetical by acronym.

AA	Aluminum Association

AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACIFS	American Cast Iron Flange Standards
ACS	American Chemical Society
ADC	Air Diffusion Council
ADSC	International Association of Foundation Drilling.
AEIC	Association of Edison Illuminating Companies
AF&PA	American Forest and Paper Association
ABMA	American Bearing Manufacturers Association (formerly Anti- Friction Bearing Manufacturers Association (AFBMA))
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHDGA	American Hot Dip Galvanizers Association
AI	Asphalt Institute
AIA	American Institute of Architects
AIChE	American Institute of Chemical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standards Committee
AMA	Acoustical Materials Association
AMCA	Air Movement and Control Association
AMP	National Association of Architectural Metal Manufacturers, Architectural Metal Products Division
ANSI	American National Standards Institute
APA	The Engineered Wood Association
API	American Petroleum Institute
APHA	American Public Health Association

AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASA	American Standards Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society for Non-Destructive Testing
ASQ	American Society for Quality
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWCI	Association of the Wall and Ceiling Industry
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BAAQMD	Bay Area Air Quality Management District
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
BOCA	Building Officials and Code Administrators
CBMA	Certified Ballast Manufacturers Association
CDA	Copper Development Association
CEMA	Conveyor Equipment Manufacturers Association
CGA	Compressed Gas Association
CISCA	Ceilings and Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute

CMAA	Crane Manufacturers Association of America
CPSC	Consumer Product Safety Commission
CRSI	Concrete Reinforcing Steel Institute
CSI	Construction Specifications Institute
DIN	Deutsches Institut fur Normung eV (German Institute for Standardization)
DIPRA	Ductile Iron Pipe Research Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ETL	Intertek Testing Services, Inc. (formerly ETL Testing Laboratories, Inc.)
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FDEP	Florida Department of Environmental Protection
FHWA	Federal Highway Administration
FM	Factory Mutual (FM Global)
FRPI	Fiberglass Reinforced Plastics Institute
FS	Federal Specification
GA	Gypsum Association
GANA	Glass Association of North America
HEW	United States Department of Health, Education and Welfare
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFI	Industrial Fasteners Institute

IFCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	Instrumentation, Systems, and Automation Society (formerly Instrument Society of America)
ISO	Insurance Services Office
IOS	International Organization for Standardization
LPI	Lightning Protection Institute
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
MSS	Manufacturers' Standardization Society
MMA	Monorail Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Pipe Fabricators, Inc.
NARUC	National Association of Regulatory Utilities Commissioners
NBHA	National Builders Hardware Association
NBS	United States Department of Commerce, National Bureau of Standards
NCMA	National Concrete Masonry Association
NEC	National Electric Code
NELMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NHPMA	Northern Hardwood and Pine Manufacturers Association

NIST	United States Department of Commerce, National Institute of Standards and Technology
NLGA	National Lumber Grades Authority
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation
NSSGA	National Stone, Sand, and Gravel Association
NTMA	National Terrazzo and Mosaic Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PEI	Porcelain Enamel Institute
PFI	Pipe Fabrication Institute
PPI	Plastics Pipe Institute
PGMC	Primary Glass Manufacturers Council
PS	Product Standards Section, United States Department of Commerce
RCSC	Research Council on Structural Connections (part of AISC)
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
SBCCI	Southern Building Code Congress International, Inc.
SCAQMD	Southern California Air Quality Management District
SCPRF	Structural Clay Products Research Foundation
SCTE	Society of Cable Telecommunications Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractor’s National Association
SPI	Society of the Plastics Industry

SPIB	Southern Pine Inspection Bureau
SSPC	Society for Protective Coatings
SWI	Steel Window Institute
TCNA	Tile Council of North America
TEMA	Tubular Exchanger Manufacturers Association
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USAB	United States Access Board
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
USGS	United States Geological Survey
USPHS	United States Public Health Service
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCMA	Wood Component Manufacturers Association
MDMA	Window and Door Manufacturers Association
WWEMA	Water and Wastewater Equipment Manufacturers Association
WWPA	Western Wood Products Association

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 51 00

TEMPORARY UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. Contractor shall provide temporary utilities required for the Project and to complete the Work.

1. Make arrangements with utility service companies for temporary services and obtain required permits and approvals for temporary utilities.

2. Pay utility service costs, including connection fees, required for the Work as needed.

3. Continuously maintain adequate utilities for all purposes during the Project, until removal of temporary utilities and temporary facilities. At minimum, provide and maintain temporary utilities through Substantial Completion.

4. Maintain, including cleaning, temporary utilities and continuously provide consumables as required.

5. Temporary utilities and temporary facilities shall be adequate for personnel using the Site and requirements of Project.

6. Provide temporary utilities and temporary facilities in compliance with Laws and Regulations and, when applicable, requirements of utility owners.

B. Provide the following temporary utilities:

1. Sanitary facilities.

2. First-aid facilities.

3. Fire protection.

1.02 ADMINSTRATIVE REQUIREMENTS

A. Use of Owner's System:

1. Existing Utility Systems: Do not use systems in existing buildings or structures for temporary utilities without Owner's written permission and mutually acceptable

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basis agreed upon by the parties for proportionate sharing of costs between Owner and Contractor.

1.03 SYSTEM DESCRIPTION

A. Sanitary facilities:

1. Contractor shall provide suitably-enclosed chemical or self-contained toilets for Contractor's employees and visitors to the Site. Location of temporary toilets shall be acceptable to Owner and screened from public observation.

2. Facilities shall be maintained and provided in accordance with State Labor Regulations and local ordinances. Contents shall be removed and disposed in accordance with local and state regulations as required.

3. Contractor shall be prohibited from committing nuisances within, on, or in the vicinity of the Site.

B. First-aid facilities:

1. Contractor shall provide one temporary first-aid station. Locations of first-aid stations shall be determined by Contractor's safety representative.

2. Contractor shall provide list of emergency telephone numbers at the Site. List shall be in accordance with the list of emergency contact information required in Section 01 31 19 – Project Meetings.

C. Fire protection:

1. Contractor shall comply with NFPA 241, Safeguarding Building Construction, Alteration, and Demolition Operations, and requirements of fire marshals and authorities having jurisdiction at the Site.

2. Contractor shall provide temporary fire exits, fire extinguishers, hoses and safety devices as required by authorities having jurisdiction.

3. Contractor shall notify Engineer, Owner, and fire marshals in the event of fire at the Site including, but not limited to, fuel tanks and similar hazardous utilities and devices. Contractor shall cooperate with Owner of fuel tank and utilities to prevent occurrence of fire or explosion.

4. Contractor shall perform safety precautions and comply with fire marshal's instructions in the event of fire.

PART 2 – PRODUCTS

2.01 EQUIPMENT

A. Materials and equipment for temporary systems may be new or used but shall be adequate for purposes intended and shall not create unsafe conditions and shall comply with Laws and Regulations.

B. Provide required materials, equipment, and facilities, including piping, wiring, and controls.

C. Electrical system requirements: System shall consist of wiring, switches, insulated supports, poles, fixtures, sockets, receptacles, lamps, guards, cutouts and fuses as required for completion of the Work.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install temporary facilities in neat, orderly, manner, and make structurally, mechanically, and electrically sound throughout.

B. Location of Temporary Utilities and Temporary Facilities:

1. Locate temporary systems for proper function and service.

2. Temporary systems shall not interfere with or provide hazards or nuisances to: the Work under this and other contracts, movement of personnel, traffic areas, materials handling, hoisting systems, storage areas, finishes, and work of utility companies.

3. Do not install temporary utilities on the ground, with the exception of temporary extension cords, hoses, and similar systems in place for short durations.

C. Modify and extend temporary systems as required by progress of the Work.

3.02 MAINTENANCE

A. Maintain temporary systems to provide safe, continuous service as required.

B. Properly supervise operation of temporary systems:

1. Enforce compliance with Laws and Regulations.

2. Enforce safe practices.

3. Prevent abuse of services.

4. Prevent nuisances and hazards caused by temporary systems and their use.

5. Prevent damage to finishes.

6. Ensure that temporary systems and equipment do not interrupt continuous progress of construction.

C. At end of each work day, check temporary systems and verify that sufficient consumables are available to maintain operation until work is resumed at the Site. Provide additional consumables if the supply on hand is insufficient.

D. Contractor shall replace broken and burned out lamps, blown fuses, and damaged wiring and appurtenances as required to maintain adequate and safe operating conditions.

3.03 CLOSEOUT ACTIVITES

A. Completely remove temporary utilities, facilities, equipment, and materials when no longer required. Repair damage caused by temporary systems and their removal and restore the Site to condition required by the Contract Documents; if restoration of damaged areas is not specified, restore to preconstruction condition.

END OF SECTION

SECTION 01 55 00

CONTRACTOR ACCESS AND PARKING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Contractor shall provide and maintain temporary laydown and employee parking areas and appurtenances required during the Project for use by Contractor, other contractors employed on the Project, Owner's, and emergency vehicles, as shown on the Drawings.

2. Laydown and employee parking areas shall be designed and maintained by Contractor and shall be fully passable to vehicles in all weather conditions.

3. Contractor shall provide all information required for to JEA in order to obtain access cards into plant or will need to contact plant personnel for access into and out of the plant when necessary.

1.02 ADMINSTRATIVE REQUIREMENTS

A. Access roads:

1. Contractor shall construct and maintain such temporary access roads as required to perform the Work.

2. Contractor shall construct access roads, where possible, in locations over the areas of future road systems.

3. Access roads shall be located within the property lines of the Owner unless the Contractor independently secures easements for use and convenience.

B. Use of existing access roads:

1. Contractor will be allowed to use Owner's existing roads as shown on the Drawings.

2. Prevent interference with traffic on existing roads and parking areas. At all times, keep access roads and entrances serving the Site clear and available to Owner, Owner's employees, emergency vehicles, and other contractors. Do not use access roads or Site entrances for parking or storage of materials or equipment.

3. Contractor shall indemnify and hold harmless Owner and Engineer from expenses caused by Contractor's operations over existing roads and parking areas.

4. Schedule deliveries to minimize use of driveways and Site entrances.

5. Contractor shall suitably maintain existing access road at Contractor's expense for the duration of the Contract time.

C. Contractor parking areas:

1. Contractor employee vehicles shall park in area(s) designated by Owner or as shown on the Drawings.

2. Contractor shall construct and maintain parking area at the Site.

D. JEA Badges

1. Contractor shall obtain separate site access privileges and ID for Superintendent(s) from JEA.

E. Site security:

1. Contractor shall safely guard all the Work, the Project, products, equipment, and property from loss, theft, damage, and vandalism until Substantial Completion. Contractor's duty includes safely guarding Owner's property in vicinity of the Work and Project, and other private property in the vicinity of the Project from injury and loss in connection with performance of the Project.

2. Employ watchmen as required to provide required security and prevent unauthorized entry.

3. Costs for security required under this Section shall be paid by Contractor.

4. Make no claim against Owner for damage resulting from trespass.

5. Pay full compensation for, or repair or replace, damage to property of Owner and others arising from failure to furnish adequate security.

6. Security requirements specified in the Section shall begin as soon as the contractor delivers materials to the Site and/or begins work, and shall continue until the date of Final Completion.

7. Procedures:

a. Contractor shall conform to Owner's security procedures and access restrictions at Site throughout entire Project.

b. Contractor, including Subcontractors and Suppliers, shall comply with the following:

1) Personnel Identification: All Contractor personnel shall wear at all times on-Site a badge bearing Contractor's name, employee's name and, as applicable, employee number.

2) Parking: Do not park outside of designated Contractor parking area, which is shown on the Drawings. Prepare and maintain parking area as required. Personal vehicles are not allowed outside Contractor parking area.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 75 00

CHECKOUT AND STARTUP PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Checkout of products and equipment.

2. Startup procedures of products and equipment

B. Contractor shall initially start up and place equipment installed under the Contract into successful operation, in accordance with the equipment manufacturer's written instructions and as instructed by Supplier at the Site.

C. Provide all material, labor, tools, and equipment required to complete equipment checkout and start-up.

D. General activities include:

1. Cleaning, as required under other provisions of the Contract Documents.

2. Removing temporary protective coatings.

3. Checking and correcting (if necessary) leveling plates, grout, bearing plates, anchorage devices, fasteners, and alignment of piping, conduits, and ducts that may place stress on the connected equipment.

4. All adjustments required.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate checkout and start-up with other contractors, as necessary.

2. Do not start up system or subsystem for continuous operation until all components of that system or subsystem, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.

3. Owner will provide sufficient personnel to assist Contractor in starting up equipment, but responsibility for proper operation is by Contractor.

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4. Supplier shall be present during checkout, start-up, and initial operation, unless otherwise acceptable to Engineer.

5. Do not start up system, unit process, or equipment without submitting acceptable preliminary operations and maintenance manuals by Contractor, in accordance with Section 01 78 23 – Operations and Maintenance Data.

B. Contractor's Requirements Prior to Owner's Responsibility:

1. Owner will assume responsibility for the equipment upon Substantial Completion.

2. Prior to turning over to Owner responsibility for operating and maintaining system or equipment shall be in accordance with this Section and the following requirements:

a. Submit acceptable final operations and maintenance manuals in accordance with Section 01 78 23 – Operations and Maintenance Data.

b. Provide training of operations and maintenance personnel.

c. Complete system field quality control testing in accordance with the Contract Documents.

d. Obtain from Engineer final certificate of Substantial Completion for either entire Work or the portion being turned over to Owner.

1.03 SUBMITTALS

A. Closeout Submittals: Manufacturer's certification of installation in accordance with this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PRELIMINARY REQUIREMENTS

A. Prior to the start-up of the facilities, Contractor shall have prepared and tested all equipment, subsystems and systems in accordance with the requirements of the Section to check its ability for sustained operation, including inspections and adjustments by Manufacturer's representative.

B. After the facilities are sufficiently complete to permit start-up, Contractor shall furnish competent personnel to start-up the facilities. Contractor will be responsible for startup

of all facilities constructed under this Contract. During the initial start-up period the Contractor shall check and provide for satisfactory mechanical operation of the plant facilities.

3.02 FIELD QUALITY CONTROL

A. Manufacturers' Field Services:

1. When specified, furnish services of competent, qualified representatives of material and equipment manufacturers as specified, including supervising installation, adjusting, checkout, start-up, and testing of materials and equipment.

2. Certification:

a. When services by manufacturer are required at the Site, within 14 days after first test operation of equipment, submit to Engineer a letter from manufacturer, on manufacturer's letterhead, stating that materials and equipment are installed in accordance with manufacturer's requirements and installation instructions, and in accordance with the Contract Documents.

b. Include in the final operations and maintenance manual for the associated equipment a copy of the letter or completed form, as applicable.

3. Manufacturer shall bring any discrepancies to the immediate attention of the Contractor for correction. Contractor shall promptly correct any discrepancies noted by the Manufacturer. Manufacturer shall coordinate correction of discrepancies with the Contractor. Discrepancies and their correction shall be noted in inspection records and in all required reports. Any corrections that result in changes to the work as shown on the Contract Documents shall be approved by the Engineer prior to their execution.

3.03 VIBRATION TESTING (NOT USED)

3.04 SYSTEM START-UP

A. Equipment and materials shall be provided in conformance with the manufacturer's installation instructions and in accordance with the Contract Documents.

B. Provide start-up services as specified in the individual Specification Sections.

C. Contractor shall furnish consumables required for startup including, but not limited to, electricity, water, and lubrication. Contractor shall provide a plan for disposal of water used for testing unless otherwise specified in the Contract Documents.

D. General system requirements:

1. Start-up by Contractor shall include equipment, and electrical systems.

2. Cleaning as required under provisions of the Contract Documents.

3. Remove temporary protective coatings.

4. Flushing and replacing greases and lubricants as required by Manufacturer

5. Lubrication.

6. Valves:

    a. Tighten packing glands to ensure no leakage but allow valve stems to operate without galling.

    b. Replace packing in valves to retain maximum adjustment after system is determined to be complete.

    c. Replace packing on valves that continue to leak.

    d. Remove and repair bonnets that leak.

    e. After cleaning, coat packing gland threads and valve stems with surface preparation of “Molycote” or “Fel-Pro”.

7. Verify that control valve seats are free of foreign matter and are properly positioned for intended service.

8. Tighten flanges and other pipe joints after system has been placed in operation.

9. Replace gaskets that show signs of leakage after tightening.

10. Inspect all joints for leakage:

    a. Promptly remake each joint that appears to be faulty; do not wait for rust other corrosion to form.

    b. Clean threads on both parts and apply compound and remake joints.

11. After system has been placed in operation, clean valve seats and headers in fluid system to ensure freedom from foreign matter.

12. Remove rust, scale, and foreign matter from equipment and renew defaced surfaces.

END OF SECTION

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Substantial Completion.

2. Final inspection.

3. Request for final payment.

1.02 REFERENCES

A. Definitions:

1. Substantial completion procedures for requesting and documenting are in the General Conditions, as modified by Supplemental Conditions.

2. Final inspection procedures for requesting and documenting are in the General Conditions, as modified by Supplemental Conditions.

1.03 ADMINSTRATIVE REQUIREMENTS

A. Request for Final Payment:

1. Procedure: Submit request for final payment in accordance with the Solicitation.

B. Request for final payment shall include:

1. Documents required for progress payments in Section 01 29 76 – Progress Payment Procedures.

2. Releases or Waivers of Lien Rights:

a. Provide a final release or waiver by Contractor and each Subcontractor and Supplier that provided Contractor with labor, material, or equipment totaling $10,000 or more.

b. Provide list of Subcontractors and Suppliers for which release or waiver of Lien is required.

032619

c. Each release or waiver of Lien shall be signed by an authorized representative of the entity submitting release or waiver to Contractor, and shall include Subcontractor's or Supplier's corporate seal, when applicable.

d. Release or waiver of Lien may be conditional upon receipt of final payment.

e. Manufacturer's Affidavit of Release of Liens – furnish a separate, completed form from the manufacturer.

3. Consent of Surety Company to Final Payment.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for operation and maintenance data, manuals, and documentation.

1. Submit operation and maintenance data, in accordance with this Section and in accordance with requirements elsewhere in the Contract Documents, as instructional and reference manuals by operations and maintenance personnel at the Site.

2. Required operation and maintenance data groupings are listed in this Section. At minimum, submit operation and maintenance data for:

a. Valves and actuators

b. Instrumentation

c. Electrical gear

3. For each operation and maintenance manual, submit the following:

a. Preliminary Submittal: Electronic copy of entire operation and maintenance manual or electronic copy, except for test data and service reports by Supplier. Text must be searchable.

b. Final Submittal: Printed and bound copy of complete operations and maintenance manual and electronic copy, including test data and service reports by Supplier.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Quantity Required and Timing of Submittals:

1. Preliminary Submittal:

a. Electronic Copies: One copy.

b. Submit to Engineer, whichever occurs first:

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1) 60 days prior to starting training of operations and maintenance personnel.

2) 30 days prior to field quality control testing at the Site.

c. Furnish preliminary operation and maintenance data submittal in acceptable form and content, as determined by Engineer, before associated materials and equipment will be eligible for payment.

2. Preliminary Submittal shall be reviewed by Engineer. One electronic copy shall be returned to Contractor with required revisions noted.

3. Final Submittal: Provide 14 days prior to checkout and startup procedures specified in Section 01 75 00 – Checkout and Startup Procedures, unless Submittal is specified as required prior to an interim Milestone.

a. Printed Copies: Two copies.

b. Electronic Copies: One copy.

B. Format of Printed Copies:

1. Binding and Cover:

a. Bind each operation and maintenance manual in durable, permanent, stiff-cover binder(s), comprising one or more volumes per copy as required. Binders shall be minimum one-inch wide and maximum of three-inch wide. Binders for each copy of each volume shall be identical.

b. Provide the following information on cover of each volume:

1) JEA Logo

2) Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.

3) Name or type of material or equipment covered in the manual.

4) Volume number, if more than one volume is required, listed as “Volume __ of __”, with appropriate volume-designating numbers filled in.

5) Name of Project and, if applicable, Contract name and number.

6) Name of building or structure, as applicable.

c. Provide the following information on spine of each volume:

1) Title: “OPERATING AND MAINTENANCE INSTRUCTIONS”.

2) Name or type of material or equipment covered in the manual.

3) Volume number, if more than one volume is required, listed as “Volume __ of __”, with appropriate volume-designating numbers filled in.

4) Project name and building or structure name.

2. Drawings:

a. Bind into the manual drawings, diagrams, and illustrations up to and including 11 inches by 17 inches in size, with reinforcing.

b. Documents larger than 11 inches by 17 inches shall be folded and inserted into clear plastic pockets bound into the manual. Mark pockets with printed text indicating content and drawing numbers. Include no more than three drawing sheets per pocket.

3. Copy Quality and Document Clarity:

a. Contents shall be original-quality copies. Documents in the manual shall be either original manufacturer-printed documents or first-generation photocopies indistinguishable from originals. If original is in color, copies shall be in color.

b. Clearly mark in ink to indicate all components of materials and equipment on catalog pages for ease of identification. In standard or pre-printed documents, indicate options furnished or cross out inapplicable content.

4. Organization:

a. Provide table of contents in each volume for each chapter or section.

b. Use dividers and indexed tabs between major categories of information, such as operating instructions, preventive maintenance instructions, and other major subdivisions of data in each manual.

C. Format of Electronic Copies:

1. Each electronic copy shall include all information included in the corresponding printed copy.

2. Submit each electronic copy on a separate compact disc (CD), unless another electronic data transfer method or format is acceptable to Engineer.

3. File Format:

    a. Acceptable formats include Adobe PDF, Microsoft Word, Autodesk DWF, and AutoCAD.

    b. Files shall be electronically searchable.

    c. Submit separate file for each separate document in the printed copy.

    d. Within each file, provide bookmarks for the following:

        1) Each chapter and subsection listed in the corresponding printed copy document's table of contents

        2) Each figure

        3) Each table

        4) Each appendix

4. Also submit drawings and figures in one of the following formats: ".bmp", ".tif", ".jpg", ".gif", "dwf", or "dwg". Submit files in a separate directory on the CD.

D. General Content Requirements:

1. Prepare each operations and maintenance manual specifically for the Project. Include in each manual all pertinent instructions, as-built drawings as applicable, bills of materials, technical bulletins, installation and handling requirements, maintenance and repair instructions, and other information required for complete, accurate, and comprehensive data for safe and proper operation, maintenance, and repair of materials and equipment furnished for the Project. Include in manuals specific information required in the Specification Section for the material or equipment, data required by Laws and Regulations, and data required by authorities having jurisdiction.

2. Submit complete, detailed written operating instructions for each material or equipment item including: function; operating characteristics; limiting conditions; operating instructions for start-up, normal and emergency conditions; regulation and control; operational troubleshooting; and shutdown. Also include, as applicable, written descriptions of alarms generated by equipment and proper responses to such alarm conditions.

3. Submit written explanations of all safety considerations relating to operation and maintenance procedures.

4. Submit complete, detailed, written preventive maintenance instructions including all information and instructions to keep materials, equipment, and systems properly lubricated, adjusted, and maintained so that materials, equipment, and systems function economically throughout their expected service life. Instructions shall include:

    a. Written explanations with illustrations for each preventive maintenance task such as inspection, adjustment, lubrication, calibration, and cleaning. Include pre-startup checklists for each equipment item and maintenance requirements for long-term shutdowns.

    b. Recommended schedule for each preventive maintenance task.

    c. Lubrication charts indicating recommended types of lubricants, frequency of application or change, and where each lubricant is to be used or applied.

    d. Table of alternative lubricants.

    e. Troubleshooting instructions.

    f. List of required maintenance tools and equipment.

5. Submit complete bills of material or parts lists for materials and equipment furnished. Lists or bills of material may be furnished on a per-drawing or per-equipment assembly basis. Bills of material shall indicate:

    a. Manufacturer’s name, address, telephone number, fax number, and Internet website address.

    b. Manufacturer’s local service representative’s or local parts supplier’s name, address, telephone number, fax number, Internet website address, and e-mail addresses, when applicable.

    c. Manufacturer’s shop order and serial number(s) for materials, equipment or assembly furnished.

    d. For each part or piece include the following information:

        1) Parts cross-reference number. Cross-reference number shall be used to identify the part on assembly drawings, Shop Drawings, or other type of graphic illustration where the part is clearly shown or indicated.

        2) Part name or description.

        3) Manufacturer’s part number.

        4) Quantity of each part used in each assembly.

5) Current unit price of the part at the time the operations and maintenance manual is submitted. Price list shall be dated.

6. Submit complete instructions for ordering replaceable parts, including reference numbers (such as shop order number or serial number).

7. Submit manufacturer's recommended inventory levels for spare parts, extra stock materials, and consumable supplies for the initial two years of operation. Consumable supplies are items consumed or worn by operation of materials or equipment, and items used in maintaining the operation of material or equipment, including items such as lubricants, seals, reagents, and testing chemicals used for calibrating or operating the equipment. Include estimated delivery times, shelf life limitations, and special storage requirements.

8. Submit manufacturer's installation and operation bulletins, diagrams, schematics, and equipment cutaways. Where materials pertain to multiple models or types, mark the literature to indicate specific material or equipment supplied. Marking may be in the form of checking, arrows, or underlining to indicate pertinent information, or by crossing out or other means of obliterating information that does not apply to the materials and equipment furnished.

9. Submit original-quality copies of each approved and accepted Shop Drawing, product data, and other submittal, updated to indicate as-installed condition. Reduced drawings are acceptable only if reduction is to not less than one-half original size and all lines, dimensions, lettering, and text are completely legible on the reduction.

10. Submit complete electrical schematics and wiring diagrams, including complete point-to-point wiring and wiring numbers or colors between all terminal points.

11. Submit copy of warranty bond and service contract as applicable.

12. When copyrighted material is used in operations and maintenance manuals, obtain copyright holder's written permission to use such material in the operation and maintenance manual.

1.03 SUBMITTALS

A. Action/Informational Submittals: Submit preliminary schedule (listing) of operations and maintenance data for Engineer's review. Preliminary operations and maintenance data shall be grouped as major equipment and material systems and divided into sub-systems as required for clarity, subject to Engineer's approval.

B. Closeout Submittals:

1. Operation and maintenance data: Submit the operations and maintenance data indicated in the Contract Documents, grouped into submittals as approved by Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE

A. Manuals to be provided: (NOT USED)

B. Provide final process control documentation.

END OF SECTION

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SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for recording changes to record documents.

2. Requirements for electronic files furnished by Engineer.

B. Contractor shall maintain and submit to Engineer with record documents in accordance with the Specifications, General Conditions, and Supplementary Conditions.

1.02 ADMINSTRATIVE REQUIREMENTS

A. Maintenance of Record Documents:

1. The following record documents shall be maintained in the Contractor's field office:

a. Drawings, Specifications, and Addenda.

b. Shop Drawings, Samples, and other Contractor submittals, including records of test results, approved or accepted as applicable, by Engineer.

c. Change Orders, Work Change Directives, Field Orders, photographic documentation, survey data, and all other documents pertinent to the Work.

2. Update record documents on a monthly basis, minimum.

3. Make record documents available for inspection upon request of Engineer or Owner.

4. Do not use record documents for purpose other than serving as Project record.

B. Submittal of Record Documents:

1. Submit to Engineer the following record documents: Drawings.

2. Prior to readiness for final payment, submit to Engineer one copy of final record documents. Submit complete record documents; do not make partial submittals.

3. Submit record documents with transmittal letter on contractor letterhead complying with letter of transmittal requirements in Section 01 33 00 – Submittal Procedures.

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4. Record documents submittal shall include certification, with original signature of official authorized to execute legal agreements on behalf of Contractor.

C. Electronic Files Furnished by Engineer:

1. CADD files can be furnished by Engineer upon the following conditions:

a. Contractor shall submit to Engineer a letter on Contractor letterhead requesting CADD files and providing specific definition(s) or description(s) of how files will be used, and specific description of benefits to Owner (including credit proposal, if applicable) if the request is granted.

b. Contractor shall execute Engineer's standard agreement for release of electronic files and shall abide by all provisions of the agreement for release of electronic files.

c. Layering system incorporated in CADD files shall be maintained as transmitted by Engineer. CADD files transmitted by Engineer containing cross-referenced files shall not be bound by Contractor. Drawing cross-references and paths shall be maintained. If Contractor alters layers or cross-reference files, Contractor shall restore all layers and cross-references prior to submitting record documents to Engineer.

d. Contractor shall submit record drawings to Engineer in same CADD format that files were furnished to Contractor.

1.03 SUBMITTALS

A. Closeout Submittals: Provide record documentation as specified in this Section.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL REQUIREMENTS:

A. At the start of the Project, label each record document to be submitted as, "PROJECT RECORD" using legible, printed letters. Letters on record copy of the Drawings shall be two inches high.

B. Keep record documents current. Make entries on record documents within two working days of receipt of information required to record the change.

C. Do not permanently conceal the Work until required information has been recorded.

D. Accuracy of record documents shall be such that future searches for items shown on the record documents may rely reasonably on information obtained from Engineer-accepted record documents.

E. Marking of Entries:

1. Use erasable, colored pencils (not ink or indelible pencil) for marking changes, revisions, additions, and deletions to record documents.

2. Clearly describe the change by graphic line and make notations as required. Use straight-edge to mark straight lines. Writing shall be legible and sufficiently dark to allow scanning of record documents into legible electronic files.

3. Date all entries on record documents.

4. Call attention to changes by drawing a “cloud” around the change(s) indicated.

5. Mark initial revisions in red. In the event of overlapping changes, use different colors for subsequent changes.

3.02 RECORDING CHANGES TO DRAWINGS:

A. Record changes on copy of the Drawings. Submittal of Contractor-originated or -produced drawings as a substitute for recording changes on the Drawings is unacceptable.

