ADDENDUM 3

DOCUMENT 00 01 10

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ADDENDUM 3

SECTION 01 12 16

WORK SEQUENCE

PART 1 GENERAL

1.01 SUMMARY

A. General identification of Work sequence.

B. Related Sections:
1. Section 01 11 00 - Summary of Work
2. Section 01 31 13 - Coordination
3. Section 01 33 00 - Submittal Procedures
4. Section 02 41 13 - Building Removal
5. Section 33 11 00 - Water Distribution Systems
6. Section 40 23 10 - Process Water and Waste Piping

1.02 QUALITY ASSURANCE

A. Coordinate all equipment shutdowns, startups, and general scheduling with Owner.

1.03 SUBMITTALS

A. Conform to Section 01 33 00.

B. Work Plans:
1. Work plans and schedules shall be submitted for all work activities involving temporary shutdown of the Owner's water treatment plants, potable water storage facilities, or existing pump stations.
2. Work plans and schedules shall be submitted for all temporary and permanent process systems, electrical and control systems requiring testing and/or commissioning prior to system start-up and integration into the Owner's existing systems and/or operations.
3. Excavation and shoring work plans.
4. Piping Systems:
    a. Plan and schedule for all pipeline work requiring connections to the Owner's existing pipeline systems.
    b. Detailed piping connection layouts for connection to existing and proposed pipe and equipment.
    c. Plan for Disinfection Procedures
    d. Plan for Flushing Operations
    e. Plan for Hydrostatic Testing Procedures
5. Others as required by the Owner and/or specified elsewhere.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Construct Work in phases to allow for Owner's continuous occupancy as required for operation of the existing Unit Well 19, Reservoir, and Booster Pumps 1, 2, and 3. Coordinate construction schedule and operations with Owner and Engineer.

B. All utility interruptions to the Owner's system shall occur at off-peak hours of operation and at other such times as suitable to the Owner. Contractor shall assume that these interruption periods will occur on evenings and overnight.

C. Contractor shall request a shut down for connection of new equipment and piping to the existing system no less than 14 days prior to requested date of shutdown.
   1. A request shall be specific for the scope of work to be performed and at a minimum shall include the following information:
      a. Date and time of requested shutdown.
      b. Work to be performed.
      c. Existing equipment or piping to be removed from service to accommodate the shutdown.
      d. Duration of shutdown requested/anticipated duration of work.
   2. Shutdowns to connect new equipment or piping to existing will not be permitted on Friday, Saturdays, or Sundays.

D. Determine type and extent of temporary facilities the Project requires to maintain continuous operation.

E. Provide all temporary connections, parallel temporary lines, temporary power, temporary bulkheads, temporary equipment, and temporary operations necessary to perform Work.

F. The Owner may disallow any impacts to system or facility operations due to expected, and/or unexpected system demands. In the event that the Owner has to cancel a planned shutdown, the Contractor shall work with the Owner to reschedule the shutdown at a mutually convenient time. No additional compensation shall be allowed due to the cancellation of a previously scheduled utility or system shutdown.

G. Submit a detailed Phasing Schedule in accordance with Section 01 33 00. Schedule to include:
   1. Proposed phasing for the Project.
   2. Construction dates for each component of Work identified in each phase.
   3. Description of Work sequence.
   4. Description of interaction with existing plant facilities.
   5. Temporary pumping, piping, and utility services to maintain operability for facilities.
   6. A plan of action for each impact to normal operations of the system. A plan of action shall include:
      a. Description of the work impacting normal operations.
      b. Outline of procedure to minimize the amount of time normal operations will be impacted.
      c. Description of potential issues that could arise and how to avoid/correct these issues.
      d. Must be approved by Owner.
   7. Resubmit until approved by Engineer.

H. Review existing facilities with Owner to become familiar with potentially difficult items that must remain in service. No Work procedures will be permitted that require shutting down of any portion of existing facilities, except as authorized by Owner.

3.02 SEQUENCING REQUIREMENTS

A. Construction sequencing of the water main and pump station are subject to Contractor's means and methods. Contractor shall clearly identify work sequence on Construction Schedules

B. New piping and equipment will not be permitted to be connected to the existing system until flushing and disinfection requirements have been met.

C. The following is a list of sequencing requirements. This is not intended to be exhaustive, nor does it relieve the contractor of any responsibility in developing or implementing a Phasing Schedule.
   1. Work will be permitted on the site beginning March 1, 2024
   2. Contractor shall mow and prepare the staging area prior to April 15, 2024. If the staging area is not mowed and prepared prior to April 15, 2024, the area will not be permitted for use until October 15, 2024.

3. The well house, chemical feed systems, reservoir, and booster pumps shall be in service during high demand months, defined as ~~May 1~~ June 1, 2024 to ~~October 15~~ September 30, 2024. This period may change at the sole discretion of the Owner/Engineer based on system demands.
~~4. The reservoir and booster pumps shall be in service during low demand months, defined as October 16 to April 30.~~
5. Unit Well 19 (well, chemical feed systems, reservoir, and booster pumps) could be taken out of service entirely during the period of October 1, 2024 until June 1, 2025, to allow flexibility to complete phases of the work that require shutdowns of equipment.

END OF SECTION

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ADDENDUM 3

SECTION 01 51 00

TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Temporary utility services and facilities including, but not limited to:
   1. Electric Power Service.
   2. Lighting.
   3. Telephone Services and Internet Access.
   4. Heat.
   5. Weather Instrumentation and Siren
   6. Sanitary Facilities.

B. Related Requirements:
   1. Section 01 57 00 - Temporary Controls

1.02 PRICE AND PAYMENT PROCEDURES

A. Temporary utilities are incidental to the installation of proposed applicable permanent utility improvements and include:
   1. Devices required by Section 01 57 00.
   2. Costs associated with required tests and inspections.

B. The Drawings do not show all of the temporary facilities that the Contractor ultimately uses to complete the Work.

C. All costs in connection with temporary services, including, but not limited to, installation, utility company service charges, maintenance, relocation and removal shall be borne by the Contractor at no additional cost to the Owner.

1.03 REFERENCES

A. ANSI - A10 Series Safety Requirements Standards

B. NECA - NJG-6 - Temporary Job Utilities and Services

C. NEMA

D. NFPA:
   1. 70 - National Electrical Code
   2. 241 - Safeguarding Construction, Alteration, and Demolition Operations

E. Underwriter's Laboratory (UL)

1.04 COORDINATION

A. Coordinate with Madison Gas and Electric to provide a separate and temporary metered electric service for use during the construction of this project for site power. This temporary service shall also feed the existing weather instrumentation equipment located on the reservoir, the existing warning siren on the site, and the grinder pump station connected to the facility, as these cannot be out of service at any point during the project.

B. Utility interruptions required for tie-ins:
   1. Determine requirements, time constraints, etc. for installing temporary service to the Site, or to make connections to existing service.
      a. Shall be requested by Contractor in writing to Engineer.
      b. Shall not commence until Contractor has received written response from Engineer.
      c. Engineer reserves the right to restrict the time and duration of interruption.
   2. Arrange with utility companies for service interruption, where necessary, to make connections for temporary services.

1.05 SUBMITTALS

A. Refer to Section 01 12 16.

1.06 QUALITY ASSURANCE

A. Comply with requirements of local laws and regulations governing construction and local industry standards, in the installation and maintenance of temporary utilities and related services.

B. Comply with requirements of NECA NJG-6, NFPA 241, and ANSI A10

C. Comply with applicable NEMA, NECA, and UL standards and governing regulations for materials and layout of temporary electric service.

D. Where local laws and regulations conflict with the requirements of NEMA, NFPA, ANSI, or NECA, comply with the most stringent requirements.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Provide all required materials and equipment for temporary utilities, services, and facilities.

B. Used materials and equipment may be used, if acceptable to Engineer.

C. Provide only materials and equipment that are suitable for intended use and comply with appropriate standards.

2.02 UTILITIES

A. Where local utility company provides only a portion of temporary utility, provide remainder with matching, compatible materials and equipment. Comply with utility company’s recommendations and requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide each temporary service and facility ready for use at each location when service or facility is first needed.

B. Locate temporary utilities where they will serve Project and result in minimum interference with performance of the Work.

C. Maintain, relocate, modify, and extend utilities as required during course of Work.

D. Use qualified trade persons for installation of temporary utilities.

3.02 ELECTRIC POWER SERVICE

A. Provide a weatherproof, grounded temporary electric power service and distribution system of sufficient size, capacity, and power characteristics to accommodate performance of Work.

B. Contractor shall pay for electricity used for construction purposes.
   1. Electrical service shall be provided and installed by Contractor.
   2. Any Trade requiring power with different characteristics than provided shall arrange and pay for access to such power.

C. Install service and grounding in compliance with NFPA 70. Include necessary meters, transformers, overload protected disconnect, and main distribution switch gear.

D. Connect temporary service to local electric power company main as directed by electric company officials.

E. Install temporary service with an automatic ground-fault interrupter feature, activated from circuits of the system.

F. Install circuits of adequate size and proper characteristics for each use.
   1. Run wiring overhead and rise vertically where wiring will be least exposed to damage from construction operations.
   2. Install rigid steel conduit or equivalent raceways for wiring that must be exposed on grade, floors, decks, or other areas of possible damage or abuse.

G. Provide identification/warning signs at power outlets that are other than 110 to 120 volt power.

H. Provide polarized outlets for plug-in type outlets, to prevent insertion of 110 to 120 volt plugs into higher voltage outlets.

I. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for plug-in connection of power tools and equipment.

J. Use only grounded extension cords.
   1. Use “hard-service” cords where exposed to abrasion and traffic.
   2. Use single lengths or waterproof connectors to connect separate lengths of electric cords.

3.03 LIGHTING

A. Install local switching of temporary lighting, spaced to allow lighting to be turned off in patterns to conserve energy and retain light suitable for work-in-progress, access traffic, security check, and Project lock-up.

B. Provide not less than one 200-watt incandescent lamp per 1,000 square feet of floor area, uniformly distributed, for general construction lighting, or equivalent illumination of a similar nature.
   1. In corridors and similar traffic areas, provide not less than one 100-watt incandescent lamp every 50 feet.
   2. In stairways and at ladder runs, locate not less than one 100-watt incandescent lamp for illuminating each landing and flight.

C. Install and operate temporary lighting that will fulfill security and protection requirements, without the necessity of operating entire temporary lighting system.

D. Provide general service incandescent lamps of wattage required for adequate illumination.

E. Protect lamps with guard cages or tempered glass enclosures.

3.04 TELEPHONE SERVICES AND INTERNET ACCESS

A. Contractor shall maintain and pay for telephone (and fax machine) on Site for use of Contractors, Engineers, Architect, and others who have legitimate need for telephone communication in pursuit of Work of this Project.

B. Arrange for local telephone company to install temporary service. Install telephone on a separate line for each temporary office and first aid station.

C. At each telephone location post a list of important telephone numbers, including:
   1. Local police and fire departments.
   2. Doctor.
   3. Ambulance service.
   4. Contractor's offices.
   5. Engineer's offices.
   6. Subcontractor's offices.

D. Long distance calls are to be by credit card.

E. Contractor shall maintain internet service to site.

3.05 HEAT

A. Provide temporary heat for performance of the Work, curing or drying of recently installed work, or protection of work-in-place from adverse effects of elements.

B. Provide temporary heating units, tested and labeled by UL, FM, or other recognized trade association related to the fuel being consumed.

C. Select units known to be safe and without deleterious effect upon work-in-place or being installed.
   1. Use only smokeless portable heaters acceptable to Engineer

D. After Enclosure:
   1. Owner will allow installation and use of permanent heating system for temporary heat after building is weather-tight and concrete floor slabs have been poured.
   2. Cost of temporary heat after enclosure shall be borne by Contractor.
      a. Contractor shall install new filters at time of Substantial Completion.

E. Maintain a minimum temperature of 50 degrees in once any structure is enclosed.

F. Maintain a temperature of 65 F before and during the application of interior finishing, painting, etc.

G. Any work damaged by dampness or insufficient or abnormal heating shall be replaced by the Contractor at no additional cost to the Owner.

3.06 WEATHER INSTRUMENTATION AND SIREN

A. Provide temporary 240V power to weather instrumentation located on site. Use existing disconnect for point of connection.
   1. Provide necessary equipment to ensure safe and continuous operation of weather instrumentation while on temporary power and during switchovers. Coordinate with Madison Water Utility or designated contact/owner of the weather station equipment for switchovers and to verify continuous operations.

B. Provide temporary power to Emergency Warning Siren located on site.
   1. Test equipment to ensure proper operation while on temporary power. Coordinate with Dane County Emergency Management.

3.07 SANITARY FACILITIES

A. Provided by Contractor for workers engaged in this Work. (Construction personnel may not use sanitary facilities within owner's existing facilities.)

B. Refer to section 01 52 19.

C. Provide temporary power for the grinder pump station, existing or new, which services the facilities existing bathroom and floor drains sewer waste.

3.08 OPERATION, TERMINATION, AND REMOVAL

A. Enforce strict discipline in use of temporary services and facilities at the Site.
   1. Limit availability of temporary services and facilities to essential and intended uses to minimize waste and abuse.
   2. Do not permit temporary installations to be abused or endangered.
   3. Do not allow hazardous, dangerous, or unsanitary conditions to develop or persist on Site.

B. Operate temporary services and facilities in a safe and efficient manner.
   1. Do not overload temporary services or facilities.
   2. Protect from damage by freezing temperatures and similar elements.
   3. Prevent water-filled piping from freezing by use of ground covers, insulation, draining, or by temporary heating.
   4. Maintain distinct markers for underground lines.
   5. Protect from damage during excavation operations.

C. Unless Engineer requests that it be maintained for a longer period of time, remove each temporary service and facility promptly when no longer needed, when it has been replaced by the authorized use of a permanent facility, or no later than Substantial Completion.

D. Complete or restore permanent Work which may have been delayed because of interference with temporary service or facility.

E. Repair damaged Work, clean exposed surfaces, and replace Work which cannot be satisfactorily repaired.

F. Materials and facilities that constitute temporary services and facilities are, and will remain, the property of Contractor.

G. At Substantial Completion, clean and renovate permanent services and facilities that have been used to provide temporary services and facilities during construction, including but not limited to:
   1. Replace air filters and clean inside of ductwork and housings.
   2. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
   3. Replace lighting system lamps that are burned out or noticeably dimmed.

END OF SECTION

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ADDENDUM 3

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Administrative and procedural requirements for contract closeout, including:
   1. Submittals.
   2. Inspection procedures.
   3. Warranties.
   4. Record document submittals.
   5. Final cleaning.
   6. Pest control.

B. Related Sections:
   1. Section 01 78 23 - Operation and Maintenance Data
   2. Specific requirements for individual units of work are included in appropriate technical sections.
   3. City of Madison's Standard Specifications for Public Works Construction - 2023 Edition.

1.02 BENEFICIAL OCCUPANCY

A. Completion Dates
   1. Deadline for beneficial occupancy will be September ~~August~~ 30, 2025.
   2. Failure to meet beneficial occupancy requirements will result in liquidated damages.
      a. Liquidated damages are specified in the City of Madison's Standard Specifications for Public Works Construction - 2023 Edition, Section 109.9.

