

SECTION 16010
GENERAL REQUIREMENTS – ELECTRICAL

PART 1 GENERAL

1.1 DESCRIPTION

A. Work Included

1. All items of labor, materials, and equipment, not specified in detail or shown on drawings but necessary for complete installation and proper operation of work described or implied, shall be furnished and installed.
2. Test all electrical conductors, after completion of installation of wiring and apparatus, to ensure continuity, proper splicing, freedom from grounds, except "made grounds" and those required for protection and insulation resistance. Use testing instruments, i.e. megger. Activation of each circuit will be required as final test. Testing shall be done at no additional expense to the Owner.
3. Drawings are indicative of work to be installed but do not indicate all bends, fittings, boxes, etc. that will be required in this Contract. The structural and finished conditions of the project shall be investigated prior to construction.
4. Coordinate work with other trades to avoid interference between piping, ducts, equipment, architectural or structural features. In case of interference, the Engineer decides which work is to be relocated, regardless of which is first installed.
5. Visit the site to determine actual conditions. No extra compensation will be allowed by failure to determine existing conditions.

B. Products Installed But Not Furnished Under This Section

1. The Owner will furnish the Well House Control Panel.
2. The Contractor shall receive, unload, store, install, mount, and secure the control panel at the location indicated on the Drawings. The Contractor shall furnish and install all raceways, conductors, grounding, power wiring, control wiring, and network cabling shown on the Drawings and required for a complete installation, unless specifically noted otherwise.
3. The Contractor shall terminate all field-installed wiring within the control panel in accordance with the panel shop drawings, wiring diagrams, and instructions provided by the Owner.
4. The Contractor shall coordinate all installation requirements, conduit routing, cable requirements, termination points, and startup requirements with the Owner.
5. During startup and commissioning, the Contractor shall provide qualified personnel to assist the Owner as required. Assistance shall include verification of power and control wiring, continuity testing, point-to-point checkout, correction of wiring deficiencies, troubleshooting of circuits and field devices, and re-termination or repair of wiring installed under this Contract as necessary to achieve a fully operational system.

6. The Contractor shall cooperate with and provide reasonable support to the Owner's SI during system startup, testing, and commissioning activities until all installed equipment and control functions operate as specified."

1.2 QUALITY ASSURANCE

A. Regulations, Standards and Publications

1. ANSI American National Standards Institute, Inc.
2. ASTM American Society for Testing and Materials
3. BOCA Building Officials and Code Administrators
4. IEEE Institute of Electrical and Electronic Engineers
5. IPCEA Insulated Power Cable Engineers Association
6. ISA International Society of Automation
7. NEC National Electrical Code of National Fire Protection Association
8. NEMA National Electrical Manufacturers Association
9. NESC National Electrical Safety Code
10. NFPA 70E Standard for Electrical Safety in the Workplace
11. UL Underwriters' Laboratories

B. Electrical Requirements

1. The installation shall comply with all Federal and State, municipal or other authority's laws, rules and/or regulations.
2. Inspections by the required authorities shall be made. Original final wiring certificates with two copies shall be submitted to the Owner.
3. The electrical inspections shall be made by the County.
4. All electrical equipment and its components and materials shall meet all applicable UL criteria and bear the appropriate label of the Underwriters' Laboratory.
5. All electrical equipment or apparatus of any one system shall be of the same quality as produced by one or more manufacturers, suitable for use in a unified system. The term "manufacturer" shall be understood as applying to a reputable firm who assumes full responsibility for its products.

1.3 SUBMITTALS

A. Shop Drawings

1. All shop drawings shall be submitted to the Engineer for review. All shop drawing submittals shall clearly indicate, using arrows and/or highlighting on all copies, which item(s) are being submitted and that each item being submitted is in compliance with all requirements on the drawings and in these specifications. All pertinent specification and drawing requirements shall be indicated on the shop drawings. If incorrect, they shall be resubmitted in quantity according to Contract conditions until satisfactory. Work shown on shop drawings shall not be executed until such drawings are approved. Electrical items shall not be installed until final approval of the shop drawings has been given by the Engineer.
2. See specific sections for a breakdown of shop drawing items.