B. Record changes on plans, sections, schematics, and details as required for clarity, making reference dimensions and elevations (to Project datum) for complete record documentation.

C. Record actual construction including:

1. Field changes of dimensions, arrangements, and details.

2. Changes made in accordance with Change Orders, Work Change Directives, and Field Orders.

3. Changes in details on the Drawings. Submit additional details prepared by Contractor when required to document changes.

3.03 RECORDING CHANGES FOR SCHEMATIC LAYOUTS:

A. In some cases, on the Drawings, arrangements of conduits, piping, and similar items are shown schematically and are not intended to portray physical layout. For such cases, the final physical arrangement shall be determined by Contractor subject to acceptance by Engineer.

B. Record on record documents all revisions to schematics on Drawings, including: piping schematics, process and instrumentation diagrams, control and circuitry diagrams, electrical one-line diagrams, and other schematics when included in the Contract. Record actual locations of equipment, lighting fixtures, in-place grounding system, and other pertinent data.

C. When dimensioned plans and dimensioned sections on the Drawings show the Work schematically, indicate on the record documents, by dimensions accurate to within one inch in the field, centerline location of items of Work such as conduit, piping, ducts, and similar items

1. Clearly identify the Work item by accurate notations such as “cast iron drain”, “rigid electrical conduit”, “copper waterline”, and similar descriptions.

2. Show by symbol or note the vertical location of Work item; for example, “embedded in slab”, “under slab”, “in ceiling plenum”, “exposed”, and similar designations. For piping not embedded, also provide elevation dimension relative to Project datum.

3. Descriptions shall be sufficiently detailed to be related to Specifications.

D. Engineer may furnish written waiver of requirements relative to schematic layouts shown on plans and sections when, in Engineer’s judgment, dimensioned layouts of Work shown schematically will serve no useful purpose. Do not rely on waiver(s) being issued.

3.04 REQUIREMENTS FOR SUPPLEMENTAL DRAWINGS:

A. In some cases, drawings produced during construction by Engineer or Contractor supplement the Drawings and shall be included with record documents submitted by Contractor. Supplemental record drawings shall include drawings provided with Change Orders, Work Change Directives, and Field Orders and that cannot be incorporated into the Drawings due to space limitations.

B. Supplemental drawings provided with record drawings shall be integrated with the Drawings and include necessary cross-references between drawings. Supplemental record drawings shall be on sheets the same size as the Drawings.

C. When supplemental drawings developed by Contractor using computer-aided drafting/design (CADD) software are to be included in record drawings, submit electronic files for such drawings in AutoCAD (latest version) as part of record drawing submittal. Submit electronic files on compact disc labeled, “Supplemental Record Drawings”, together with Contractor name, Project name, and Contract name and number.

3.05 RECORDING CHANGES TO SPECIFICATIONS AND ADDENDA:

A. Mark each Section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually provided.

2. Changes made by Addendum, Change Orders, Work Change Directives, and Field Orders.

END OF SECTION

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SECTION 40 61 13

PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SCOPE

A. The Contractor shall provide components, system installation services, as well as required and specified ancillary services in connection with the Instrumentation, Control and Information System.

B. The System includes materials, labor, tools, fees, charges, and documentation required to furnish, install, test and place in operation a complete and operable instrumentation, control and information system.

C. The scope of the work to be performed under this Division includes but is not limited to the following:

1. The Contractor shall retain overall responsibility for the instrumentation and control system as specified herein.

2. Configure the new RAS valve actuators to communicate via Profibus to the existing Siemens PLC and integrate the specified monitoring and control signals.

3. Program the existing PLC and HMI systems to implement the specified Process Control Descriptions to automate the RAS valves and optimize the entire RAS conveyance system including existing RAS pumps. Adjust RAS pump programming to tune the system to achieve responsive and stable process control. All programming shall follow the Owner's programming standards and guidelines.

4. Provide system testing, calibration, training and startup services as specified herein and as required to make systems fully operational.

D. It is the intent of the Contract Documents to construct a complete and working installation. Items of equipment or materials that may reasonably be assumed as necessary to accomplish this end shall be supplied whether or not they are specifically stated herein.

1.02 RELATED ITEMS

A. Field mounted switches, torque switches, limit switches, valve and gate operator position transmitters, and other instrumentation and controls furnished with mechanical or electrical equipment shall be furnished, installed, tested, and calibrated by the Owner unless otherwise indicated.

B. Related work performed by the Owner includes the following:

1. Furnish and install conduit and raceways for instrumentation and control system signal wiring, grounding systems, special cables and communication network cables.

2. Furnish, install and terminate control system Profibus communication cables.

3. Final wiring and termination to A.C. grounding systems and to A.C. power sources (e.g., panelboards, motor control centers, and other sources of electrical power).

1.03 GENERAL INFORMATION AND DESCRIPTION

A. Where manufacturers are named for a particular item of equipment, it is intended as a guide to acceptable quality and performance and does not exempt such equipment from the requirements of these Specifications or Drawings.

B. The Contractor shall retain total responsibility for the proper detailed design, fabrication, inspection, test, delivery, assembly, installation, activation, checkout, adjustment and operation of the entire instrumentation and control system as well as equipment and controls furnished by the Owner. The Contractor shall be responsible for the delivery of detailed drawings, manuals and other documentation required for the complete coordination, installation, activation and operation of mechanical equipment, equipment control panels, local control panels, field instrumentation, control systems and related equipment/systems and shall provide for the services of a qualified installation engineer to supervise activities required to place the completed facility in stable operation under full digital control.

C. The instrumentation and control system shall be capable of simultaneously implementing all real time control and information system functions, and servicing all operator service requests as specified, without degrading the data handling and processing capability of other system components.

D. Control system inputs and outputs are listed in Section 40 61 93 – Process Control System Input/Output List. This information, together with the process control descriptions, describes the real time monitoring and control functions to be performed. In addition, the system shall provide various human-machine interface and data reporting functions as specified in the software sections of this Specification.

E. The terms "Instrumentation," "Instrumentation and Control System," and "Instrumentation, Control and Information System" shall hereinafter be defined as equipment, labor, services, and documents necessary to meet the intent of the Specifications.

1.04 INSTRUMENTATION AND CONTROL SYSTEM CONTRACTORS

A. Instrumentation and control system contractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for wastewater treatment facilities. Instrumentation and control system

subcontractors shall have a minimum of five years of such experience and shall have completed a minimum of three projects of similar type and size as that specified herein. The instrumentation and control system subcontractor's programmer working on this project shall have completed at least one project using Siemens PLCs and Profibus DP connected valve actuators. As used herein, the term "completed" shall mean that a project has been brought to final completion and final payment has been made.

B. Acceptable instrumentation and control system subcontractors shall be Information Technologies Group (ITG) or DSI Innovations, no substitution.

1.05 DEFINITIONS

A. Solid State: Wherever the term solid state is used to describe circuitry or components in the Specifications, it is intended that the circuitry or components shall be of the type that convey electrons by means of solid materials such as crystals or that work on magnetic principles such as ferrite cores. Vacuum tubes, gas tubes, slide wires, mechanical relays, stepping motors or other devices will not be considered as satisfying the requirements for solid state components of circuitry.

B. Bit or Data Bit: Whenever the terms bit or data bit are used in the Specification, it is intended that one bit shall be equivalent to one binary digit of information. In specifying data transmission rate, the bit rate or data bit rate shall be the number of binary digits transmitted per second and shall not necessarily be equal to either the maximum pulse rate or average pulse rate.

C. Integrated Circuit: Integrated circuit shall mean the physical realization of a number of circuit elements inseparably associated on or within a continuous body to perform the function of a circuit.

D. Mean Time Between Failures (MTBF): The MTBF shall be calculated by taking the number of system operating hours logged during an arbitrary period of not less than six months and dividing by the number of failures experienced during this period plus one.

E. Mean Time to Repair (MTTR): The MTTR shall be calculated by taking the total system down time for repair over an arbitrary period of not less than six months coinciding with that used for calculation of MTBF and dividing by the number of failures causing down time during the period.

F. Availability: The availability of a non-redundant device or system shall be related to its MTBF and MTTR by the following formula:

$$A = 100 \times (MTBF / (MTBF + MTTR)) \text{ Percent}$$

The availability of a device or system provided with an automatically switched backup device or system shall be determined by the following formula:

$$A = A2 + 1 - ((1 - A1) * (1 - A1))$$

where:

A1 = availability of non-redundant device or system

A2 = availability of device or system provided with an automatically switched backup device or system

G. Abbreviations: Specification abbreviations include the following:

1. A - Availability
2. ADC - Analog to Digital Converter
3. AI - Analog Input
4. AO - Analog Output
5. AVAIL - Available
6. BCD - Binary Coded Decimal
7. CSMA/CD - Carrier Sense Multiple Access/Collision Detect
8. CPU - Central Processing Unit
9. CRC - Cyclic Redundancy Check
10. CS - Control Strategy
11. DAC - Digital to Analog Converter
12. DBMS - Data Base Management System
13. DI - Discrete Input
14. DMA - Direct Memory Access
15. DO - Discrete Output
16. DPDT - Double Pole, Double Throw
17. DVE - Digital to Video Electronics
18. EPROM - Erasable, Programmable Read Only Memory
19. FDM - Frequency Division Multiplexing
20. FSK - Frequency Shift Keyed

21. HMI - Human Machine Interface (Software)
22. I/O - Input/Output
23. LAN - Network and Communication Equipment
24. LCD - Liquid Crystal Display
25. LDFW - Lead Follow
26. MCC - Motor Control Center
27. MTBF - Mean Time Between Failures
28. MTTR - Mean Time to Repair
29. OS - Operating System
30. PAC - Programmable Automation Controller
31. PCB - Printed Circuit Board
32. PID - Proportional Integral and Derivative Control
33. PLC - Programmable Logic Controller or Programmable Controller
34. PROM - Programmable Read Only Memory
35. RAM - Random Access Memory
36. RDY - Ready
37. RMSS - Root Mean Square Summation
38. RNG - Running
39. ROM - Read Only Memory
40. RTU - Remote Telemetry Unit
41. SPDT - Single Pole, Double Throw
42. ST/SP - Start/Stop
43. TDM - Time Division Multiplexing
44. UPS - Uninterruptible Power Supply
45. VFD - Variable Frequency Drive

H. To minimize the number of characters in words used in textual descriptions on displays, printouts and nameplates, abbreviations may be used subject to the Engineer's approval. If a specified abbreviation does not exist for a particular word, an abbreviation may be generated using the principles of masking and or vowel deletion. Masking involves retaining the first and last letters in a word and deleting one or more characters (usually vowels) from the interior of the word.

1.06 ENVIRONMENTAL CONDITIONS

A. Instrumentation equipment and enclosures shall be suitable for ambient conditions specified. All system elements shall operate properly in the presence of telephone lines, power lines, and electrical equipment.

B. Inside control rooms and climate-controlled electrical rooms, the temperature will normally be 20 to 25 degrees C; relative humidity 40 to 80 percent without condensation and the air will be essentially free of corrosive contaminants and moisture. Appropriate air filtering shall be provided to meet environmental conditions (e.g., dust).

C. Other indoor areas may not be air conditioned/heated; temperatures may range between 0 and 40 degrees C with relative humidity between 40 and 95 percent.

D. Field equipment including instrumentation and panels may be subjected to wind, rain, lightning, and corrosives in the environment, with ambient temperatures from -20 to 40 degrees C and relative humidity from 10 to 100 percent. All supports, brackets, interconnecting hardware, and fasteners shall be aluminum, type 316 stainless steel, or metal alloy as otherwise suitable for chemical resistance within chemical feed/storage areas shown on the installation detail drawings.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SCHEDULE OF PAYMENT

A. Payment to the Contractor for Control and Information System materials, equipment, and labor shall be in accordance with the General and Supplementary Conditions. The schedule of values submitted as required by the General and Supplementary Conditions shall reflect a breakdown of the work required for completion of the Control and Information System. The breakdown shall include sufficient detail to permit the Engineer to administer payment for the Control and Information System.

3.02 CLEANING

A. The Contractor shall thoroughly clean soiled surfaces of installed equipment and materials.

B. Upon completion of the instrumentation and control work, the Contractor shall remove surplus materials, rubbish, and debris that has accumulated during the construction work. The entire area shall be left neat, clean, and acceptable to the Owner.

3.03 FINAL ACCEPTANCE

A. Final acceptance of the Instrumentation, Control and Information System will be determined complete by the Engineer, and shall be based upon the following:

1. Receipt of acceptable start up completion and availability reports and other documentation as required by the Contract Documents.

2. Completion of the Availability Demonstration.

3. Completion of control system training requirements.

4. Completion of punch-list items that are significant in the opinion of the Engineer.

B. Final acceptance of the System shall mark the beginning of the warranty period.

END OF SECTION

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SECTION 40 61 14

PRELIMINARY DESIGN REVIEW

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall conduct a preliminary design review meeting for Owner personnel and the Engineer to ensure design compliance with all requirements in the Contract Documents. Other supplemental design review meetings may be held as required by the Engineer or the Owner to resolve specific problems, to provide positive assurance to the Owner that the design conforms to contractual requirements, or to allow for concurrent planning activities by the Owner that are dependent upon the as-built system configuration/operation.

B. The Preliminary Design Review shall, at the discretion of the Owner, be conducted at the Owner’s facility, the Contractor's facility, or at a location suggested by the Owner.

C. The Preliminary Design Review shall be conducted no later than 30 days after notice to proceed.

1.02 PRELIMINARY DESIGN REVIEW

A. The Preliminary Design Review (PDR) shall be a formal meeting to review the overall system design with emphasis being placed upon the arrangement and interactive operation of all items of digital equipment and software.

B. While the Preliminary Design Review is a meeting rather than a submittal, to the greatest extent possible all data to be presented at the PDR shall be furnished to the Owner two (2) weeks prior to the meeting date. Data made available by the Contractor shall include, but not be limited to the following:

1. Brief description of the proposed changes and additions to the PLC and HMI programming required under this Contract.

2. Brief description of the intended plan for implementing system development, checkout, hardware/software performance verification, installation, activation and test activities.

3. Preliminary construction schedule, including submittal dates.

4. Resumes listing qualifications of process control system engineering and technical personnel (including field installation personnel) expected to be assigned to the project, together with an estimate of the percentage of time such personnel are expected to devote to the project.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 15
PROCESS CONTROL SYSTEM SUBMITTALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall submit for review complete Shop Drawings for all equipment in accordance with the General and Supplemental Conditions and Division 1 of the Specifications. All submittal material shall be complete, legible, and reproducible, and shall apply specifically to this project.

B. All submittal materials shall be tailored to this project by highlighting relevant items or crossing out non-applicable items. Generic submittals without identified options will be returned the Contractor without review.

C. Compliance, Deviations, and Exceptions (CD&E) Letter:

1. Where a named manufacturer and product is specified and a substitution or an “or equal” product is submitted, the submittal shall be accompanied by a “Compliance, Deviations, and Exceptions (CD&E) letter.” If the required submittal is submitted without the letter, the submittal will be rejected.

2. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor, subcontractor (if applicable), and the equipment Manufacturer/Supplier. This letter shall include a copy of the Specification Section to which the submittal pertains. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in.

   a. The letter "C" shall be for full compliance with the requirement.

   b. The letter "D" shall be for a deviation from the requirement.

   c. The letter "E" shall be for taking exception to a requirement.

3. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions shall not be acceptable.

4. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 – Submittals

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B. Section 40 61 13 – Process Control System General Provisions

1.03 EXISTING CONDITIONS / AS-BUILT DOCUMENTATION SUBMITTAL

A. Prior to modifying, demolishing, removing, or decommissioning equipment or software, thoroughly investigate and document the existing conditions. Please note that Owner's record drawings alone are not sufficient for documentation. The record drawings, if present, shall be verified in the field prior to submitting. Submit drawings, markup, sketches, information, or other materials for documenting the following existing conditions:

1. Profibus network cables and connectors at existing RAS valve actuators.

2. Profibus network configuration and I/O signals of existing RAS valve actuators.

3. Existing PLC and HMI software versions.

4. Documented existing PLC code related to monitoring and control of the RAS valves and RAS pumping operations.

5. Screen shots of existing HMI graphics and database tags related to monitoring and control of the RAS valves and RAS pumping operations.

B. When all information has been gathered, it shall be submitted to Engineer along with a clear and unequivocal statement that the existing conditions have been documented and understood. Contractor shall be held responsible for all issues that arise due to Contractor's modifications, demolition, removal, or decommissioning of existing equipment, including necessary reversion back to previous conditions.

1.04 NOT USED

1.05 SOFTWARE SUBMITTALS

A. Submit information on the following software:

1. Software configuration, including:

a. Graphic display organization.

b. Database configuration for operator workstations and database management system.

c. Trends.

d. System security.

e. Formats for all reports, including all required calculations.

f. Intercommunications between software products required to implement system functions.

B. Control Strategies

1. Description of automatic logic and all non-standard manual logic using plain English, for non-technical persons, and written in Contractor's own words. The write-up shall include references to associated I/O, tag/loop numbers, alarming/interlocks.

2. Submitting language verbatim to Section 40 61 96 – Process Control Descriptions shall not be acceptable.

C. Application Software

1. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

2. Application software includes all custom routines developed specifically for this project, or pre-written routines used for accomplishing specified functions for this project. This shall include any add-in custom software.

D. Graphic Displays

1. Submit all graphic displays required to perform the control and operator interface functions specified herein. Submitted graphic displays shall be for both new and modified graphics.

2. Submit the complete set of graphic displays for review by the Owner and the Engineer at least 30 days prior to commencement of field testing.

3. The Contractor shall allow for one major cycle of revisions to the displays prior to field testing. A cycle of revisions shall be defined as all revisions necessary to complete a single set of changes marked by the Engineer and the Owner. Additional corrections shall be performed during start-up as required to accommodate changes required by actual field conditions, at no additional cost to the Owner.

4. The required submittals in each revision cycle shall be full color prints of the entire set of displays.

5. Displays shall be printouts of actual process graphics implemented in the system.

1.06 NOT USED

1.07 NOT USED

1.08 NOT USED

1.09 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall deliver equipment operation and maintenance manuals in compliance with Section 01 33 00 – Submittals. Operation and maintenance (O&M) manuals shall consist of two basic parts:

1. Manufacturer standard O&M manuals for all equipment and software furnished under this Division.

2. Custom O&M information describing the specific configuration of equipment and software, and the operation and maintenance requirements for this particular project.

B. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustrated parts shall be numbered for identification. All modifications to manufacturer standard equipment and/or components shall be clearly identified and shown on the drawings and schematics. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

C. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

D. The operating instructions shall clearly describe the step by step procedures that must be followed to implement all phases of all operating modes. The instructions shall be in terms understandable and usable by operating personnel and maintenance crews and shall be useful in the training of such personnel.

E. The maintenance instructions shall describe the detailed preventive and corrective procedures required, including environmental requirements during equipment storage and system operation, to keep the System in good operating condition. All hardware maintenance documentation shall make reference to appropriate diagnostics, where applicable, and all necessary wiring diagrams, component drawings and PCB schematic drawings shall be included.

F. Software documentation shall conform to a standard format and shall include, but not be limited to, the following:

1. A program abstract that includes:

a. Program Name - The symbolic alphanumeric program name.

b. Program Title - English text identification.

c. Program Synopsis - A brief text shall be provided that specifies the need for the program, states when it shall be used and functionally describes all inputs, outputs and functions performed. This descriptive text shall be written in a language that is understandable by non-programming-oriented readers.

2. A program description that shall include, but not be limited to, the following:

a. Applicable Documents - List all documents (standard manufacturer's literature, other program descriptions, etc.) by section, if practical, that apply to the program. One complete copy of all applicable reference material shall be provided.

b. Input Output - Identify each input and output parameter, variable, and software element used by the program. State the purpose of all inputs, outputs, and variables.

c. Processing - This section shall contain a description of the overall structure and function of the program. Describe the program run stream and present a detailed description of how the program operates. Describe the timing and sequencing of operations of the program relative to other programs. Describe all interactions with other programs. Processing logic that is not readily described without considerable background information shall be handled as a special topic with references to an appendix or to control strategy document that details the necessary information. Reference shall also be made to an appendix or control strategy document for equation and program algorithm derivations.

d. System Configuration - Describe in detail the system configuration or status required for program implementation, if appropriate.

e. Limitations and Constraints - Summarize all known or anticipated limitations of the program, if appropriate.

f. Storage - Define program storage requirements in terms of disk or RAM memory allocation.

g. Verification - Describe, as a minimum, a test that can be used by the operator to assure proper program operation. Define the required system configuration, input requirements and criteria for successful test completion.

h. Diagnostics - Describe all program diagnostics, where applicable. Descriptions shall list each error statement, indicate clearly what it means, and specify what appropriate actions should be taken.

i. Malfunction Procedures - Specify procedures to follow for recovering from a malfunction due to either operator error or other sources.

1.10 FINAL SYSTEM DOCUMENTATION

A. All documentation shall be delivered to the Owner prior to final system acceptance in accordance with the Contract Documents. As a minimum, final documentation shall contain all information originally part of the control system submittals.

B. Provide a complete set of detailed electrical interconnection diagrams required to define the complete instrumentation and control system. All diagrams shall be 11 X 17-inch original reproducible prints. All diagrams shall be corrected to describe final "as built" hardware configurations and to reflect the system configuration and control methodology adopted to achieve final system acceptance.

C. Provide system software documentation for the operation and maintenance of all system software programs provided as a part of the digital system. All system software documentation shall be amended as required to delineate all modifications and to accurately reflect the final as built software configurations.

D. Provide application software documentation that contains program descriptions for the operation, modification, and maintenance of all application programs provided for the digital system.

E. Provide control strategy documentation which shall include control strategy (block oriented or ladder logic) diagrams to describe the control of all processes. Control strategy documentation shall reflect the system configuration and control methodology adopted to achieve final system acceptance. Control strategy documentation shall conform to the submittal requirements listed hereinabove.

F. O&M documentation shall be amended with all final, adjusted values for all setpoints and other operating parameters for Owner reference.

G. The Owner recognizes the fact that not all possible problems related to real time events, software interlocks, and hardware maintenance and utilization can be discovered during the Acceptance Tests. Therefore, the Contractor shall investigate, diagnose, repair, update, and distribute all pertaining documentation of the deficiencies that become evident during the warranty period. All such documentation shall be submitted in writing to the Owner within 30 days of identifying and solving the problem.

1.11 PROGRAMS AND SOURCE LISTINGS

A. Provide one copy of all standard, of-the-shelf system and application software (exclusive of firmware resident software) on original media furnished by the software manufacturer.

B. Provide one copy of source listings on digital media, acceptable to Engineer, for all custom software/logic written specifically for this facility, all database files configured for

this facility, and all control strategies. All source listings shall include a program abstract, program linkage and input/output data. Comments describing the program flow shall be frequently interspersed throughout each listing.

C. All software/logic shall be in both its native format and in Adobe Portable Document Format.

1.12 SUBMITTAL/DOCUMENTATION FORMAT

A. All drawing-type submittals and documentation shall be rendered and submitted in the latest version of AutoCAD.

B. All textual-type submittals and documentation shall be rendered and submitted in the latest version of Microsoft Word or in searchable Adobe Portable Document Format (PDF). Raster scans will not be accepted.

1.13 ELECTRONIC O&M MANUALS

A. Subject to acceptance by the Engineer, the O&M information may be submitted in part or in whole in an electronic format on digital media.

B. Electronic O&M manuals shall contain information in standard formats (searchable Adobe PDF, Word, AutoCAD, HTML, etc.) and shall be easily accessible using standard, “off-the-shelf” software such as an Internet browser. Raster scans will not be accepted.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 21
PROCESS CONTROL SYSTEM TESTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall test the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21.72 – Field Testing

C. Section 40 61 21.73 – Final Acceptance Test

1.03 SUBMITTALS

A. For each of the specified tests, submit a test plan to the Engineer at least 21 days in advance of commencement of the tests. The test plan shall contain the following at a minimum:

1. A schedule of all testing to be conducted.

2. A brief description of the testing to be performed

3. Test objectives.

4. Testing criteria per the Specifications.

5. Check lists and procedures for performing each of the specified tests.

6. Sample test result documentation.

7. Requirements for other parties.

1.04 GENERAL REQUIREMENTS

A. All system start-up and test activities shall follow detailed test procedures; check lists, etc., previously approved by the Engineer. The Engineer reserves the right to have his and/or the Owner's representatives in attendance.

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B. The Contractor shall provide the services of experienced factory trained technicians, tools and equipment to field calibrate, test, inspect, and adjust all equipment in accordance with manufacturer's specifications and instructions.

C. The Contractor (or designee) shall maintain master logbooks for each phase of installation, startup and testing activities specified herein. Each logbook shall include signal, loop or control strategy tag number, equipment identification, description and space for sign-off dates, Contractor signature and Engineer signature. Example test documentation specific to each phase of testing shall be approved prior to initiation of that testing, as specified hereinabove.

D. All test data shall be recorded on test forms, previously approved by the Engineer. When each test has been successfully completed, a certified copy of all test results shall be furnished to the Engineer together with a clear and unequivocal statement that all specified test requirements have been met and that the system is operating in accordance with the Contract Documents.

E. The Engineer will review test documentation in accordance with the Contract Documents and will give written notice of the acceptability of the tests within 10 days of receipt of the test results.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 21.72
FIELD TESTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform field testing on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21 – Process Control System Testing

C. Section 40 61 21.73 – Final Acceptance Test

1.03 GENERAL REQUIREMENTS

A. Control system start-up and testing shall be performed to ensure that all plant processes shall be systematically and safely placed under digital control in the following order:

1. Confirm readiness of valve actuators and flow meters for commissioning including Profibus network validation as specified herein.

2. Each final control element shall be individually tested as specified hereinafter.

3. Each control loop shall be tested as specified hereinafter.

4. Each control strategy shall be tested under automatic digital control as specified hereinafter.

5. The entire control system shall be tested for overall monitoring, control, communication, and information management functions, and demonstrated for system availability as specified hereinafter.

B. System start-up and test activities shall include the use of RAS to establish service conditions that simulate, to the greatest extent possible, various operating conditions in terms of applied process loads, operating ranges and environmental conditions. All such testing shall be coordinated with the Owner to minimize disruption to plant operations.

C. Each phase of testing shall be fully and successfully completed and all associated documentation submitted and approved prior to the next phase being started. Specific exceptions are allowed if written approval has been obtained in advance from the Engineer.

020119

1.04 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall ensure that all mechanical equipment, equipment control panels, local control panels, field instrumentation, control system equipment and related equipment and/or systems are tested for proper installation, adjusted and calibrated on a loop-by-loop basis prior to control system startup to verify that each is ready to function as specified. Each test shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

B. Upon completion of Profibus network terminations by the Owner, the Contractor shall utilize a ProfiTrace 2 protocol analyzer, or equivalent, to validate proper functionality of each Profibus network segment at 1.5 Mbps communications to the existing PLC. The Contractor shall assist the Owner in troubleshooting and repair of the network as necessary. The Contractor shall submit a report using output from the protocol analyzer to demonstrate proper functionality of the networks.

C. The Contractor shall be responsible for coordination of meetings with the Owner. A meeting shall be held each morning to review the day's test schedule. Similarly, a meeting shall be held each evening to review the day's test results and to review or revise the next day's test schedule as appropriate.

1.05 FINAL CONTROL ELEMENT TESTING

A. The proper control of all final control elements shall be verified by tests conducted in accordance with the requirements specified herein.

B. All modulating final control elements shall be tested for appropriate speed or position response by applying power and input demand signals, and observing the equipment for proper direction and level of reaction. Each final control element shall be tested at 0, 25, 50, 75, and 100 percent of signal input level and the results checked against specified accuracy tolerances. Final control elements, such as VFDs, that require turndown limits shall be initially set during this test.

C. All non-modulating final control elements shall be tested for appropriate position response by applying and simulating control signals, and observing the equipment for proper reaction.

1.06 LOOP CHECKOUT

A. Prior to control system startup and testing, each monitoring and control loop shall be tested on an individual basis from the primary element to the final element, including the operator workstation or loop controller level, for continuity and for proper operation and calibration.

B. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses. Simulated input data signals may be used subject to prior written approval by the Engineer. All modes of control shall be exercised and checked for proper operation.

C. The accuracy of all DACs shall be verified by manually entering engineering unit data values at the operator workstation and then reading and recording the resulting analog output data.

D. The accuracy of all ADCs shall be verified using field inputs or by manually applying input signals at the final controller, and then reading and recording the resulting analog input data at the operator workstation.

E. Each loop tested shall be witnessed, dated and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.07 CONTROL SYSTEM STARTUP AND TESTING

A. Control system startup and testing shall be performed to demonstrate complete compliance with all specified functional and operational requirements. Testing activities shall include the simulation of both normal and abnormal operating conditions.

B. All digital hardware shall be fully inspected and tested for function, operation and continuity of circuits. All diagnostic programs shall be run to verify the proper operation of all digital equipment.

C. Final control elements and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using local area control panels, motor control center circuits, and local field mounted control circuits. All hardwired control circuit interlocks and alarms shall be operational. The control to final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits.

D. Signals from transducers, sensors, and transmitters shall be utilized to verify control responses for final control elements. Simulated input data signals may be used subject to prior written approval by the Engineer.

E. Each control strategy shall be tested to verify the proper operation of all required functions. The control system start-up and test activities shall include procedures for tuning all control loops incorporating PID control modules, and for adjusting and testing all control loops as required to verify specified performance.