B. Complete the following before requesting Engineer's inspection for certification of beneficial occupancy:
   1. Assure the following:
      a. All equipment signed off from the vendor
      b. All equipment has been tested, adjusted and properly started and commissioned.
      c. Facility commissioning is successful (see section 01 75 00)
      d. All inspections complete (see below)
      e. MWU has unrestricted use of entire facility.
      f. MWU is able to operate the complete facility as designed and is able to provide safe and reliable water supply to the water distribution system.
   2. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   3. Obtain, submit releases enabling Owner unrestricted use of the Work and access to services and utilities.
   4. Regulatory requirements:
      a. Where required, obtain occupancy permits, operating certificates, similar releases.
      b. Obtain necessary State, City, Fire, Building Department, Generator inspections as required
      c. Generator and EC inspections will be allowed after beneficial occupancy and before final completion.
   5. Bonding and insurance:
      a. Consent of Surety to Reduction In or Partial Release of Retainage.
      b. Advise Owner of pending insurance change-over-requirements.

C. Inspection Procedures:
   1. When prerequisites are complete, submit request in writing to Engineer stating that all requirements are satisfied, and requesting inspection.
   2. Upon receipt of Contractor's request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled prerequisites.

3. Following initial inspection, Engineer will either prepare Certificate of Substantial Completion, or advise Contractor of work which must be performed before certificate will be issued. Engineer will repeat inspection when requested and when assured that work has been substantially completed.
4. Results of completed inspection will form the basis of requirements for Final Acceptance.

1.03 FINAL ACCEPTANCE & SUBSTANTIAL COMPLETION

A. Completion Dates
1. Deadline for substantial completion will be October 31, 2025.
2. Failure to meet substantial completion requirements will result in liquidated damages.
   a. Liquidated damages are specified in the City of Madison's Standard Specifications for Public Works Construction - 2023 Edition, Section 109.9.
3. Deadline for final acceptance will be November 28, 2025

B. Before requesting final inspection for determining date of Substantial Completion, complete the following:
1. Submittals:
   a. Lien Waivers (from all subcontractors and suppliers).
   b. Certificate of Substantial Completion (AIA G704) - 3 copies.
   c. Contractor's Affidavit of Payment of Debts and Claims (AIA G706).
   d. Contractor's Affidavit of Release of Liens (AIA G706A).
   e. Consent of Surety (if Performance Bond provided).
      1) To Partial Release of Retainage (AIA G707A).
      2) To Final Payment (AIA G707).
   f. Assurance that unsettled claims will be settled.
   g. Proof that fees and similar obligations have been paid.
   h. Evidence of final, continuing insurance coverage complying with insurance requirements.
   i. Certified copy of Engineer's final punch list of itemized work to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and has been endorsed and dated by Engineer.
2. Warranties: Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certifications, similar documents on, but not limited to, the following items:
   a. Pumps
   b. Filters
   c. Chemical Feed Equipment
   d. Automated valves
   e. Valves
   f. Water quality monitoring equipment
   g. HVAC Equipment
   h. Electrical Equipment
   i. Control Systems
3. Maintenance:
   a. Materials (each type and color):
      1) Masonry.
      2) Tile.
      3) Ceiling panels.
      4) Paint.
      5) Fuses.
   b. Equipment
      1) Pumps
      2) Filters
      3) Chemical Feed Equipment
      4) Automated valves
      5) Valves
      6) Water quality monitoring equipment
      7) HVAC Equipment
      8) Electrical Equipment
      9) Control Systems
   c. Maintenance instructions.

d. Maintenance services:
   1) Roof hatches.
e. Maintenance manuals: See Section 01 78 23
   1) Organize operating, maintenance data into suitable sets of manageable size.
   2) Bind into individual heavy-duty 2-inch, 3-ring vinyl-covered binders with pocket folders, each set of data, marked with appropriate identification on both front and spine of each binder.
   3) Include:
      a) Emergency instructions.
      b) Spare parts listing.
      c) Copies of warranties.
      d) Wiring diagrams.
      e) Recommended “turnaround” cycles.
      f) Inspection procedures.
      g) Shop Drawings and Product Data.

4. Miscellaneous Record Submittals:
   a. Refer to other sections of specifications for requirements of miscellaneous record keeping and submittals in connection with actual performance of work.
   b. Complete miscellaneous records, place in good order, properly identified and bound or filed, ready for continued use and reference.
5. Records:
   a. Test/adjust/balance records.
   b. Startup performance reports.
   c. Inspection Reports:
      1) All performed tests.

C. Record Drawings: Submit to Engineer a set of record prints marked to show “as-built” conditions for work of contract.

D. Adjusting:
1. Repair and restore marred exposed finishes.
2. Touch up of painting of marred surfaces.
3. Complete final cleaning requirements.

E. Final Payment Request:
1. Include certificates of insurance for products and completed operations where required.
2. Updated final statement, accounting for final additional changes to Contract Sum.
3. Final liquidated damages settlement statement, acceptable to Owner.

F. Re-inspection Procedure:
1. Engineer will re-inspect work upon receipt of notice that work, including punch list items resulting from earlier inspections, has been completed, except for items whose completion has been delayed because of circumstances that are acceptable to Engineer.
2. Engineer will either prepare a certificate of final acceptance, or will advise Contractor of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
3. If necessary, re-inspection procedure will be repeated.

1.04 TRANSFER OF SITE TO OWNER

A. Deliver tools, spare parts, extra materials and similar items to location designated by Owner. Label with manufacturer’s name and model number where applicable.

B. Change door locks to Owner’s access. Advise Owner’s personnel of changeover in security provisions.

C. Advise Owner of changeover in heat and other utilities.

D. Submit changeover information related to Owner’s occupancy, use, operation, and maintenance.

1.05 OPERATING AND MAINTENANCE INSTRUCTIONS/DEMONSTRATIONS

A. Arrange for each installer of operating equipment and other work requiring regular or continuing maintenance, to meet at Site with Owner's personnel to provide necessary basic instruction in proper operation and maintenance of entire work. Where installers are not experienced in required procedures, include instruction by manufacturer's representatives.

B. Provide detailed review of following items:
   1. Maintenance manuals.
   2. Record documents.
   3. Spare parts and materials.
   4. Tools.
   5. Lubricants.
   6. Fuels.
   7. Identification systems.
   8. Control sequences.
   9. Hazards.
   10. Cleaning materials and procedures.
   11. Warranties, bonds, maintenance agreements similar continuing commitments.

C. As part of this instruction for operating equipment, demonstrate following procedures:
   1. Start-up.
   2. Shut-down.
   3. Emergency operations.
   4. Noise and vibration adjustments.
   5. Safety procedures.
   6. Economy and efficiency adjustments.
   7. Effective energy utilization.

D. Provide a video tape of above procedures.

PART 2 PRODUCTS

2.01 CLEANING AGENTS

A. Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned.

B. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 EXECUTION

3.01 FINAL CLEANING

A. Provide final cleaning, following manufacturer's written instructions.

B. Conduct cleaning and waste-removal operations to comply with local laws and ordinances, and federal and local environmental and antipollution regulations.

C. Employ experienced workers or professional cleaners for final cleaning.

D. Comply with safety standards for cleaning.
   1. Do not burn waste materials.
   2. Do not bury debris or excess materials on Owner's property.
   3. Do not discharge volatile, harmful, or dangerous materials into drainage systems.

4. Remove waste materials from Site and dispose of lawfully.

E. Clean Site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

F. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program.
   1. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   2. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   3. Remove tools, construction equipment, machinery, and surplus material from Site.
   4. Remove snow and ice to provide safe access to building.
   5. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   6. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   7. Sweep concrete floors broom clean in unoccupied spaces.
   8. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
   9. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   10. Remove labels that are not permanent.
   11. Wipe surfaces of mechanical and electrical equipment**,** elevator equipment**,** and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   12. Replace parts subject to unusual operating conditions.
   13. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   14. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   15. Clean ducts, blowers, and coils if units were operated without filters during construction.
   16. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

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ADDENDUM 3

SECTION 26 24 19

MOTOR-CONTROL CENTERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes MCCs for use with ac circuits rated 600 V and less, with combination controllers and having the following factory-installed components:
   1. Incoming main lugs and OCPDs.
   2. Feeder-tap units.
   3. Full-voltage magnetic controllers.
   4. VFDs.
   5. Surge Protection.
   6. Instrumentation and customer metering.
   7. Auxiliary devices.

1.03 DEFINITIONS

A. CPT: Control power transformer.

B. GFCI: Ground fault circuit interrupting.

C. LAN: Local area network.

D. MCC: Motor-control center.

E. MCCB: Molded-case circuit breaker.

F. MCP: Motor-circuit protector.

G. SPD: Surge protective device.

H. SSRV: Solid State Reduced Voltage Starter.

I. VFD: Variable-frequency drive.

J. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.04 SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for MCCs.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each cell of the MCC.

B. Shop Drawings: For each MCC, manufacturer's approval drawings as defined in UL 845. In addition to requirements specified in UL 845, include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details.
   1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Each installed unit's type and details.
      b. Factory-installed devices.
      c. Enclosure types and details.
      d. Nameplate legends.
      e. Short-circuit current (withstand) rating of complete MCC, and for bus structure and each unit.
      f. Features, characteristics, ratings, and factory settings of each installed controller and feeder device, and installed devices.
      g. Specified optional features and accessories.
   2. Schematic Wiring Diagrams: For power, signal, and control wiring for each installed controller.
   3. Nameplate legends.
   4. Vertical and horizontal bus capacities.
   5. Features, characteristics, ratings, and factory settings of each installed unit.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For MCCs, all installed devices, and components to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Manufacturer's Record Drawings: As defined in UL 845. In addition to requirements specified in UL 845, include field modifications incorporated during construction by manufacturer, Contractor, or both.
      b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
      c. Manufacturer's written instructions for setting field-adjustable overload relays.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Indicating Lights: Two of each type and color installed.
   4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
   5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.07 QUALITY ASSURANCE

A. Source Limitations: Obtain MCCs and controllers of a single type from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, and marked for intended use.

C. UL Compliance: MCCs shall comply with UL 845 and shall be listed and labeled by a qualified testing agency.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver MCCs in shipping splits of lengths that can be moved past obstructions in delivery paths.

B. Handle MCCs according to the following:
   1. NECA 402, "Recommended Practice for Installing and Maintaining Motor Control Centers."

2. NEMA ICS 2.3, "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts."

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature Rating: Not less than 0 deg F (minus 18 deg C) and not exceeding 104 deg F (40 deg C), with an average value not exceeding 95 deg F (35 deg C) over a 24-hour period.
   2. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)
   3. Humidity Rating: Less than 95 percent (noncondensing).
   4. Altitude Rating: Not exceeding 6600 feet (2000 m), or 3300 feet (1000 m) if MCC includes solid-state devices.

B. Interruption of Existing Electrical Service or Distribution Systems: Do not interrupt electrical service to, or distribution systems within, a facility occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Construction Manager and Engineer no fewer than 7 days in advance of proposed interruption of electrical service.
   2. Indicate method of providing temporary electrical service.
   3. Do not proceed with interruption of electrical service without Construction Manager's or Engineer’s written permission.
   4. Comply with NFPA 70E.
   5. Coordinate service demo with construction sequence.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for MCCs, including clearances between MCCs and adjacent surfaces and other items.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate features of MCCs, installed units, and accessory devices with remote pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each MCC, each controller, and each installed unit with ratings and characteristics of supply circuits, motors, required control sequences, and duty cycle of motors and loads.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. MCC manufacturer basis of design is Rockwell Automation:
   1. Rockwell Automation, Inc. Bulletin 2100.
   2. No substitutions allowed.

B. General Requirements for MCCs: Comply with NEMA ICS 18 and UL 845.

2.02 RATINGS

A. Nominal System Voltage: 480Y/277 V, three phase, four wire.

B. Short-Circuit Current Rating: Fully rated, as shown on the one-line diagrams.

2.03 MOTOR CONTROL CENTER ENCLOSURES

A. Indoor Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, **Type 1** unless otherwise indicated to comply with environmental conditions at installed location.

B. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's **standard gray** finish over a rust-inhibiting primer on treated metal surface.

2.04 ASSEMBLY

A. Structure:
   1. Comply with UL requirements for service entrance equipment.
   2. Units up to and including Size 3 shall have drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
   3. Pull-apart terminal strips for external control connections.

B. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners.
   1. Interlock compartment door to require that the disconnecting means is "off" before door can be opened or closed, except by operating a concealed release device.
   2. Compartment construction shall allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC.
   3. The same-size compartments shall be interchangeable to allow rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

C. Owner's Metering Compartment: A separate customer metering compartment and section with front hinged door, metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include PTs having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

D. Wiring Spaces:
   1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
   2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

E. Provisions for Future:
   1. Compartments marked "future" shall be bused, wired and equipped with guide rails or equivalent, and ready for insertion of drawout units.
   2. Compartments marked "spare" shall include provisions for connection to the vertical bus.

F. Control Power:
   1. 120-V ac; obtained from CPT integral with controller; with primary and secondary fuses. The CPT shall be of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
      a. CPT Spare Capacity: 100 VA.

G. Factory-Installed Wiring: Factory installed, with bundling, lacing, and protection included. Use flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
   1. Wiring Class: NEMA ICS 18, Class II Type B.

H. Bus:
   1. Main Horizontal and Equipment Ground Buses: Uniform capacity for entire length of MCC's main and vertical sections. Provide for future extensions.
   2. Vertical Phase and Equipment Ground Buses: Uniform capacity for entire usable height of vertical sections, except for sections incorporating single units.

3. Ground Bus: Hard-drawn copper of 98 percent minimum conductivity, with pressure connector for ground conductors, minimum size 1/4-by-2 inches. Equip with mechanical or compression connectors for outgoing conductors.
4. Neutral Disconnect Link: Bolted, uninsulated, 1/4-by-2-inch copper bus, arranged to connect neutral bus to ground bus.

2.05 MAIN DISCONNECT AND OVERCURRENT PROTECTIVE DEVICE(S)

A. Incoming Mains Location: Bottom.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Adjustable magnetic trip setting for main circuit-breaker frame sizes 250 A up to 600A.
   2. Main breakers 600A and greater shall be electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Individually adjustable ground-fault setting and time delay for 1000 amp and larger.
      e. Provide arc flash reduction mode (ARM):
         1) For each breaker 800 A or greater, provide a manual switch on the compartment door to switch the circuit breaker tripping characteristic to instantaneous with minimum pickup setting, in order to reduce the available energy at downstream equipment.
         2) Provide a lock feature for the ARM switch so that it may be locked in either the normal or instantaneous position.
         3) Provide a yellow LED indicating light when ARM switch is in instantaneous mode.
         4) Wire contacts on all ARM switches to a common alarm input to the power monitoring system digital meter.
   3. MCCB Features and Accessories:
      a. Standard frame sizes, trip ratings, and number of poles.
      b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
      c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

C. Surge Suppression: Factory installed as an integral part of the incoming feeder, complying with UL 1449, SPD shall be service entrance type surge protective device suitable for use as Type 1 or Type 2 device per UL1449 4th Edition, applied to the line or load side of the utility feed inside the facility.

2.06 FEEDER TAP UNITS

A. MCCBs: Fixed mounted, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A to 600A, Electronic trip circuit breakers 800-1200A. Comply with UL 489, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
   1. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   2. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response for 1000A and greater.
   3. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.

2.07 MAGNETIC CONTROLLERS

A. Full-Voltage Controllers:
   1. General Requirements for Full-Voltage Enclosed Controllers: Comply with NEMA ICS 2, general purpose, Class A.
   2. Magnetic Controllers: Full voltage, across the line, electrically held.
      a. Controller Units: Combination controllers.
      b. Configuration: Non-reversing.

B. Disconnects:
   1. MCP:
      a. UL 489, with interrupting capacity complying with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
      b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
   2. MCCB:
      a. UL 489, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
      b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
      c. Lockable Handle: For three padlocks and interlocks with cover in closed position.
      d. NC alarm contact that operates only when MCCB has tripped.