3. Submit certification that all equipment is UL listed.
 4. Shop drawings shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices.
 5. The Engineer reserves the right to request additional shop drawings.
- B. Installation, Operation and Maintenance Manuals
1. Submit required number of installation, operation and maintenance manuals for all equipment being provided for the electrical system. These manuals shall be submitted in 3-ring loose-leaf binders and shall be complete, neat, orderly and indexed.
 2. The installation, operation and maintenance manuals shall include a copy of the approved shop drawings for all electrical items installed on the project.

1.4 PRODUCT DELIVERY, HANDLING AND STORAGE

- A. Product Handling
1. Deliver all materials in good condition. Store in dry place, off ground, and keep dry at all times.
- B. Protection of Installation
1. All unfinished installations, construction materials and equipment shall be protected during construction.

PART 2 PRODUCTS

2.1 SEE SPECIFIC SECTIONS FOR PRODUCTS

PART 3 EXECUTION

3.1 INSTALLATION

- A. Protection of Installation
1. All equipment shall be protected during construction. All damaged equipment caused by noncompliance with this requirement shall be repaired at no expense to the Owner.
- B. Openings and Chases
1. Determine locations of chases and openings prior to construction so that same may be provided where required. If openings or chases are made after building construction is accomplished, such cutting and repairing of the building shall be made by this Contractor in complete coordination with other trades on the job site to match original conditions in quality, color and type of materials used, and at no additional expense to the Owner.
- C. Position of Outlets

1. The Engineer shall determine the position of all relocated outlets and equipment if the required location differs from that indicated on the drawings.
- D. Moving Outlets
1. The Owner reserves the right to move any outlet a distance of ten feet before roughing in, at no additional expense.
- E. Methods and Materials
1. All work shall be installed in a first-class, neat and workmanlike manner by skilled mechanics. All materials shall be new. Firmly support all materials and equipment.
- F. Cutting, Repairing and Finishing
1. All cutting, repairing, finishing and painting required for the installation of work under this Contract shall be performed under this Contract.
 2. All disturbed surfaces shall be repaired and finished to match adjacent surfaces by skilled mechanics working in their respective fields.
- G. Excavation and Backfilling
1. Excavation and backfilling shall be in accordance with the requirement of Division 2 and as required to complete the work according to details on drawings.
- H. Concrete
1. Concrete work shall be in accordance with the requirements of Division 3 and as required to complete the work according to details on drawings.
- I. Cutting and Patching of Concrete Areas
1. Openings in concrete required for Electrical construction shall be made by taking extreme precautions to prevent excessive damage to existing facilities. Prior to completion, all disturbed areas shall be closed, restored to normal and finished to match surrounding areas.
- J. Access
1. Install all conduit, wire, cable, wiring devices and equipment to preserve access to all equipment installed under this Contract.
- K. Layout of Wiring
1. The layout of wiring as shown on the drawings shall not be considered as absolute. It shall be subject to changes where necessary to overcome obstacles in construction. Where a major deviation from the plans is indicated by practical consideration, shop drawings shall be submitted showing all deviations in detail to clearly indicate the necessity or desirability for the change.

L. Miscellaneous Supports

1. Furnish and install all necessary angles, beams, channels, hanger rods or other supports for equipment and piping furnished under this Contract requiring support or suspension from building structure.

M. Continuity of Service

1. Uninterrupted electrical service shall be maintained during the entire time required for complete installation of the work proposed in the Drawings and in the specifications.
2. Temporary equipment, cable, and whatever else is necessary shall be provided as required to maintain electrical service to all facilities. Temporary service facilities, if required at any time, shall not be disconnected or removed until new services are placed in proper operation.
3. If any service or system must be interrupted, the Contractor shall request permission in writing stating the date and time the service will be interrupted, and the areas affected. This request shall be made in sufficient time for proper arrangements to be made. Written permission shall be obtained from the Owner before interrupting electrical service to any facility.