F. The control system start-up and test activities shall include running tests to prove that the Instrumentation, Control and Information System is capable of continuously, safely and reliably regulating processes, as required by the Contract, under service conditions that simulate, to the greatest extent possible, normal plant operating ranges and environmental conditions.

G. A witnessed functional acceptance test shall be performed to demonstrate satisfactory performance of individual monitoring and control loops and control strategies. At least one test shall be performed to verify that the control and instrumentation system is capable of simultaneously implementing all specified operations.

H. Each loop and control strategy test shall be witnessed and signed off by both the Contractor (or designee) and the Engineer upon satisfactory completion.

1.08 FACILITY STARTUP COORDINATION

A. Facility start-up shall comply with requirements specified in the Contract Documents and those requirements specified herein. Facility start-up shall commence after all previously described start-up and test activities have been successfully completed and shall demonstrate that the Instrumentation, Control and Information System can meet all Contract requirements with equipment operating over full operating ranges under actual operating conditions.

B. The control system start-up period shall be coordinated with process startup activities and shall be extended as required until all plant processes are fully operational and to satisfy the Engineer that all control system Contract requirements have been fulfilled in accordance with the Contract Documents.

C. The Contractor's personnel shall be resident at the facility to provide both full time (eight hours/day, five days/week) and 24 hours on call (seven days/week) support of operating and maintenance activities for the duration of the start-up period.

D. At least one qualified control systems technician shall be provided for control system startup and test activities and at least two when loop checkout is being performed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 21.73
FINAL ACCEPTANCE TEST

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall perform the Final Acceptance Test on the Control and Information System as specified herein to demonstrate compliance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 21 – Process Control System Testing

C. Section 40 61 21.72 – Field Testing

1.03 AVAILABILITY DEMONSTRATION AND FINAL SYSTEM ACCEPTANCE

A. Upon completion of all control system startup activities and prior to final system acceptance, the Contractor shall demonstrate that the availability of the entire control system, including operation under conditions of digital equipment fail-over, initiated either automatically or manually, shall be not less than 99.8 percent during a 14-day availability test period. The Owner shall be given seven days' notice of the starting date of the 14-day availability test.

B. For purposes of determining availability figures, downtime of each system or portions of each system resulting from the causes specified hereunder will not be considered system failures.

1. Downtime of a portion of the system resulting from failure of any field sensor shall not be considered a system failure provided that the system operates as specified under this condition.

2. Total shutdown of a single PLC resulting from a software fault shall be considered a system failure.

3. An erroneous command to the process that can be specifically related to a software fault shall be considered as one (1) hour of downtime.

4. The inoperability of any subsystem resulting from a software fault shall be considered a system failure.

5. The failure of the same component more than one time during the 14-day test shall be considered a system failure.

020119

C. If the system fails the 14-day availability test, the 14-day test period shall be restarted after the failed component or software is repaired/replaced and full operation is restored. The system shall be demonstrated for the full 14-day period following the restart.

D. The Contractor shall submit an availability demonstration report that shall state that all system availability requirements have been met.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 26
PROCESS CONTROL SYSTEM TRAINING

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. To familiarize the Owner's personnel with the process control system and field instrumentation, training shall be provided as detailed hereunder.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

1.03 SUBMITTALS

A. A minimum of 30 days prior to beginning training, submit a detailed training plan describing the following:

1. A listing of all courses to be conducted.

2. Course content.

3. Applicability of each course to management, operations, maintenance, laboratory, etc., personnel.

4. Course schedules.

5. Qualifications and experience of individual(s) providing training.

B. A minimum of 14 days prior to beginning each training course, submit documentation for use by the Owner's personnel during training. The training documentation shall be specific to the particular course, and shall include the following:

1. A listing of all subjects to be covered.

2. Course schedule.

3. Documentation/lesson plans covering all subjects to be covered during the course instruction. Information shall be in a "how to" format, with sufficient background documentation and references to manufacturer literature to provide a thorough and clear understanding of the materials to be covered.

1.04 GENERAL REQUIREMENTS

A. All costs of providing the training courses shall be borne by the Contractor.

B. As used herein, the term "day" shall mean an eight-hour day, and the term "week" shall mean a five-day, 40-hour week.

C. Training courses, especially those for operator training, may be required to be scheduled during non-standard business hours (i.e., not between the hours of 8:00 am and 5:00 pm) to accommodate the working schedule of the Owner’s personnel. No additional compensation will be awarded to the Contractor for training at non-standard hours.

D. All training courses shall complement the experience and skill levels of the Owner's personnel.

E. Training courses shall be structured in order of increasing capability or security levels. The purpose of this requirement is to allow personnel with lesser training requirements or security password levels to drop out of the training at certain times while the training continues for personnel with greater requirements or higher security levels.

F. All training courses shall include lecture as well as "hands on" experience for each of the attending personnel. The Contractor shall provide sufficient equipment for this to be accomplished. For example, training in which the instructor uses the computer and the Owner's personnel passively observe as the instructor demonstrates system functions shall not be acceptable.

G. Unless otherwise specified, all training courses shall be conducted in the Owner's facilities.

H. All training shall be completed prior to system acceptance.

I. Standard manufacturer training courses are acceptable pending approval by the Engineer and Owner.

1.05 OPERATOR TRAINING

A. Three two-hour courses shall be conducted to provide instruction in the use of the Control and Information System to monitor and control the modified RAS valve and RAS pump systems.

B. Operator training shall include familiarization training covering the Control and Information System. Operators shall be instructed in the names, locations, functions, and basic operation of all items of digital equipment and associated software.

C. Operator training shall cover process and equipment operation both individually and collectively as an operating system. Normal as well as abnormal operating conditions shall be covered, including the response to failure occurrences and system alarms. All operator/system interactions shall be described.

D. Operators shall be trained to instruct other operators and shall be provided with all course materials.

1.06 PLC TRAINING

A. A one-day course of specific training shall be provided by the instrumentation subcontractor in the use and modification of all control strategies provided under this Division. Training shall include startup, commissioning, programming and configuration of RAS valve actuators and magnetic flow meters to PLC and SCADA system.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 40 61 93

PROCESS CONTROL SYSTEM INPUT / OUTPUT LIST

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all control system inputs and outputs as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 96 – Process Control Descriptions

PART 2 – CONTROL SYSTEM INPUT / OUTPUT SCHEDULE

Service Description	State/Span	Type	Remarks
Aeration Basin No.1 RAS Valve	Remote	PDI	MOV-601
Aeration Basin No.1 RAS Valve Position Control	0-100%	PAO	
Aeration Basin No.1 RAS Valve Position Feedback	0-100%	PAI	
Aeration Basin No.1 RAS Valve	Fail	PDI	Read all fault codes
Aeration Basin No.2 RAS Valve	Remote	PDI	MOV-602
Aeration Basin No.2 RAS Valve Position Control	0-100%	PAO	
Aeration Basin No.2 RAS Valve Position Feedback	0-100%	PAI	
Aeration Basin No.2 RAS Valve	Fail	PDI	Read all fault codes
Aeration Basin No.3 RAS Valve	Remote	PDI	MOV-603
Aeration Basin No.3 RAS Valve Position Control	0-100%	PAO	
Aeration Basin No.3 RAS Valve Position Feedback	0-100%	PAI	
Aeration Basin No.3 RAS Valve	Fail	PDI	Read all fault codes
Aeration Basin No.4 RAS Valve	Remote	PDI	MOV-604
Aeration Basin No.4 RAS Valve Position Control	0-100%	PAO	
Aeration Basin No.4 RAS Valve Position Feedback	0-100%	PAI	
Aeration Basin No.4 RAS Valve	Fail	PDI	Read all fault codes
Aeration Basin No.5 RAS Valve	Remote	PDI	MOV-605

020119

Service Description	State/Span	Type	Remarks
Aeration Basin No.5 RAS Valve Position Control	0-100%	PAO	
Aeration Basin No.5 RAS Valve Position Feedback	0-100%	PAI	
Aeration Basin No.5 RAS Valve	Fail	PDI	Read all fault codes
Aeration Basin No.6 RAS Valve	Remote	PDI	MOV-606
Aeration Basin No.6 RAS Valve Position Control	0-100%	PAO	
Aeration Basin No.6 RAS Valve Position Feedback	0-100%	PAI	
Aeration Basin No.6 RAS Valve	Fail	PDI	Read all fault codes
Aeration Basin No.7 RAS Valve	Remote	PDI	MOV-607
Aeration Basin No.7 RAS Valve Position Control	0-100%	PAO	
Aeration Basin No.7 RAS Valve Position Feedback	0-100%	PAI	
Aeration Basin No.7 RAS Valve	Fail	PDI	Read all fault codes
Aeration Basin No.8 RAS Valve	Remote	PDI	MOV-608
Aeration Basin No.8 RAS Valve Position Control	0-100%	PAO	
Aeration Basin No.8 RAS Valve Position Feedback	0-100%	PAI	
Aeration Basin No.8 RAS Valve	Fail	PDI	Read all fault codes

NOTES:

1. Input/Output types are as follows:
   a. PDI – Profibus DP Discrete Input
   b. PDO – Profibus DP Discrete Output
   c. PAI – Profibus DP Analog Input
   d. PAO – Profibus DP Analog Output

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install and place in satisfactory operation all equipment as herein specified and as shown on the Drawings. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING COMPLETE FUNCTIONING SYSTEMS AS DESCRIBED HEREIN.

B. Together with the control system input/output schedule, the equipment specifications (including functional descriptions for local equipment control panels), and the Drawings, the functional control descriptions describe the required operation, monitoring, and control of the facilities included in this Contract.

C. THE FUNCTIONAL DESCRIPTIONS CONTAIN REQUIREMENTS FOR FURNISHING AND INSTALLING LABOR AND MATERIALS THAT MAY NOT APPEAR ELSEWHERE IN THE CONTRACT DOCUMENTS.

D. All services required to implement the monitoring and control functions described herein or in the process input/output schedules shall be provided by the Contractor.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 93 – Process Control System Input/Output List

PART 2 – FUNCTIONAL CONTROL DESCRIPTIONS, GENERAL

2.01 DEFINITIONS

A. RUNNING status signals shall be from auxiliary contacts provided with the motor control equipment (i.e., starter, VFD, SCR, etc.).

B. AUTO status signals shall be defined as HAND-OFF-AUTO switch in the AUTO position or process control system in AUTO (versus MANUAL).

C. FAIL status signals shall be defined as motor overload and/or any other shut down mode such as overtorque, overtemperature, low oil pressure, high vibration, etc.

D. READY status signal shall be defined as all conditions, including equipment control power, satisfied to permit remote control of the equipment.

020119

2.02 CONVENTIONS

A. Operator workstation graphic display symbols and style shall conform to the Owner's existing convention.

2.03 PROCESS CONTROL

A. Where setpoints, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable and, based on actual operating conditions, the Contractor shall make all necessary adjustments to provide smooth, stable operation at no additional cost to the Owner.

B. Provision shall be made in PLC logic to suppress nuisance alarms and control actions by the following means:

1. For alarms and control actions derived from analog input signals, use adjustable time delays and deadbands.

2. For alarms and control actions derived from discrete input signals, use adjustable time delays.

3. Initial settings for time delays shall be 10 seconds (range 0-120 seconds). Initial settings for deadbands shall be 5% of span (range 0-100%).

4. Equipment that is started or stopped manually by the operator shall start or stop immediately, with no time delay.

C. Unless otherwise specified, all equipment shall automatically restart after a power failure utilizing adjustable start delay timers in PLC control logic. Unless otherwise specified, all PLC control strategies shall be based upon automatic restart after a power failure and shall return to a normal control mode upon restoration of power.

D. The PLC shall be capable of receiving initial run-time values for existing and proposed equipment. Initial run-time shall not automatically be assumed to be zero.

E. A control discrepancy alarm shall be generated through the PLC for any drive, motor, etc. for which a command has been issued, but for which the PLC is not receiving a confirming status signal (e.g., start command with no run feedback). The failure shall be logged.

F. An instrument failure alarm shall be generated for any instrument which is generating a signal that is less than 4 mA or greater than 20 mA.

G. Unless otherwise specified in an individual control description, an instrument failure or control discrepancy alarm shall cause the control strategy to maintain last values, place the associated equipment into manual mode, and to generate an alarm. Manual initiation of the automatic control strategy shall be required.

H. A control program that controls multiple pieces of equipment shall not be prevented from running because not all of the equipment is in AUTO. If equipment within an equipment chain is required to be running for program operation and it is running in HAND or MANUAL, then the program shall run and control the other equipment that is in AUTO.

I. All PLC wait states (internal time delays, etc.) after an operator action shall be displayed on the operator workstation.

PART 3 – FUNCTIONAL CONTROL DESCRIPTIONS

3.01 RETURN ACTIVATED SLUDGE DISTRIBUTION CONTROL

A. Process Overview

1. Return activated sludge (RAS) is conveyed from secondary clarifiers to the aeration basins by variable speed RAS pumps. The RAS pumps may be controlled to maintain a constant speed, a constant flow rate, or a variable flow rate based upon the plant effluent flow rate. These controls are existing and will not be modified under this Contract. However, the pump control settings (such as controller limits and PID loop tuning parameters) shall be adjusted as required to optimize the overall performance and stability of the RAS conveyance system with the automation of the RAS valves.

2. Distribution of RAS to individual aeration basins will be achieved via modulating valves and magnetic flow meters located at each of the eight (8) aeration basin RAS influent lines. Total RAS flow will be divided among the online aeration basins according to a predefined formula defined below. The RAS valves will utilize a most-open-valve (MOV) control strategy to ensure the valves remain as far open as possible while achieving the desired distribution of flow.

B. RAS Distribution Control Operations

1. When the RAS valve LOCAL-OFF-REMOTE switch is in LOCAL, the valve shall be controlled manually at the valve operator via the OPEN (STOP) CLOSE pushbuttons. When the local switch is in “OFF” the valve shall not operate regardless of other run commands. When the local switch is in “REMOTE”, control is transferred to the PLC.

2. When the RAS valve LOCAL-OFF-REMOTE switch is in REMOTE, RAS flowrate to each Aeration Basin shall be controlled by the PLC. RAS from the RAS pump stations is discharged to eight RAS flow control valves and magnetic flow meters. One valve and flow meter are dedicated to each aeration basin.

3. If an aeration basin is offline the RAS valve associated with that basin shall be manually closed and shall remain in the local mode of operation.

4. The RAS valve for each online basin shall modulate to maintain a desired fraction of total RAS flow. The fraction of RAS flow to each aeration basin shall be set by the following:

    a. The number of 1-4 basins (1 to 4) in operation is an operator input (Y); the number of 5-8 basins (1 to 4) in operation is an operator input (Z).

        - Qt = sum of all eight RAS flow rates
        - X = 1/[Y+Z(1.222)]
        - RAS flow to each basin (basins 1-4) = (Qt)(X)
        - RAS flow to each basin (basins 5-8) = 1.222(Qt)(X)

5. The valve shall be modulated until the desired flowrate is measured at the magnetic flow meter using a floating point control algorithm. An adjustable time deadband shall be provided between the modulating valve and the control program. The adjustable time deadband shall initially be set at a maximum of ten (10) adjustments per minute. The amount of change, increase or decrease, the valve is allowed to make per each adjustment shall be adjustable. An adjustable deadband (initially set at +/- 5%) for the desired RAS flow shall be provided such that if the flow is within this deadband, no valve adjustment is necessary.

6. Only one valve shall be allowed to move at a time. When a valve stops moving, start a time delay (adjustable from 0 – 15 seconds). During the time delay, no valves shall be allowed to move.

7. Most-Open Valve (MOV) Control

    a. Provide the following adjustable parameters for MOV Control on a password-protected HMI graphic screen.

        1) Maximum Valve Position setpoint (Max%) – Initially set at 80%

        2) Minimum Valve Position setpoint (Min%) – Initially set at 20%

    b. Sequence:

        1) Upon placing a valve into automatic mode, move the valve to a predefined startup position (adjustable between minimum and maximum positions). The startup position setting shall be adjustable per valve. For all valves already in automatic mode, skip to step 2.

        2) If more than one valve is at the maximum position, all valves shall be allowed to move as required by the flow ratio control algorithm.

        3) When only one valve is at the maximum position, that valve shall be flagged as the Most-Open-Valve (MOV). The MOV shall have flow

control suspended and the position shall be fixed at the maximum position.

4) When changes in flow conditions occur (e.g., step changes in RAS flow setpoints from secondary clarifiers, taking biological reactors offline, bringing biological reactors online, changing the number of operating RAS pumps, etc.) valve positions will be adjusted based on the flow control algorithm to maintain the RAS flow split.

5) Repeat sequence above continuously.

c. If basin associated with MOV is taken out of service, flag valve with next highest % position as MOV.

1) If newly-flagged MOV position is below the maximum valve position:

a) Temporarily suspend control loops.

b) Calculate difference between MOV position and maximum valve position and drive all valves more open by this amount.

c) Let system stabilize (adjustable period of time, 0-300 seconds).

2) Resume valve control to maintain flow split after system has stabilized.

8. Miscellaneous

a. Acquire detailed fault codes via Profibus communications (channel 349) from each RAS valve actuator and display active faults on the HMI.

b. Provide a manually toggled “Maintenance Mode” option for each RAS flow meter to allows the operator to enter an estimated flow rate while the instrument is under maintenance. The estimated flow rate shall be used in the control logic to minimize the error in the total RAS flow rate calculations. This shall be provided for all eight RAS valve flow meters and for the five RAS pump flow meters.

c. Compare the total flow rate from the RAS pump station flow meters to the total flow rate from the RAS valve flow meters. Generate an alarm if the difference in the two total RAS flow rates exceeds 0.50 MGD (adjustable) for more than 30 seconds (adjustable).

END OF SECTION

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SECTION 40 68 00.13

PROCESS CONTROL SOFTWARE (MODIFY EXISTING)

PART 1 – GENERAL

1.01 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place in satisfactory operation all control and information system software with all required programming and software appurtenances as herein specified and as shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 61 13 – Process Control System General Provisions

B. Section 40 61 93 – Control System Input/Output List

C. Section 40 61 96 – Process Control Descriptions

PART 2 – PRODUCTS - (NOT USED)

PART 3 – EXECUTION

3.01 OVERALL SYSTEM CONFIGURATION

A. The Owner's existing Human-Machine Interface (HMI) software, including but not limited to all relevant displays, alarm summary pages, data collection, and historical trending/reporting, shall be modified to include all work performed under this Contract.

B. The Owner's existing control system shall be modified to include the inputs and outputs specified in the Input/Output Schedule and in other Sections of this Division.

3.02 SOFTWARE MODIFICATIONS

A. All HMI software configuration performed under this Contract shall be coordinated with the Owner and shall match in all possible respects the "look and feel," in the opinion of the Engineer, of the existing SCADA System. Specified features and functions of this Contract that do not already exist, even if only for "look and feel," shall be provided. Details on how to best implement these features and functions shall be discussed with Owner and Engineer.

B. Major HMI software scope of work shall include, but shall not be limited to, the following:

031519

1. Create new and modify existing HMI graphic displays and database tags to provide the functionality described in Section 40 61 96 – Process Control Descriptions.

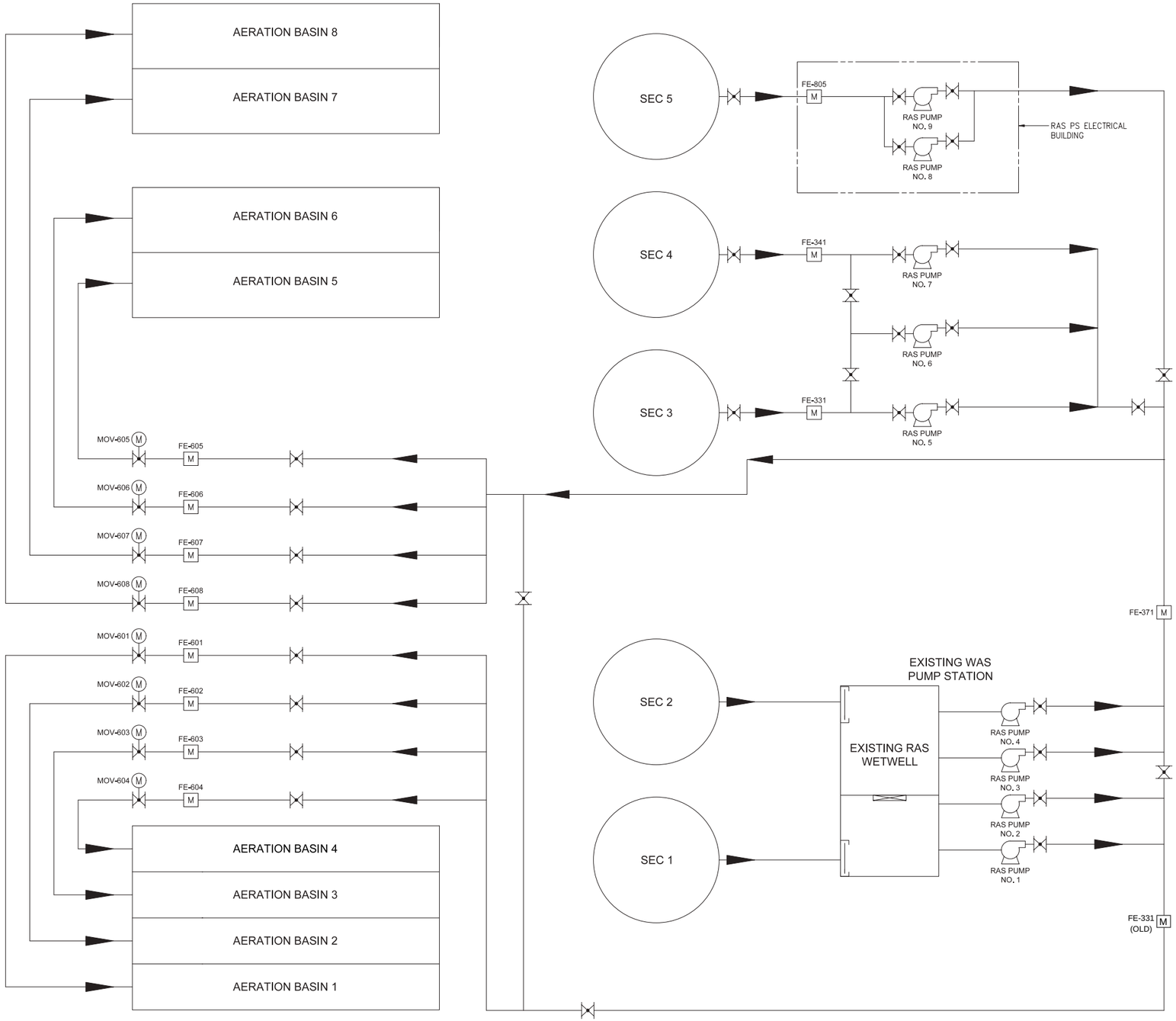
2. Modify existing reports and trend graphs as required to accommodate the functions specified under this Contract.

C. Logic resident in existing PLCs shall be modified to perform the functions described as specified herein and in Section 40 61 96 – Process Control Descriptions. Specifically, the existing PLCs shall be programmed to accept the I/O specified in Section 40 61 93 – Control System Input/Output List, make this data readily available on the plant network, and shall be programmed to execute the logic necessary to implement all control functions associated with the scope of work specified under this Contract. The PLC logic shall be written and laid out to match the “look and feel” of the existing logic. Nested function blocks are not to be used unless reviewed and approved by the Owner prior to installation. Function blocks may be used for individual pieces of equipment or specific functions, not whole systems. Logic shall be written and documented in such a manner as to allow for ease of troubleshooting and future changes.

D. All discrete and analog data acquisition, pre-processing, storage and process control functions shall be performed at the PLC level. The HMI software shall not be used for this purpose.

END OF SECTION

Appendix A



DESIGN, PLANT TOTAL RAS FLOWS

MINIMUM	10 MGD
AVERAGE	15 MGD
MAXIMUM	25 MGD

RAS PUMPS 1-4

TYPE	VERTICAL NON-CLOG CENTRIFUGAL
NUMBER	4
CAPACITY	3,964 GPM @ 17 FT TDH
POWER	75 HP
DRIVE TYPE	VARIABLE SPEED

RAS PUMPS 5-7

TYPE	VERTICAL NON-CLOG CENTRIFUGAL
NUMBER	3
CAPACITY	4,717 GPM @ 23 FT TDH
POWER	40 HP
DRIVE TYPE	VARIABLE SPEED

RAS PUMPS 8-9

TYPE	HORIZONTAL NON-CLOG CENTRIFUGAL
NUMBER	2
CAPACITY	6,683 GPM @ 39 FT TDH
POWER	100 HP
DRIVE TYPE	VARIABLE SPEED

REV	ISSUED FOR	DATE	BY

PROJECT ENGINEER: P. BENJAMIN
DESIGNED BY: P. BENJAMIN
DRAWN BY: J. JORDAN
CHECKED BY: C. KLUG
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO FULL SCALE 0 1/2" 1"

100% SUBMITTAL

Hazen
HAZEN AND SAWYER
6675 CORPORATE CENTER PARKWAY
SUITE 330
JACKSONVILLE, FLORIDA 32216

ARLINGTON EAST WRF SITE
RAS VALVE REPLACEMENT
JEA sm Building Community sm

EXISTING RAS PROCESS FLOW DIAGRAM

DATE: JANUARY 2020
HAZEN NO.: 42000-018
CONTRACT NO.: 00
DRAWING NUMBER: M001

JEA

INDEX

GENERAL DESCRIPTION:

This document covers the design of faceplates for the WinCC (HMI)-Human Machine Interface. When selecting any Actuator, Instrument or Process Controller on the HMI a faceplate relating to that device will open up.

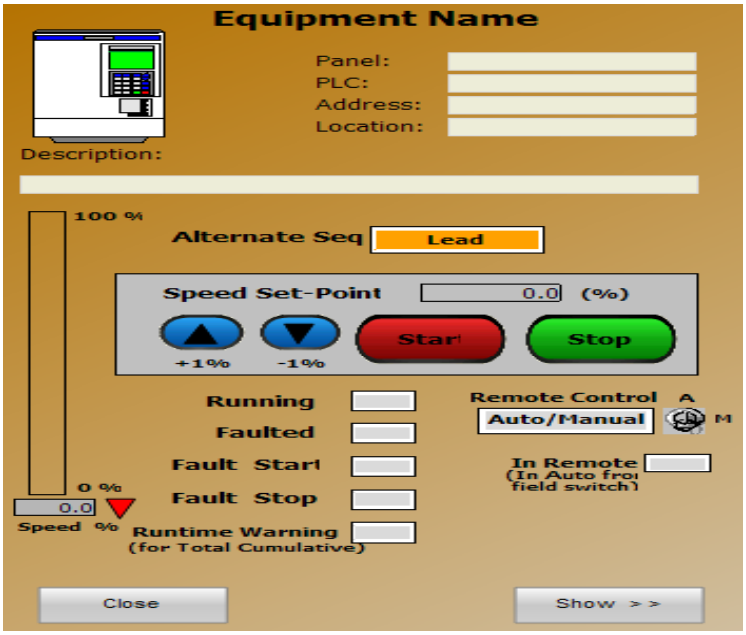
The actuators have two different control modes: Remote from the HMI or Local in the field. While an actuator is in Remote control, in the field, the equipment can be operated as Manual or Automatic from the HMI. In HMI-Manual the operator can manage the equipment from the HMI such as to open/close the valve or turn on/off motor. In HMI-Automatic, the equipment follows the commands from the PLC program according to the loop control logic.

The information about the equipment is shown in the faceplate: panel, address, location and a brief description. The faceplate has two windows which are the Standard Window and Information Window. Standard Window is the operating window that allows the operator to work the device and provides basic information. Information Window provides additional status information that only can be shown by clicking on the Show button.

In the Information Window are four types of attributes; the number and type chosen for each faceplate will be application specific. Consult the JEA Qualified Representative/Engineer prior to system development.

- Trend: All the pertinent data associated with a device is to be trended. For the Process Control Faceplate the Process Value, Control Value and Setpoint will all be able to be trended.
- Commands (Cmd): Are all the commands sent to a device, which include the operating mode from the HMI. Examples of these commands but not limited to are Auto, Manual, Alarm Setpoints, Delays and PID Setpoints.
- Status (Stat): Are the status variables that indicate the status of the equipment. Examples of these but not limited to are Auto, Manual, Process Value, Warnings and Alarms.
- Historical (Hist): Historical information about the equipment that is useful for maintenance purposes. Examples of these but not limited to are Daily Total, Previous Total, Cumulative Total and Starts.

An example of opening a faceplate on an HMI could be a motor shown on the screen. If the Operator selects that motor a faceplate for that device will open up. The faceplate shown below is for a (VFD) - Variable Frequency Drive.



If the Operator requires more information related with the device they will click on the Show button to see additional information on the tabs. For example:

- Commands (Cmd): Are the commands sent to the equipment, which include the operating mode from the HMI. Normally this attribute is set with 1 when we want to activate the command, otherwise is 0. Such as Cmd_Reset_Acum that can be used to reset accumulative total.