C. Overload Relays:
   1. Solid-State Overload Relays:
      a. Switch or dial selectable for motor-running overload protection.
      b. Sensors in each phase.
      c. **Class 10/20 selectable** tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
   2. Two (2) NC isolated overload alarm contacts.
   3. External overload reset push button.

2.08 VARIABLE FREQUENCY DRIVES

A. Application: Constant torque and variable torque as required for equipment installed.

B. Controller Units: Combination controllers, consisting of variable-frequency power converter that is factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged for self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency. Comply with NEMA ICS 7, NEMA ICS 61800-2 and UL 508C.
   1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
   2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
   3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

C. Disconnects:
   1. MCP:
      a. UL 489, with interrupting capacity complying with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
      b. Lockable Handle: For three padlocks and interlocks with cover in closed position.
      c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
      d. NC alarm contact that operates only when MCP has tripped.

e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

2. MCCB:
   a. UL 489, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
   b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   c. Lockable Handle: For three padlocks and interlocks with cover in closed position.
   d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
   e. NC alarm contact that operates only when MCCB has tripped.
3. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.

D. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. VFDs shall be heavy duty rated.

F. Verify motor current requirements prior to ordering.

G. Output Rating: Three-phase; 10 to 60 Hz for variable torque load or 10 to 66 Hz, with torque contact as speed change for constant torque loads, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

H. Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96percent under any load or speed condition.
6. Overload Capability:
   a. For variable-torque controllers, 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
   b. For constant-torque controllers, 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
7. Starting Torque: Minimum of 100 percent of rated torque from 3 to 60 Hz.
8. Speed Regulation: Plus or minus 5 percent.
9. Output Carrier Frequency: Field selectable.
10. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

I. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to a minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:
1. Input transient protection by means of SPDs for three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
2. Loss of Input Signal Protection: Selectable response strategy including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFD

overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved and listed and labeled by an NRTL.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor overtemperature fault.

K. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
1. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

L. Operator Station:
1. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
2. Isolated Control Interface: Allows VFDs to follow remote-control signal over a minimum 40:1 speed range.
3. Panel-mounted, manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
   a. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
   b. Security Access: Electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

M. Displays:
1. Historical Logging Information and Displays:
   a. Real-time clock with current time and date.
   b. Running log of total power versus time.
   c. Total run time.
   d. Fault log, maintaining last four faults with time and date stamp for each.
2. Indicating Devices: Digital display mounted flush in VFD door and connected to display VFD parameters including the following:
   a. Output frequency (Hz).
   b. Motor speed (rpm).
   c. Motor status (running, stop, fault).
   d. Motor current (amperes).
   e. Motor torque (percentage).
   f. Fault or alarming status (code).
   g. PID feedback signal (percentage).
   h. DC-link voltage (V dc).
   i. Set-point frequency (Hz).
   j. Motor output voltage (V ac).

N. Provide with Ethernet output connection to Allen-Bradley PLC.
1. Ethernet outputs shall allow all data to be transmitted to PLC, including but not limited to:
   a. Motor running.
   b. Fault.
   c. Speed input.
   d. Speed output.
   e. Motor current (amperes).
   f. Motor Speed (rpm).
   g. Voltage.
   h. Frequency.
   i. VFD shall be capable of receiving motor control, (start/stop) and motor speed setting input commands from the PLC via Ethernet.

O. VFD conditioning and filtering:
   1. Each VFD shall be provided with input line conditioning, 5-percent line reactors minimum.
   2. Harmonic Distortion:
      a. Drives shall be designed to limit the harmonic currents which are generated on the AC service and which would produce electromagnetic interference (EMI) or radio frequency interference (RFI). Individual current harmonic distortion and the total demand distortion expressed as percent of maximum demand load current shall not exceed the values specified in IEEE 519 – Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, Table 10.3.
      b. Total Harmonic Distortion (THD) shall not exceed 5 percent, and individual voltage harmonic distortion shall not exceed 3 percent per IEEE 519.
      c. If the drives generate objectionable interference, EMI or RFI drive manufacturer shall provide the specifications for the equipment required to reduce it to acceptable levels. The VFD supplier shall have in possession filters to alleviate interference if encountered.
      d. The Owner will provide the equipment specified by the drive manufacturer to correct the problem through a direct purchase or a Change Order to the Contract.

P. Manufacturer:
   1. Allen-Bradley Powerflex 755 or approved equal.

2.09 CONTROLLER-MOUNTED AUXILIARY DEVICES

A. Control-Circuit and Pilot Devices: Factory installed in controller enclosure cover unless otherwise indicated. Comply with NEMA ICS 5.
   1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oil-tight type.
      a. Push Buttons: Recessed type; momentary contact unless otherwise indicated.
      b. Pilot Lights: LED type; color as indicted on drawings, push to test.
      c. Selector Switches: Rotary type.

B. Elapsed-Time Meters: Heavy duty with digital readout in hours**;** non-resettable.

C. Auxiliary Dry Contacts: Reversible NC/NO.

D. Control Relays:
   1. Time Delay: Auxiliary and adjustable solid-state time-delay relays.
   2. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections and adjustable undervoltage, overvoltage, and time-delay settings.

2.10 MEASUREMENT AND CONTROL DEVICES

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
   1. PTs: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
   2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
   3. CPTs: Dry type, mounted in separate compartments for units larger than 3 kVA.
   4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, for selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker and ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
   1. Listed or recognized by a nationally recognized testing laboratory.
   2. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
   3. Panel mounted with built-in LCD display

4. Measurement of the following values with the indicated maximum accuracy tolerances:
   a. Phase Currents, Each Phase: Plus or minus 1 percent.
   b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
   c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
   d. Three-Phase Real Power (Megawatts): Plus or minus 2 percent.
   e. Power Factor: Plus or minus 2 percent.
   f. Frequency: Plus or minus 0.5 percent.
   g. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
5. Ethernet IP communication to connect to Allen-Bradley PLC.
6. Mounting: Display and control unit flush or semiflush mounted in MCC compartment door.
7. Manufacturer: Allen-Bradley PowerMonitor 5000, with communication over Ethernet I/P.

C. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from CPT.

D. Control Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

E. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.11 SURGE PROTECTION DEVICE

A. Comply with UL 1449, 4th edition and UL 1283 5th edition. Type 1 or Type 2.

B. Manufacturer: SPD's integral to the MCC shall be by MCC manufacturer, externally mounted SPD's shall be:
   1. ABB/Current Technology, Inc.
   2. Approved Substitution.

C. Surge Protection Device Description: IEEE C62.41-compliant, solid-state, parallel-connected, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the MCC short-circuit rating, and with the following features and accessories:
   1. Fuses, if required, rated at 200-kA interrupting capacity.
   2. Fabrication using bolted compression lugs for internal wiring.
   3. Integral disconnect switch.
   4. Redundant suppression circuits.
   5. Redundant replaceable modules.
   6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
   7. LED indicator lights for power and protection status.
   8. Audible alarm, with silencing switch, to indicate when protection has failed.
   9. Form-C contacts rated at 5 A and 250-V ac, one NO and one NC, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
   10. Four-digit, transient-event counter set to totalize transient surges.

D. Peak Single-Impulse Surge Current Rating: 150 kA per mode/~~320~~ 200 kA per phase.

E. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

F. Features and Accessories:
   1. Provide protection against both transient surges under 100 microseconds and temporary overvoltages, (TOV) and swells up to 3600 cycles.
   2. Operating temperature range shall be -40 degrees Celsius +60 degrees Celsius (-40 degrees Fahrenheit to +140 degrees Fahrenheit).

3. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
4. Indicator light display for protection status.
5. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
6. Surge counter.

G. Ratings:
1. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:
   a. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
   b. Line to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.
   c. Neutral to Ground: 1000 V for 480Y/277 V, 700 V for 208Y/120 V.
   d. Line to Line: 2000 V for 480Y/277 V, 1200 V for 208Y/120 V.
2. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
   a. Line to Neutral: 700 V.
   b. Line to Ground: 700 V.
   c. Neutral to Ground: 700 V.
   d. Line to Line: 1200 V.
3. The SPD shall provide Temporary Overvoltage (TOV) and voltage swell protection to the following:
   a. TOV - should be capable of surviving and continue to protect critical loads against multiple TOV events (described as 200% nominal voltage by 8 milliseconds (ms).
   b. Swell - should be capable of protection against swells up to 180% nominal for 0.7 ohms load for greater than 3600 cycles.
4. Minimum Single Pulse Surge Current Capacity based on ANSI/IEEE 8x20 microsecond wave shape. Surge currents shall be verified by an independent 3rd party test lab.

H. Test system for repetitive sequential ANSI/IEEE C62.41 Category C3 waveforms. Minimum repetitive strikes of 1.2 X 50 s, 20 kilovolt (KV) open circuit voltage and 8 X 20 s, 10 kiloampere (KA) short circuit current with no more than 10% degradation of clamping voltage at the specified surge current. Service entrance units shall survive minimum exposure of 12,000 events, Panelboard units shall survive 5,000 events with no more than 10% degradation.

I. Electrical Noise Filter: each unit shall include a high-performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB at 142kHz, per MIL-STD-220B.
1. SPD shall include an EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.

~~**2.12 SOURCE QUALITY CONTROL**~~

~~A. MCC Testing: Test and inspect MCCs according to requirements in NEMA ICS 18.~~

~~B. VFD Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.~~
~~1. Test each VFD while connected to a motor that is comparable to that for which the VFC is rated.~~
~~2. Verification of Performance: Rate VFDs according to operation of functions and features specified.~~

~~C. MCCs will be considered defective if they do not pass tests and inspections.~~

~~D. Prepare test and inspection reports.~~

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. NEMA Industrial Control and Systems Standards: Comply with parts of NEMA ICS 2.3 for installation and startup of MCCs.

B. Coordinate layout and installation of MCCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Floor Mounting: Install MCCs on 4-inch (100-mm) nominal-thickness concrete base.
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in control circuits if not factory installed.

F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Comply with NECA 1.

3.03 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.
   1. Identify field-installed conductors, interconnecting wiring, and components.
   2. Install required warning signs.
   3. Label MCC and each cubicle with engraved nameplate.
   4. Label each enclosure-mounted control and pilot device.
   5. Mark up a set of manufacturer's connection wiring diagrams with field-assigned wiring identifications and return to manufacturer for inclusion in Record Drawings.

B. Provide arc flash and available arc fault current labeling on the equipment per NEC 110.16 and 110.24.

3.04 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices and facility's central-control system.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
   2. Connect selector switches within enclosed controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

~~B. Acceptance Testing Preparation:~~
   ~~1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.~~
   ~~2. Test continuity of each circuit.~~

C. Tests and Inspections:
   1. Inspect controllers, wiring, components, connections, and equipment installation.
   ~~2. Test insulation resistance for each enclosed controller element, component, connecting motor supply, feeder, and control circuits.~~
   3. Test continuity of each circuit.
   4. Verify that voltages at controller locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
   5. Test each motor for proper phase rotation.
   ~~6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.~~
   7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   ~~8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:~~
      ~~a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multipole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.~~
      ~~b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multipole enclosed controller 11 months after date of Substantial Completion.~~
      ~~c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.~~
   9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
   10. Mark up a set of manufacturer's drawings with all field modifications incorporated during construction and return to manufacturer for inclusion in Record Drawings.

D. MCCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.06 STARTUP SERVICE

~~A. Engage a factory-authorized service representative to perform startup service.~~
   ~~1. Complete installation and startup checks according to NETA Acceptance Testing Specification and manufacturer's written instructions.~~

B. After startup, VFDs shall be thoroughly cleaned.
   1. Cleaning shall include wiping down of the enclosure and removal of all debris and dirt from the interior of the enclosure.
   2. Cleaning procedure shall include vacuuming the drive interior and wipe down of all exterior surfaces, utilization of compressed air for cleaning is not acceptable.

3.07 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload relay pickup and trip ranges.

B. Adjust overload relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage, solid-state controllers.

E. Program microprocessors in VFDs for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

F. Set field-adjustable circuit-breaker trip ranges.

3.08 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage, solid-state controllers.

END OF SECTION

ADDENDUM 3

SECTION 33 16 50

SUBMERSIBLE TANK MIXING SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Submersible mixing system.
   2. Accessories.
   3. Electrical Power Connection.

1.02 PERFORMANCE REQUIREMENTS

A. Sized to completely mix a minimum 3,060,037-million-gallon water storage tank with a tank height of 20.35 feet, tank diameter of 160 feet, and hatch size of 12 inches, pulling water from the lower level of the tank and pushing it upward, high flow.

B. Approximately 1.6 MGD will pass through the reservoir tank per day.

C. Complete Water Circulation Required. To meet the project objectives, the tank or reservoir circulation shall be achieved by a single or multiple submerged units within the reservoir capable of providing long distance circulation of water. The mixer shall have a direct measurable flow rate where suction shall enter specified mixer's intake positioned within 2 inches of reservoir floor and discharging water vertically in a sheet flow pattern to induce a large volume, low velocity flow to reach the tank or reservoir water surface. The mixer must be placement flexible in design to allow best hydraulic positioning for tank or reservoir conditions to prevent hydraulic short circuiting within tank or reservoir. Suction not within 2 inches of tank or reservoir floor is not allowed.

D. Complete Mix: The mixer manufacturer guarantees that the subject tank will be completely mixed by the mixer. In continuous operation of the mixer:
   1. At least once per 24 hours all water temperatures within the tank shall converge to within 0.8 degrees C, and
   2. At least once per 72 hours all chlorine concentrations within the tank shall converge to within 0.18 mg/L.

E. Fit Through Small Hatch Opening. The mixer shall be capable of fitting through a clear, unobstructed opening of 12" diameter without requiring disassembly or assembly.

F. Continuous Operation With 120VAC, 20 Amp Power Source. The mixer shall operate continuously during day and night while connected to electric grid power.

G. Stainless Steel Construction. The mixer shall be constructed of Type 316 stainless steel metal for strength and superior corrosion resistance.

H. Motor. The mixer shall be mechanically operated by a submersible motor that meets the following criteria.
   1. Direct Drive, with no gearbox and no lubrication maintenance required.
   2. Designed for submersible operation. Mixer design shall include flow sleeve or housing around motor to provide water flow past motor per submersible motor design criteria to lower the total motor temperature and increase winding life.
   3. Designed for Continuous Operation without overheating or compromising motor life expectancy. Constant, full speed operation, variable frequency drive or other method of speed reduction not required and not allowed.
   4. 120 VAC, 20 Amp power source shall be supplied by others and not the mixer manufacturer.

I. Exposed Rotating Protection. The mixer shall not have any rotating equipment openly exposed. Rotating shafts, impellers, and motors shall not be openly exposed, and in the event of any part of the mixer exterior contacting the floor or cord, it shall not cause damage to either.

J. Low Elevation Intake: The mixer shall be supplied with an intake capable of being positioned at the lowest elevation of the tank or reservoir floor. The intake level shall bring water into the mixer at horizontal layer within 2 inches of the tank or reservoir floor to prevent hydraulic short circuiting of inflow water through the tank.

K. Restraint System. The mixer shall not require any brackets, penetrations, rope, ties, or fixed connections to the tank or reservoir columns, walls, or floor below the overflow elevation. The mixer shall allow for placement and servicing without requiring tank or reservoir to be drained. The mixer shall not require the use of a diver or diving team to enter the tank or reservoir to complete placement or service of the specified equipment.

L. Functional for All Water Levels. The mixer shall function properly and not be negatively impacted by fluctuating water levels down to 24 inches of water depth. Devices requiring more than 24 inches of water depth to properly function without damage not allowed.

M. SCADA and Controls. The mixer shall have the option to add an Electric Control Box including a motor current indicator in a 4-20mA analog output and remote on/off control via 24VDC relay.