N. Clean Up

1. Upon completion of all work under the electrical specifications, furnish labor, materials, and incidentals to accomplish the following: remove all dirt, foreign materials, stains, fingerprints, etc. from all lighting fixtures, glassware, panelboards, wall plates, system equipment, floors, walls and ceilings adjacent to the above equipment and leave the electrical work in such a condition that no cleaning will be required by the Owner. The complete system shall be subject to inspection and approval by the Owner.

END OF SECTION

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SECTION 16700 INSTRUMENTATION

PART 1 GENERAL

1.1 DESCRIPTION

- A. Work Included
 - 1. Furnish and install all instrumentation and provide services as specified herein or as indicated on the Drawings.

1.2 QUALITY ASSURANCE

- A. Regulations and Standards
 - 1. UL Underwriters' Laboratories
 - 2. NEC National Electrical Code
 - 3. NEMA National Electrical Manufacturers Association
 - 4. ANSI American National Standards Institute
 - 5. IEEE Institute of Electrical and Electronic Engineers
 - 6. ISA Instrument Society of America
 - 7.
- B. All instrumentation equipment supplied shall be of the most current and proven design. Specifications and drawings call attention to certain features but do not purport to cover all details entering into the design of the instrumentation equipment.
- C. All necessary fuses and cables required for instrumentation equipment shall be provided with the equipment.

1.3 SUBMITTALS

- A. Shop Drawings
 - 1. Submit shop drawings on all instrumentation in accordance with the requirements of Section 01330. Shop drawings shall be complete in all respects and shall indicate all dimensions, installation methods, size, weight, capacity, ratings, integral controls and types of materials, elevations, and sections. Submittals shall include a complete bill of material, catalog information, descriptive literature of all components and wiring diagrams.

PART 2 PRODUCTS

2.1 MAGNETIC FLOW METERS

- A. Flow meter shall meet the requirements of AWWA C751-2019 and components in contact with the potable water shall meet the requirements of NST/ANSI/CAN 61-2023 and the Safe Drinking Water Act (SDWA).

- B. Magnetic flow meters shall be of the low frequency and short form characterized coil design. The characterized field principle of electro-magnetic induction shall produce a positive DC pulsed signal directly and linearly proportional to the flow rate.
- C. The meter body shall be carbon steel. The flow meter shall have a flanged body to fit between ANSI Class 150 pipe flanges. The flow meter shall have a polyurethane liner and Type 316 stainless steel electrodes. The electrodes shall be flush mounted type. Liners and electrodes shall be suitable for potable water. Provide all required mounting hardware, stainless steel grounding rings and grounding straps for the installation of the magnetic flow meter.
- D. The coils, which generate the field, shall be inside the pipe wall and shall be encapsulated in epoxy resin and encased behind the meter lining material. The ratio of flow velocity to reference voltage signals generated shall be compatible with the readout instrument without the necessity of circuit modifications. The meter shall have an average power consumption of 60 watts. Accuracy of the meter shall be $\pm 0.5\%$ of rate.
- E. The meter housing shall be splash-proof and weather resistant design. The meter shall be capable of accidental submergence in up to 30 feet of water for up to 48 hours without damage to the electronics.
- F. The meter shall be hydraulically calibrated at the manufacturer's calibration facility against a master meter, which is traceable to the National Bureau of Standards. Calibration curves shall be submitted for each flow meter for 3 points within the specified flow range.
- G. Complete zero stability shall be inherent characteristic of the meter system. This shall eliminate the requirement for valving downstream of the meter for creating a full pipe zero flow condition for calibration purposes. Meter systems requiring field zero adjustment will not be acceptable.
- H. The flow meter shall have a remote mounted microprocessor based, NEMA 4X signal converter. The signal converter shall have an LCD display to indicate the flow rate. The signal converter shall convert the meter's DC pulsed signal to a linear 4-20mA dc signal which is proportional to the flow rate. The converter shall operate on a 120V AC, 60 Hz power source and shall have RFI protection. Provide a signal cable to connect the signal converter to the flow meter. Length of cable shall be as required for the installation (See Electrical Drawings).
- I. The Magnetic Flow Meters shall be Endress & Hauser Promag W 400, Toshiba GF642, or equal.