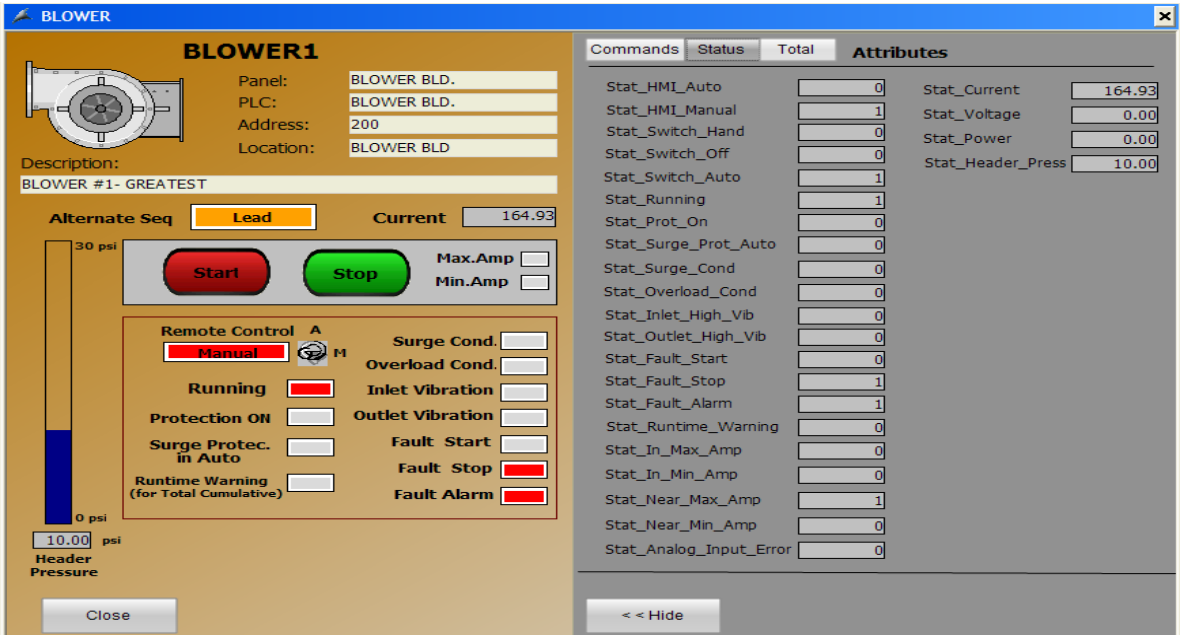
- Status (Stat): Are the status variables that indicate some status of the equipment. Usually the attribute is set when the status is activated.

- Historical (Hist): Stores historical information about the equipment that can be useful for performance evaluation. There are three different totalizer values: Total Today, Total Last 24 Hours, and Cumulative Total. The last one can be reset by setting the command Cmd_Reset_Acum.

The HMI is required to have a faceplate for every device, for example:

- Valves On/Off.
- Butterfly valves.
- Variable Frequency Driver: Pumps, Mixers, Blowers.

The following is an example of the faceplate:



LABELS AND UNITS NAMES:

All labels and units names on the screen are obvious to the operator. The real equipment tag name should appear also in the description of the faceplate for maintenance purpose and traceability with the electrical drawings. All internal tag names used in the HMI project are to match the project tag names.

PROGRAM DEVELOPMENT:

All scripts, for face plates, are to be written in direct dialog. All attempts to avoid VB scripts for object animation are to be made. WinCC can act very sluggish when loading a screen if it has too many scripts. If a script is the only solution it's to be written in VB and not C script.

FACEPLATE FOR: OPEN/CLOSE ACTUATOR

DESCRIPTION: Control of all Open / Close Actuators. It's possible to open or close the valve using the commands, see its status and the historical information.

ATTRIBUTES:

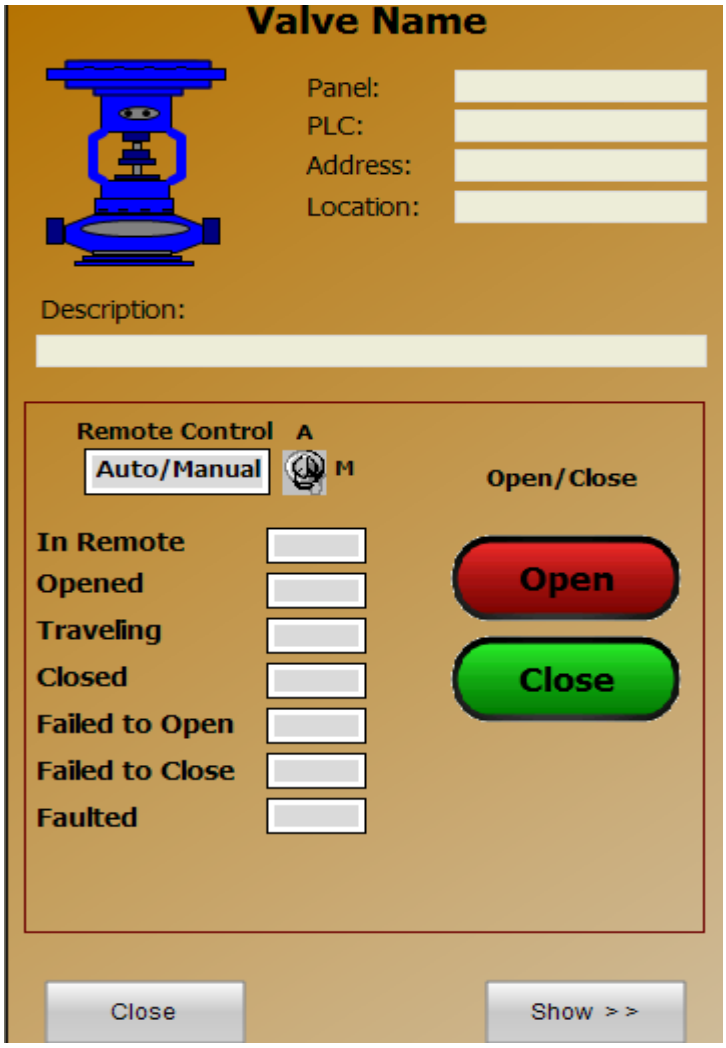
Commands	**Format**	**Description**
Cmd_HMI_Auto	BIT	Set HMI Auto mode (1)
Cmd_HMI_Manual	BIT	Set HMI manual mode (1)
Cmd_Open	BIT	Open the valve in automatic mode
Cmd_Close	BIT	Close the valve in automatic mode
Cmd_Man_Open	BIT	Open the valve from HMI in manual mode
Cmd_Man_Close	BIT	Close the valve from HMI in manual mode
Cmd_Reset_Cum	BIT	Reset the cumulative historical information
Cmd_Reset_Alarm	BIT	Reset all faults and alarms
Cmd_Change_Day	BIT	Indicate the change of day to manage Totals

Status:	**Format**	**Description**
Stat_HMI_Auto	BIT	Indicate that it is in automatic mode
Stat_HMI_Manual	BIT	Indicate that it is in manual mode (From HMI)
Stat_Switch_Hand	BIT	Indicate the field switch is in Hand (Local)
Stat_Switch_Off	BIT	Indicate the field switch is in Off (By Pass)
Stat_Switch_Auto	BIT	Indicate the field switch is in Auto or Remote (PLC)
Stat_FTO	BIT	Indicate failure to open
Stat_FTC	BIT	Indicate failure to close
Stat_Fault_Alarm	BIT	Indicate that some failure alarm has occurred
Stat_Travelling	BIT	Indicate when it is traveling
Stat_Action_Open	BIT	It is doing the action to open
Stat_Action_Close	BIT	It is doing the action to close
Stat_Opened	BIT	It is completely opened
Stat_Closed	BIT	It is completely closed
Stat_T_Open_ACC	BIT	It is traveling to open
Stat_T_Close_ACC	BIT	It is traveling to close

HIST	**Format**	**Description**
HIST_Num_Opened_Today	DINT	Total times the valve was opened today
HIST_Num_Closed_Today	DINT	Total times the valve was closed today
HIST_Num_FTO_Today	DINT	Total times the valve fault to open today
HIST_Num_FTC_Today	DINT	Total times the valve fault to close today
HIST_Time_Opn_Today	DINT	Total hours the valve was opened today
HIST_Time_Cls_Today	DINT	Total hours the valve was closed today
HIST_Num_Opened_24h	DINT	Total times the valve was opened in the last 24 hours
HIST_Num_Closed_24h	DINT	Total times the valve was closed in the last 24 hours
HIST_Num_FTO_24h	DINT	Total times the valve fault to open in the last 24 hours

HIST_Num_FTC_24h	DINT	Total times the valve fault to close in the last 24 hours
HIST_Time_Opn_24h	DINT	Total hours the valve was opened in the last 24 hours
HIST_Time_Cls_24h	DINT	Total hours the valve was closed in the last 24 hours
HIST_Num_Opened_Cum	DINT	Cumulative Total times the valve was opened
HIST_Num_Closed_Cum	DINT	Cumulative Total times the valve was closed
HIST_Num_FTO_Cum	DINT	Cumulative Total times the valve fault to open
HIST_Num_FTC_Cum	DINT	Cumulative Total times the valve fault to close
HIST_Time_Opn_Cum	DINT	Cumulative Total hours the valve was opened
HIST_Time_Cls_Cum	DINT	Cumulative Total hours the valve was closed

PICTURE:



FACEPLATE FOR: POSITIONING ACTUATOR

DESCRIPTION:

Control of all Positioning Actuators such us Aeration-Based Valves and Inlet Valves. The actuators can be opened a specified percent or closed completely. It's possible to open or close the actuator using the commands, see its status and the historical information.

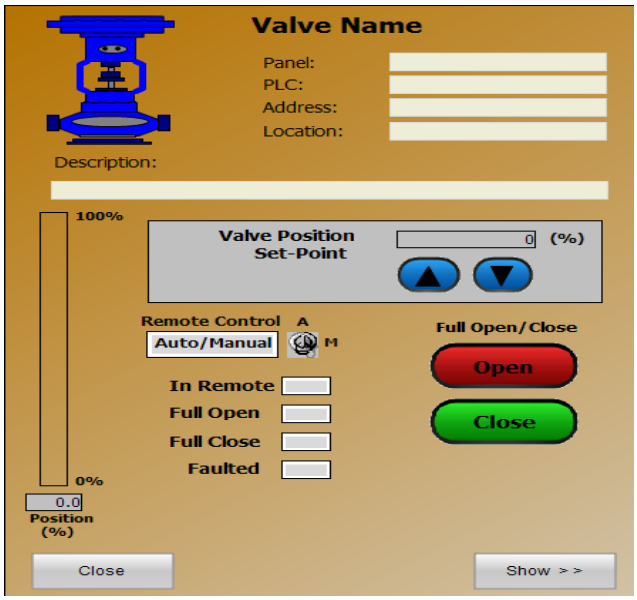
ATTRIBUTES:

Commands	Format	Description
Cmd_HMI_Auto	BIT	Set HMI Auto mode (1)
Cmd_HMI_Manual	BIT	Set HMI manual mode (1)
Cmd_Valve_Pos	REAL	Set-Point to open the valve in the any mode
Cmd_Hold_Pos	BIT	Keep firm the actual Cmd_Valve_Pos, don't allow any change of Valve Position.
Cmd_Reset_Total_Cum	BIT	Reset the cumulative total information
Cmd_Reset_Alarm	BIT	Reset all faults and alarms
Cmd_Change_Day	BIT	Indicate the change of day to manage Totals
Ctrl_Max_Pos	REAL	Used to detect when reach max. position
Ctrl_Min_Pos	REAL	Used to detect when reach min. position
Ctrl_Avg_Sample_Time	TIME	Time (sec) to take the sample to calculate average opened percent.
Ctrl_Fail_Pos_Time	TIME	Time (sec) to detect fail reaching position command
Ctrl_Fail_Deadband	REAL	Deadband to detect fail to get position

Status	Format	Description
Stat_HMI_Auto	BIT	Indicate that it is in automatic mode (From HMI)
Stat_HMI_Manual	BIT	Indicate that it is in manual mode (From HMI)
Stat_Switch_Hand	BIT	Indicate the Field switch is in Hand (Manually)
Stat_Switch_Off	BIT	Indicate the Field switch is in Off (By Pass)
Stat_Switch_Remote	BIT	Indicate the Field switch is in Remote (PLC)
Stat_Full_Opened	BIT	Indicate when the valve is completely open
Stat_Full_Closed	BIT	Indicate when the valve is completely closed
Stat_Analog_Input_Error	BIT	Indicate analog input conversion out of range
Stat_Analog_Output_Error	BIT	Indicate analog output conversion out of range
Stat_Fail_Position	BIT	Indicate fault to reach the Cmd_Valve_Position setpoint after some time (Hist_Fail_Pos_Time) and inside of the deadband (Hist_Fail_Pos_Deadband)
Stat_Fault_Alarm	BIT	Indicate that some failure alarm has occurred
Stat_In_Max_Pos	BIT	Indicate when it has reached the max. position
Stat_In_Min_Pos	BIT	Indicate when it has reached the min. position
Stat_Valve_Pos	REAL	Indicate the current opened percent
Stat_In_Hold_Pos	BIT	Indicate it is in Hold Position, and doesn't allow to change the Valve Position

HIST	Format	Description
HIST_Avg_Opened_Today	REAL	Total average percent the valve was opened today (opened percent >0)
HIST_Num_Closed_Today	DINT	Total times the valve was closed today (opened percent =0)
HIST_Num_Fail_Pos_Today	DINT	Total times the valve got fail to reach position setpoint today (Stat_Fail_Position)
HIST_Avg_Opened_24h	REAL	Total average percent the valve was opened last 24h (opened percent >0)
HIST_Num_Closed_24h	DINT	Total times the valve was closed last 24h (opened percent =0)
HIST_Num_Fail_Pos_24h	DINT	Total times the valve got fail to reach position setpoint last 24h (Stat_Fail_Position)
HIST_Avg_Opened_Cum	REAL	Total average percent cumulative the valve was opened (opened percent >0)
HIST_Num_Closed_Cum	DINT	Total times cumulative the valve was closed (opened percent =0)
HIST_Num_Fail_Pos_Cum	DINT	Total times cumulative the valve got fail to reach position setpoint (Stat_Fail_Position)

PICTURE:



FACEPLATE FOR: Motors ON/OFF

DESCRIPTION:

This will control all across the line Motors such as Mixers and Clarifiers. It's possible to start or stop the motor using the commands, view status and historical information.

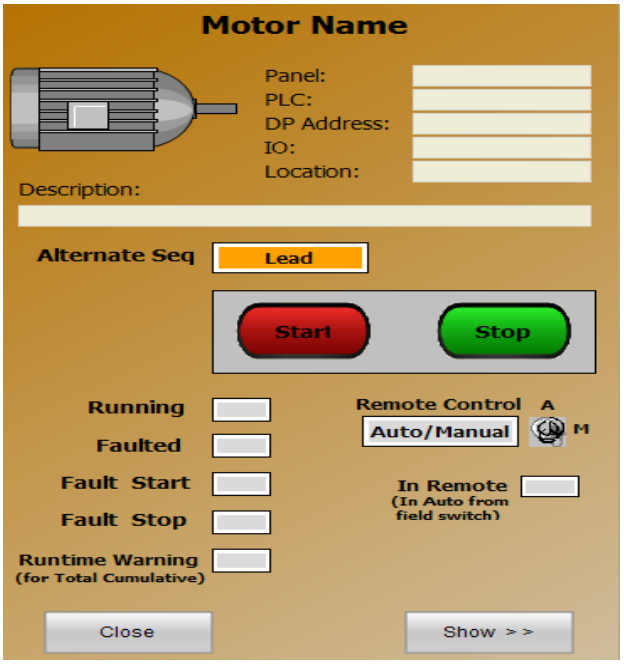
ATTRIBUTES:

Commands	**Format**	**Description**
Cmd_Lead_Lag	INT	Specify Lead-Lag for the Motor: Lead (0), Lag1(1), Lag2 (2), Lag3 (3).
Cmd_HMI_Auto	BIT	Set HMI Auto mode (1)
Cmd_HMI_Manual	BIT	Set HMI manual mode (1)
Cmd_Start	BIT	Start the motor in automatic mode
Cmd_Stop	BIT	Stop the motor in automatic mode
Cmd_Man_Start	BIT	Start the motor in manual mode
Cmd_Man_Stop	BIT	Stop the motor in manual mode
Cmd_Reset_Total_Cum	BIT	Reset the cumulative total information
Cmd_Reset_Alarm	BIT	Reset all faults and alarms
Cmd_Change_Day	BIT	Indicate the change of day to manage Totals

Status	**Format**	**Description**
Stat_HMI_Auto	BIT	Indicate It is in automatic mode (From HMI)
Stat_HMI_Manual	BIT	Indicate It is in manual mode (From HMI)
Stat_Switch_Hand	BIT	Indicate the field switch is in Hand (Local)
Stat_Switch_Off	BIT	Indicate the field switch is in Off (By Pass)
Stat_Switch_Auto	BIT	Indicate the field switch is in Auto (PLC)
Stat_Running	BIT	Indicate when the equipment is running
Stat_Fault_Start	BIT	Indicate when the fault to start alarm is triggered
Stat_Fault_Stop	BIT	Indicate when the fault to stop alarm is triggered
Stat_Fault_Alarm	BIT	Indicate when any fault alarm is triggered
Stat_Runtime_Warning	BIT	When Total_Runtime_Cum >= Runtime_Warning_Trigger
Stat_Current	REAL	Show the consumption of the motor
Stat_Voltage	REAL	Show the voltage of the motor
Stat_Power	REAL	Show the power of the motor

HIST	Format	Description
Hist_Num_Starts_Today	DINT	Total times that the equipment was started today
Hist_Num_Faults_Today	DINT	Total times that the equipment was in fault today
Hist_Runtime_Today	REAL	Total hours the equipment was running today
Hist_Current_Today	REAL	Total current reading today
Hist_Voltage_Today	REAL	Total voltage reading today
Hist_Power_Today	REAL	Total power reading today
Hist_Num_Starts_24h	DINT	Total times that the equipment was started in the last 24hours
Hist_Num_Faults_24h	DINT	Total times that the equipment was in fault in the last 24hours
Hist_Runtime_24h	REAL	Total hours the equipment was running in the last 24hours
Hist_Current_24h	REAL	Total current reading last 24 hours
Hist_Voltage_24h	REAL	Total voltage reading last 24 hours
Hist_Power_24h	REAL	Total power reading last 24 hours
Runtime_Warning_Trigger	REAL	Set point to trigger the warning (if Hist_Runtime > Runtime_Warning_Trigger)
Hist_Runtime_Cum	REAL	Total hours the equipment was running
Hist_Num_Starts_Cum	DINT	Total times that the equipment was started
Hist_Num_Faults_Cum	DINT	Total times that the equipment was in fault
Hist_Current_Cum	REAL	Cumulative total current
Hist_Voltage_Cum	REAL	Cumulative Total voltage
Hist_Power_Cum	REAL	Cumulative Total power

PICTURE:



FACEPLATE FOR: Variable Frequency Driver (VFD)

DESCRIPTION: Control all the equipment with VFD's such as RAS Pumps. It's possible to start or stop the equipment using the commands, view status and historical information.

ATTRIBUTES:

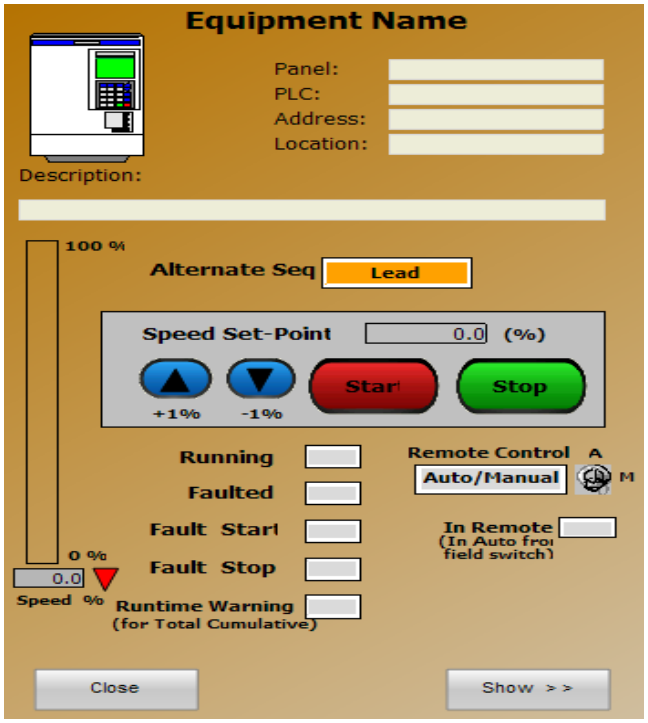
Commands	Format	Description
Cmd_Lead_Lag	INT	Specify Lead-Lag for the motor: Lead (0), Lag1(1), Lag2 (2), Lag3 (3).
Cmd_HMI_Auto	BIT	Set HMI Auto mode (1)
Cmd_HMI_Manual	BIT	Set HMI manual mode (1)
Cmd_Start	BIT	Start the equipment in automatic mode
Cmd_Stop	BIT	Stop the equipment in automatic mode
Cmd_Man_Start	BIT	Start the equipment in manual mode
Cmd_Man_Stop	BIT	Stop the equipment in manual mode
Cmd_Speed	REAL	Speed Set-point (%) for any mode
Cmd_Reset_Total_Cum	BIT	Reset the cumulative total information
Cmd_Reset_Alarm	BIT	Reset all faults and alarms
Cmd_Change_Day	BIT	Indicate the change of day to manage Totals

Status	Format	Description
Stat_HMI_Auto	BIT	Indicate It is in automatic mode (Frm HMI)
Stat_HMI_Manual	BIT	Indicate It is in manual mode (From HMI)
Stat_Switch_Hand	BIT	Indicate the Field switch is in Hand (Manually)
Stat_Switch_Off	BIT	Indicate the Field switch is in Off (By Pass)
Stat_Switch_Auto	BIT	Indicate the Field switch is in Auto (PLC)
Stat_Running	BIT	Indicate when the equipment is running
Stat_Fault_Start	BIT	Indicate when the fault to start alarm is triggered
Stat_Fault_Stop	BIT	Indicate when the fault to stop alarm is triggered
Stat_Fault_Alarm	BIT	Indicate when any fault alarm is triggered
Stat_Runtime_Warning	BIT	When Total_Runtime_Cum > Runtime_Warning_Trigger
Stat_Speed	REAL	Show the motor speed in percent (0-100%)
Stat_Inter_Min_Speed	BIT	Interlocks status for minimum speed.(1-OK,0-Blocked)
Stat_Analog_Input_Error	BIT	Analog Input converted with Error
Stat_Analog_Output_Error	BIT	Analog Output converted with Error
Stat_Current	REAL	Show the consumption of the motor
Stat_Voltage	REAL	Show the voltage of the motor
Stat_Power	REAL	Show the power of the motor
Stat_Torque	REAL	Show the % Torque of the motor

Interlocks	Format	Description
Inter_Min_Speed	REAL	Interlock Minimum Speed (%) for the motor

HIST	Format	Description
Hist_Num_Starts_Today	DINT	Total times that the equipment was started today
Hist_Num_Faults_Today	DINT	Total times that the equipment was in fault today
Hist_Runtime_Today	REAL	Total hours the equipment was running today
Hist_Current_Today	REAL	Total current reading today
Hist_Voltage_Today	REAL	Total voltage reading today
Hist_Power_Today	REAL	Total power reading today
Hist_Num_Starts_24h	DINT	Total times that the equipment was started in the last 24hours
Hist_Num_Faults_24h	DINT	Total times that the equipment was in fault in the last 24hours
Hist_Runtime_24h	REAL	Total hours the equipment was running in the last 24hours
Hist_Current_24h	REAL	Total current reading last 24 hours
Hist_Voltage_24h	REAL	Total voltage reading last 24 hours
Hist_Power_24h	REAL	Total power reading last 24 hours
Runtime_Warning_Trigger	REAL	Set point to trigger the warning (if Hist_Runtime > Runtime_Warning_Trigger)
Hist_Num_Starts_Cum	DINT	Cumulative Total times that the equipment was started
Hist_Num_Faults_Cum	DINT	Cumulative Total times that the equipment was in fault
Hist_Runtime_Cum	REAL	Total hours the equipment was running
Hist_Current_Cum	REAL	Cumulative Total current
Hist_Voltage_Cum	REAL	Cumulative Total voltage
Hist_Power_Cum	REAL	Cumulative Total power

PICTURE:



FACEPLATE FOR: Instruments

DESCRIPTION:

This faceplate allows you to view the process value or the configuration of an instrument such as Level, Pressure, Flow, DO and other process values. It is possible to see the process value, monitoring of alarms in three categories (lost signal, process, and warning) after period of time, set the range for scaling, and signal buffer filtering. This will also show the trends and all attributes (commands or configuration, and status- including the raw value before scaling). The faceplate has the ability to simulate the instruments value in case of a failure and need to continue the process.

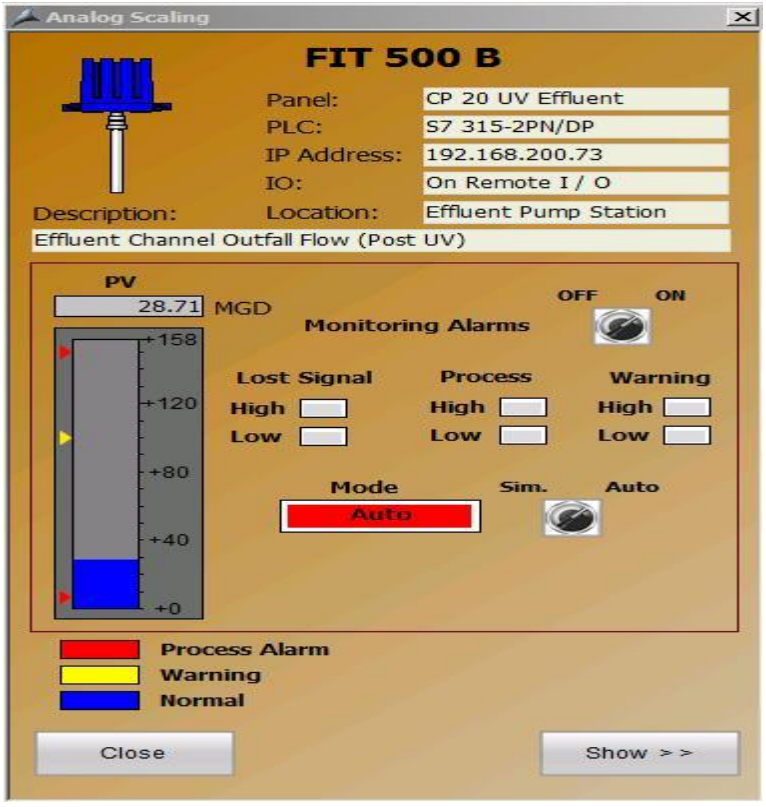
ATTRIBUTES:

Commands	Format	Description
Cmd_Auto	BIT	Set Auto mode
Cmd_Sim	BIT	Set Simulation mode
Cmd_Sim_Value	REAL	Set the simulation value (only enable when it is in Simulation mode)
Cmd_Proc_Alarm_En	BIT	Enable the process alarms
Cmd_Warning_Alarm_En	BIT	Enable warning alarms
Cmd_Alarm_En	BIT	Enable monitoring alarm or not
Cmd_Filter_En	BIT	Filtering signal is enable (average sampling)
Cmd_Reset_Alarm	BIT	Reset alarms
Cmd_Clear_Table	BIT	Clear the filtering buffer table
Cfg_High_Range	REAL	High Range for scaling
Cfg_Low_Range	REAL	Low Range for scaling
Cfg_Scale_Offset	REAL	Scaling offset
Cfg_High_Proc	REAL	High Process alarm
Cfg_Low_Proc	REAL	Low Process alarm
Cfg_High_Warn	REAL	High Warning alarm
Cfg_Low_Warn	REAL	Low Warning alarm
Cfg_Range_Timer	TIME	Delay timer to detect out of range
Cfg_Proc_Timer	TIME	Delay timer to detect process alarm
Cfg_Warn_Timer	TIME	Delay timer to detect warning alarm
Cfg_Num_Samples	INT	Total samples for averaging in circular buffer
Cfg_Sample_Time	TIME	How often should take sample
Cfg_Return_Auto	TIME	Return automatically from simulation to auto after some time. If 0, will never return, has to do it manually from the HMI switch.