N. Chlorine Boost Connection: The mixer shall be supplied with a connection point for injection of sodium hypochlorite. The connection point shall be compatible with a 1/2-inch (1.3 cm) diameter hose and be rated for contact with 12.5 percent Sodium Hypochlorite solution.

O. The complete mixer shall be NSF/ANSI Standard 61 and NSF/ANSI Standard 372 listed for safe contact with potable water. The mixer shall be NSF/ANSI Standard 61 listed to be safely in contact with a potable water volume as low as 5,000 gallons.

P. Maintenance Requirements. The mixer shall operate normally with the following maintenance features.
1. No scheduled lubrication is required of any system components including motor.
2. No spare parts shall be required to be kept on hand.

Q. Equipment Support. The mixer manufacturer shall offer full factory support with the following staff and support services.
1. Customer Service, Application Engineering, and Equipment Engineering staff available by email or toll-free phone.
2. Field personnel for placing and servicing the specified mixer.
3. Public website with detailed information available describing the mixer for this project and related applications of this equipment into potable water tanks and reservoirs.
4. Service plans for preventative maintenance and continued technology improvements for the specified mixer.

1.03 SUBMITTALS

A. Mixing System:
1. Mixing unit Size and Model Number.
2. Mixing system Specifications & Dimensions.
3. Head Capacity & Horsepower Curves.
4. Motor Specifications.
5. ~~Interior Water Wiring Plan~~
6. Installation diagram and instructions showing wiring and mounting assembly.
7. Operations and Maintenance Manual.

ADDENDUM 3

PART 2 PRODUCTS

2.01 ELECTRIC SUBMERSIBLE MIXER

A. GridBee GS-12 or approved equal.

B. Nominal Dimensions:
   1. Length: 36 inches.
   2. Height: 10 inches.
   3. Width: 10 inches.

C. Weight - 80 pounds maximum.

D. 120 Volt AC.

E. NSF/ANSI Standard 61 and NSF/ANSI 372 approved components.

2.02 ACCESSORIES

A. Include items for a complete system including, but not limited to, the following.
   1. NEMA 4x Control Box with SCADA Monitoring: ~~Control Box~~:
      a. UL listed, NEMA 4X.
      b. 120VAC, 1 Ph, 60 Hz.
      c. SCADA Monitoring and Control Capability.
      d. HAND-OFF-AUTO switch.
      e. Indicator light.
      f. Locking hatch.
      g. Control Box shall include a 4-20 mA current transducer providing analog output for motor current allowing for monitoring proper operation.
      h. Control Box shall include a 24 VDC relay to allow for remote on and off control of the mixer.
      i. Integration of 4-20 mA output and remote on/off relay into existing PLC/RTU shall be provided by an approved controls system integrator.
   2. Manufacturer supplied submersible electrical cable. ~~Power Cord~~.
   3. Retrieval Chain.
   4. Cord penetrator bolt.
   5. ~~Power cable penetration thru~~ Through-tank fitting for power cord pass-through and cord strain relief.
   6. Chemical Injection hose penetration thru-tank fitting. Allow for conversion from 2 inches electrical conduit to tank fitting. Fitting design shall be such that the chemical injection hose is not damaged during operation.
   7. Suspension kit.
   8. Grip cord.
   9. Mounting accessories.
   10. Junction Box.
   ~~11. NEMA 4x Control Box with SCADA Monitoring.~~
   12. Chain grab tools.
   13. O&M Manual.
   14. Installation Sealant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify location of other ~~riser~~ reservoir amenities (exterior and interior) to avoid conflicts with system installation.

3.02 INSTALLATION

A. Install mixer in accordance with manufacturer recommendations through existing ~~vent~~ hatch opening at top of tank. Location is shown on the Drawings on sheet 01 P101 – Process Plan.

B. Install retrieval chain within reach of the tank access manway.

C. Contractor shall take care as to not allow debris to enter the tank. If debris enters the tank, Contractor shall disinfect the tank according to AWWA C652, Method 3.

D. Install mixer control panel (CP-RM) with Hand-Off-Auto switch and on/off indicating light at location as shown on the electrical plans ~~in Chemical Feed Station.~~

E. Demonstrate proper operation.

F. Install ~~standard 75-foot~~ manufacturer cable, retrieval chain, top of tank ~~roof~~ junction box, through-tank fitting, and cord seal using the necessary manufacturer recommended tools and practices.~~, chain grab tools, 1 5/16-inch hole saw, Lexel sealant, kellem grip and cord seal.~~

~~3.03 ELECTRICAL~~

~~A. Secure and pay for the services of a licensed electrician.~~

~~B. Furnish and install all necessary electrical components to provide power to mixer.~~

~~C. Route power inside appropriate rigid PVC conduit.~~

~~D. Maintain electrical devices and equipment including SCADA features.~~

~~E. Complete all work in a workmanlike manner.~~

3.04 FIELD QUALITY CONTROL

A. Manufacturer Field Services:
   1. Representative to supervise and inspect mixer installation.

3.05 DISINFECTION

A. Disinfect mixing system prior to placing unit into tank.

B. If the Contractor causes debris to enter the tank, disinfection of the entire tank will be required according to AWWA C652, Method 3.

3.06 WARRANTY

A. 5-year extended warranty.

END OF SECTION

ADDENDUM 3

SECTION 40 23 30

PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Miscellaneous process piping items.

B. Related Sections:
   1. Section 40 23 00 - Process Piping General Provisions
   2. Section 40 23 10 - Process Water and Waste Piping

1.02 REFERENCES

A. ASTM:
   1. C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
   2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005
   3. E96 - Standard Test Methods for Water Vapor Transmission of Materials; 2000

B. NFPA:
   1. 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; 2006

C. UL:
   1. 723 - Standard for Test for Surface Burning Characteristics of Building Materials, 2003

1.03 SUBMITTALS

A. Submit Product Data which includes the following for each item furnished:
   1. Manufacturer and model.
   2. Component materials.
   3. Dimensions.

B. Seal Installation Through Fire-rated Wall, Roof, or Floor:
   1. Provide Engineer and Code Official with 2 copies each of proposed firestop system for each pipe penetration.
   2. System information shall include:
      a. UL system numbers.
      b. F and T ratings.
      c. Detailed drawing.
      d. Manufacturer name.
      e. Installation procedure.
      f. List of components.

PART 2 PRODUCTS

2.01 EXPANSION JOINTS

A. EPDM or Teflon single-filled arch spool type.

B. Full face steel flanges.

C. Temperature Range: 40 to 100 degrees F.

D. Design for UV exposure.

E. Maximum Working Pressure: 125 psi.

F. Furnish tie rods, limiter sleeves, and retaining brackets where indicated on Drawings.

G. Acceptable Manufacturers:
   1. Proco Products, Inc.
   2. Red Valve Co., Inc.
   3. Approved equals.

2.02 PRESSURE GAGES AND COCKS

A. Pressure Gage:
   1. Size: 4-1/2 inch dial.
   2. Range: 0-160 psi, unless shown on Drawings.
   3. Graduation: 2 psi.
   4. Accuracy: 1/2 percent.
   5. Movement: Heavy-duty stainless steel.
   6. Case: Fiberglass Reinforced Polypropylene.
   7. Mounting: Direct (stem).
   8. Connection: 1/4-inch NPT, bottom.
   9. Glycerin - filled.
   10. Manufacturer: Weksler AY04 or approved equal.

B. Isolation Cock:
   1. Ball valve.
   2. Suitable to 200 psi.
   3. 1/4-inch NPT male and female connections.

2.03 PIPE COUPLINGS

A. Sleeve type.

B. Furnish to match pipe being coupled.
   1. Size.
   2. Material.
   3. Pressure.
   4. Service of pipe.

C. Acceptable Manufacturers/Models:
   1. Dresser, Style 38.
   2. Smith Blair, Type 411.
   3. Approved equal.

2.04 FLANGED ADAPTERS

A. Furnish to match the pipe being connected:
   1. Size.
   2. Material.
   3. Pressure.
   4. Service of pipe.

B. Acceptable Manufacturers/Models:
   1. EBBA Iron Series 2100 Megaflange.
   2. Dresser, Style 127.
   3. Smith Blair, Type 911.
   4. Approved equal.

2.05 PIPE SLEEVES

A. Material: Steel Pipe.
   1. Furnish zinc-coated steel pipe in the following installations:
      a. Masonry walls and floor.
      b. Fire-rated gypboard partitions.
      c. Masonry or steel deck roofs.
   2. Furnish zinc-coated sheet steel in the following installation:
      a. Non fire-rated gypboard partitions.

B. Size:
   1. Minimum: 2 nominal pipe sizes larger than respective pipe.

C. Acceptable Manufacturers/Models:
   1. American Cast Iron Pipe, Model A-01770.
   2. Approved equal.

2.06 SEALS

A. Furnish positive hydrostatic pipe link seal.
   1. Sealing Element: Synthetic rubber material expanded by tightening of zinc galvanized plate carbon bolts.

B. Acceptable Manufacturers:
   1. Thunderline Corp.
   2. Approved equal.

2.07 WALL PIPES

A. Material: Ductile iron.

B. Size and End Connections: Match adjacent pipe.

C. Furnish with welded or integrally-cast waterstop collar.

D. Acceptable Manufacturers:
   1. Clow Pipe.
   2. American Cast Iron Pipe.
   3. Approved equal.

2.08 FLOATING SUCTION STRAINERS AND HOSES

A. Contractor shall furnish and install a floating suction strainer in each backwash reclaim tank.
   1. Dimensions of tank are shown in contract drawings.

B. Approved Manufacturer:
   1. Megator Corporation Dolphin Floating Suction Strainer.
   2. Pureflow Filtration Division Floating Decanter System.

C. Provide two 4-inch suction strainer with a minimum capacity of 300 gallons per minute for installation in the rehabilitated lagoon.

D. Materials and construction:
   1. Stainless steel construction.
   2. Floating chamber of polyurethane foam.
   3. Freely turning tube to prevent hose from twisting.
   4. Eye for providing mooring or for attaching weight.
   5. Anti-vortex plates.

E. Non-floating hose:
   1. Approved Manufacturer: Dayco U-10 non-floating hose or Engineer approved equal.
   2. Floating suction strainer manufacturer shall provide 20-feet of hose.
   3. Cut hose to fit during installation.
   4. Hose shall connect to 4-inch DIP flange.

F. Contractor shall fabricate a cable system to keep floating suction from drifting and to allow vertical movement of flexible hose.

2.09 SPRAY NOZZLES

A. Approved Manufacturers:
   1. Spraying Systems Company, Wheaton Illinois.
   2. Or Engineer approved equal.

B. Materials and Construction.

C. Uni-Let Model 1/4 TT4060 brass nozzles:
   1. Qty: As called for in the Drawings.

D. Uni-Let Model 1/4 TT1560 brass nozzles:
   1. Qty: As called for in the Drawings.

E. Provide the following nozzles assembly for each nozzle listed above:
   1. Nozzle body.
   2. Spray tip.
   3. Tip retainer.
   4. No. 5540 swivel assembly.

F. In general, installation of the spray wash nozzles is as described:
   1. The head end of the tanks, are the shallow ends and the hopper end is the deep end of the tanks.
   2. Along the head ends of the tanks, four (4) 1560 type nozzles are to be installed in the center of the tanks along the springline (equator) of the spray wash pipe.
   3. Four (4) 1560 type are to be installed on the bottom of the head end pipe, two near the pipe center pointing in toward the center of the head end of the tank, and two installed near the corner 90's oriented in the same manner.
   4. Along the long sides of the tanks, 1560 type nozzles are to be installed along the bottom of the spray wash pipes at 6 feet - 0 inch spacing starting 6 inches away from the head end 90's.
   5. Along the spring-lines of the long side pipes, 4060 type nozzles are to be installed where spacing is greater than 6 inches on center.
   6. Use 1560 type nozzles at the head of the tanks where nozzles are spaced at 6 inches on center.
   7. The spring-line nozzle spacing notes are identified per one side of the tank and apply equally to all long sides.

2.10 STATIC MIXER

A. Furnish and install two (2) static mixers for blending chemical with the water.
   1. Number of units: 2.
   2. Location: See sheet GP 002 and 01-P101 Keynote 9 and 32.
      a. One (1) in the raw water pipe.
      b. One (1) in the filtered water pipe.
   3. Pipeline Diameter: 12-inch.

4. Flow Rate: 2,300 gpm.
5. Chemical Feed Taps on each mixer:
    a. Qty: 3.
    b. Sizes on raw water:
        1) one (1) 1.5-inch for chlorine feed.
        2) one (1) 0.75-inch spare.
        3) one (1) 0.75-inch spare.
    c. Sizes on finished water:
        1) one (1) 0.75-inch for fluoride feed.
        2) one (1) 0.75-inch spare.
        3) one (1) 0.75-inch spare.
6. Elements: One set of six (6) vane style elements designed to suit the mixer with a length to diameter ratio of 1D (Element length = 1 nominal mixer diameter).
7. Maximum Pressure Drop: 0.4 psi.
8. Overall Length of Unit: 12-inch.
9. Construction: 316SS.
10. Manufacturer
    a. Statiflo DSM Series (1D Version).
    b. Or equal pre-approved by Engineer.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
1. Install all items in accordance with manufacturer's recommendations.
2. Install items only where indicated on the Drawings.
3. Installation at other location only with prior approved by the Engineer.

B. Pipe Sleeves:
1. Sleeve each pipe individually.
2. Floor Installation: Extend sleeve 2 inches above finished floor.
3. Roof Installation:
    a. Extend sleeve from 4 inches below to 12 inches above roof deck.
    b. Furnish with welded attachment brackets.
    c. Furnish with weather skirt for each sleeve.
4. Provide continuously welded waterstop collar on sleeves set in masonry or concrete.

C. Seals:
1. Installation through fire-rated wall, floor, or roof.
2. Seal annular space between piping and sleeve with approved brand fire barrier caulk or putty.

END OF SECTION

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ADDENDUM 3

SECTION 40 92 13

CONTROL PANELS AND SCADA SYSTEM COMPONENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Control Panels

B. Local Control Stations

C. Installation, Identification, Testing and Commissioning, and Training.

1.02 RELATED SECTIONS

A. Section 40 23 20 - Process Piping Valves

B. Section 40 90 00 - Control System Functional Descriptions

C. Section 40 90 05 - Commissioning

D. Section 40 91 19 - Instrumentation

E. Section 40 92 40 - Process Valve Actuators

1.03 REFERENCES

A. National Fire Protection Association (NFPA), latest adopted version.

B. National Electrical Manufactures Association (NEMA)
   1. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies.
   2. NEMA 250 Enclosures for Electrical Equipment.

C. Underwriters Laboratories (UL)
   1. UL 508 Industrial Control Equipment.
   2. UL 698A Industrial Control panels for Hazardous Locations.
   3. UL 913 Intrinsically safe Apparatus and associated apparatus for use in Class I, II and III, Division 1, Hazardous Locations.

1.04 SCOPE

A. Furnish and install a new control system for the Deep Well #19 facility as described herein. This shall include but not be limited to:
   1. New Main Control Panel SCP-19 at the well facility.
      a. Controls Systems Integrator shall design and provide all aspects of the PLC control panel as specified herein, except that the City of Madison will provide the Hope Industrial Computer/OIT, The Dell Optiplex computer to the Controls Systems Integrator for installation and integration with the PLC control panel.
   2. New Remote Control Panel RCP-19 at the well facility.
      a. Controls Systems Integrator shall design and provide all aspects of the control panel as specified herein, except that the City of Madison will provide the Hope Industrial Computer/OIT and the Dell Optiplex computer to the Controls Systems Integrator for installation and integration with the PLC control panel.
   3. Motor Control Center as specified in Section 26 24 19.