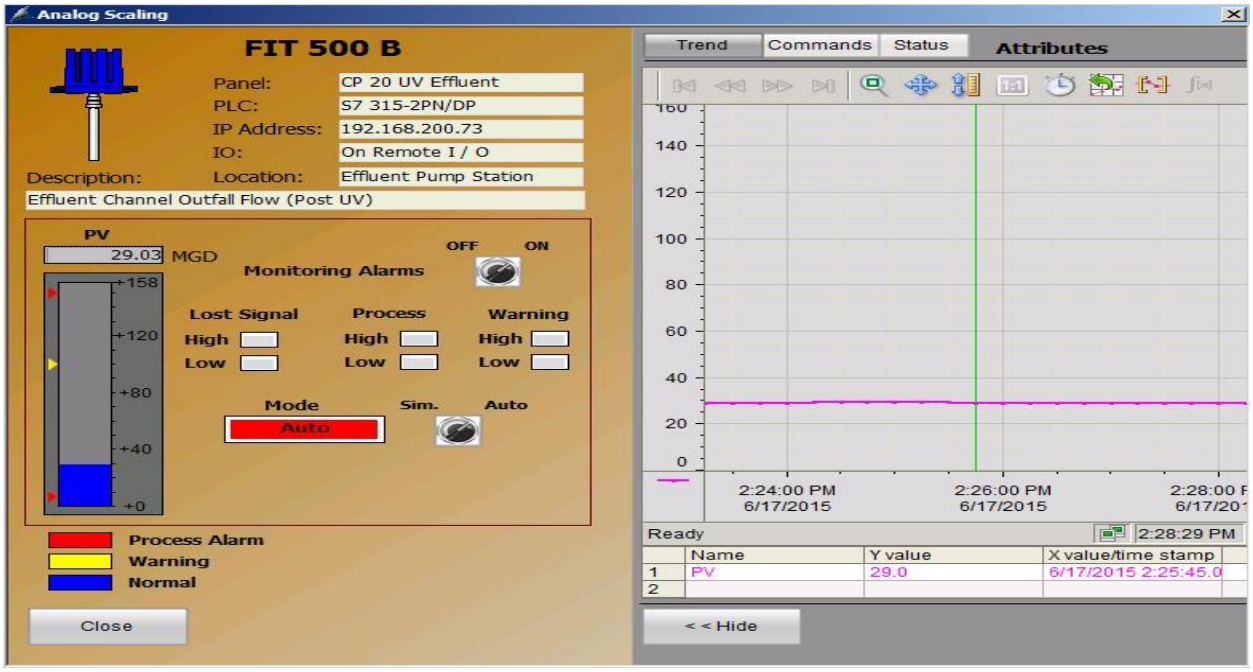
Status	Format	Description
Stat_Auto	BIT	Indicate that it is in automatic or normal mode
Stat_Sim	BIT	It is in simulation mode
Stat_Raw	LONG	Shows the raw value
Stat_PV	REAL	Store the process value after filtering
Stat_Scale	REAL	Shows the process value already scaled without filtering
Stat_Fault	BIT	It is a common alarm, it will be high if got any fault or alarm group
Stat_High_Range	BIT	There is a high range alarm (pv > high range)
Stat_Low_Range	BIT	There is a Low range alarm (pv < Low range)
Stat_High_Proc	BIT	There is high process alarm (pv > high process and < high range)
Stat_Low_Proc	BIT	There is low process alarm (pv < low process and > low range)
Stat_High_Warning	BIT	There is a high warning alarm (pv > high warning and < high process)
Stat_Low_Warning	BIT	There is a low warning alarm (pv < low warning and > low process)

Examples of Faceplates: Flow and Level Instruments

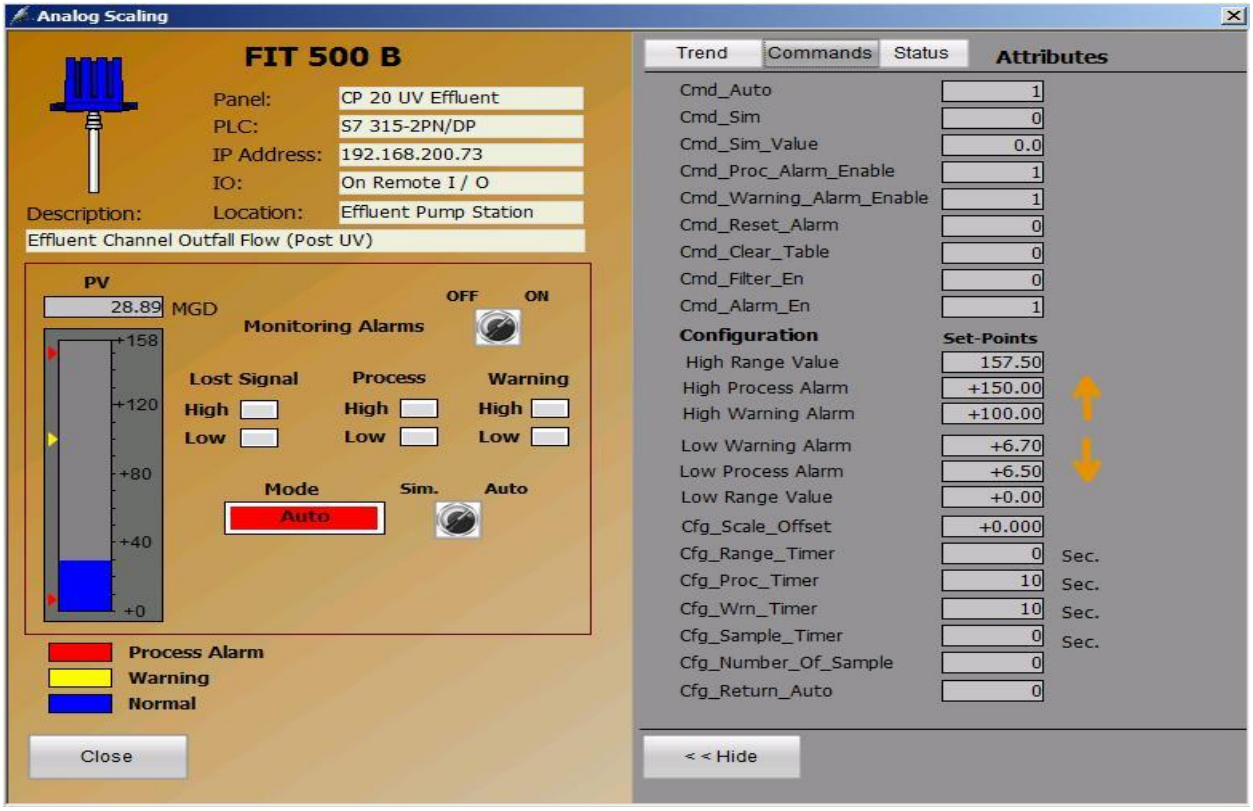
FIT 500B: Flow Instrument



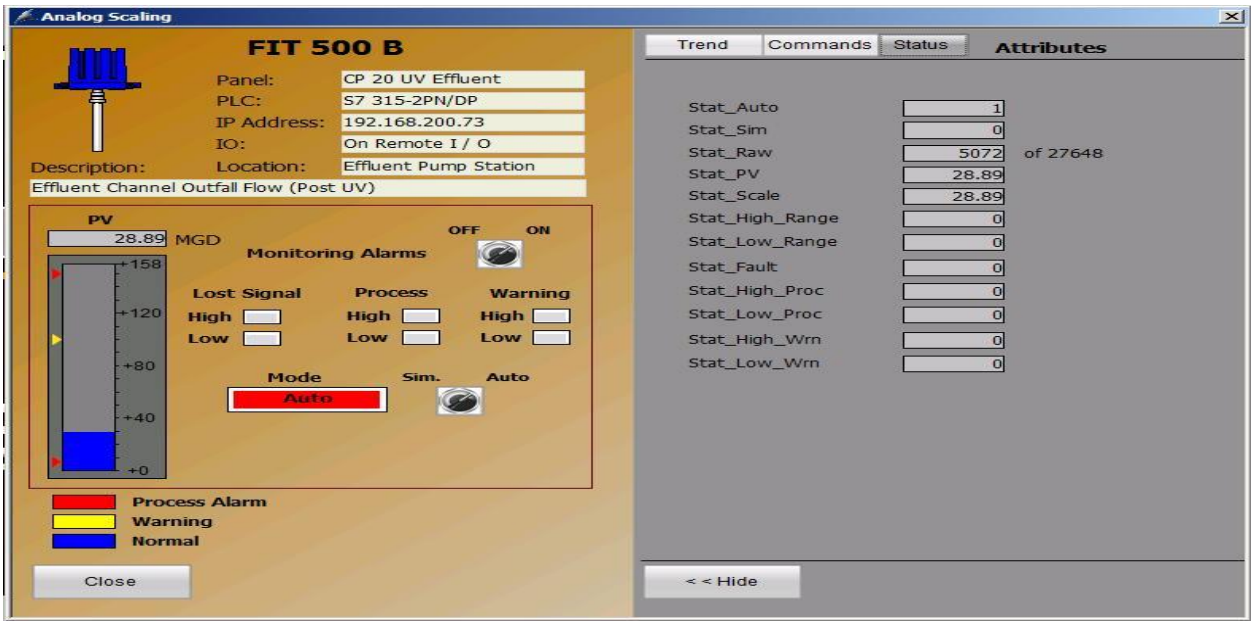
FIT 500B - trend



FIT 500 B- Commands:



FIT 500 B- Status

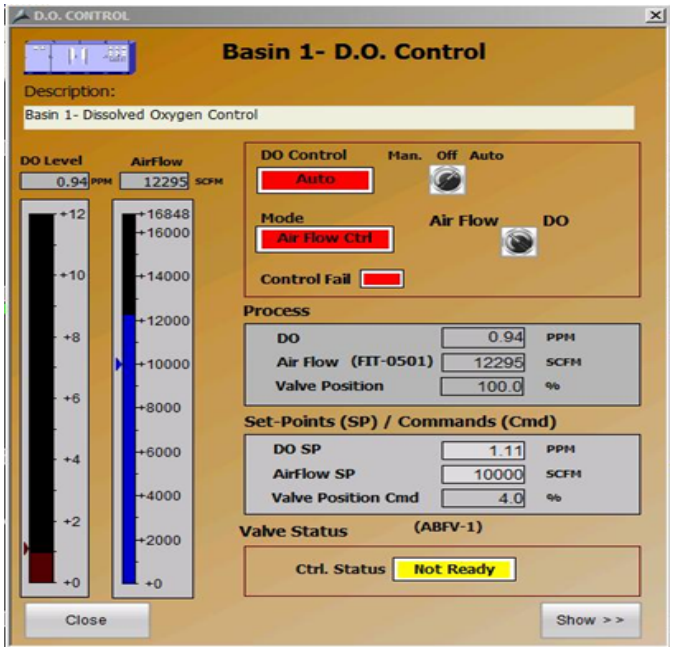


FACEPLATE FOR: Process Controller

DESCRIPTION: The goal of the Process Controller is to maintain the Process Value around a specific Set Point entered by the Operator. Each Process Controller is to be configured application specific with all the necessary interfaces to control each process. Some processes will require multiple process values such as the DO controller example below. This particular DO Controller example can control off of Air Flow or DO based on the selector setting.

ATTRIBUTES: By selecting the Show button below the Operator will have three separate tabs for Trend, Commands and Status. These tabs will provide all pertinent data and control for the particular process.

PICTURE:



JEA

Document: Functional Specification Standard	Version: 03	Date: 04/02/15
	Page 1 of 2	

1. Purpose

This is a general guideline to prepare a Functional Specification for JEA projects. This document is typically to be developed by the Engineer of the project and is intended to be given to the System Integrator so that they can develop a Software Design Document.

2. History of Revisions

Version	Date	Modification	By
01	06/18/11	Creation of functional Standard for JEA	ITG
02	10/6/11	- Modification	ITG
03	08/25/11	- Update main screen and main menu.	JEA
04	04/02/15	Updated Procedure	JEA

3. Procedure

In general, functional specifications should include the following:

3.1. *Index*

3.2. *General description of the system*: A brief description of the process should be supplied, its subsystems, main stages of the process and characteristics.

3.3. *List of all subsystems*: List the name of all subsystems, general function and its PLC identification.

For each PLC, describe the following:

3.3.1. General information: Describe the name of the subsystem, location, function, functional requirements.

3.3.2. Risk detection: Identify all the risk for the process, operator, or for the equipment itself.

3.3.3.List of I/O and Instruments: List Location, Type, Tag, I/O address, Range and Description.

Location	*Type (DI/DO,AI/AO,PB)*	*Equipment Tag*	*I/O Address*	*Range*	*Description*
ICP1	PB (Profibus)	FT-5030	PIW 256	0-5MGD	SBR Sludge Flow

3.3.4. Process Control: Identify all the process control involved, description of function, the operating modes (auto / manual), bump less transfer if needed, the control logic in a block or flowchart diagram, and Set-points used, range and units. Define all formulas used for control and all interlock conditions.

3.3.5. List of alarms by type of devices: All alarms should be listed, its text, condition to trigger, system/operator response, description.

No	*Alarm Text*	*Condition to trigger*	*System/operator Response*	*Description*

3.3.6. System Trends & Reports: All report and trends should be listed with a name, objective and an example of them.

3.3.7.

3.4. Appendix: The P&ID, workflow diagrams, communication protocols and hardware diagram which can be referenced here.

1. Purpose

To describe the general guide for the design of the WRF (Water Reclamation Facilities) HMI (Human Machine Interface) for JEA New Installations and Upgrading the HMI for Control System Projects.

2. History of Revisions

Version	Date	Modification	By
01		Creation of the HMI Standard for JEA	PH

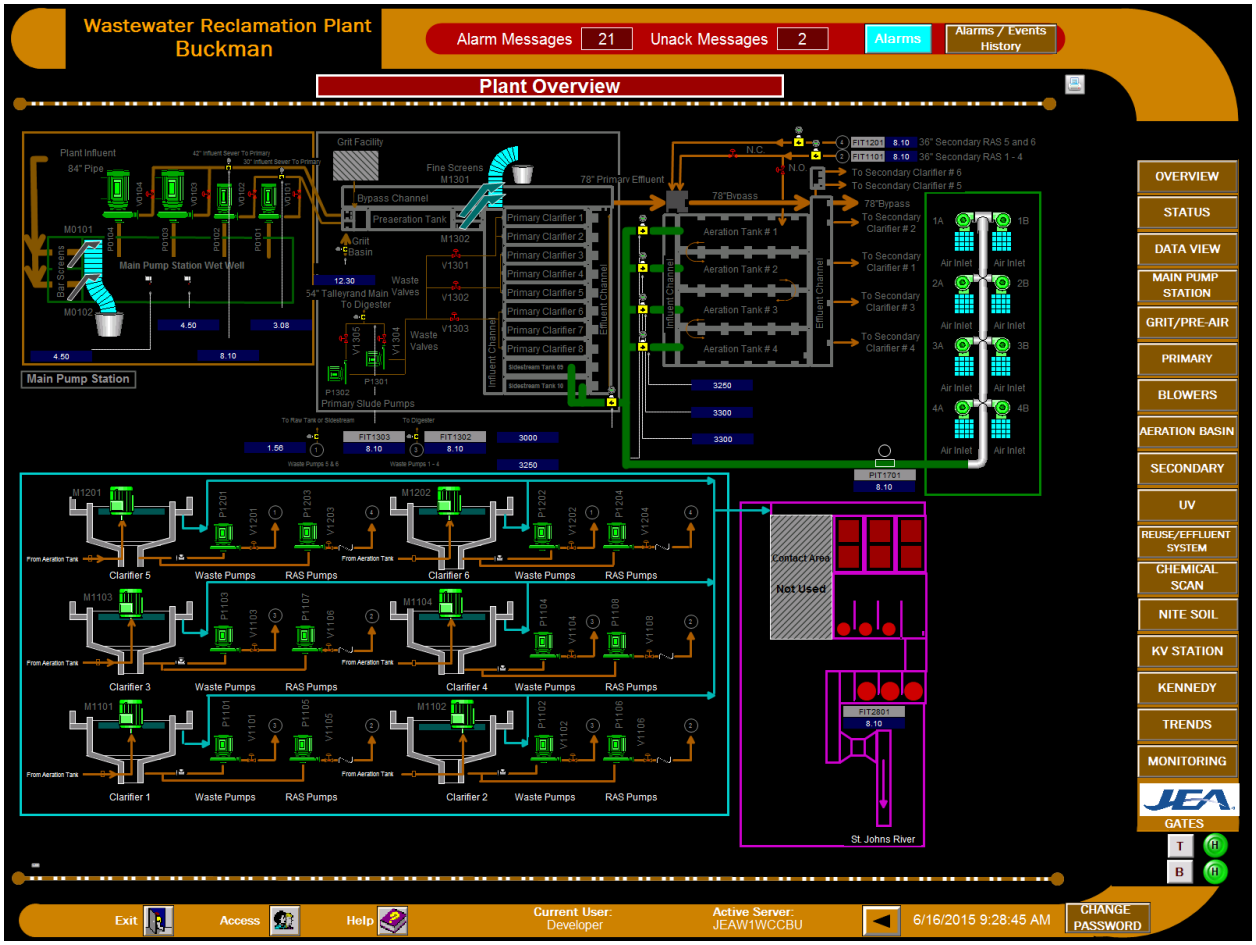
3. HMI General Idea

The HMI will be designed using Siemens **WinCC, version 7.3** *(contact JEA for latest service pack version)*, using the resolution of **1920 x 1080** pixels. The WinCC is to be configured with WebNavigator which will allow client applications to view the HMI through Web based applications. The HMI manages the communication with PLCs, and allows the operator to see all the process values, show trends, alarms, reports and control all devices in two operating modes: Automatic or Manual. In the Automatic mode the device follows the commands from the PLC program, while in the Manual mode the operator is able to open/close the valve, start/stop motor or blower, etc. from the HMI.

The screens are to be based on the P&ID diagrams. Each P&ID sheet is to have its own screen. If a screen is too cluttered it may be required to be broken out. All instrumentation and control devices are to be integrated into the HMI in an efficient easily navigable format. Provide adequate information to allow for operations to tune the process without having to alter the PLC program.

Note: all graphics are to be scalable. That way if a particular display doesn't have the exact resolution that the HMI was developed in the images can adapt.

3.1 Structure of the screen



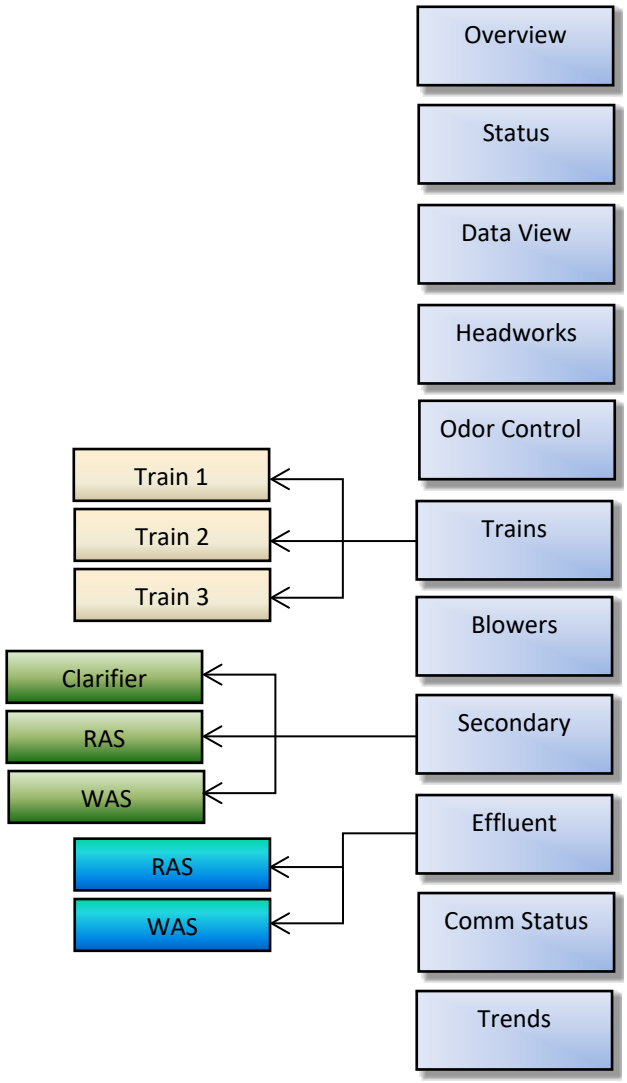
The screen is divided by three main windows:

- Upper window: It shows some information about plant name, alarm messages total, unacknowledged alarms total, alarm button and alarm history button.

- Middle window: Has navigation buttons on the far right side of the screen, which allow the operator to go to any screen by clicking on them. The main screen shows objects that can be devices, instruments, trends, alarms according to the screen that was activated. When in screens an operator can click on an object and a faceplate will pop up, that will allow operation of the device and to see additional information. Each screen is to have a Print option to allow the operator to print the screen.

- Lower window: Exit button – To close down the WinCC. Access button – allows user to log into the HMI. Help button – is an overview screen of all the instrumentation and actuator possible states with live animation. It also allows access to the Operations Manual for the plant. Current User – indicates user logged in. Active Server – Is the WinCC Server Name. Back button – takes you to the previous screen. Change Password button – allows user to change the password.

Below is an example of the structure and navigation of the main menu. This structure will vary based on different plants and processes.



3.2 Use of colors

The color code to be used to represent the status of the objects in the HMI is:
For Equipment:

- Red: When the device is active (running motor, valve opened, etc.)
- Green: When the device is not active (motor stopped, valve closed, etc.)
- Blinking Red: When there is a device has any fault: fault to start/open, stop/close, or hardware fault.
- Blinking Yellow Text: Indicate manual operation from the HMI or Local operation from the field. This is to be indicated with a text below the object. Use "HMI-M" to indicate manual operation from HMI, or the text "H" to indicate manual or hand operation from the field.

For Instrument:

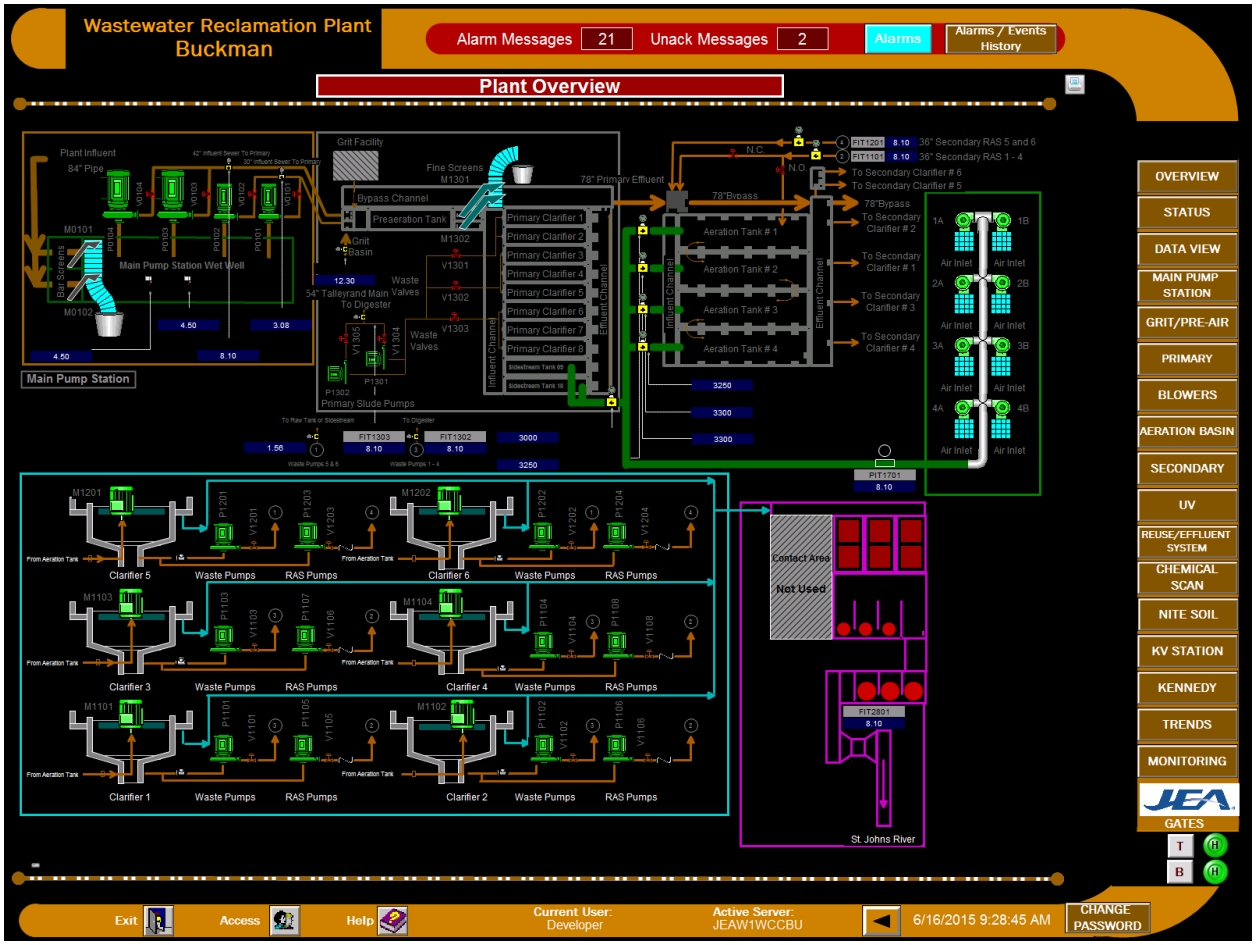
- Blinking Red (Background): For range alarms (High/Low) or process alarms (High/Low).
- Blinking Yellow (Background): For warning alarms (High/Low).
- Black Background with green color indication: For no alarms.

3.3 Faceplates Design

All devices can be selected by the operator thru a faceplate. It is used as an interface to show the information about the equipment, status, faults and to operate the device in manual mode. Reference the **WRF Faceplate Standard** for further details.

3.4 Plant Overview Screen

The intention of this screen is to show the whole process flow of the plant and key components. Each section that you move over, such as Main Pump Station, will be highlighted. If you click on the highlighted object the it will open the Main Pump Station screen. All items are to be clearly labeled to reference the P&ID labeling. Every HMI application is to be provided with a Plant Overview. Below is an example of an overview layout.



3.5 Status Overview Screen

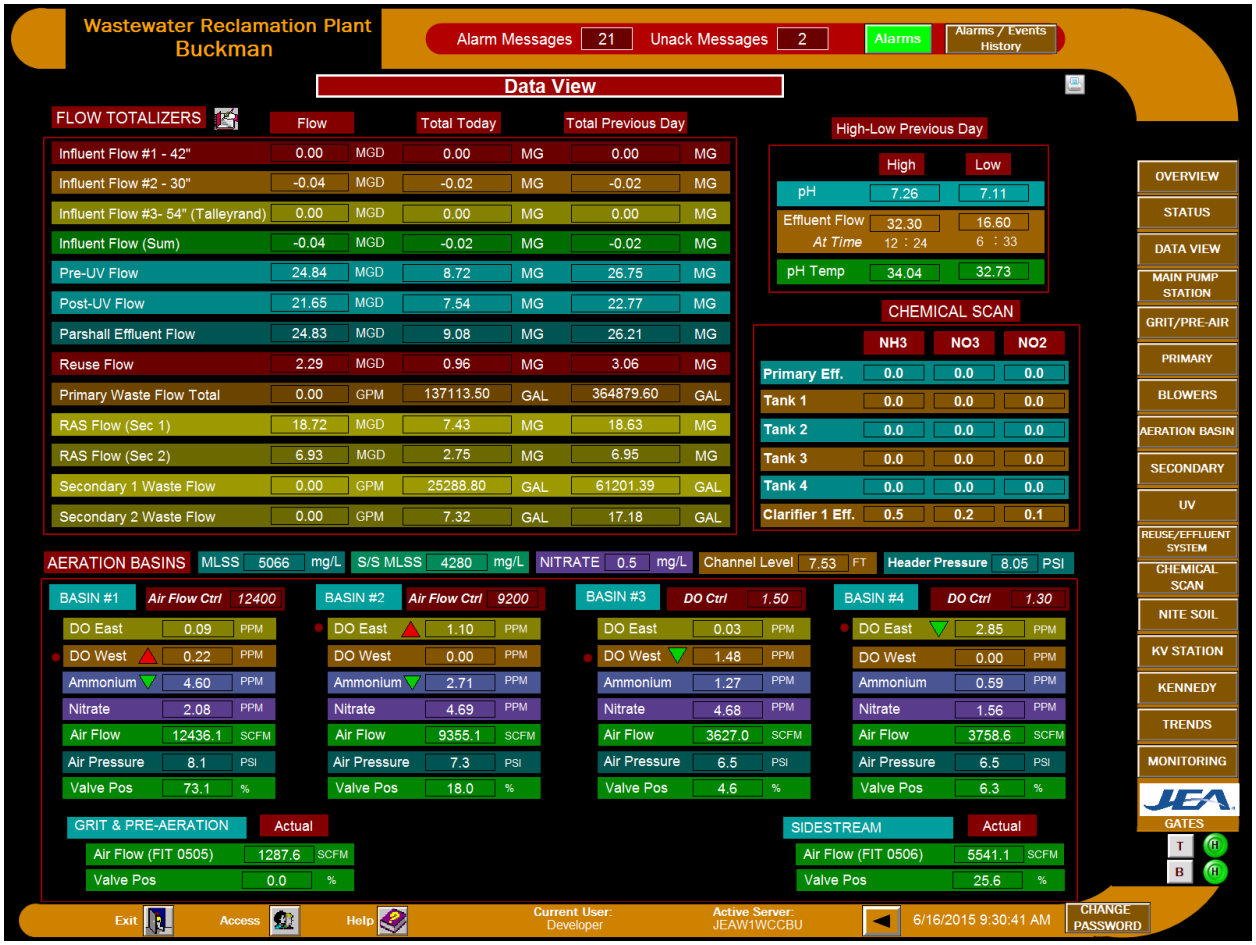
The intention of this screen is to give a quick overview of key plant equipment. It will show device details such as flows, motor status, valve position and activity of all the devices. Each section that you move over, such as UV System, will be highlighted. If you click on the highlighted object it will take you to that screen. Every HMI application is to be provided with a Status Overview. Below is an example of a Status Overview layout.

3.6 Data Overview Screen

This screen is to allow operations to be able to view all the key Data to running the plant on one screen. This screen will also show statuses as follow.

- Process Controller Indication – any processes that are controlled, such as DO, and that are out of range will have a colored arrow indication. Red Up Arrow – will indicate an increase is required in the process. Green Down Arrow - will indicate a decrease is required in the process. If multiple devices are reading, but only one device is selected to read, a red dot will be next to that device to indicate it's providing the Process Value to the Process Controller.
- Actuator Indication – if it isn't in normal operation state an indication will flash on the device indicating its current state. Note that Auto is also a normal state and any device that isn't in auto will flash the mode it's in on the actuator listed.

Every HMI application is to be provided with a Data Overview. Below is an example of a Data Overview layout.



3.7 Tags & Structured Tags

In the WinCC use structured tags for mapping directly into the PLC using Data Blocks.

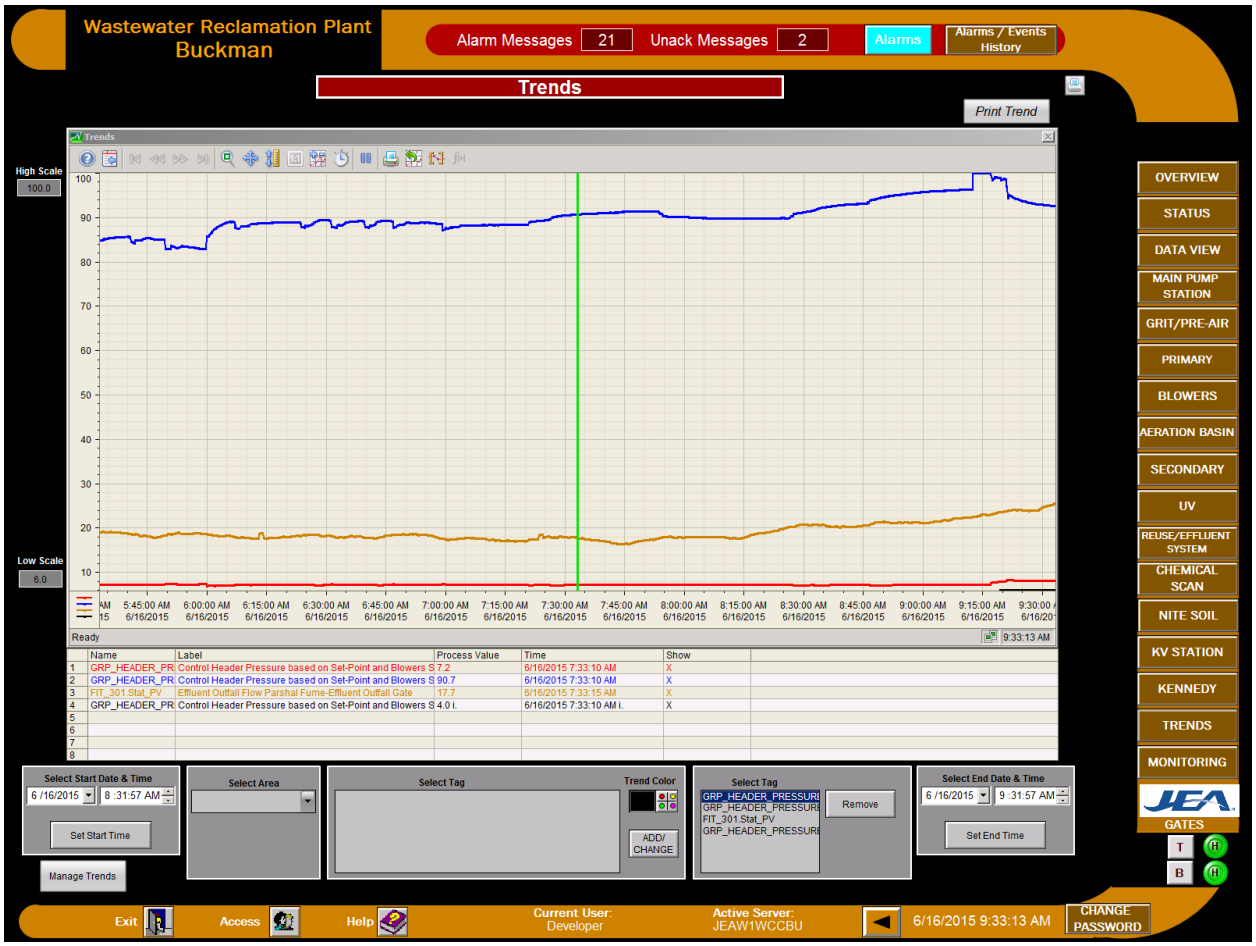
3.8 Historical Data Collection

A. Data to be collected in the HMI for historical data retention:
   1. All Process Values.
   2. Controllers such as PID
      a. Set point
      b. Commanded Output
      c. Commanded Output Feedback
      d. Process value
   3. Running Status
      a. Discrete
      b. Analog
   4. Actuator Position Feedback
      a. Discrete
      b. Analog
   5. UV
      a. All values listed on P&ID
   6. Power Meter
      a. Voltage of all phase
      b. Current of all phases
      c. Kilo Watts
      d. Kilo Watt Hours Current
      e. Kilo Watt Hours Previous Day
   7. All Permit required data.

3.9 Trend Screen

The trend screen will trend any value that is in the archived in the Historical Data Collection.

- High Scale and Low Scale - to vary the scale.
- Print Trend – Above the trend screen you will find this button which allows you to print the current trend.
- Select Date and Time – Selects the start date and time.
- Select Area – Allows you to view only the tag group selected from the archived tags.
- Select Tag Add/Change – Allows you to add tags you want to trend based on the area selected. This section will also allow you to select the color.
- Select Tag Remove – Allows you to remove a tag previously selected.
- Select End Date & Time – Allows you to set the end date and time for the trend.
- Manage Trends Button – This button will allow you to save all the trend tags with a name to recall for future use.



3.10 Alarms

A. General Overview:

All Failures, Alarms and Warnings are to be created in the Alarm Logging configurator in the HMI. To see all the alarms the operator should click on the Alarm Button in the navigation bar. In that window it will be possible the acknowledge alarms and to see all the alarms. It will also be able to filter all alarms according to its type. Two separate alarm screens will be provided. The first alarm screen will be for current alarms while the other one will be for viewing historical alarms.

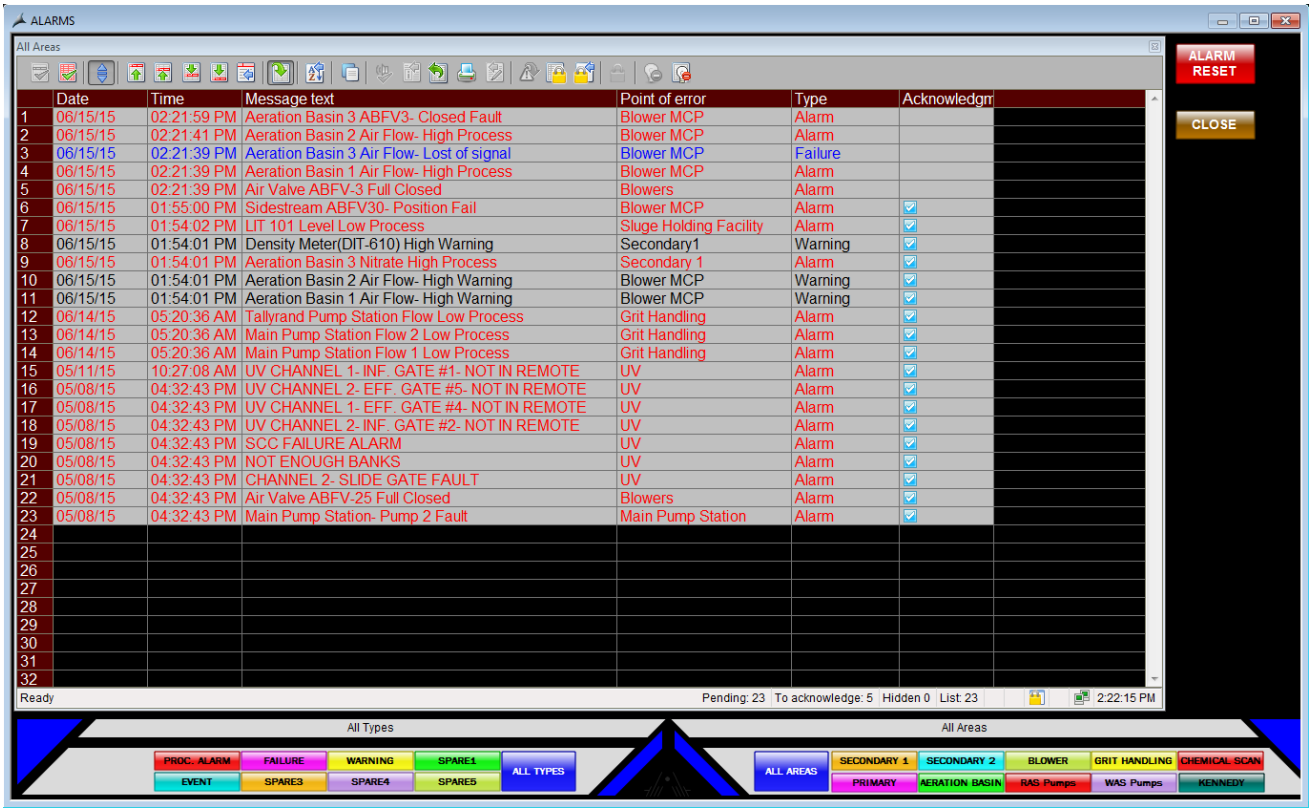
B. Alarms:

1. Provide alarms as noted:
    a. Any actuator with feedback that is given a command and that doesn't meet that command in a specified time will alarm.
    b. Any process input that is out of its normal range will trigger an alarm. All process inputs will have adjustable set points for warnings and alarms.
2. Sequencing and Display:
    a. Indicate the alarm condition on HMI and activate Alarm Tone if a Failure or Alarm condition.
    b. Upon acknowledgement silence the alarm tone and indicate acknowledgement.
    c. Remove acknowledged alarms from the alarm summary once they are cleared.
    d. Log alarm occurrence, acknowledgement, and clearance in the alarm log file.
    e. Unless otherwise noted Failures, Alarms and Warnings will automatically clear when the acknowledged alarm condition clears.
    f. Summary Display:
        1. Alarm Types:
            a. **Failure** is considered a high level. An example can be a loss of a device such a VFD fault, loss of communication, Overload Trip or any other type of hardware failure.
                - Blue text indicates a Failure.
                - Green text indicates the Failure has cleared.
            b. **Alarm** is considered a mid-level. An example can be an indication that a Process is out of rage or that an Actuator hasn't met its command.
                - Red text indicates a Failure.
                - Green text indicates the Alarm has cleared.
            c. **Warning** is considered a low level. An example can be that a Process is getting close to being out of range such as a high or low level.
                - Black text indicates a warning.
        2. Display information for each alarm type:

a. Date
b. Time
c. Message Text – Detailed description of Alarm or Warning
d. Point of Error – Area in process
e. Type – Failure, Alarm or Warning
f. Duration – Indicates how long before acknowledged.
g. Acknowledge Indicator – Indicates if acknowledged.

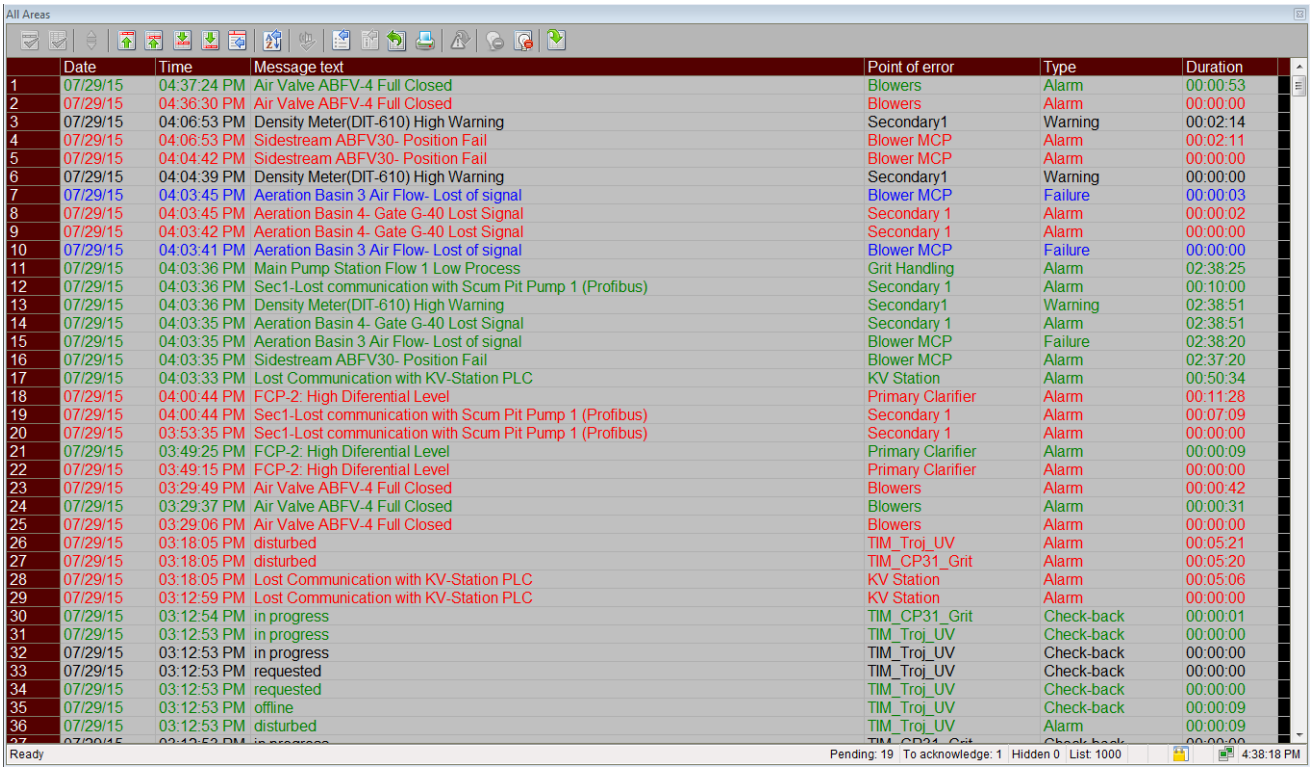
3. Provide for operator adjustable filtering and sorting by:
    a. Area
    b. Process Alarms
    c. Failures
    d. Warnings
4. Nuisance Failure, Alarm, and Warning suppression:
    a. Shall be provided with an adjustable delay timer prevent nuisance indicators. The delay timer is to reside in the PLC but shall be adjustable from the HMI.
    b. Shall be provided with a dead band to prevent nuisance indicators. The dead band is to reside in the PLC but shall be adjustable from the HMI.
    c. Conditioning alarm signals. For example, disable all but selected alarms when power is off, and include startup delays, momentary excursion delays, and contact bounce delays. Suppress dysfunctional alarms during and immediately following power outages.
    d. Provide alarm disable functions:
        i. Selectable by the supervisor on a point-by-point basis.
        ii. Does not prevent point status from being shown on graphic process displays.
        iii. Maintain summary of disabled alarms.
5. Process Inputs:
    a. Provide a filter that can average out the signal for noise. The filter is to reside in the PLC but shall be adjustable from the HMI.
    b. Will be configured with a fully adjustable time delay and a dead band in the PLC to prevent nuisance indication but shall be adjustable from the HMI.
    c. All process inputs used for interlocking and control:
        i. Executed in the PLC and not external.
        ii. Have time delay and dead band settings.
        iii. Supervisor accesses for process switch set points.
        iv. Scaled to floating point values.

Below is an example of an Alarm Screen.



C. Alarm History:
   1. Provide history as noted:
      a. All Failures, Alarms, and Warnings previously cleared and acknowledged.
      b. Summary Display:
         1. Alarm Types:
            Failure, Alarm and Warning are the same text color scheme as for the Alarm section.
         2. Display for each alarm type:
            a. Date
            b. Time
            c. Message Text – Detailed description of Alarm or Warning
            d. Point of Error – Area in process
            e. Type – Failure, Alarm or Warning
            f. Duration – Indicates time it took to acknowledge
         3. Provide for operator adjustable filtering and sorting by:
            a. Area
            b. Process Alarms
            c. Failures
            d. Warnings

Below is an example of the Alarm History Screen.



	Date	Time	Message text	Point of error	Type	Duration
1	07/29/15	04:37:24 PM	Air Valve ABFV-4 Full Closed	Blowers	Alarm	00:00:53
2	07/29/15	04:36:30 PM	Air Valve ABFV-4 Full Closed	Blowers	Alarm	00:00:00
3	07/29/15	04:06:53 PM	Density Meter(DIT-610) High Warning	Secondary1	Warning	00:02:14
4	07/29/15	04:06:53 PM	Sidestream ABFV30- Position Fail	Blower MCP	Alarm	00:02:11
5	07/29/15	04:04:42 PM	Sidestream ABFV30- Position Fail	Blower MCP	Alarm	00:00:00
6	07/29/15	04:04:39 PM	Density Meter(DIT-610) High Warning	Secondary1	Warning	00:00:00
7	07/29/15	04:03:45 PM	Aeration Basin 3 Air Flow- Lost of signal	Blower MCP	Failure	00:00:03
8	07/29/15	04:03:45 PM	Aeration Basin 4- Gate G-40 Lost Signal	Secondary 1	Alarm	00:00:02
9	07/29/15	04:03:42 PM	Aeration Basin 4- Gate G-40 Lost Signal	Secondary 1	Alarm	00:00:00
10	07/29/15	04:03:41 PM	Aeration Basin 3 Air Flow- Lost of signal	Blower MCP	Failure	00:00:00
11	07/29/15	04:03:36 PM	Main Pump Station Flow 1 Low Process	Grit Handling	Alarm	02:38:25
12	07/29/15	04:03:36 PM	Sec1-Lost communication with Scum Pit Pump 1 (Profibus)	Secondary 1	Alarm	00:10:00
13	07/29/15	04:03:36 PM	Density Meter(DIT-610) High Warning	Secondary1	Warning	02:38:51
14	07/29/15	04:03:35 PM	Aeration Basin 4- Gate G-40 Lost Signal	Secondary 1	Alarm	02:38:51
15	07/29/15	04:03:35 PM	Aeration Basin 3 Air Flow- Lost of signal	Blower MCP	Failure	02:38:20
16	07/29/15	04:03:35 PM	Sidestream ABFV30- Position Fail	Blower MCP	Alarm	02:37:20
17	07/29/15	04:03:33 PM	Lost Communication with KV-Station PLC	KV Station	Alarm	00:50:34
18	07/29/15	04:00:44 PM	FCP-2: High Diferential Level	Primary Clarifier	Alarm	00:11:28
19	07/29/15	04:00:44 PM	Sec1-Lost communication with Scum Pit Pump 1 (Profibus)	Secondary 1	Alarm	00:07:09
20	07/29/15	03:53:35 PM	Sec1-Lost communication with Scum Pit Pump 1 (Profibus)	Secondary 1	Alarm	00:00:00
21	07/29/15	03:49:25 PM	FCP-2: High Diferential Level	Primary Clarifier	Alarm	00:00:09
22	07/29/15	03:49:15 PM	FCP-2: High Diferential Level	Primary Clarifier	Alarm	00:00:00
23	07/29/15	03:29:49 PM	Air Valve ABFV-4 Full Closed	Blowers	Alarm	00:00:42
24	07/29/15	03:29:37 PM	Air Valve ABFV-4 Full Closed	Blowers	Alarm	00:00:31
25	07/29/15	03:29:06 PM	Air Valve ABFV-4 Full Closed	Blowers	Alarm	00:00:00
26	07/29/15	03:18:05 PM	disturbed	TIM_Troj_UV	Alarm	00:05:21
27	07/29/15	03:18:05 PM	disturbed	TIM_CP31_Grit	Alarm	00:05:20
28	07/29/15	03:18:05 PM	Lost Communication with KV-Station PLC	KV Station	Alarm	00:05:06
29	07/29/15	03:12:59 PM	Lost Communication with KV-Station PLC	KV Station	Alarm	00:00:00
30	07/29/15	03:12:54 PM	in progress	TIM_CP31_Grit	Check-back	00:00:01
31	07/29/15	03:12:53 PM	in progress	TIM_Troj_UV	Check-back	00:00:00
32	07/29/15	03:12:53 PM	in progress	TIM_Troj_UV	Check-back	00:00:00
33	07/29/15	03:12:53 PM	requested	TIM_Troj_UV	Check-back	00:00:00
34	07/29/15	03:12:53 PM	requested	TIM_Troj_UV	Check-back	00:00:00
35	07/29/15	03:12:53 PM	offline	TIM_Troj_UV	Check-back	00:00:09
36	07/29/15	03:12:53 PM	disturbed	TIM_Troj_UV	Alarm	00:00:09

3.11 Security

The HMI is to have different levels of access with user names and passwords that protect the integrity of the Plant: Engineering, Manager, Operator and Guest. All Operators are to have unique user names and passwords. The User Name of the Operator is to be based on the JEA 4+2 naming convention. Reference the Security & Authorization Table below.

Security & Authorization Table

Area	Operations	Guest	Operator	Manager	Engineer
Equipment Faceplate	Start / Stop	NO	YES	YES	YES
	Auto / Manual	NO	YES	YES	YES
	Set-Point in Manual	NO	YES	YES	YES
	Command attr.	NO	NO	YES	YES
	Configuration attr.	NO	NO	NO	YES
	Hist. Reset Button	NO	NO	YES	YES
Control Loop Faceplate	Auto / Manual	NO	YES	YES	YES
	Change Set Points	NO	YES	YES	YES
	Commands attr.	NO	NO	YES	YES
	PID Parameters attr.	NO	NO	NO	YES
Instrument Faceplate	Auto / Simulation	NO	NO	NO	YES
	Commands attr.	NO	NO	YES	YES
	Configuration attr.	NO	NO	NO	YES
General	Train Enable/Disable	NO	NO	NO	YES
	Change Password	NO	NO	NO	YES
	Exit Runtime	NO	NO	NO	YES
	Alarm Reset Button	NO	YES	YES	YES
	Alarm Ack.	NO	YES	YES	YES
	Navigation	YES	YES	YES	YES

JEA

Document: Software Design Document	Version: 01	Date: 04/02/15
	Page 1 of 3	

1. Purpose

This is a general guideline to prepare a Software Design Document for JEA projects. This document is typically to be developed by the System Integrator of the project. The System Integrator is to develop the Software Design Document from the Functional Specification.

2. History of Revisions

Version	Date	Modification	By
01	04/02/2015	Creation of Software Design Document Standard	JEA

3. Document Contents

In general, Software Design Document will include the following:

3.1. *Index*

3.2. *Purpose:* The purpose of this document is to provide an approach in the development of both the PLC and HMI program; this includes drivers, control loops, faceplates and screens to be used in the project.

3.3. *Scope of Work*: A brief description of PLC's and Processes that the document covers.

3.4. *PLC*

3.4.1. *General*: List the software to program the PLC and HMI. List method of communication for PLC and HMI.

3.4.2.*List of Equipment*: Each PLC shall have its own list of equipment. List the P&ID location, Type of Equipment, Equipment Name and Driver. Reference example below.

MCP (Blower Building)

P&ID	*Type of Equipment*	*Equipment Name*	*Driver*
I1.05	Pressure Transmitter	Header Pressure PIT-500	Analog_Filt_Scale
I1.03 and I1.04	Blower	Blower 1A, 1B, 2A, 2B, 3A, 3B, 4A and 4B	DRV_VFD_Blower

3.4.3. Driver Description: With each Driver list the following information below.

- I/O List
  - Inputs – Name, Type (Bool,Int,…) and Description
  - Setpoints – Name, Type (Bool,Int,…) and Description
  - Outputs – Name, Type (Bool,Int,…) and Description
- Connection with HMI – Name of Faceplate in HMI
- Interlocks
- Data Structure – The I/O list will be used as the Input/Output parameters in the Function Block. The Data Block (instance for each equipment) should include the PLC Input/Output Parameters (Prefix with the letter PI_ for Inputs, and PO_ for outputs, followed by its name) and after the corresponding Faceplate Attributes (Cmd – Commands, Stat, Hist- Historical Information).
- Control Logic – List the name and description for all below.
  - List all Drivers
  - Group/Loop Control – Blocks that contains multiple blocks
  - Special Function Blocks
  - Special Functions

4. **General Alarms**

List of alarms by type of devices: All alarms should be listed, its text, condition to trigger, system/operator response, description.

No	*Alarm Text*	*Trigger Condition*	*Condition to Inactivate*	*Reason for Alarm*

5. HMI Design

5.1. HMI General Idea -This is the general idea of the HMI design interface with the operator. It should also list the software version of the HMI.

5.2. Navigation Structure – This is to be a tree structure of the navigation.

5.3. Overview Screen and all other Screen Images

5.4. Faceplate Images.

5.5. Reports

5.6. Security & Authorization Table. Reference the JEA HMI Standard for the table example.

6. **Appendix**

Diagram can be attached here.

JEA – PLC Standard

1.0 SCOPE

This specification details JEA requirements for PLC / HMI software configuration and documentation, any deviation required will be brought to the attention of the JEA Qualified Representative/Engineer for Resolution. The HMI Standard is in separated document.
JEA reserves the right to determine/assign a Qualified Representative

2.0 REQUIREMENTS

See Requirements sheet Appendix A

2.1 Hardware compliance

All PLC and related hardware shall comply with the required Company standard – Siemens S7 300/400. The SIMATIC S7-300 CPU 315-2 PN/DP [Processor] shall be considered the standard PLC.

PLC Field I/O devices shall be Profibus DP compatible

PLC Processor to Processor Communications shall be Ethernet

PLC processor should have 25% available memory and I/O once programming complete. If more than one processor exists in the system each processor shall have 25% available memory and I/O.

The Contractor shall ensure that the equipment supplied is suitable for the duty required. Should the Contractor find any contradiction between this requirement and any Clause of this specification he shall bring it to the attention of the JEA Qualified Representative/Engineer for Resolution.

Any additional costs which may result shall be approved prior to the costs being incurred.

2.2 Functional specification

Unless provided by a JEA Qualified Representative/Engineer, the Contractor shall document the functional specification of the complete system and each subsystem prior to the development of any PLC / HMI code. Approval of the functional specification shall be obtained from a JEA Qualified Representative/Engineer prior to any further system development.

2.3 Software design and structure

PLC Programs to be developed with Simatic Version 5.4 with Service Pack 4 (minimum requirement)

The Contractor shall design and document the software structure of the PLC / HMI programs prior to the development of any code. The software structure shall be modeled after the requirements of the functional specification.

The use of standards supplied by JEA is preferred; see appendix C for PLC software standard details; if any deviation from the standard is required will be brought to the attention of the JEA Engineer for Resolution.

In the case of multiple PLCs, each PLC shall comply with the design standard.

2.4 Design Approval

The documented design as specified in sections 2.2 / 2.3 shall be submitted for Approval to the JEA Qualified Representative/Engineer prior to further system development by the Contractor.

2.5 Prototyping

A prototype of intended PLC code design shall be implemented and tested by the Contractor.

The use of standards supplied by JEA is preferred; see appendix C for PLC software standard details; if any deviation from the standard is required will be brought to the attention of the JEA Engineer for Resolution.

The prototype shall be presented for Approval to the JEA Qualified Representative/Engineer prior to further system development by the Contractor.

2.6 Inspection of software

A JEA Qualified Representative/Engineer reserves the right to inspect the software and system during any stage of development or commissioning.

2.7 Simulation Qualification

The Simulation Qualification shall be developed by the contractor; approved and signed off by the JEA Qualified Representative/Engineer prior to the simulation qualification.

The fully configured system shall be tested for compliance software design and structure document prior to shipping to site for commissioning. This test may be performed by I/O simulation within the PLC software or with internal PLC memory/register manipulation in the absence of real I/O devices.

All system communication links for each device within this test shall be active; this includes but is not limited to Ethernet, Profibus, and wireless communications.

Input / Output registers are to be considered the point of entry / exit of a field wired device in relation to PLC memory.

Each discrete input point will be simulated at incoming PLC address/register. The discrete inputs will be confirmed On/Off and checked for correct mapping to each HMI/OIT display if available.

Each analog input device will be simulated at incoming PLC address/register and will be checked at 0%, 25%, 50%, 75%, and 100% of the analog value. The analog inputs will be checked for correct mapping / scaling at each HMI/OIT display if available.

All HMI /OIT controls for discrete outputs will be triggered at HMI and checked for correct mapping to each PLC output address/register.

Any discrete output not controlled via HMI/OIT shall be tested at the controlling coil/word/ byte/register. The path to the PLC output register shall be verified by triggering the controlling coil/word/ byte/register.

All HMI /OIT analog / integer/ floating point value controls will be varied and will be checked for Mapping / Scaling to each PLC address/register. All analog values will be checked at 0%, 25%, 50%, 75%, and 100%.

All warnings and alarms shall be tested via simulation or by modifying the source PLC address/register to trigger the event. This test shall include analog / discrete alarm triggers.

The testing procedure shall be documented by the Contractor and witnessed by JEA Qualified Representative/Engineer; any deviation will be brought to the attention of the Engineer for resolution; once complete the test shall be signed off by the Engineer.

2.8 Installation/Operational Qualification

The Installation Qualification shall be developed by the contractor; approved and signed off by the JEA Qualified Representative/Engineer prior to the simulation qualification.

The Contractor shall ensure that suitably skilled personnel are available for the installation / operation qualification process.

All system communication links for each device within this test shall be active; this includes but is not limited to Ethernet, Profibus, and wireless communications.

Input / Output registers are to be considered the point of entry / exit of a field wired device in relation to PLC memory.

If an analog/digital input/output device cannot be removed or placed in manual for the verification the device can be tested with a current/voltage source/meter; the source/meter must be connected at the field device disconnection point; the point in which the instrument is connected to the system. No other connection point shall be considered a valid test.

Each discrete/analog input point will be triggered / simulated at the field device. The discrete inputs will be confirmed On/Off within PLC input memory register. PLC Analog input devices will be checked at three different analog values and confirmed within PLC memory input register.