B. Software Licenses and Programming
   1. The City of Madison will provide all PLC, computer, OIT, HMI software licenses and programming as part of this project. Programming will follow the functional descriptions outlined in Section 40 90 00.
   2. Controls System Integrator shall closely coordinate with the City's programmer to make sure that the PLC control panel design coordinates with the programming and operating requirements.

C. It is the intent of the Contract Documents that all equipment specified in this Section of the specifications be supplied by a single-source supplier ("Systems Integrator"). The supplier shall assume full responsibility along with the Contractor for furnishing, installing and start-up procedures so as to make the system operate per the intent of the Contract Documents.

D. The work specified in this Section includes furnishing, installing, start-up, testing, and adjusting of all required equipment, including instruments, equipment, hardware, software, wiring, accessory equipment, and training to provide a completely operational process instrumentation and control system.

E. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation. The contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the Contract Documents.

F. It shall be the responsibility of the Contractor and supplier to examine all new and existing equipment that is transmitting a signal to, or receiving a signal from, equipment specified in this Section. The Contractor shall be responsible for providing signal converters, buffer amplifiers, and isolation devices to make signal levels, reference to ground, etc. compatible between devices specified in this Section and existing equipment or equipment specified in other Sections.

G. It is the intent of the Contract Documents that a complete plant control system be provided and installed to include but not limited to PLCs, programming, instruments, controls, and ancillary devices for a complete and operational system.

H. The labor specified herein includes but is not limited to engineering software development, panel fabrication, equipment calibration and adjustment, testing, training, and documentation.

I. This section includes coordination with the work of other sections and requires identification of exact interface requirements with motor and control devices provided under other portions of this specification. It shall be the responsibility of the Systems Integrator specified under this section to execute this coordination during the shop drawing submittal phase of the work.

J. This section includes coordination with electrical contractor to ensure that the proper number and type of conductors are installed. It shall be the responsibility of the Systems Integrator to coordinate this work with the installing electrician.

1.05 SUBMITTALS

A. Technical data in conformance with Division 1 and including:
   1. All equipment and components indicated on the Drawings and specified in Part 2 of this Section.
   2. Software packages including complete description of features and capabilities.

B. Shop Drawings in conformance with Division 1 and including:
   1. Panel Drawings including system schematic drawings, terminal numbering, wire numbering, component schematic drawings, dimension drawings, layout drawings and nameplate schedule.
      a. Panel exterior general arrangement drawings showing location of surface and flushed mounted equipment.
      b. Panel interior arrangement drawings including:
         1) Locations and identification of terminal blocks.
         2) Locations and identification of racks/chassis and equipment mounted within.

3) Arrangement of other equipment mounted inside panel identified by instrument tag number.

c. Exterior panel wiring interface termination diagrams.

2. Provide complete new drawings for all existing panels that are modified under this Contract. Re-draw existing circuitry based on record drawings furnished by Owner. Drawings shall include all existing components and circuitry, and shall include all proposed components and circuitry.
3. Overall system diagram showing all components, converters, cables, and connectors.
4. Proposed computer and operator interface unit graphic displays. Submit “rough” or hand-drawn copies prior to programming.
5. Proposed report formats written specific to the project.

C. Operational and Maintenance data in conformance with Division 1 and including:
1. Panel equipment, field devices and instruments, including “as-build” system schematics.
2. Removeable media containing final PLC program, final operator interface application files and final distributed control software application fillies.
3. Removeable media containing final system record drawings, wiring diagrams and panel details. The drawings files shall be in AutoCAD format (.DWG files).
4. Complete software documentation including programming information and operator’s guides. Include hard copies of all operator interface unit and computer graphic screens.

D. Start-up report from system supplier per requirements of Division 1.

E. Spare Equipment Lists- Provide a list of recommended spare parts and equipment that is considered spare parts and equipment that is considered crucial to the operation of the system.

F. All submittals shall be bound in 3-ring binders with labeled tabs separating sections.

1.06 TESTING AGENCY CERTIFICATION

A. All new panels and subpanels furnished under this Section shall be constructed in accordance with Underwriter’s Laboratories (UL) Standard 508 - “Industrial Control Equipment”, and applicable portions of UL Standards 698A - “Industrial Control Panels for Hazardous Locations” and UL Standard 913 - “Intrinsically-Safe Apparatus and Associated Apparatus for use in Class I, II and III, Division 1, Hazardous Locations”.

1.07 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacture.

B. System Integrator shall be responsible for providing all necessary accessories required for a complete and operational system.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

D. Products: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicted.

1.08 SOFTWARE - GENERAL

A. Any software purchased shall be licensed directly to the Owner who will maintain final ownership and control. Provide proof of licensing to the Owner and any passwords or codes to the Owner. Include this information with the O&M Submittals. Note that the Owner will provide the licenses for the PLC program, the HMI program, and the Dell Optiplex and Hope Industrial computer software.

1.09 FUNCTIONAL DESCRIPTIONS

A. See Section 40 90 00.

PART 2 PRODUCTS

2.01 INTEGRATOR

A. Systems integrator shall be one of the following:
   1. L.W. Allen, Madison, WI, Mark Kane, (608) 222-8622.
   2. Integrated Process Solutions, Inc., Waunakee, WI, Eric Fisher, 608-849-4375
   3. No substitutions.

2.02 SCP-19 CONTROL PANEL FABRICATION – GENERAL

A. Enclosures for indoor control panels shall meet the following minimum requirements:
   1. NEMA 12 unless otherwise specified.
   2. Fabricate control panel of 12-gage carbon steel plate with all-welded construction throughout. Welds shall be ground smooth, corners shall be rounded, and weld spatter cleaned. Corner construction shall be minimum of 1/8 inch inside radius.
   3. 90 inches high, 20 inches deep, multiples of 36 inches wide, unless shown otherwise.
   4. Surface of control panel shall be free from mars and defects. Finished panel surfaces shall be flat within 1/16 inch in 6'-0" and be smooth with rounded edges. Finished panel surfaces shall be 3/16-inch (5 mm) thick. Instrument cutouts and drilling shall be straight and true.
   5. Provide 10-gage full height access doors. Access doors shall have triple-point latch, stainless steel handle and lock, full-length stainless steel "piano" type hinge, and sponge rubber gaskets. Door shall be supplied with devices to hold door in 105° position when fully opened.
   6. Provide, full-width, full height, real rectangular subpanel for surface mounting of programmable controller, other surface-mounted instruments, wiring troughs, and terminals strips.
   7. Provide full-length, side-mounted subpanels for installation of terminal strips.
   8. Base of control panel shall be adequately reinforced to permit anchoring to concrete pad.
   9. Supply 4 identical master keys which will operate all locks of control panel.
   10. All inside and exterior surfaces treated to prevent oxidation and painted. White on interior, manufacturer’s standard color on exterior.
   11. Devices mounted on control panel door.
      a. Hope industrial touchpanel.
      b. PLC SCAN FAIL red pilot light.
      c. Chlorine room horn silence Pushbutton.
      d. RJ-45 jack.
      e. Programming power outlet.
      f. Reservoir Control Selector Switch (REMOTE-OFF(RESET)/BACKUP FLOATS)
         1) This needs to be clarified through control loops.

B. 12-inch by 12-inch by 1-inch pocket for drawing storage on inside face of panel or inside exterior door.

C. Provide each panel/enclosure with industrial corrosion inhibitor emitters of sufficient size and quantity to protect contents of enclosure size selected. Emitters shall contain additional red metal inhibitors to protect brass and copper material in addition to ferrous metals. Hoffman A-HC110E or equal.

D. All components labeled per shop drawings.
   1. Engraved labels attached with screws.

E. All wiring terminated on barrier-type terminal strips. Terminal strips shall be labeled with engraved plastic labels.
   1. Labels shall be attached with two-part epoxy adhesive.
   2. 600-volt terminal strips.
   3. Ring or spade type clamp connectors.
   4. Wiring laced using plastic ties and plastic wiring troughs.
   5. Wiring held down with straps attached to enclosure with screws.
   6. Separate power, control and signal conductors.
   7. Power wiring: #14 AWG, stranded, 600V copper minimum.
   8. Control wiring: #18 AWG, stranded, 600V copper minimum.
   9. Signal wiring: shielded, 300V copper minimum. See Division 26.

10. Provide 15-amp, 10,000 AIC breaker on power circuits using #14 wire.
11. Connections to instruments via terminal strip or connectors. Soldering wired to terminal strips in not acceptable.

F. Tag all wires at each end with wire number matching shop drawings.

G. Programmable Logic Controller (PLC)
1. Programmable logic controller capable of performing relay logic, timing, counting, sequencing, mathematical, proportional-integral-derivative (PID) control, and other functions as required by the functional descriptions in this section. Provide complete unit with rack, power supply, modules, cables, and connectors.
2. Auto start-up after power failure. Retain program and setpoints so that system starts automatically when power is restored.
3. Provide live digital and analog inputs/outputs as indicted on Drawings, plus live spares and extra slots as specified in Part 1 of this Section. Minimum total inputs/outputs capability shall be 480 points per PLC.
4. Provide 20 percent additional I/O point for each type of I/O (DI, DO, AI, AO). Spare I/O shall be wired to terminal block inside panel.
5. I/O Requirements
   a. Digital inputs
      1) Optically isolated input rated to withstand up to 1500 VAC transients.
      2) Voltage as indicated, ±10 percent.
      3) Maximum of sixteen (16) inputs points per common neutral.
      4) LED indicator.
   b. Digital outputs
      1) Voltage as indicated.
      2) Capable of continuously driving up to 0.5-amp load.
      3) LED indictor.
   c. Analog inputs
      1) Field selectable 4-20mAdc or 1-5 VDC input on each channel.
      2) Input isolation rated 500 volts minimum.
      3) 16-bit analog-to-digital conversion having overall accuracy of ±0.75 percent of full scale or better.
      4) 250-ohm input impedance (on 4-20 mA input).
      5) 1 Megohm input impedance (on 1-5 VDC input).
   d. Analog outputs
      1) 0 to 20mAdc range. Nominal span of 4-20mAdc.
      2) Digital-to-analog conversion having overall accuracy of ±0.75 percent of full scale or better.
      3) Capable of driving up to 750ohm load.
6. Programmable in ladder logic using IBM-compatible computer as described in the functional description in this Section. Provide programming software that is standard product of the PLC manufacture. Software shall allow on-line program editing without interrupting PLC operation. Software shall have an advanced instruction set including timing, sequencing, relay logic, close-loop PID control, mathematical, trigonometric, Boolean, floating-point and integer calculations, and time and event-based interrupts.
7. PLCs shall have Ethernet ports and RD-232 serial ports to allow communications between systems components, all as described in the functional descriptions in this Section. Provide all required interface modules and converters.
8. Environmental
   a. Operating temperature - 0° to 50°C.
   b. Humidity – 0 to 95 percent (non-condensing).
   c. Noise immunity – comply with NEMA ICS-2-230.
9. Manufacturer
   a. Allen-Bradley “CompactLogix” Model 5069-L320ER processor with associated I/O cards, including options specified, and manufacturer’s programming software.
   b. No Substitutions.

H. Operator Interface Terminal
   1. Hope Industrial Touchpanel Computer will be provided by the City for installation on the control panel door. Integrator to show on all design drawings and install and wire.

I. Industrial Computer
   1. Dell Optiplex industrial computer will be provided by the City for installation inside the control panel. Integrator to show on all design drawings and install and wire.

J. Industrial Ethernet Switch
   1. All Ethernet communications from the PLC Control Panel shall be routed to the wall-mount data rack. This includes the PLC, Dell Optiplex, Hope Industrial Computer.

K. Surge protection
   1. 120VAC, 15 Amp rated in-line device. Listed for protection from ANSI/IEEE CG62.41 Category A and B Transients.
   2. 300 V peak Clamping voltage.

L. Terminals
   1. NEMA - style, barrier type, 0.4-inch spacing, nominal.
   2. 600V RMS, 55-amp rating.
   3. UL listed.
   4. Allen-Bradley 1492-CA1 series, or equal.
   5. Terminals for larger power circuits shall be 600 VAC barrier-type, sized for the conductors.

M. Surge suppressor terminal blocks.
   1. Provide surge suppressor terminal blocks for analog and discrete signals that leave building structure:
      a. Analog signal blocks: Voltage rating 24-volt ac/dc; Phoenix Contact TT-SLKK5-S-24DC, Allen Bradley 1492-HM2K024 Series, or equal.
      b. Discrete signal blocks: Voltage rating 120-volt ac/dc; Phoenix Contact TT-SLKK5/110AC, Allen Bradley 1492-HM2K120 Series, or equal.

N. Direct current power supply
   1. Series pass semiconductor type, adjustable with ±1.0 percent regulation, no load to full load from all causes, total.
   2. Operating source: 120 VAC, 69 Hz.
   3. Output protection: current limiting and “crowbar” circuit. Fused not permitted.
   4. At initial operation power supply loading shall not exceed 50 percent of rating under any condition.
   5. Convection cooled.
   6. All power supplies on the project shall be identical.

O. Uninterruptible Power Supply (UPS) – in control panels
   1. 120 VAC, 60 Hz single-phase input and output.
   2. Size at 150 percent of connected panel load or 700 VA capacity (continuous), whichever is larger, with 5-minute battery reserve time (at full-load).
   3. Continuous on-line, double-conversion type that continuous rectifies, stores, recreates the 120 VAC sinusoidal output waveform for the load. Include features that allow operation in critical environments and high-harmonic and/or noisy applications. Include adjustable input voltage parameters so that the input stage will accept low-quality input power.
   4. Eaton Powerware Series Model 9130 or approved equal.

P. Circuit Breakers:
   1. Circuit breakers will be UL labeled and shall be of the size shown. Provide breakers with an interrupting rating of not less than 22,000 amperes, symmetrical.
   2. Circuit breakers that are downstream of a main breaker or control panel step-down transformer may have 10,000 amperes interrupting rating.

Q. Control Switches
   1. Electronic Circuits
      a. Selector, momentary pushbutton or momentary selector as required. Positions as required for application.
      b. Heavy duty, oil-tight, contacts as required.
      c. Gold flashed contacts; initial resistance, 0.01 ohms; 0.5 amps at 120 VAC, resistive.
   2. Control Circuits
      a. Selector, momentary pushbutton, or momentary selector as required. Positions as required for application.
      b. Heavy duty, oil-tight, contacts as required.
      c. Contact rating shall conform to NEMA A-600.
   3. Pushbutton Color
      a. Red: Stop.
      b. Green: Run.
      c. White: Power on.

R. Control Relays and Timing Relays
   1. Plug-in type with dust cover, socket and locking spring when relay mounted horizontally.
   2. Coil: continuous operation at 120 VAC ±10 percent unless shown otherwise.
   3. Contacts, 3 pole, double throw, minimum.
      a. 10 amps, make-break, 120 VAC, resistive.
      b. Insulation resistance: 1000 megohms at 500 VDC.
      c. Dielectric: 2000 VAC, 60 Hz.
   4. Operating time
      a. 35 milliseconds (nominal) energization.
      b. 100 milliseconds (nominal) de-energization.
   5. Mechanical life: 106 operations.
   6. Temperature: 0 to 70 degrees C.
   7. Timing relays shall be of the same manufacturer and series as control relays. Provide electronic timers with range as indicated.

S. Indicating Lights.
   1. Sunlight visible, 30.5mm, high visibility LED.
   2. “Push-to-Test” type.
   3. Heavy-duty, oil-tight.
   4. NEMA 4 rating.
   5. Allen Bradley 800T, or equal.
   6. Colors.
      a. Required: Amber.
      b. Running: Green.
      c. Off: Red.
      d. Power on: White.
      e. Alarm: Red.