Each discrete output point will be triggered at HMI were applicable; if an output has no HMI control the output shall be triggered from within the PLC software at the controlling coil/word/ byte/register. The output shall be verified in the On/Off state.

Each analog output point will be varied from the HMI were applicable; if an output has no HMI control the output shall be varied from within the PLC software.PLC Analog output devices will be checked at three different analog values.

The testing procedure shall be documented by the Contractor and witnessed by qualified JEA personal; any deviation will be brought to the attention of the Engineer for resolution; once complete the test shall be signed off by the Engineer.

2.8 Process Qualification

To be developed from the System, Sub System Functional; the purpose of the Process Qualification protocol is a document stating how validation will be conducted, including test parameters, product characteristics, manufacturing equipment, and decision points on what constitutes acceptable test results.

The Process Qualification shall be developed by the contractor; approved and signed off by the JEA Qualified Representative/Engineer prior to the process qualification.

2.10 Documentation standards

All PLC software shall be fully documented.

Every internal bit and register shall be documented with a tag name which may comprise of alpha and numeric characters as required; the tag name shall comply with the established standard as shown in Appendix C.

Real I/O bits and register tags names shall match the descriptor on the system P&ID and loop drawings for ease of fault finding; see Appendix C

Every rung of ladder diagram shall be documented with comments describing the function of the ladder. Every contact, coil, register and bit shall be documented with its associated tag name above it.

Each line of statement list (STL) type code or machine code shall be commented with the function of the line; see Appendix C

2.11 Commissioning and handover documentation

One copy of the system software documentation shall be provided prior to commissioning.

The system software documentation shall include:

- Functional requirements System or Sub System
- Software design and structure
- Simulation Qualification Results
- Installation Qualification Results
- Process Qualification Results
- Tag/symbolic printout for all data types

- Tag/symbolic cross reference for all data types
- System block structure

Once the system is fully commissioned, the Contractor shall supply three copies of the system software documentation as shown above and three copies of:

- System P&IDs
- As built loop drawings
- Wiring schedules
- Any other documentation necessary for full maintenance of the commissioned system.

2.12 System backups

Upon handover of the system, the Contractor shall supply three complete system backups on suitable electronic media.

2.13 Statement of compliance

The Contractor shall submit a clause by clause statement of compliance with this specification. If the Contractor complies fully with a clause, he shall confirm compliance. In the event that the Contractor does in any way not comply with a clause this shall be indicated together with details of the non-compliance.

APPENDIX A : REQUIREMENTS SHEET

A.1	System Hardware Compliance:	Completed (YES/NO)
A.2	Statement of Compliance:	Completed (YES/NO)
A.3	Approval of Functional Specification:	Completed (YES/NO)
A.4	Approval of PLC code Prototype:	Completed (YES/NO)
A.5	Approval of Software Design/Structure:	Completed (YES/NO)
A.6	Simulation Qualification Results:	Completed (YES/NO)
A.7	Installation Qualification Results:	Completed (YES/NO)
A.8	Process Qualification Results:	Completed (YES/NO)
A.9	Compliance with JEA PLC Standard:	Completed (YES/NO)
A.10	Commissioning and Handover Documentation:	Completed (YES/NO)

APPENDIX B : RECORD OF AMENDMENTS

APPENDIX C: JEA PLC Software Requirements.

C.1 Control Overview

The PLC / HMI control logic shall be developed from a process function description derived from the systems Process and Instrumentation Diagrams.

The PLC control shall to allow continuous operations of the process equipment during loss of communications to HMI and/or Operator Interface Terminals.

Control Logic shall be maintained within the Siemens S7 300/400 PLC Processors. The PLC processors shall monitor field I/O, evaluate alarm conditions, contain control strategy logic, and execute output commands as permitted by control strategy logic.

The Human Machine Interface [HMI] and Operator Interface Terminals [OIT] shall serve as visual interfaces to the control system. The HMI and OIT will allow operators to monitor the current readings of field devices and instrumentation; enter adjustable set points for control strategy; select mode controls; manually stop/start motors and open/close valves.

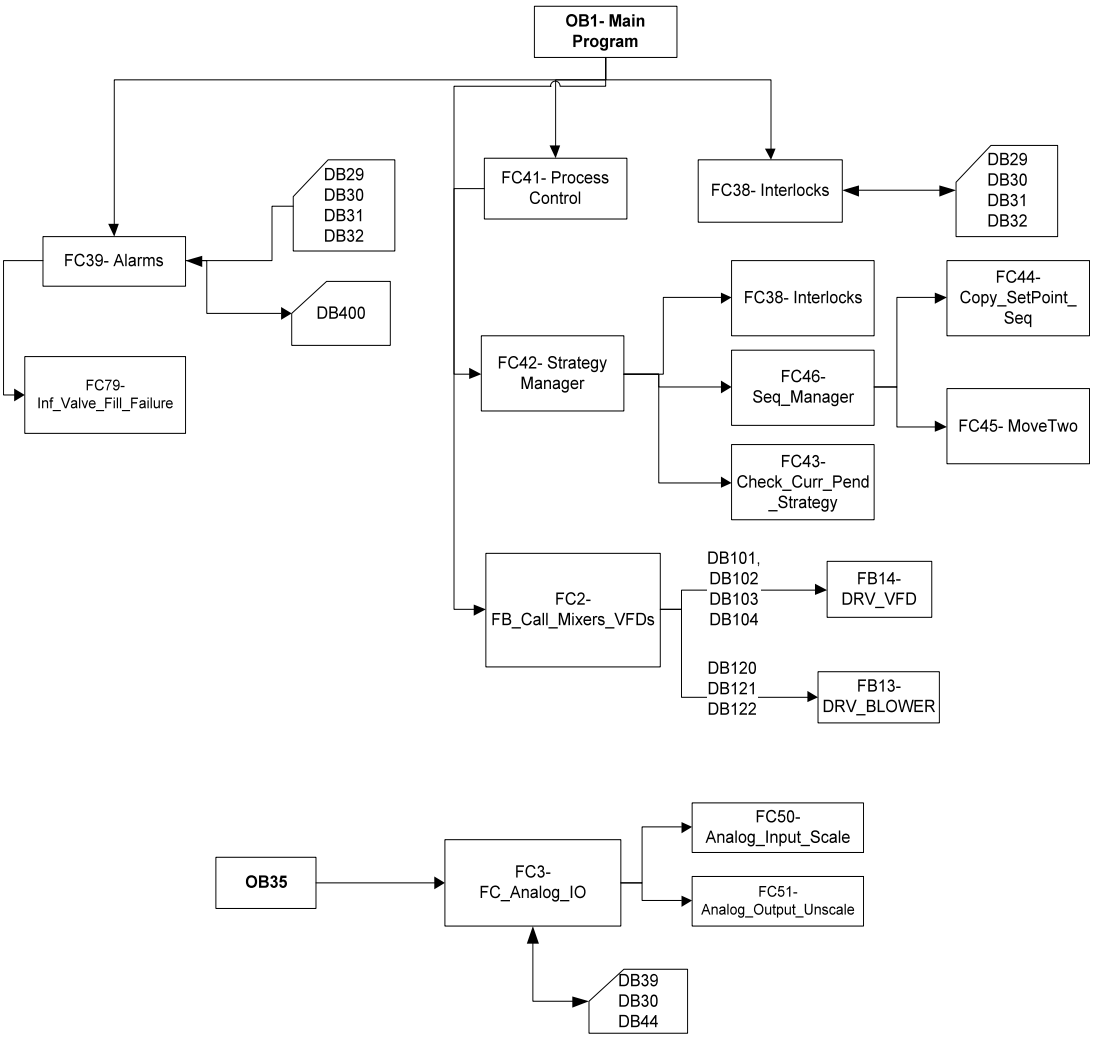
The HMI system shall also serve as the data acquisition point for all control system data. The data will be collected from field devices and instrumentation via the PLC processors and stored on the local server's hard drive. This data can be referenced for trending and reporting purposes.

The HMI and OIT shall operate in the same manner. The OIT does not require a separate control permissive. For example if a pump control strategy is in the REMOTE mode; the operator may adjust set points and/or control parameters from the HMI system or the local OIT.

PLC inputs for any field device analog or digital shall be physical PLC I/O inputs; the simulation of a field devices inputs by use PLC/HMI/OIT code is prohibited; if this type control is needed the contractor shall bring it to the attention of the Engineer for Resolution.

C.2 Structured Programming

The preferred method of PLC programming within JEA is Structured Programming. The method of breaking a Process down into manageable Tasks or in Siemens Step 7 terms Blocks. The Blocks of code perform specific tasks in the process.



C.3 Ladder / Statement List Programming

The PLC code within the FC's and FB's shall be ladder logic where applicable. JEA recognizes the need for statement list / Pascal programming for certain applications; if the use of statement list / Pascal programming is required it shall be brought to the attention the JEA Qualified Representative/Engineer for prior to any code development; approval must be obtained prior to using these programming methods.

All Control Words/Bytes/Bits shall be traceable; the use of indirect addressing is acceptable within a Function Block, but all sources must be traceable back to that function block.

C.4 S7 Database Structure

Data Blocks shall be assigned to FC's and FB's when an instance block is required; the data block number shall equal the FC or FB number.

If Data Blocks are unused by FC's and FB's they can be used as shared DB's

PLC ◄ ► HMI/OIT Communications

The HMI/OIT will read PLC memory from one data block. The data within the block shall be grouped by function; these may include but are not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

The HMI/OIT will write to one Data Block within PLC memory. The data within the block shall be grouped by function; these may include but are not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

PLC ◄ ► PLC Communications between Processors

Data Blocks DB200 to DB219 will contain data that is read from other PLC programs.

C.5 Analog Scaling

Each Analog input enters the PLC process address with a range of 0-27648; the PLC shall scale each analog signal to the engineering range of that signal. Each Analog output that leaves the PLC shall be scaled and conditioned prior to storage in the PLC output address. The HMI/OIT shall read/write data to/from PLC addresses without conditioning or scaling.

C.6 Analog Signal Alarms

Alarms for Analog signals shall be determined through PLC Logic. The HMI shall contain the database tags for set points/limits of analog signals that will be written to the PLC memory. The PLC will check that HMI database values are within a specified range and monitor the analog input signal; the PLC will trigger the alarm bit after a de-bounce time; the PLC control strategy will determine system reaction to the alarm event. The HMI will monitor PLC alarm bits and display appropriate alarm and/or warning messages.
See Equipment / Process Alarm for code example.

C.7 Flow Totalization

All real time calculations such as flow totals are to be performed in the PLC processor; NOT in the HMI application. These functions shall be located within a selectable timed interrupt routine within the PLC. The analog input for each signal flow shall be converted from the raw input to a scale to an actual engineering range. The actual reading will be converted to a flow per second

value; this value will be added to the daily flow totalizer once per second. Values will be stored in a double word address in the processor.

The HMI/OIT will read the scaled value directly from the PLC processor address without additional scaling or conditioning. Totalizer reset functions are to be provided via the HMI; once the reset function has been selected a corresponding bit within the PLC will be set and the totalized value set to zero; once the totalized value = zero the HMI generated bit will be reset by the PLC, not the HMI.

C.8 Equipment Runtimes

All real time calculations such as equipment run times are to be performed in the PLC processor; NOT in the HMI application. These functions shall be located within a selectable timed interrupt routine within the PLC. Run time ranges are 0-10000 and measured in 10ths of an hour. The run times roll over at a count of 10000. Run time reset functions are to be provided via the HMI; once the reset function has been selected a corresponding bit within the PLC will be set and the runtime value set to zero; once the runtime value = zero the HMI generated bit will be reset by the PLC, not the HMI.

C.9 Time Synchronization

Logic shall be included within the PLC program configuration for time synchronization between the HMI SCADA computer and the PLC processor clock. Every day at 10:30 the HMI will set a time synchronization address bit of each PLC processor with the system. Once the PLC receives the bit the PLC clock will be set to 10:30. Once the time has been set to 10:30 the PLC will reset this bit. The reason for the 10:30 time selection is to allow for Daylight Savings in April and October.

C.10 HMI/OIT ► PLC -- I/O Address Buffering

The HMI application or OIT interface will not write directly into PLC discrete or analog output addresses. The HMI/OIT will write into internal data base addresses where the PLC logic will check the quality of the data prior to transferring to an output address. Checks should include but are not limited to upper/lower limit verification; correct equipment “mode” of operation for current command.

C.11 PLC ◄ ► HMI/OIT Communications

PLC logic address shall be organized in a manner that allows the HMI to poll a group of contiguous addresses at one time; this will allow for more efficient communications between the HMI and the Siemens processor

For all Siemens processors the addressing for HMI communications shall be organized according to the list below:

The HMI/OIT will read PLC memory from one data block. The data within the block shall be grouped by function; these may include but are not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

The HMI/OIT will write to one Data Block within PLC memory. The data within the block shall be grouped by function; these may include but are not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

The only PLC processor memory address that the HMI/OIT may reference other than the data blocks above are processor status addresses. All real time system status information will be read by the HMI/OIT from the above databases and displayed accordingly.

C.12 HMI/OIT ► to PLC Control Bits

PLC logic shall be written to reset all pulsed outputs from the HMI/OIT. These outputs included but are not limited to flow total resets, runtime resets, equipment fail resets, and clock synchronization bits. The set bits within the PLC shall be used by the HMI as a command received confirmation indication; this reset function may have to be de-bounced if system reaction faster than the HMI update time.

C.13 PLC ◄ ► PLC Communications between Processors

Information may have to be shared between PLC processors. If the control code within a PLC requires data from another PLC processor; the processor needing the data must request (read) the data via Ethernet communication. All communications between PLC processors shall be in the form of reading data; a processor will not write data to another processor.

For all Siemens processors the addressing for PLC to PLC communications shall be organized as listed below.

Data Blocks DB200 to DB219 will contain data that is read from other PLC programs. The data block may contain data that includes but is not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

Example:

Processor A = DB200
Processor B = DB201
Processor C = DB202

Processor A has been assigned DB200; therefore any data to be read from another PLC is placed in DB200 by processor A. If processor B or C need data form processor A they read the data from DB200 in processor A and place it in DB200 within their memory structure. This ensures consistency within any PLC in a system; the data in DB200 is from processor A.

A continuous internal counter triggered every one second will be set up in every processor for communications checks. This count will be read by all processors reading a PLC. Within the Processor doing the reading if the count value does not change in 10 seconds a communication failure shall be initiated.

C.14 JEA Siemens Library File

Examples of existing/preferred FC and FB's will be provided under a Siemens S7 library file for use by the integrator in program development.

C.15 PID Control

These functions shall be located within a selectable timed interrupt routine within the PLC. The analog input for each signal flow shall be converted from the raw input to a scale to an actual engineering range.

If derivative control is to be included in the function then the analog input value will be sampled on a periodic basis; loaded into a FIFO stack that is a minimum of 50 words in length. The minimum 50 word stack will be averaged; this average value will become the Process variable input to PID Loop.

The reason for the averaging is to prevent a step change in the process variable value; thus allowing the addition of derivative control within the PID Loop. The derivate of a step change can approach ∞ thus causing unexpected PID reactions.

C.16 Equipment / Process Alarms

Device Movement Alarm; if a device movement command is given and the device has position indication sensors; code shall be written to determine that the device is in the correct position. All alarms must be reset via a bit from the HMI/OIT; Self healing code is unacceptable. Some examples of the code are given below.

Failed to Open/Run; Close/Stop; Sensor Failure

Inputs: Six Second Count [Bool]
Failure Time [Integer]
Open/Run [Bool]
Opened/Running [Bool]
Close/Stop [Bool]
Closed/Stopped [Bool]

```
IF Six Second Count AND Open/Run AND
((Opened/Running NOT) OR Closed/Stopped)
THEN Failed to Open/Run Time = Failed to Open/Run Time + 1
IF Failed to Open/Run Time > Failure Time
THEN Failed to Open/Run

IF Open/Run AND (Opened/Running OR (Closed/Stopped NOT))
THEN Failed to Open/Run Time = 0
```

Failed to Close/Stop

IF Six Second Count AND Close/Stop AND
(Opened/Running OR (Closed/Stopped NOT))
THEN Failed to Close/Stop Time = Failed to Close/Stop Time + 1
IF Failed to Close/Stop Time > Failure Time
THEN Failed to Close/Stop

IF Close/Stop AND ((Opened/Running NOT) OR (Closed/Stopped)
THEN Failed to Close/Stop Time = 0

Sensor Failure

IF ((Opened/Running NOT) AND (Closed/Stopped NOT)) OR
(Opened/Running AND Closed/Stopped)
THEN Sensor Failure Time = Sensor Failure Time + 1
IF Sensor Failure Time > Failure Time
THEN Sensor Failure

IF (Opened/Running AND (Closed/Stopped NOT)) OR
((Opened/Running NOT) AND Closed/Stopped)
THEN Sensor Failure Time = 0

Outputs:

Failed to Open/Run [Bool]
Failed to Close/Stop [Bool]
Sensor Failure Time [Bool]

Device / Process Alarm [Analog]

Inputs:

Six Second Count [Bool]

Failure Time [Integer]
Set Point [Integer]
Process Variable [Integer]
Deviation Limit Value [Integer]
Open/Run [Bool]
Close/Stop [Bool]

Deviation Limit Value High = Set Point + Deviation Limit Value
Deviation Limit Value Low = Set Point - Deviation Limit Value
Deviation Value = Set Point - Process Variable

IF Six Second Count AND ((Open/Run OR Close/Stop) OR
(Set Point ≠Previous Set Point))
AND ((Deviation Value > Deviation Limit Value High
OR (Deviation Value < Deviation Limit Value Low))
THEN Process/Position Deviation Time =
Process/Position Deviation Time + 1

IF Process/Position Deviation Time > Failure Time
THEN Process/Position Deviation Alarm

IF Deviation Limit Value Low < Deviation Value < Deviation Limit Value High
THEN Process/Position Deviation Time = 0

Outputs:

Process/Position Deviation Alarm

C.17 PLC Function Block Comments

Each function block within the PLC code shall have a help file associated with the block; when F1 is depressed this file shall be the pop up information. An example of how the block shall be detailed is shown below. The example

block show contains sections that shall be included within the help file. No comment shall be written in ALL CAPS. Version Control shall be documented in this section.

```
//*******************************************************************************
//                      Analog Filter Scale
//
//                Developed By: ******
//                        of ***
//                   Jacksonville, FL 32204
//
//*******************************************************************************
//              Version X.YZ    X = Hardware version
//              Y = Software version
//              Z = Software revision
//
//              Version 1.00    06-11-2008
//              Version 2.00    06-30-2009 - 07-02-2009
//
//
//   Version 1.00    1.) TEST DEVELOPMENT
//   Version 2.00    2.) Removed FC105 and wrote own scaling section so the error bit can
//                   be controlled.  The Error bit will now have a scaling option to
//                   determine how far out of range you want to let it.  There is also
//                   a timer that has been added so that if there is a quick overshoot
//                   the Error bit wont go off immediately.
//
//*******************************************************************************
// This code will act as a Filter on Noisy Analog Signals and will Scale the signal.
// You can select how many times to sample by setting Sample from 2 to 100.
// 100 samples are the most you can do.
//
// It also has an Error indicator if the Input goes out of range.
// The Overshoot_SP allows Input to go over the Overshoot and Undershoot ranges by 4863.
// The Overshoot_SP allows you to go 0 - 100% or 0-4863 over Rated Range.
// If Overshoot_SP is set to 0% overshoot and the tranducer goes one count out of the rated
// range then it will set the output error.
// If Overshoot_SP is set to 100% overshoot the transducer can go no more than 4863 counts
// over or under the rated range.  If it goes more then 4863 it will set the error output.

//*******************************************************************************

FUNCTION_BLOCK FB22

TITLE = 'Filt_Scale'
AUTHOR : *********
FAMILY : Analog
VERSION : '2.00'
```

```
KNOW_HOW_PROTECT

//*****************************************************************************
// Declaration of all Inputs and Outputs of the Block
//*****************************************************************************
VAR_INPUT
Input: INT;               //Unfiltered Analog Input
Max_Range_SP: REAL;        //Maximum Transducer Range
Min_Range_SP: REAL;        //Minimum Transducer Range
Overshoot_SP: REAL;        //Max % of Overshoot for no error, 0.0-100.0%
Error_T_SP: TIME;          //Time before Error is set if Overshoot
Samples_SP: INT;           //0->1=No Filtering, 2->100=# of Samples, Max 100 Samples
Bipolar_SP: BOOL;          //1=Bipolar, 0=Unipolar
END_VAR

VAR_IN_OUT
END_VAR

VAR_OUTPUT
Output: REAL;          //Filtered and Scaled Analog Output
Error: BOOL;           //1=Error if Input is in Overshoot
END_VAR

VAR
Sample: ARRAY[1..100] OF INT;   //Each Analog sample is stored in this Array
Error_TMR: SFB4;           //Multi Instance of a TON, Used for Timer on Error
END_VAR

VAR_TEMP
Error_Bit: BOOL;       //Indicates an Error
In_Adjust: INT;        //Analog input and clamped if necessary
Overshoot_Adjust: REAL; //Overshoot input clamped if necessary
Index: INT;          //Used to Index Array Pointer
Value: INT;          //Used to read and store values
Sum: DINT;           //Will store the Sum of all the samples to get the average
Denominator: DINT;     //Used to divide the total Sum
RET_Status: WORD;      //Status of Analog Read 0=OK
Averaged_Value: REAL;   //Input that has been Averaged
K1: REAL;            //Constant for Analog Scaling
K2: REAL;            //Constant for Analog Scaling
END_VAR

LABEL
//END1;
END_LABEL

//*****************************************************************************
// This section will indicate if the Analog is out of range.
// There are three ranges from the analog reading.
// The first is the Rated Range of the transducer.
```

```
// The second is the Overshoot Range which is 4863 raw counts out of range.
// The Third range is Overflow and this is anything above 4863 counts is out of range.
//
// Here is an example of a 4-20ma transducer card ranges.
//  Raw  |   Amp    | Range
// -----------------------------
// 32767 | 22.96ma  |  Overflow
// 32512 |          |
// -----------------------------
// 32511 | 22.81ma  | Overshoot
// 27649 |          |
// -----------------------------
// 27648 | 20.0ma   |
// 20736 | 16.0ma   | Rated
//   1   | 4.0006ma |
//   0   | 4.00ma   |
// -----------------------------
//  -1   |          | Undershot
// -4864 | 1.185ma  |
// -----------------------------
// -4865 |          | Underflow
// -32768|          |
// -----------------------------
//
// This section will allow you to go over the Overshoot and Undershoot ranges by 4863.
// The input setpoint of Overshoot_SP allows you to go 0 - 100% or 0-4863 over Rated Range.
// If Overshoot_SP is set to 0% overshoot and the tranducer goes one count out of the rated
// range then it will set the output error.
// If Overshoot_SP is set to 100% overshoot the transducer can go no more than 4863 counts
// over the rated range.  If it goes more then 4863 it will set the error output.
//
//*********************************************************************************

//================================================================================
// Make sure that the Overshoot_SP is within its limits of 0.0 - 100.0
// If not clamp at 0.0 or 100.0
//================================================================================
IF (Overshoot_SP >= 0.0) AND (Overshoot_SP <= 100.0) THEN
   Overshoot_Adjust := Overshoot_SP;
ELSE
   IF Overshoot_SP < 0.0 THEN
      Overshoot_Adjust := 0.0;
   ELSE
      Overshoot_Adjust := 100.0;
   END_IF;
END_IF;

//================================================================================
```

C.18 PLC Symbol Naming Convention

PLC symbols shall be derived from the following convention TTT BEE NNN", where TTT – Instrument Type, B- Building number, EE- Equipment number, NNN- Ordinal number if necessary. Instrument Type will be obtained from Piping and Instrumentation Diagrams [P&ID] which should follow **ISA** standard identification letters protocol.

Example -- Flow Indicating Transmitter [FIT]; Building 5, instrument 9; FIT509

PLC Data Block	Process variable	FIT509_PV
PLC High Value	Warning	FIT509_ASH
PLC High High Value	Alarm	FIT509_ASHH
PLC Low Value	Warning	FIT509_ASL
PLC Low Low Value	Alarm	FIT509_ASLL
PLC PID Control	Set Point	FIT509_Sp
PLC PID Control	Proportional Scalar	FIT509_Kp
PLC PID Control	Integral Scalar	FIT509_Ki
PLC PID Control	Derivative Scalar	FIT509_Kd
PLC PID Control	PID output/Control Variable	FIT509_Cv
PLC PID Control	PID in Manual	FIT509_Man
PLC PID Control	PID in Auto	FIT509_Auto
PLC Data Block	Totalized Flow	FIT509_QZ
PLC Data Block	Deviation value	FIT509_ZDV
PLC Data Block	Deviation High	FIT509_ZDSH
PLC Data Block	Deviation Low	FIT509_ZDSL

Example – Motor; Building 4; Motor number 2; Ordinal Number A; M42A

PLC Data Block	Hand	M42A_Hand
PLC Data Block	Off	M42A_Off
PLC Data Block	Auto	M42A_Auto
PLC Data Block	Start	M42A_Start
PLC Data Block	Started	M42A_SH
PLC Data Block	Stopped	M42A_SL
PLC Data Block	Overload Active	M42A_OVSH
PLC Data Block	Speed Command	M42A_SV
PLC Data Block	Actual Speed	M42A_SIT
PLC Data Block	Low Speed	M42A_SSL
PLC Data Block	High Speed	M42A_SSH
PLC PID	Set Point	M42A_Sp

Control		
PLC PID	Proportional Scalar	M42A_Kp
Control		
PLC PID	Integral Scalar	M42A_Ki
Control		
PLC PID	Derivative Scalar	M42A_Kd
Control		
PLC PID	PID output/Control Variable	M42A_Cv
Control		
PLC PID	PID in Manual	M42A_PID_Man
Control		
PLC PID	PID in Auto	M42A_PID_Auto
Control		
PLC Data Block	Deviation value	M42A_ZDV
PLC Data Block	Deviation High	M42A_ZDSH
PLC Data Block	Deviation Low	M42A_ZDSL
PLC Data Block	Voltage	M42A_EZ
PLC Data Block	Actual Voltage Reading	M42A_EIT
PLC Data Block	Voltage Low	M42A_ESL
PLC Data Block	Voltage High	M42A_ESH
PLC Data Block	Current	M42A_IZ
PLC Data Block	Actual Current Reading	M42A_IIT
PLC Data Block	Current Low	M42A_ISL
PLC Data Block	Current High	M42A_ISH
PLC Data Block	Power	M42A_JV
PLC Data Block	Actual Power Reading	M42A_JIT
PLC Data Block	Power Low	M42A_JSL
PLC Data Block	Power High	M42A_JSH
PLC Data Block	Flow	M42A_FV
PLC Data Block	Actual Flow Reading	M42A_FIT
PLC Data Block	Flow Low	M42A_FSL
PLC Data Block	Flow High	M42A_FSH

JEA

Document: WRF PLC Programming Standard	Version: Beta 1	Date: 06/16/15
	Page 1 of 29	

1.0 SCOPE

This specification details JEA requirements for PLC software configuration and documentation, any deviation required will be brought to the attention of the JEA Qualified Representative/Engineer for Resolution.

Software Design Document: This document must be completed and approved before the programming begins.

2.2 Functional specification

Unless provided by a JEA Qualified Representative/Engineer, the Contractor shall document the functional specification of the complete system and each subsystem prior to the development of any PLC / HMI code. Approval of the functional specification shall be obtained from a JEA Qualified Representative/Engineer prior to any further system development.

2.3 Software design and structure

PLC Programs to be developed with Simatic Version 5.4 with Service Pack 4 (minimum requirement)

The Contractor shall design and document the software structure of the PLC / HMI programs prior to the development of any code. The software structure shall be modeled after the requirements of the functional specification.

The use of standards supplied by JEA is preferred; see appendix C for PLC software standard details; if any deviation from the standard is required will be brought to the attention of the JEA Engineer for Resolution.

In the case of multiple PLCs, each PLC shall comply with the design standard.

2.4 Design Approval

The documented design as specified in sections 2.2 / 2.3 shall be submitted for Approval to the JEA Qualified Representative/Engineer prior to further system development by the Contractor.

2.5 Prototyping

A prototype of intended PLC code design shall be implemented and tested by the Contractor.

The use of standards supplied by JEA is preferred; see appendix C for PLC software standard details; if any deviation from the standard is required will be brought to the attention of the JEA Engineer for Resolution.

The prototype shall be presented for Approval to the JEA Qualified Representative/Engineer prior to further system development by the Contractor.

2.6 Inspection of software

A JEA Qualified Representative/Engineer reserves the right to inspect the software and system during any stage of development or commissioning.

2.7 Simulation Qualification

The Simulation Qualification shall be developed by the contractor; approved and signed off by the JEA Qualified Representative/Engineer prior to the simulation qualification.

The fully configured system shall be tested for compliance software design and structure document prior to shipping to site for commissioning. This test may be performed by I/O simulation within the PLC software or with internal PLC memory/register manipulation in the absence of real I/O devices.

All system communication links for each device within this test shall be active; this includes but is not limited to Ethernet, Profibus, and wireless communications.

Input / Output registers are to be considered the point of entry / exit of a field wired device in relation to PLC memory.

Each discrete input point will be simulated at incoming PLC address/register. The discrete inputs will be confirmed On/Off and checked for correct mapping to each HMI/OIT display if available.

Each analog input device will be simulated at incoming PLC address/register and will be checked at 0%, 25%, 50%, 75%, and 100% of the analog value. The analog inputs will be checked for correct mapping / scaling at each HMI/OIT display if available.

All HMI /OIT controls for discrete outputs will be triggered at HMI and checked for correct mapping to each PLC output address/register.