T. Other devices as necessary for a complete control panel installation.

U. Corrosion inhibitors: Hoffman A-HC110E or equal.

2.03 RCP-19 CONTROL PANEL FABRICATION - GENERAL

A. Enclosures for indoor control panels shall meet the following minimum requirements:
   1. NEMA 12 unless otherwise specified.
   2. Fabricate control panel of 12-gage carbon steel plate with all-welded construction throughout. Welds shall be ground smooth, corners shall be rounded, and weld spatter cleaned. Corner construction shall be minimum of 1/8 inch inside radius.
   3. Wall-mount 36 inches high, 18 inches deep, 36 inches wide, as minimum size. Provide larger size if required to meet panel layout requirements.

4. Surface of control panel shall be free from mars and defects. Finished panel surfaces shall be flat within 1/16 inch in 6'-0" and be smooth with rounded edges. Finished panel surfaces shall be 3/16-inch (5 mm) thick. Instrument cutouts and drilling shall be straight and true.
5. Provide 10-gage full height access doors. Access doors shall have triple-point latch, stainless steel handle and lock, full-length stainless steel "piano" type hinge, and sponge rubber gaskets. Door shall be supplied with devices to hold door in 105° position when fully opened.
6. Provide, full-width, full height, real rectangular subpanel for surface mounting of controllers, other surface-mounted instruments, wiring troughs, and terminals strips.
7. Provide full-length, side-mounted subpanels for installation of terminal strips.
8. Base of control panel shall be adequately reinforced to permit anchoring to concrete pad.
9. Wall-mount anchors.
10. All inside and exterior surfaces treated to prevent oxidation and painted. White on interior, manufacturer's standard color on exterior.
11. Devices mounted on control panel door.
    a. Hope industrial touchpanel.
    b. RJ-45 jack.

B. 12-inch by 12-inch by 1-inch pocket for drawing storage on inside face of panel or inside exterior door.

C. Provide each panel/enclosure with industrial corrosion inhibitor emitters of sufficient size and quantity to protect contents of enclosure size selected. Emitters shall contain additional red metal inhibitors to protect brass and copper material in addition to ferrous metals. Hoffman A-HC110E or equal.

D. All components labeled per shop drawings.
1. Engraved labels attached with screws.

E. All wiring terminated on barrier-type terminal strips. Terminal strips shall be labeled with engraved plastic labels.
1. Labels shall be attached with two-part epoxy adhesive.
2. 600-volt terminal strips.
3. Ring or spade type clamp connectors.
4. Wiring laced using plastic ties and plastic wiring troughs.
5. Wiring held down with straps attached to enclosure with screws.
6. Separate power, control and signal conductors.
7. Power wiring: #14 AWG, stranded, 600V copper minimum.
8. Control wiring: #18 AWG, stranded, 600V copper minimum.
9. Signal wiring: shielded, 300V copper minimum. See Division 26.
10. Provide 15-amp, 10,000 AIC breaker on power circuits using #14 wire.
11. Connections to instruments via terminal strip or connectors. Soldering wired to terminal strips in not acceptable.

F. Tag all wires at each end with wire number matching shop drawings.

G. Operator Interface Terminal
1. Hope Industrial Touchpanel Computer will be provided by the City for installation on the control panel door. Integrator to show on all design drawings and install and wire.

H. Industrial Computer
1. Dell Optiplex industrial computer will be provided by the City for installation inside the control panel. Integrator to show on all design drawings and install and wire.

I. Industrial Ethernet Switch
1. All Ethernet communications from the PLC Control Panel shall be routed to the wall-mount data rack. This includes the Dell Optiplex, Hope Industrial Computer.

J. Surge protection
1. 120VAC, 15 Amp rated in-line device. Listed for protection from ANSI/IEEE CG62.41 Category A and B Transients.
2. 300 V peak Clamping voltage.

K. Terminals
1. NEMA – style, barrier type, 0.4-inch spacing, nominal.
2. 600V RMS, 55-amp rating.
3. UL listed.
4. Allen-Bradley 1492-CA1 series, or equal.
5. Terminals for larger power circuits shall be 600 VAC barrier-type, sized for the conductors.

L. Surge suppressor terminal blocks.
1. Provide surge suppressor terminal blocks for analog and discrete signals that leave building structure:
   a. Analog signal blocks: Voltage rating 24-volt ac/dc; Phoenix Contact TT-SLKK5-S-24DC, Allen Bradley 1492-HM2K024 Series, or equal.
   b. Discrete signal blocks: Voltage rating 120-volt ac/dc; Phoenix Contact TT-SLKK5/110AC, Allen Bradley 1492-HM2K120 Series, or equal.

M. Uninterruptible Power Supply (UPS) – in control panels
1. 120 VAC, 60 Hz single-phase input and output.
2. Size at 150 percent of connected panel load or 500 VA capacity (continuous), whichever is larger, with 5-minute battery reserve time (at full-load).
3. Continuous on-line, double-conversion type that continuous rectifies, stores, recreates the 120 VAC sinusoidal output waveform for the load. Include features that allow operation in critical environments and high-harmonic and/or noisy applications. Include adjustable input voltage parameters so that the input stage will accept low-quality input power.
4. APC SmartUPS, or approved equal.

N. Circuit Breakers:
1. Circuit breakers will be UL labeled and shall be of the size shown. Provide breakers with an interrupting rating of not less than 22,000 amperes, symmetrical.
2. Circuit breakers that are downstream of a main breaker or control panel step-down transformer may have 10,000 amperes interrupting rating.

O. Other devices as necessary for a complete control panel installation.

P. Corrosion inhibitors: Hoffman A-HC110E or equal.

2.04 LOCAL CONTROL STATIONS (SHOWN AS “LCS” ON DRAWINGS)

A. Provide local control stations to house selector switches, pushbuttons, and pilot lights at the equipment location to meet the configurations shown on the drawings.
1. Outdoor control stations shall be NEMA 4X, 316 stainless steel construction. Allen-Bradley 800T or equivalent.
2. Indoor control stations shall be NEMA 4X, Gray thermoplastic polyester blend. Allen-Bradley 800H or equivalent.
3. Local control station pilot devices shall be per the requirements of the drawings. If no requirements are shown, provide a three-position selector switch (Hand-Off-Auto), a red alarm pilot light, and a green running pilot light.

2.05 TERMINATION ENCLOSURES

A. Enclosures shall meet the following minimum requirements:
1. NEMA 4X, Type 316 stainless steel.
2. Removable steel inner panel, painted white.
3. Minimum 24 inches high, 8 inches deep, 16 inches wide. Actual size shall be by the Systems Integrator.
4. Panels shall be flanged, corners welded ground smooth.
5. Stainless steel continuous hinge.
6. Clamp type with padlocking.
7. Manufacture by Hoffman, or equal.

B. All wiring terminated on barrier-type terminal strips. Terminal strips shall be labeled with engraved plastic labels.
   1. Labels shall be attached with two-part epoxy adhesive.
   2. 600-volt terminal strips.
   3. Ring or spade type clamp connectors.
   4. Wiring laced using plastic ties and plastic wiring troughs.
   5. Wiring held down with straps attached to enclosure with screws.

PART 3 EXECUTION

3.01 LABELING

A. Label all field mounted control devices, instrumentation, switches, etc., with tag number and item description.

B. Labels shall be engraved laminated plastic with ¼" high lettering. Labels shall be attached with stainless steel screws to the device or nearby wall.

3.02 CALIBRATION, ADJUSTING AND TESTING

A. Devices requiring field calibration shall be calibrated in the presence of the Engineer's representative and documented.

B. GENERAL
   1. Contractor and Systems Integrator to work together to complete the testing specified herein.
   2. Track results of all testing on an Owner-approved project specific status sign off form or similar document.
   3. Required tests are as follows:
      a. Factory Testing:
         1) Unwitnessed Factory Test (UFT).
         2) Witnessed Factory Test (WFT).
      b. Field Testing:
         1) Operational Readiness Test (ORT).
         2) Functional Demonstration Test (FDT).
         3) Network Outage Test (NOT).
         4) Power Outage Test (POT).
         5) Site Acceptance Test (SAT).
   4. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.
   5. Coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.
   6. Do not ship equipment to the project location until Engineer and Owner has received all Factory Testing results and approved the system as ready for shipment.
   7. Engineer and Owner reserve the right to test or re-test any functions.
   8. Correction of Deficiencies:
      a. Correct deficiencies in workmanship and/or items not meeting specified testing requirements to meet specification requirements at no additional cost to Owner.
      b. Repeat testing after correction of deficiencies is made until specified requirements are met, and at no additional cost to Owner.

C. FACTORY TESTING – UNWITNESSED FACTORY TEST (UFT)
   1. Purpose: to check system prior to Engineer/Owner attending factory testing.
   2. Temporary network connections will be required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.
   3. Include all control system devices shown on System Architecture drawings in the UFT, except for equipment-vendor provided equipment.

4. Include the following in the tests to be performed. Address each of these tests in Test Procedure submittal.
   a. Thoroughly inspect panels and enclosures being provided to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
   b. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Provide the following documentation of audit at factory test and submit as part of O&M Manual Documentation:
      1) For each microprocessor-based component connected to control communication backbone in system (PLCs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)
      2) Ensure all equipment running firmware (processors, controllers, switches, routers, modems) are updated with the current firmware at the time of testing.
   c. Perform pull tests on panel wiring to ensure all wiring is terminated with appropriate torque to prevent wires from coming loose.
   d. Test UPS to verify UPS switches power correctly while keeping all UPS powered loads online. Testing of UPS to determine if they have been sized correctly to maintain specified run time shall be performed during field testing.
   e. Load program into PLC, set PLC to RUN mode; cycle power to the PLC and confirm the PLC follows the proper procedure for safe shutdown and then returns to the RUN mode.
   f. If the panel contains an OIT, load the program into the OIT, then cycle the power to confirm the OIT returns in a ready state.
   g. Physically remove network cable from PLC, wait 20-30 seconds, then reconnect network cable to PLC; confirm PLC reconnects to network and returns to proper operation.
   h. Physically remove network cable from OIT, wait 20-30 seconds, then reconnect network cable to OIT; confirm OIT reconnects to network and returns to proper operation.
   i. Perform 100 percent I/O point checkout to verify proper operation of input/output points from panel terminations to HMI nodes. At a minimum, I/O checkout consists of four steps.
      1) Jumper discrete input signals at field terminal blocks in control panels to verify proper status in HMI nodes.
      2) Connect analog input signals to a signal generator at field terminal blocks in control panels to verify proper status in HMI nodes. Verify signals at zero percent, 50 percent, and 100 percent of full scale.
      3) Test discrete output signals by switching equipment to manual control at HMI nodes and turning the output on or other means to turn the output on. Verify command from PLC has properly executed contact by connecting a digital multimeter to measure continuity at terminations.
      4) Test analog output signals by switching the equipment to manual control at HMI nodes and turning output on or other means to turn the output on. Verify output by utilizing a digital multimeter to measure current or voltage generated at termination points. Verify signals at zero percent, 50 percent and 100 percent of full scale.
   j. Verify control strategies using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies, such as instrument failures, equipment failures, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.
   k. Inspect hardware enclosures for the following: cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
   l. Inspect enclosure subpanels for the following: I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.
   m. Inspect other control panel circuitry not covered in tests above.
5. Upon successful completion of UFT. Notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner, at their discretion, can schedule a test date within 15 days of receipt of this submittal.

D. FACTORY TESTING – WITNESSED FACTORY TEST (WFT)
1. Purpose: to allow Engineer and/or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system, located at panel fabrication facility.
2. Required Documents for Test:
   a. Clean set of Owner-approved panel drawings and wiring diagrams.
   b. Set of Contract Documents - all drawings and specifications.
   c. All design-change related documentation.
   d. Master copy of the Owner-approved factory testing signoff forms.
   e. Testing procedures.
3. Operate system continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. Correct all deficiencies identified during these tests and re-test prior to completing WFT or shipment of panels to project location, as determined by Owner/Engineer.
4. Repeat tests specified in the UFT as part of the WFT, using the following daily schedule during these tests:
   a. Morning meeting to review the day's test schedule.
   b. Scheduled tests and sign-offs.
   c. End of day meeting to review day's test results and to review or revise next day's test schedule.
   d. Unstructured testing period by witnesses.

E. FIELD TESTING – OPERATIONAL READINESS TEST
1. Purpose: to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if equipment is ready for operation.
2. Complete ORT prior to functional demonstration test (FDT) and startup. Install and mechanically test relevant process equipment, instruments, control panels, and complete field wiring prior to starting this test.
3. Required Documents for Test:
   a. Master copy of the Owner-approved field-testing signoff forms.
   b. Testing procedures.
   c. Calibration forms.
4. These inspections, calibrations, and tests do not require witnessing; Engineer reserves the right to review and spot-check testing process periodically. Correct deficiencies found prior to commencement of FDT.
5. Maintain Sign-off forms and Calibration forms at project location and make them available to Engineer/Owner as requested.
6. Perform the following tests as part of ORT:
   a. Instrument calibration, configuration, and set-up.
   b. Communications Testing.
   c. Input/Output (I/O) Testing to HMI.
   d. Testing of control strategies.
7. Instrument calibration, configuration, and set-up:
   a. Calibrate, configure, and set-up all components and instruments to perform specified functions.
   b. Calibration form:
      1) Maintain a calibration form in field for any component or instrument requiring dip switch settings, calibration, or custom configuration, documenting this information. These forms shall provide a summary of the actual settings used in the field to allow complete replacement of the device and reconfiguration to function as it did before.
      2) Add this information to Instrument data sheet, shall be added to a copy of manufacturer's standard "Configuration Sheet", or create a separate form.
         a) If a separate form, list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value on the form.

3) Some examples of required information are:
    a) For Discrete Devices: Actual trip points and reset points.
    b) For Instruments: Any configuration or calibration settings entered into instrument
    c) For Controllers: Mode settings (PID).
    d) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).
4) Maintain a copy of these forms in field during testing and make them available for inspection at any time.
5) For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection.

8. Communications Testing:
    a. Purpose: to check that the cellular telemetry system has been properly configured, including all intermediary devices, and is communicating successfully from the remote location back to the main system location and vice versa.
    b. Test bi-directional communications over the cellular telemetry system. Complete the following for a successful test:
        1) Communicate one digital input, one digital output, one analog input, and one analog output from the remote location to the HMI nodes at the main system location.
        2) Enter one start/stop command and one setpoint at the HMI nodes at the main system location and verify reception by the PLC at the remote location.
9. I/O Testing:
    a. Purpose: is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
    b. Test signals under process conditions, as close as possible to end elements and utilizing them whenever possible. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, test using simulation methods and make a note on sign-off form.
    c. Perform the following I/O tests:
        1) Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, pilot lights, horns, beacons, etc.
        2) Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, recorders, digital indicators, etc.
        3) Discrete output signals shall be tested by switching equipment to manual control at the HMI nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
        4) Analog output signals shall be tested by switching equipment to manual control at HMI nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.
10. Testing of Automatic Control Strategies:
    a. Test automatic control strategies in conjunction with the Contractor.
    b. Verify all automatic control strategies using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.
11. Repeat all systems tests specified under factory testing.
12. Test UPS to verify UPS switches power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching offline power to UPS and verify if they maintain specified run time.
13. Test internal panel temperature for all panels with enclosures modified by this Contract under full running conditions to ensure proper cooling/ventilation is being provided.
14. Upon successful completion of ORT, request scheduling of FDT.

F. FIELD TESTING – FUNCTIONAL DEMONSTRATION TEST

1. After facility is started-up and running treatment process in automatic control to extent possible, perform a Functional Demonstration Test (FDT), to allow Engineer and/or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.
2. Required documents for FDT include:
   a. Set of panel drawings and wiring diagrams from ORT with corrections noted.
   b. Set of Contract Documents - all drawings and specifications.
   c. All design-change related documentation.
   d. Signed-off master copy of the Contractor-developed field-testing signoff forms.
   e. Testing procedures.
   f. Copy of completed calibration forms.
   g. One copy of all O & M Manuals for Contractor-supplied equipment.
3. Perform a witnessed FDT on each process area. Repeat testing performed during ORT, to the extent possible.
4. Follow daily schedule specified to be followed during factory tests during FDT.
5. After coordinating with Operations, perform a "Black Start" of the pump station to confirm pump station operation recovers as specified in Contract Documents. Black start means shutting off power to the pump station and turning it back on.
6. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, perform repairs, replacement, and/or retest within 10 days.

G. FIELD TESTING – NETWORK OUTAGE TEST (NOT)

1. After successful completion of the FDT, perform a Network Outage Test (NOT) to allow Engineer and/or Owner representatives to witness response of SCADA system equipment to loss of network connectivity and response of system once connectivity is restored.
2. Required documents for the NOT include:
   a. Set of panel drawings and wiring diagrams from FDT with corrections noted.
   b. Set of Contract Documents - all drawings and specifications.
   c. All design-change related documentation.
   d. Signed-off master copy of the Contractor-developed field-testing signoff forms.
   e. Testing procedures.
   f. Copy of completed calibration forms.
   g. One copy of all O & M Manuals for Contractor-supplied equipment.
3. After coordination with Operations, perform a witnessed NOT on each SCADA control panel, by disconnecting the panel completely from the rest of the SCADA network for a minimum of [X] minutes and observing the response of the controls, both associated with the control panel and within the rest of the SCADA network. After the proposed testing period has elapsed, reconnect the SCADA network to the control panel and observe the response of the controls, both associated with the control panel and within the rest of the SCADA network.
4. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, perform repairs, replacement, and/or retest within 10 days.

H. FIELD TESTING – POWER OUTAGE TEST (POT)

1. After successful completion of the FDT, perform a Power Outage Test (NOT) to allow Engineer and/or Owner representatives to witness response of SCADA system equipment to loss of power and response of system once power is restored.
2. Required documents for the POT include:
   a. Set of panel drawings and wiring diagrams from FDT with corrections noted.
   b. Set of Contract Documents - all drawings and specifications.
   c. All design-change related documentation.
   d. Signed-off master copy of the Contractor-developed field-testing signoff forms.
   e. Testing procedures.
   f. Copy of completed calibration forms.
   g. One copy of all O & M Manuals for Contractor-supplied equipment.
3. After coordination with Operations, perform a witnessed POT on each SCADA control panel, by powering down the panel completely for a minimum of [X] minutes and observing the response of

the controls, both associated with the control panel and within the rest of the SCADA network. After the proposed testing period has elapsed, restore power to the control panel and observe the response of the controls, both associated with the control panel and within the rest of the SCADA network.

4. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, perform repairs, replacement, and/or retest within 10 days.
5. Upon successful completion of the POT, submit a record copy of test results as specified in "Part 1 - General".

I. FIELD TESTING – SITE ACCEPTANCE TEST (SAT)

1. Once FDT, NOT and POT are completed, and system is started-up and running treatment process in automatic control to extent possible, operate system for a period of 30 consecutive days, without a single non-field repairable malfunction. The 30-day acceptance test may occur concurrently with the FDT. Continue network performance monitoring throughout the 30-day test period.
2. While this test is proceeding, Engineer and Owner shall have full use of system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes. Plant operations shall remain responsibility of Owner and decision of plant operators regarding plant operations shall be final.
3. Ensure availability of Contractor and Systems Integrator personnel, knowledgeable in the equipment, hardware and software that make up the system, to address any potential issues that would impact system operation throughout the duration of the SAT. When not on-site, provide cell phone numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.
4. Analyze and correct any malfunction during the tests. Engineer will determine whether any such malfunctions are critical and warrant a repeat of this test. Network performance excursions that exceed the maximum levels for errors are considered a system malfunction.
5. Any malfunction during this 30-day (consecutive) test period which cannot be corrected within 24 hours of occurrence. or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction.
6. Repeat the test, as specified herein, upon completion of repairs.
7. Perform repairs or replacement within 5 days in the event of rejection of any part or function.
8. All computer equipment, network equipment, controllers, data base, process controller logic, and graphical interface system errors must be functioning as required per the specifications prior to the start of each test period. The 30-day test will not be considered successful until all data base points, and logic functions are tested and verified to be correct.
9. For acceptance, the total availability of the system must exceed 99.5 percent during this test period. Availability, in the context of this test, is defined as:
   a. AVAILABILITY = (TOTAL TIME – DOWN TIME)/TOTAL TIME
10. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided, do not contribute to the availability test times above.
11. Throughout duration of SAT, do not modify software or hardware without prior approval from Owner or Engineer.

3.03 PROJECT MANAGEMENT

A. Supplier shall provide engineering and administrative services necessary to fulfill the requirements of this specification.

B. Supplier shall provide the services of an experienced project manager as the overall coordinator during the course of the project.

3.04 PROGRAMMING SERVICES

A. Program the programmable logic controllers (PLCs) and computer as required by the functional descriptions.

B. Provide additional programming during start-up, training, and call-back periods as specified.

3.05 INSTALLATION AND START-UP

A. Supplier shall provide a skilled programmer/instrumentation engineer or technician who shall complete troubleshooting and star-up to place the entire system into satisfactory operation. The engineer or technician shall make the necessary inspection of the completed installation, make the necessary final field adjustments, and make program revisions are required for start-up.

B. Conduct a two-day demonstration of all system features and functions to Owner and Engineer.

C. Coordinate installation and start-up scheduling with Owner and Engineer.

~~3.06 ACCEPTANCE TESTING~~

~~A. On-Site Testing and Commissioning:~~
~~1. Provide services of a systems integrator technician checkout, test, and commission the system on Project Site.~~
~~2. Place equipment into service and provide operation as specified.~~
~~3. Provide actual activation of each control function and alarm in the system. If actual activation is not possible, the function shall be simulated. The Owner or Engineer shall witness and sign off on each function.~~
~~4. Record all Changes in the Control Systems:~~
~~a. Revise all wiring diagrams and schematic diagrams to show final installation.~~
~~b. Insert revised diagrams into each operation and maintenance manual in place of original diagrams.~~

~~B. After the installation is complete, and proper operation has been demonstrated, a 60-day acceptance test shall begin. The entire system shall be required to operate for 60 days with no malfunctions, field repairable malfunctions excepted. Any malfunction during the 60-day test which cannot be corrected within 24 hours by the supplier shall be considered a non-field repairable malfunction and after repairs are complete, the test shall be repeated.~~

~~C. The acceptance test shall apply to all equipment furnished under this Section.~~

3.07 ON-SITE SERVICES

A. In addition to other services specified, provide a competent programmer/instrumentation engineer or technician to perform the following services:
1. Software revisions - Five (5), eight (8) hour days on-site to make software revisions per Owner and Engineer direction. Days shall be no-continuous, number trips five (5).
2. Training - One (1) eight (8) hour days on-site to train Owner's personnel on:
   a. Operation and maintenance of all equipment furnished.
   b. Computer software operation and programming including building reports, building graphics and modifying tags and database.

B. All on-site services shall be at times approved by Owner.

C. At project completion, supplier shall certify in Writing that all un-used service hours will be provided at Owner's request during the first three years of operation. The remaining service hours shall be fulfilled by either a software engineer or field service technician as required by the task required by the Owner, at no cost.

3.08 CALL-BACK SERVICES

A. In addition to other services specified, provide a competent programmer/instrumentation engineer or technician to return to the project site for two (2), non-consecutive eight (8) hour days during the first year of operations. During each trip, the supplier's representative shall be prepared to calibrate and check equipment furnished under this contract, give miscellaneous training, and make software revisions.

B. Call-back trips shall be at times determined by the Owner.

3.09 SUPPLIES

A. Contractor shall provide all expandable items such as lamps, fuses, etc. For system startup, checkout, and during the acceptance test.

3.10 SPARE PARTS

A. Contractor shall furnish the following spare parts to the Owner. Spares shall be delivered in boxes labeled on the outside with manufacturer and part number identified on the box:
   1. Two (2) DC power supplies (as used in control panels)
   2. Six (6) each of every type of control relay used in control panels.
   3. Twenty (20) percent spare fuses and lamps of each type furnished, but not less than six (6) of each type.

3.11 MAINTAINING AUTOMATIC CONTROLS DURING CONSTRUCTION

A. Contractor shall coordinate construction activities to keep the existing plant instrumentation and controls system operational throughout the course of the project. Contractor shall furnish and install temporary controls and wiring as required to maintain automatic operation, and shall remove such temporary controls and wiring once permanent controls and wiring are operational and accepted.

B. When existing panel or instruments are modified or replaced under this Contract, Contractor shall schedule the work in advance with Owner and Engineer, and shall perform the Work so as to minimize the impact on Owner's operation of the facility. Controls shall only be removed from automatic operation during normal working hours, Monday thru Friday.

C. For scheduled outages or cutovers, once the control system revisions begin, Contractor shall work continuously until automatic operation is restored.

3.12 PLC INPUT AND OUTPUT LIST

A. **The estimated input/output list is provided below.** This list shall not be considered all-inclusive and Contractor shall estimate input/output requirements based on all information provided in each specification section and the drawings. This list is prepared to give an estimation of the inputs and outputs that are required, but it is up to the Contractor to provide a complete control system that is inclusive of all the control system requirements described in this, and other specification sections and shown on the drawings to function as required.

SCP-19 SUPERVISORY CONTROL PANEL		
DEVICE	**DESCRIPTION**	**I/O TYPE**
LE-R-H	FLOAT SWITCH HIGH	DI
LE-R-L	FLOAT SWITCH LOW	DI
LE-R-LL	FLOAT SWITCH LOW-LOW	DI
R-LT-1	LEVEL TRANSMITTER	AI
GP-LT-1	LEVEL TRANSMITTER	AI
WP-19-LT-1	LEVEL TRANSMITTER	AI
BW-LT-1	LEVEL TRANSMITTER	AI
BW-LT-2	LEVEL TRANSMITTER	AI
LE-BW1-H	FLOAT SWITCH HIGH	DI
LE-BW1-L	FLOAT SWITCH LOW	DI
LE-BW1-LL	FLOAT SWITCH LOW-LOW	DI
LE-BW2-H	FLOAT SWITCH HIGH	DI
LE-BW2-L	FLOAT SWITCH LOW	DI
LE-BW2-LL	FLOAT SWITCH LOW-LOW	DI
FT-FW-1	FLOW METER SIGNAL	AI
FT-FW-2	FLOW METER SIGNAL	AI

ADDENDUM 3

SCP-19 SUPERVISORY CONTROL PANEL		
DEVICE	**DESCRIPTION**	**I/O TYPE**
FT-WP-19-1	FLOW METER SIGNAL	AI
FT-BWR-1	FLOW METER SIGNAL	AI
FT-BWW-1	FLOW METER SIGNAL	AI
FT-SW-1	FLOW METER SIGNAL	AI
FT-SW-2	FLOW METER SIGNAL	AI
MP-FL-1 START	START CHEM METER PUMP RECEPTACLE	DO
MP-FL-1 AO	CHEM FEED PACING SIGNAL	AO
HZ-CL2	GAS SHUT-OFF ACTIVATED	DI
GF1-CL2	GAS FEEDER RATE SIGNAL	AO
GF1-CL2	GAS FEEDER RUN	DO
GF1-CL2	GAS FEEDER FAIL	DI
SV-CL2-1	SOLENOID VALVE SIGNAL	DO
AIT-CL2-1 DETECTOR	GAS LEAK DETECTOR LEVEL	AI
AIT-CL2-1 ALARM	GAS LEAK DETECTOR ALARM	DI
AIT-CL2-1 TROUBLE	GAS LEAK DETECTOR TROUBLE	DI
AIT-CL2-2	CHLORINE ANALYZER	AI
AIT-CL2-3	CHLORINE ANALYZER	AI
WIT-FL-1	SCALE	AI
WIT-CL2-1	SCALE CYLINDER 1	AI
WIT-CL2-1	SCALE CYLINDER 2	AI
KEYSCAN	DOOR ACCESS CONTROLLER ALARM	DI
FD-1	FLOOD ALARM SWITCH	DI
DC-1	DOOR CONTACT OPEN	DI
DC-2	DOOR CONTACT OPEN	DI
DC-3	DOOR CONTACT OPEN	DI
DC-4	DOOR CONTACT OPEN	DI
DC-5	DOOR CONTACT OPEN	DI
DC-6	DOOR CONTACT OPEN	DI
DC-7	DOOR CONTACT OPEN	DI
DC-8	DOOR CONTACT OPEN	DI
DC-9	DOOR CONTACT OPEN	DI
DC-10	DOOR CONTACT OPEN	DI
DC-11	DOOR CONTACT OPEN	DI
DC-12	DOOR CONTACT OPEN	DI
DC-13	DOOR CONTACT OPEN	DI
DC-14	DOOR CONTACT OPEN	DI
DC-1	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-2	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-3	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-4	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-5	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-6	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-7	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-8	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-9	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-10	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-11	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-12	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-13	DOOR CONTACT OPEN TO KEYSCAN	DO
DC-14	DOOR CONTACT OPEN TO KEYSCAN	DO
TS-1	LOW TEMPERATURE ALARM THERMOSTAT	DI
TS-2	LOW TEMPERATURE ALARM THERMOSTAT	DI
TS-3	LOW TEMPERATURE ALARM THERMOSTAT	DI
TS-4	LOW TEMPERATURE ALARM THERMOSTAT	DI