Any discrete output not controlled via HMI/OIT shall be tested at the controlling coil/word/ byte/register. The path to the PLC output register shall be verified by triggering the controlling coil/word/ byte/register.

All HMI /OIT analog / integer/ floating point value controls will be varied and will be checked for Mapping / Scaling to each PLC address/register. All analog values will be checked at 0%, 25%, 50%, 75%, and 100%.

All warnings and alarms shall be tested via simulation or by modifying the source PLC address/register to trigger the event. This test shall include analog / discrete alarm triggers.

The testing procedure shall be documented by the Contractor and witnessed by JEA Qualified Representative/Engineer; any deviation will be brought to the attention of the Engineer for resolution; once complete the test shall be signed off by the Engineer.

2.8 Installation/Operational Qualification

The Installation Qualification shall be developed by the contractor; approved and signed off by the JEA Qualified Representative/Engineer prior to the simulation qualification.

The Contractor shall ensure that suitably skilled personnel are available for the installation / operation qualification process.

All system communication links for each device within this test shall be active; this includes but is not limited to Ethernet, Profibus, and wireless communications.

Input / Output registers are to be considered the point of entry / exit of a field wired device in relation to PLC memory.

If an analog/digital input/output device cannot be removed or placed in manual for the verification the device can be tested with a current/voltage source/meter; the source/meter must be connected at the field device

disconnection point; the point in which the instrument is connected to the system. No other connection point shall be considered a valid test.

Each discrete/analog input point will be triggered / simulated at the field device. The discrete inputs will be confirmed On/Off within PLC input memory register. PLC Analog input devices will be checked at three different analog values and confirmed within PLC memory input register.

Each discrete output point will be triggered at HMI were applicable; if an output has no HMI control the output shall be triggered from within the PLC software at the controlling coil/word/ byte/register. The output shall be verified in the On/Off state.

Each analog output point will be varied from the HMI were applicable; if an output has no HMI control the output shall be varied from within the PLC software.PLC Analog output devices will be checked at three different analog values.

The testing procedure shall be documented by the Contractor and witnessed by qualified JEA personal; any deviation will be brought to the attention of the Engineer for resolution; once complete the test shall be signed off by the Engineer.

2.8 **Process Qualification**

To be developed from the System, Sub System Functional; the purpose of the Process Qualification protocol is a document stating how validation will be conducted, including test parameters, product characteristics, manufacturing equipment, and decision points on what constitutes acceptable test results.

The Process Qualification shall be developed by the contractor; approved and signed off by the JEA Qualified Representative/Engineer prior to the process qualification.

2.10 Documentation standards

All PLC software shall be fully documented.

Every internal bit and register shall be documented with a tag name which may comprise of alpha and numeric characters as required; the tag name shall comply with the established standard as shown in Appendix C.

Real I/O bits and register tags names shall match the descriptor on the system P&ID and loop drawings for ease of fault finding; see Appendix C

Every rung of ladder diagram shall be documented with comments describing the function of the ladder. Every contact, coil, register and bit shall be documented with its associated tag name above it.

Each line of statement list (STL) type code or machine code shall be commented with the function of the line; see Appendix C

2.11 Commissioning and handover documentation

One copy of the system software documentation shall be provided prior to commissioning.

The system software documentation shall include:

- Functional requirements System or Sub System
- Software design and structure
- Simulation Qualification Results
- Installation Qualification Results
- Process Qualification Results
- Tag/symbolic printout for all data types
- Tag/symbolic cross reference for all data types
- System block structure

Once the system is fully commissioned, the Contractor shall supply three copies of the system software documentation as shown above and three copies of:

- System P&IDs
- As built loop drawings
- Wiring schedules
- Any other documentation necessary for full maintenance of the commissioned system.

2.12 System backups

Upon handover of the system, the Contractor shall supply three complete system backups on suitable electronic media.

2.13 Statement of compliance

The Contractor shall submit a clause by clause statement of compliance with this specification. If the Contractor complies fully with a clause, he shall confirm compliance. In the event that the Contractor does in any way not comply with a clause this shall be indicated together with details of the non-compliance.

APPENDIX C: JEA PLC Software Requirements.

C.1 Control Overview

The PLC / HMI control logic shall be developed from a process function description derived from the systems Process and Instrumentation Diagrams.

The PLC control shall to allow continuous operations of the process equipment during loss of communications to HMI and/or Operator Interface Terminals.

Control Logic shall be maintained within the Siemens S7 300/400 PLC Processors. The PLC processors shall monitor field I/O, evaluate alarm conditions, contain control strategy logic, and execute output commands as permitted by control strategy logic.

The Human Machine Interface [HMI] and Operator Interface Terminals [OIT] shall serve as visual interfaces to the control system. The HMI and OIT will allow operators to monitor the current readings of field devices and instrumentation; enter adjustable set points for control strategy; select mode controls; manually stop/start motors and open/close valves.

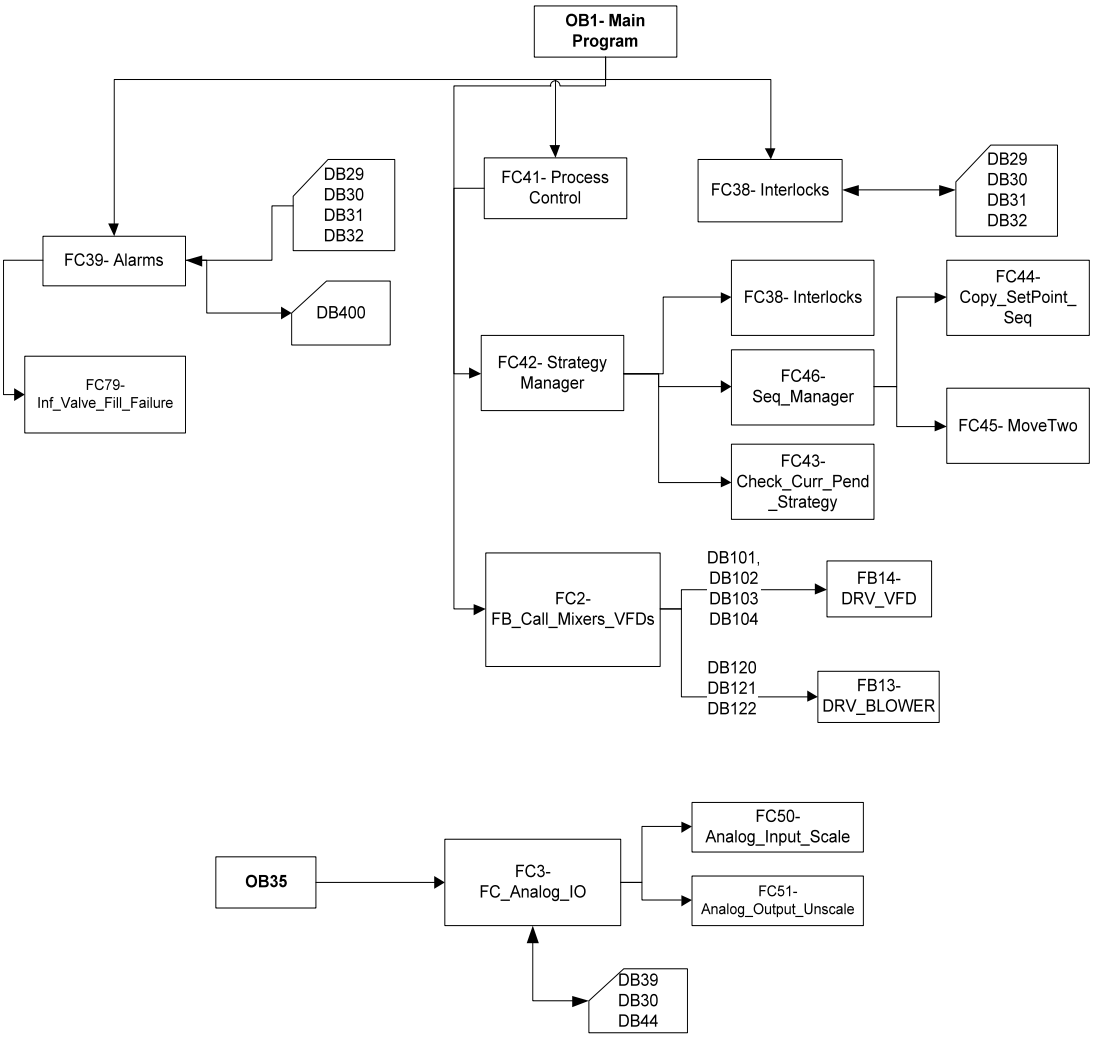
The HMI system shall also serve as the data acquisition point for all control system data. The data will be collected from field devices and instrumentation via the PLC processors and stored on the local server's hard drive. This data can be referenced for trending and reporting purposes.

The HMI and OIT shall operate in the same manner. The OIT does not require a separate control permissive. For example if a pump control strategy is in the REMOTE mode; the operator may adjust set points and/or control parameters from the HMI system or the local OIT.

PLC inputs for any field device analog or digital shall be physical PLC I/O inputs; the simulation of a field devices inputs by use PLC/HMI/OIT code is prohibited; if this type control is needed the contractor shall bring it to the attention of the Engineer for Resolution.

C.2 Structured Programming

The preferred method of PLC programming within JEA is Structured Programming. The method of breaking a Process down into manageable Tasks or in Siemens Step 7 terms Blocks. The Blocks of code perform specific tasks in the process.



C.3 Ladder / Statement List Programming

The PLC code within the FC's and FB's shall be ladder logic where applicable. JEA recognizes the need for statement list / Pascal programming for certain applications; if the use of statement list / Pascal programming is required it shall be brought to the attention the JEA Qualified Representative/Engineer for prior to any code development; approval must be obtained prior to using these programming methods.

All Control Words/Bytes/Bits shall be traceable; the use of indirect addressing is acceptable within a Function Block, but all sources must be traceable back to that function block.

C.4 S7 Database Structure

Data Blocks shall be assigned to FC's and FB's when an instance block is required; the data block number shall equal the FC or FB number.

If Data Blocks are unused by FC's and FB's they can be used as shared DB's

PLC ◄ ► HMI/OIT Communications

The HMI/OIT will read PLC memory from one data block. The data within the block shall be grouped by function; these may include but are not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

The HMI/OIT will write to one Data Block within PLC memory. The data within the block shall be grouped by function; these may include but are not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

PLC ◄ ► PLC Communications between Processors

Data Blocks DB200 to DB219 will contain data that is read from other PLC programs.

C.5 Analog Scaling

Each Analog input enters the PLC process address with a range of 0-27648; the PLC shall scale each analog signal to the engineering range of that signal. Each Analog output that leaves the PLC shall be scaled and conditioned prior to storage in the PLC output address. The HMI/OIT shall read/write data to/from PLC addresses without conditioning or scaling.

C.6 Analog Signal Alarms

Alarms for Analog signals shall be determined through PLC Logic. The HMI shall contain the database tags for set points/limits of analog signals that will be written to the PLC memory. The PLC will check that HMI database values are within a specified range and monitor the analog input signal; the PLC will trigger the alarm bit after a de-bounce time; the PLC control strategy will determine system reaction to the alarm event. The HMI will monitor PLC alarm bits and display appropriate alarm and/or warning messages.
See Equipment / Process Alarm for code example.

C.7 Flow Totalization

All real time calculations such as flow totals are to be performed in the PLC processor; NOT in the HMI application. These functions shall be located within a selectable timed interrupt routine within the PLC. The analog input for each signal flow shall be converted from the raw input to a scale to an actual engineering range. The actual reading will be converted to a flow per second

value; this value will be added to the daily flow totalizer once per second. Values will be stored in a double word address in the processor.

The HMI/OIT will read the scaled value directly from the PLC processor address without additional scaling or conditioning. Totalizer reset functions are to be provided via the HMI; once the reset function has been selected a corresponding bit within the PLC will be set and the totalized value set to zero; once the totalized value = zero the HMI generated bit will be reset by the PLC, not the HMI.

C.8 Equipment Runtimes

All real time calculations such as equipment run times are to be performed in the PLC processor; NOT in the HMI application. These functions shall be located within a selectable timed interrupt routine within the PLC. Run time ranges are 0-10000 and measured in 10ths of an hour. The run times roll over at a count of 10000. Run time reset functions are to be provided via the HMI; once the reset function has been selected a corresponding bit within the PLC will be set and the runtime value set to zero; once the runtime value = zero the HMI generated bit will be reset by the PLC, not the HMI.

C.9 Time Synchronization

Logic shall be included within the PLC program configuration for time synchronization between the HMI SCADA computer and the PLC processor clock. Every day at 10:30 the HMI will set a time synchronization address bit of each PLC processor with the system. Once the PLC receives the bit the PLC clock will be set to 10:30. Once the time has been set to 10:30 the PLC will reset this bit. The reason for the 10:30 time selection is to allow for Daylight Savings in April and October.

C.10 HMI/OIT ► PLC -- I/O Address Buffering

The HMI application or OIT interface will not write directly into PLC discrete or analog output addresses. The HMI/OIT will write into internal data base addresses where the PLC logic will check the quality of the data prior to transferring to an output address. Checks should include but are not limited to upper/lower limit verification; correct equipment “mode” of operation for current command.

C.11 PLC ◄ ► HMI/OIT Communications

PLC logic address shall be organized in a manner that allows the HMI to poll a group of contiguous addresses at one time; this will allow for more efficient communications between the HMI and the Siemens processor

For all Siemens processors the addressing for HMI communications shall be organized according to the list below:

The HMI/OIT will read PLC memory from one data block. The data within the block shall be grouped by function; these may include but are not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

The HMI/OIT will write to one Data Block within PLC memory. The data within the block shall be grouped by function; these may include but are not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

The only PLC processor memory address that the HMI/OIT may reference other than the data blocks above are processor status addresses. All real time system status information will be read by the HMI/OIT from the above databases and displayed accordingly.

C.12 HMI/OIT ► to PLC Control Bits

PLC logic shall be written to reset all pulsed outputs from the HMI/OIT. These outputs included but are not limited to flow total resets, runtime resets, equipment fail resets, and clock synchronization bits. The set bits within the PLC shall be used by the HMI as a command received confirmation indication; this reset function may have to be de-bounced if system reaction faster than the HMI update time.

C.13 PLC ◄ ► PLC Communications between Processors

Information may have to be shared between PLC processors. If the control code within a PLC requires data from another PLC processor; the processor needing the data must request (read) the data via Ethernet communication. All communications between PLC processors shall be in the form of reading data; a processor will not write data to another processor.

For all Siemens processors the addressing for PLC to PLC communications shall be organized as listed below.

Data Blocks DB200 to DB219 will contain data that is read from other PLC programs. The data block may contain data that includes but is not limited to; physical I/O; alarm limit values; alarm bits and data; process variables; control variables; set points; control bytes, words, and bits; motor, pump, blower statistical data; system statistical data.

Example:

Processor A = DB200
Processor B = DB201
Processor C = DB202

Processor A has been assigned DB200; therefore any data to be read from another PLC is placed in DB200 by processor A. If processor B or C need data form processor A they read the data from DB200 in processor A and place it in DB200 within their memory structure. This ensures consistency within any PLC in a system; the data in DB200 is from processor A.

A continuous internal counter triggered every one second will be set up in every processor for communications checks. This count will be read by all processors reading a PLC. Within the Processor doing the reading if the count value does not change in 10 seconds a communication failure shall be initiated.

C.14 JEA Siemens Library File

Examples of existing/preferred FC and FB's will be provided under a Siemens S7 library file for use by the integrator in program development.

C.15 PID Control

These functions shall be located within a selectable timed interrupt routine within the PLC. The analog input for each signal flow shall be converted from the raw input to a scale to an actual engineering range.

If derivative control is to be included in the function then the analog input value will be sampled on a periodic basis; loaded into a FIFO stack that is a minimum of 50 words in length. The minimum 50 word stack will be averaged; this average value will become the Process variable input to PID Loop.

The reason for the averaging is to prevent a step change in the process variable value; thus allowing the addition of derivative control within the PID Loop. The derivate of a step change can approach ∞ thus causing unexpected PID reactions.

C.16 Equipment / Process Alarms

Device Movement Alarm; if a device movement command is given and the device has position indication sensors; code shall be written to determine that the device is in the correct position. All alarms must be reset via a bit from the HMI/OIT; Self healing code is unacceptable. Some examples of the code are given below.

Failed to Open/Run; Close/Stop; Sensor Failure

Inputs: Six Second Count [Bool]
Failure Time [Integer]
Open/Run [Bool]
Opened/Running [Bool]
Close/Stop [Bool]
Closed/Stopped [Bool]

```
IF Six Second Count AND Open/Run AND
((Opened/Running NOT) OR Closed/Stopped)
THEN Failed to Open/Run Time = Failed to Open/Run Time + 1
IF Failed to Open/Run Time > Failure Time
THEN Failed to Open/Run

IF Open/Run AND (Opened/Running OR (Closed/Stopped NOT))
THEN Failed to Open/Run Time = 0
```

Failed to Close/Stop

IF Six Second Count AND Close/Stop AND
(Opened/Running OR (Closed/Stopped NOT))
THEN Failed to Close/Stop Time = Failed to Close/Stop Time + 1
IF Failed to Close/Stop Time > Failure Time
THEN Failed to Close/Stop

IF Close/Stop AND ((Opened/Running NOT) OR (Closed/Stopped)
THEN Failed to Close/Stop Time = 0

Sensor Failure

IF ((Opened/Running NOT) AND (Closed/Stopped NOT)) OR
(Opened/Running AND Closed/Stopped)
THEN Sensor Failure Time = Sensor Failure Time + 1
IF Sensor Failure Time > Failure Time
THEN Sensor Failure

IF (Opened/Running AND (Closed/Stopped NOT)) OR
((Opened/Running NOT) AND Closed/Stopped)
THEN Sensor Failure Time = 0

Outputs:

Failed to Open/Run [Bool]
Failed to Close/Stop [Bool]
Sensor Failure Time [Bool]

Device / Process Alarm [Analog]

Inputs:

Six Second Count [Bool]

Failure Time [Integer]

Set Point [Integer]

Process Variable [Integer]

Deviation Limit Value [Integer]

Open/Run [Bool]

Close/Stop [Bool]

Deviation Limit Value High = Set Point + Deviation Limit Value

Deviation Limit Value Low = Set Point - Deviation Limit Value

Deviation Value = Set Point - Process Variable

IF Six Second Count AND ((Open/Run OR Close/Stop) OR
(Set Point ≠Previous Set Point))
AND ((Deviation Value > Deviation Limit Value High
OR (Deviation Value < Deviation Limit Value Low))
THEN Process/Position Deviation Time =
Process/Position Deviation Time + 1

IF Process/Position Deviation Time > Failure Time
THEN Process/Position Deviation Alarm

IF Deviation Limit Value Low < Deviation Value < Deviation Limit Value High
THEN Process/Position Deviation Time = 0

Outputs:

Process/Position Deviation Alarm

C.17 PLC Function Block Comments

Each function block within the PLC code shall have a help file associated with the block; when F1 is depressed this file shall be the pop up information. An example of how the block shall be detailed is shown below. The example

block show contains sections that shall be included within the help file. No comment shall be written in ALL CAPS. Version Control shall be documented in this section.

```
//*************************************************************************************
//                      Analog Filter Scale
//
//                Developed By: ******
//                        of ***
//                   Jacksonville, FL 32204
//
//*************************************************************************************
//              Version X.YZ    X = Hardware version
//              Y = Software version
//              Z = Software revision
//
//              Version 1.00    06-11-2008
//              Version 2.00    06-30-2009 - 07-02-2009
//
//
//   Version 1.00    1.) TEST DEVELOPMENT
//   Version 2.00    2.) Removed FC105 and wrote own scaling section so the error bit can
//                   be controlled.  The Error bit will now have a scaling option to
//                   determine how far out of range you want to let it.  There is also
//                   a timer that has been added so that if there is a quick overshoot
//                   the Error bit wont go off immediately.
//
//*************************************************************************************
// This code will act as a Filter on Noisy Analog Signals and will Scale the signal.
// You can select how many times to sample by setting Sample from 2 to 100.
// 100 samples are the most you can do.
//
// It also has an Error indicator if the Input goes out of range.
// The Overshoot_SP allows Input to go over the Overshoot and Undershoot ranges by 4863.
// The Overshoot_SP allows you to go 0 - 100% or 0-4863 over Rated Range.
// If Overshoot_SP is set to 0% overshoot and the tranducer goes one count out of the rated
// range then it will set the output error.
// If Overshoot_SP is set to 100% overshoot the transducer can go no more than 4863 counts
// over or under the rated range.  If it goes more then 4863 it will set the error output.

//*************************************************************************************

FUNCTION_BLOCK FB22

TITLE = 'Filt_Scale'
AUTHOR : *********
FAMILY : Analog
VERSION : '2.00'
```

```
KNOW_HOW_PROTECT

//*********************************************************************************
// Declaration of all Inputs and Outputs of the Block
//*********************************************************************************
VAR_INPUT
Input: INT;                //Unfiltered Analog Input
Max_Range_SP: REAL;         //Maximum Transducer Range
Min_Range_SP: REAL;         //Minimum Transducer Range
Overshoot_SP: REAL;         //Max % of Overshoot for no error, 0.0-100.0%
Error_T_SP: TIME;           //Time before Error is set if Overshoot
Samples_SP: INT;            //0->1=No Filtering, 2->100=# of Samples, Max 100 Samples
Bipolar_SP: BOOL;           //1=Bipolar, 0=Unipolar
END_VAR

VAR_IN_OUT
END_VAR

VAR_OUTPUT
Output: REAL;           //Filtered and Scaled Analog Output
Error: BOOL;            //1=Error if Input is in Overshoot
END_VAR

VAR
Sample: ARRAY[1..100] OF INT;   //Each Analog sample is stored in this Array
Error_TMR: SFB4;            //Multi Instance of a TON, Used for Timer on Error
END_VAR

VAR_TEMP
Error_Bit: BOOL;       //Indicates an Error
In_Adjust: INT;        //Analog input and clamped if necessary
Overshoot_Adjust: REAL; //Overshoot input clamped if necessary
Index: INT;           //Used to Index Array Pointer
Value: INT;           //Used to read and store values
Sum: DINT;            //Will store the Sum of all the samples to get the average
Denominator: DINT;     //Used to divide the total Sum
RET_Status: WORD;      //Status of Analog Read 0=OK
Averaged_Value: REAL;   //Input that has been Averaged
K1: REAL;             //Constant for Analog Scaling
K2: REAL;             //Constant for Analog Scaling
END_VAR

LABEL
//END1;
END_LABEL

//*********************************************************************************
// This section will indicate if the Analog is out of range.
// There are three ranges from the analog reading.
// The first is the Rated Range of the transducer.
```

```
// The second is the Overshoot Range which is 4863 raw counts out of range.
// The Third range is Overflow and this is anything above 4863 counts is out of range.
//
// Here is an example of a 4-20ma transducer card ranges.
//  Raw  |   Amp    | Range
// -----------------------------
// 32767 | 22.96ma  |  Overflow
// 32512 |          |
// -----------------------------
// 32511 | 22.81ma  | Overshoot
// 27649 |          |
// -----------------------------
// 27648 | 20.0ma   |
// 20736 | 16.0ma   | Rated
//   1   | 4.0006ma |
//   0   | 4.00ma   |
// -----------------------------
//  -1   |          | Undershot
// -4864 | 1.185ma  |
// -----------------------------
// -4865 |          | Underflow
// -32768|          |
// -----------------------------
//
// This section will allow you to go over the Overshoot and Undershoot ranges by 4863.
// The input setpoint of Overshoot_SP allows you to go 0 - 100% or 0-4863 over Rated Range.
// If Overshoot_SP is set to 0% overshoot and the tranducer goes one count out of the rated
// range then it will set the output error.
// If Overshoot_SP is set to 100% overshoot the transducer can go no more than 4863 counts
// over the rated range.  If it goes more then 4863 it will set the error output.
//
//*******************************************************************************

//===============================================================================
// Make sure that the Overshoot_SP is within its limits of 0.0 - 100.0
// If not clamp at 0.0 or 100.0
//===============================================================================
IF (Overshoot_SP >= 0.0) AND (Overshoot_SP <= 100.0) THEN
   Overshoot_Adjust := Overshoot_SP;
ELSE
   IF Overshoot_SP < 0.0 THEN
      Overshoot_Adjust := 0.0;
   ELSE
      Overshoot_Adjust := 100.0;
   END_IF;
END_IF;

//===============================================================================
```

C.18 PLC Symbol Naming Convention

PLC symbols shall be derived from the following convention TTT BEE NNN", where TTT – Instrument Type, B- Building number, EE- Equipment number, NNN- Ordinal number if necessary. Instrument Type will be obtained from Piping and Instrumentation Diagrams [P&ID] which should follow **ISA** standard identification letters protocol.

Example -- Flow Indicating Transmitter [FIT]; Building 5, instrument 9; FIT509

PLC Data Block	Process variable	FIT509_PV
PLC High Value	Warning	FIT509_ASH
PLC High High Value	Alarm	FIT509_ASHH
PLC Low Value	Warning	FIT509_ASL
PLC Low Low Value	Alarm	FIT509_ASLL
PLC PID Control	Set Point	FIT509_Sp
PLC PID Control	Proportional Scalar	FIT509_Kp
PLC PID Control	Integral Scalar	FIT509_Ki
PLC PID Control	Derivative Scalar	FIT509_Kd
PLC PID Control	PID output/Control Variable	FIT509_Cv
PLC PID Control	PID in Manual	FIT509_Man
PLC PID Control	PID in Auto	FIT509_Auto
PLC Data Block	Totalized Flow	FIT509_QZ
PLC Data Block	Deviation value	FIT509_ZDV
PLC Data Block	Deviation High	FIT509_ZDSH
PLC Data Block	Deviation Low	FIT509_ZDSL

Example – Motor; Building 4; Motor number 2; Ordinal Number A; M42A

PLC Data Block	Hand	M42A_Hand
PLC Data Block	Off	M42A_Off
PLC Data Block	Auto	M42A_Auto
PLC Data Block	Start	M42A_Start
PLC Data Block	Started	M42A_SH
PLC Data Block	Stopped	M42A_SL
PLC Data Block	Overload Active	M42A_OVSH
PLC Data Block	Speed Command	M42A_SV
PLC Data Block	Actual Speed	M42A_SIT
PLC Data Block	Low Speed	M42A_SSL
PLC Data Block	High Speed	M42A_SSH
PLC PID	Set Point	M42A_Sp

Control		
PLC PID	Proportional Scalar	M42A_Kp
Control		
PLC PID	Integral Scalar	M42A_Ki
Control		
PLC PID	Derivative Scalar	M42A_Kd
Control		
PLC PID	PID output/Control Variable	M42A_Cv
Control		
PLC PID	PID in Manual	M42A_PID_Man
Control		
PLC PID	PID in Auto	M42A_PID_Auto
Control		
PLC Data Block	Deviation value	M42A_ZDV
PLC Data Block	Deviation High	M42A_ZDSH
PLC Data Block	Deviation Low	M42A_ZDSL
PLC Data Block	Voltage	M42A_EZ
PLC Data Block	Actual Voltage Reading	M42A_EIT
PLC Data Block	Voltage Low	M42A_ESL
PLC Data Block	Voltage High	M42A_ESH
PLC Data Block	Current	M42A_IZ
PLC Data Block	Actual Current Reading	M42A_IIT
PLC Data Block	Current Low	M42A_ISL
PLC Data Block	Current High	M42A_ISH
PLC Data Block	Power	M42A_JV
PLC Data Block	Actual Power Reading	M42A_JIT
PLC Data Block	Power Low	M42A_JSL
PLC Data Block	Power High	M42A_JSH
PLC Data Block	Flow	M42A_FV
PLC Data Block	Actual Flow Reading	M42A_FIT
PLC Data Block	Flow Low	M42A_FSL
PLC Data Block	Flow High	M42A_FSH

4. Nuisance Failure, Alarm, and Warning suppression:

a. Shall be provided with an adjustable delay timer prevent nuisance indicators. The delay timer is to reside in the PLC but shall be adjustable from the HMI.

b. Shall be provided with a dead band to prevent nuisance indicators. The dead band is to reside in the PLC but shall be adjustable from the HMI.

c. Conditioning alarm signals. For example, disable all but selected alarms when power is off, and include startup delays, momentary excursion delays, and contact bounce delays. Suppress dysfunctional alarms during and immediately following power outages.

d. Provide alarm disable functions:

i. Selectable by the supervisor on a point-by-point basis.

ii. Does not prevent point status from being shown on graphic process displays.

iii. Maintain summary of disabled alarms.

5. Process Inputs:

a. Provide a filter that can average out the signal for noise. The filter will be able to sample up to 200 times at 100 mS intervals. The samples will be able to be fully adjustable.

b. Will be configured with a fully adjustable time delay and a dead band to prevent nuisance indication.

c. All process inputs used for interlocking and control:

i. Executed in the PLC and not external.

ii. Have time delay and dead band settings.

iii. Supervisor accesses for process switch set points.

iv. Scaled to floating point values.

Bumpless Transfer

All Process Controllers in the software are to have bumpless transfer.

Manual to Auto Transfer – If a device is running in Manual and is then transitioned to Auto it will begin control from that manual setpoint, unless the auto mode isn't commanding it. The controller will gradually transition the Manual setpoint to the Auto commanded setpoint to ensure no disruption in the process.

Auto to Manual Transfer – If a device is running in Auto and placed in Manual the device will continue to operate at the previously commanded setpoint, which will be the new Manual setpoint.

Any actuated device that is currently running in Manual and then transitioned into Auto