ADDENDUM 3

SCP-19 SUPERVISORY CONTROL PANEL		
DEVICE	**DESCRIPTION**	**I/O TYPE**
TS-5	LOW TEMPERATURE ALARM THERMOSTAT	DI
SV-F1	SOLENOID VALVE SIGNAL	DO
SV-F2	SOLENOID VALVE SIGNAL	DO
SV-F3	SOLENOID VALVE SIGNAL	DO
SV-F4	SOLENOID VALVE SIGNAL	DO
SV-F5	SOLENOID VALVE SIGNAL	DO
SV-F6	SOLENOID VALVE SIGNAL	DO
SV-F7	SOLENOID VALVE SIGNAL	DO
SV-F8	SOLENOID VALVE SIGNAL	DO
SV-F9	SOLENOID VALVE SIGNAL	DO
SV-F10	SOLENOID VALVE SIGNAL	DO
SV-F11	SOLENOID VALVE SIGNAL	DO
SV-F12	SOLENOID VALVE SIGNAL	DO
SV-F13	SOLENOID VALVE SIGNAL	DO
SV-F14	SOLENOID VALVE SIGNAL	DO
SV-F15	SOLENOID VALVE SIGNAL	DO
SV-F16	SOLENOID VALVE SIGNAL	DO
SV-BWW-1	SOLENOID VALVE SIGNAL	DO
LSO-SV-BWW-1	VALVE LIMIT SWITCH OPEN	DI
LSC-SV-BWW-1	VALVE LIMIT SWITCH CLOSE	DI
SV-BWW-2	SOLENOID VALVE SIGNAL	DO
LSO-SV-BWW-2	VALVE LIMIT SWITCH OPEN	DI
LSC-SV-BWW-2	VALVE LIMIT SWITCH CLOSE	DI
SV-SW-1	SOLENOID VALVE SIGNAL	DO
LSO-SV-SW-1	VALVE LIMIT SWITCH OPEN	DI
LSC-SV-SW-1	VALVE LIMIT SWITCH CLOSE	DI
SV-SW-2	SOLENOID VALVE SIGNAL	DO
LSO-SV-SW-2	VALVE LIMIT SWITCH OPEN	DI
LSC-SV-SW-2	VALVE LIMIT SWITCH CLOSE	DI
PT-DP-1	FILTER DIFFERENTAL PRESSURE TRANSDUCER	AI
PT-DP-2	FILTER DIFFERENTAL PRESSURE TRANSDUCER	AI
SV-BFV-RF-1	SOLENOID VALVE SIGNAL	DO
LSO-BFV-RF-1	VALVE LIMIT SWITCH OPEN	DI
LSC-BFV-RF-1	VALVE LIMIT SWITCH CLOSE	DI
FCV-FW-1 AO	MOTORIZED VALVE POSITION SIGNAL	AO
FCV-FW-1 AI	MOTORIZED VALVE POSITION SIGNAL	AI
PT-WP-19-1	PRESSURE TRANSDUCER	AI
PT-FW-1	PRESSURE TRANSDUCER	AI
PT-FW-2	PRESSURE TRANSDUCER	AI
CP-GPS	GRINDER PUMPS COMMON ALARM	DI
MCC-PM	MCC MOUNTED POWER METER MONITORED OVER ETHERNET. MONITOR: VOLTAGE THREE PHASES, AMPERAGE THREE PHASES, kW, kVA	ETHERNET
VFD-WP-19 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI
VFD-WP-19 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
VFD-WP-19 RUNNING	PUMP RUNNING CONTACT	DI
VFD-WP-19 FAIL	PUMP FAIL CONTACT	DI
VFD-WP-19 START	PUMP CALL TO RUN SIGNAL	DO
VFD-WP-19 OVERTEMP	PUMP OVERTEMP RELAY	DI
VFD-WP-19 VIBRATION N/S	HIGH VIBRATION TRANSDUCER NORTH/SOUTH DIRECTION	AI
VFD-WP-19 VIBRATION E/W	HIGH VIBRATION TRANSDUCER EAST/WEST DIRECTION	AI
VFD-WP-19 VIBRATION	PLC VIBRATION LOCKOUT RELAY	DO
VFD-BP-1 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI

ADDENDUM 3

SCP-19 SUPERVISORY CONTROL PANEL		
DEVICE	**DESCRIPTION**	**I/O TYPE**
VFD-BP-1 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
VFD-BP-1 RUNNING	PUMP RUNNING CONTACT	DI
VFD-BP-1 FAIL	PUMP FAIL CONTACT	DI
VFD-BP-1 START	PUMP CALL TO RUN SIGNAL	DO
VFD-BP-1 OVERTEMP	PUMP OVERTEMP RELAY	DI
VFD-BP-1-LSO	VALVE LIMIT SWITCH OPEN	DI
LS-BP VIA TD3	VALVE FAIL TO OPEN LIMIT SWITCH LOCKOUT	DI
VFD-BP-2 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI
VFD-BP-2 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
VFD-BP-2 RUNNING	PUMP RUNNING CONTACT	DI
VFD-BP-2 FAIL	PUMP FAIL CONTACT	DI
VFD-BP-2 START	PUMP CALL TO RUN SIGNAL	DO
VFD-BP-2 OVERTEMP	PUMP OVERTEMP RELAY	DI
VFD-BP-2-LSO	VALVE LIMIT SWITCH OPEN	DI
LS-BP-2 VIA TD3	VALVE FAIL TO OPEN LIMIT SWITCH LOCKOUT	DI
VFD-BP-3 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI
VFD-BP-3 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
VFD-BP-3 RUNNING	PUMP RUNNING CONTACT	DI
VFD-BP-3 FAIL	PUMP FAIL CONTACT	DI
VFD-BP-3 START	PUMP CALL TO RUN SIGNAL	DO
VFD-BP-3 OVERTEMP	PUMP OVERTEMP RELAY	DI
VFD-BP-3-LSO	VALVE LIMIT SWITCH OPEN	DI
LS-BP-3 VIA TD3	VALVE FAIL TO OPEN LIMIT SWITCH LOCKOUT	DI
VFD-BWW-1 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI
VFD-BWW-1 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
VFD-BWW-1 RUNNING	PUMP RUNNING CONTACT	DI
VFD-BWW-1 FAIL	PUMP FAIL CONTACT	DI
VFD-BWW-1 START	PUMP CALL TO RUN SIGNAL	DO
VFD-BWW-1 LLCO	BACKWASH TANK LOW LEVEL CUT OUT	DO
VFD-BWW-1 LLCO	LOW LEVEL CUTOUT RELAY	DI
VFD-BWW-1 OVERTEMP	PUMP OVERTEMP RELAY	DI
VFD-BWW-2 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI
VFD-BWW-2 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
VFD-BWW-2 RUNNING	PUMP RUNNING CONTACT	DI
VFD-BWW-2 FAIL	PUMP FAIL CONTACT	DI
VFD-BWW-2 START	PUMP CALL TO RUN SIGNAL	DO
VFD-BWW-2 LLCO	BACKWASH TANK LOW LEVEL CUT OUT	DO
VFD-BWW-2 LLCO	LOW LEVEL CUTOUT RELAY	DI
VFD-BWW-2 OVERTEMP	PUMP OVERTEMP RELAY	DI
VFD-BWR-1 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI
VFD-BWR-1 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
VFD-BWR-1 RUNNING	PUMP RUNNING CONTACT	DI
VFD-BWR-1 FAIL	PUMP FAIL CONTACT	DI
VFD-BWR-1 START	PUMP CALL TO RUN SIGNAL	DO
VFD-BWR-1 LLCO	BACKWASH TANK LOW LEVEL CUT OUT	DO
VFD-BWR-1 LLCO	LOW LEVEL CUTOUT RELAY	DI
VFD-BWR-1 OVERTEMP	PUMP OVERTEMP RELAY	DI
VFD-BWR-2 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI
VFD-BWR-2 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
VFD-BWR-2 RUNNING	PUMP RUNNING CONTACT	DI
VFD-BWR-2 FAIL	PUMP FAIL CONTACT	DI
VFD-BWR-2 START	PUMP CALL TO RUN SIGNAL	DO
VFD-BWR-2 LLCO	BACKWASH TANK LOW LEVEL CUT OUT	DO
VFD-BWR-2 LLCO	LOW LEVEL CUTOUT RELAY	DI

SCP-19 SUPERVISORY CONTROL PANEL		
DEVICE	**DESCRIPTION**	**I/O TYPE**
VFD-BWR-2 OVERTEMP	PUMP OVERTEMP RELAY	DI
STR-BP-CL2 IN HAND	PUMP HOA SWITCH IN HAND POSITION	DI
STR-BP-CL2 IN AUTO	PUMP HOA SWITCH IN AUTO POSITION	DI
STR-BP-CL2 RUNNING	PUMP RUNNING CONTACT	DI
STR-BP-CL2 START	PUMP CALL TO RUN SIGNAL	DO
FACP ALARM	FIRE ALARM CONTROL PANEL ALARM	DI
FACP TROUBLE	FIRE ALARM CONTROL PANEL TROUBLE	DI

END OF SECTION

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ADDENDUM 3

SECTION 40 92 43

ELECTRIC ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. The furnishing and installation of electric valve actuators.

1.02 SUBMITTALS

A. Performance test certificate
   1. Each actuator must be performance tested and individual test certificates shall be supplied. The test equipment should simulate a typical valve load, and the following parameters should be recorded.
      a. Current at maximum torque setting
      b. Torque at maximum torque setting
      c. Flash test voltage
      d. Actuator output speed or operating time
   2. In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic, and second stage gearing if provided, drive closing direction, wiring diagram number.

B. A list of valve operating torques, including seating and unseating torques, shall be provided to Engineer with shop drawing submittal. This list shall accompany a list of actuators selected for each application and the actuators' torque capabilities.

C. Operation and Maintenance Manuals

PART 2 PRODUCTS

2.01 GENERAL

A. The actuators shall be suitable for use on a nominal 120 volt, single phase, 60 Hz power supply and are to incorporate motor integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.

B. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

C. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits, and configuration of the indication contacts shall be carried out without the removal of any actuator covers. Commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators.

D. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool.

2.02 MANUFACTURERS

A. Rotork Controls IQ Series.

B. Auma 2000 Series.

C. EIM Control Series 2000.

D. Or equal pre-approved by engineer.

2.03 ACTUATOR SIZING

A. The actuator shall be sized to guarantee valve closure at the differential pressure for each valve location. The Contractor shall be responsible for coordinating with the valve manufacturer to ensure that the actuator will be sized correctly for each valve model and size. Differential pressures for each valve shall be verified by the Contractor as necessary, and each actuator shall be adjusted to ensure correct operation under all plant conditions.

B. It shall be the responsibility of the Contractor to verify the maximum valve operating torque for existing valves that are to be fitted with electric actuators prior to actuator selection. The actuator selected shall be capable of operating the valve in its existing condition.

C. A list of valve operating torques, including seating and unseating torques, shall be provided to Engineer with shop drawing submittal. This list shall accompany a list of actuators selected for each application and the actuators' torque capabilities.

D. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10 percent below nominal.

E. The operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise determined necessary in coordination with Owner during Start-up (see Article 3.02). All actuator operating speeds shall be verified by Owner during Start-up.

2.04 ENCLOSURE

A. Actuators shall be O-ring sealed, watertight to NEMA 4, 6/IP68 and shall at the same time have an inner watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator.

B. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for site for cabling.

C. Enclosure must allow for temporary site storage without the need for electrical supply connection.

D. All external fasteners shall be of stainless steel, however, the use of unprotected stainless steel fasteners (including grease lubricated) in aluminum alloy casings is not permitted.

2.05 MOTOR

A. The electric motor shall be Class F insulated, with a time rating of at least 15 minutes at 104 deg. F or twice the valve stroking time, whichever is the longer, at an average load of at least 33 percent of maximum valve torque.

B. The motor shall be of the induction type, totally enclosed, non-ventilated, with cooling fans to dissipate the heat generated during operation. The motor shall be designed for severe duty allowing for 1,200 starts per hour without damage to the motor.

C. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gearcase.

2.06 MOTOR PROTECTION

A. Protection shall be provided for the motor as follows:
   1. The motor shall be de-energized in the event of a stall when attempting to unseat a jammed valve.

2. Motor temperature shall be sensed by a thermostat de-energizing the motor in case of overheating.
3. Lost phase protection.

2.07 GEARING

A. The actuator gearing shall be totally enclosed in an oil-filled gearcase suitable for operation at any angle. All drive gearing and components must be of metal construction and incorporate a lost-motion hammerblow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gearcase for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

2.08 HAND OPERATION

A. A handwheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The handwheel or selection lever shall not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.

B. The handwheel drive must be mechanically independent of the motor drive and any handwheel gearing should be such as to permit emergency manual operation in a reasonable time. Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated in the job specification.

2.09 DRIVE BUSHING

A. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bushing shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base should be of the sealed for life type.

2.10 TORQUE AND TURNS LIMITATION

A. Torque and turns limitation to be adjustable as follows:
1. Position setting range 2.5 to 100,000 turns, with resolution to 15 degrees of actuator output.
2. Torque setting: 40 percent to 100 percent rated torque.

B. "Latching" to be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads.

C. The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

2.11 REMOTE VALVE POSITION/ACTUATOR STATUS INDICATION.

A. Four contacts shall be provided which can be selected to indicate any position of the valve, Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.

B. The contacts shall be rated at 5A, 250V AC, 30V DC.

C. As an alternative to providing valve position any of the four above contacts shall be selectable to signal one of the following:
1. Valve opening, closing or moving
2. Thermostat tripped, lost phase

3. Motor tripped on torque in mid travel, motor stalled
4. Remote selected
5. Actuator being operated by handwheel

2.12 LOCAL POSITION INDICATION

A. The actuator shall include a digital position indicator with a display from fully open to fully closed in 1 percent increments.

B. Red, green and yellow lights corresponding to Open, Closed and Intermediate position shall be included on the indicator. End of travel indication colors shall be reversible. The digital display shall be maintained and updated during handwheel operation when all external power to the actuator is isolated. The display shall incorporate valve, actuator and control status indication. Provision shall be made to orientate the display through increments of 90 degrees.

2.13 INTEGRAL STARTER & TRANSFORMER

A. The reversing starter, control transformer and local controls shall be integral with the valve actuator suitably housed to prevent breathing and condensation. The starter shall be suitable for 1200 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It shall have the necessary tappings and be adequately rated to provide power for the following functions:
   1. Energization of the contactor coils.
   2. 24V DC output where required for remote controls.
   3. Supply for all the internal electrical circuits.

2.14 INTEGRAL LOCAL CONTROL AND CONTROL MODE SELECTOR

A. The actuator shall incorporate local controls for Open, Close and Stop and a Local/Stop/Remote mode selector switch lockable in any one of the following three positions: local control only, stop (no electrical operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.

B. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

C. Provision shall be made to orientate the local controls through increments of 90 degrees.

2.15 HEATERS

A. Exterior valve actuators shall include internal heaters for use in the winter.

2.16 CONTROL FACILITIES

A. The necessary wiring and terminals shall be provided in the actuator for the following control functions:
   1. Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.
   2. Remote controls fed from an internal 24V DC supply and/or from an external supply between 20V and 120V AC or 20V and 60 V DC, to be suitable for any one or more of the following methods of control:
      a. Open, Close and Stop control.
      b. Open and Close maintained or “push to run” (inching) control.
      c. Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact.
      d. Two-wire control, energize to close (or open), de-energize to open (or close).
   3. It shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of the contactor coils.

B. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 1.1kV.

2.17 MONITORING FACILITIES

A. Facilities shall be provided for monitoring actuator operation and availability as follows:
   1. Monitor (availability) relay, having one changeover contact, the relay being energized from the control transformer only when the Local/Off/Remote selector is in the Remote position to indicate that the actuator is available for remote (control room) operation.

B. Where required, it shall be possible to provide indication of Thermostat trip and Remote selected as discreet signals.

2.18 WIRING AND TERMINALS

A. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end.

B. The terminals shall be embedded in a terminal block of high tracking resistance compound.

C. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal and shall be provided with a minimum of 3 threaded cable entries with provision for a minimum of 4.

D. All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

E. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:
   1. Serial number
   2. External voltage values
   3. Wiring diagram number
   4. Terminal layout

F. This must be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

2.19 START-UP KIT

A. Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide at least 1 day of installation supervision by the manufacturer's representative.

B. Install equipment at the locations shown on the Drawings.

C. Install equipment and accessories in accordance with the manufacturer's instructions.

3.02 INSPECTION START-UP & ADJUSTMENT

A. The manufacturer or single source supplier of equipment shall inspect the completed installation, make all necessary adjustments, corrections, or modifications prior to start-up.

B. After start-up is authorized by the Engineer, the manufacturer or supplier shall furnish a qualified representative to inspect the completed installation, to supervise the system's initial start-up, and to train the operating personnel in the operation and equipment maintenance. At least 1 day shall be reserved for start-up and adjustment.

C. After equipment has been placed into operation, the manufacturer's representative shall make all final adjustments for the proper operation of the equipment.

D. Adjust valve closing and opening speeds during Start-up of each unit treatment process associated with a given valve. Valve closing and opening speeds to be determined in coordination with Owner.

E. Adjust actuator seating and unseating torque during Start-up to ensure effective operation of each valve.

3.03 OPERATOR TRAINING

A. Provide a minimum of 4 hours of operator training at the Owner's convenience after equipment is operational.

B. The plant's personnel shall be sufficiently trained and thoroughly acquainted with the operations and maintenance materials to operate all components of the system.

END OF SECTION