SCHEDULE OF MAGNETIC FLOW METERS

SIZE	FLOW RANGE	LOCATION	SERVICE
1"	2.5 to 80 gpm	Well House	Potable water flow
6"	90 to 2,650 gpm	Well House	Potable water high flow

2.2 PRESSURE TRANSMITTERS:

- A. The components in contact with the potable water shall meet the requirements of NST/ANSI/CAN 61-2023 and the Safe Drinking Water Act (SDWA).
- B. The pressure transmitters shall be a single chamber capacitance type electronic transmitter, which shall produce a linear current output signal proportional to the gage pressure.
- C. The process connection shall be 1/4" NPT female and shall be 316L stainless steel. The transmitter shall have a ceramic process isolating diaphragm.
- D. The transmitter shall have a continuous 100 to 1 span adjustment. Reference accuracy shall be $\pm 0.05\%$ of span.
- E. Zero and span adjustment shall be electronic by means of zero and span buttons.
- F. Process temperature limits shall be -13 to +257°F. The temperature limits for the electronics shall be -4 to +158°F. Humidity limits shall be 0-100% relative humidity.
- G. The transmitter shall be a true 2-wire device with 24-volt DC power being derived from the control panel power supply. The electronic unit shall be of modular plug-in design utilizing integrated circuitry. The transmitter output shall be a linear 4-20mA dc signal with superimposed HART protocol.
- H. The range of the pressure transmitter shall be as indicated on the schedule below.
- I. The transmitter electronics housing shall be constructed of die cast aluminum with a polyurethane coating. The transmitter housing shall meet NEMA 4X requirements. The electrical connection shall be a 1/2" NPT conduit thread.
- J. Each transmitter shall be furnished with a mounting bracket and stainless steel bolts suitable for wall mounting the transmitter.
- K. Provide a calibration data sheet for each pressure transmitter.
- L. The pressure transmitters shall be Endress & Hauser Cerabar S PMC71, or equal.

SCHEDULE

PRESSURE RANGE	LOCATION	SERVICE
0-150 psi	Well House	Potable water pressure

2.3 SUBMERSIBLE LEVEL TRANSDUCERS:

- A. The submersible level transducers shall be an industrial submersible pressure transducer submerged in well water to accurately sense the hydrostatic level. The transducer shall be furnished with an integral signal cable with a molded cable seal.
- B. The transducer shall have a weatherproof housing constructed of 316 stainless steel. The transducer shall have a 1.65" sensing area and an integral diaphragm protector.
- C. The transducer shall operate in a temperature range of -4° to 176° F.
- D. The transducer cable shall be a polyethylene jacketed shielded cable. Length of cable shall be as required for transducer installation. Provide a stainless-steel cable hanger to support the cable.
- E. The pressure transducer shall be a 2-wire device with dc power being provided from the 24vdc power supply in the control panel. The transducer shall output a 4-20mA dc signal proportional to the wet well level.
- F. The accuracy shall be $\pm 0.05\%$ full span from 23° to 122° F with a resolution of $\pm 0.005\%$ full span.
- G. The submersible level transducers shall be In-Situ Level Troll 400, or equal.

SCHEDULE

ELEVATION	PRESSURE RANGE	LOCATION	SERVICE
Approximately 230 ft bls.	0 - 100 psia	Well House	Well level

2.4 CHLORINE RESIDUAL ANALYZERS:

- A. Chlorine residual analyzers shall use colorimetric DPD chemistry to continuously monitor the sampled water for free or total residual chlorine. The analyzer shall use a DPD indicator and a buffer solution.
- B. The analyzer shall be capable of measuring free or total residual chlorine by changing the indicator and buffer solutions.
- C. The analyzer shall take a measurement every 2.5 minutes and the results shall be displayed on a three-digit LCD readout in the range of 0-5 mg/l.

- D. The analyzer shall be designed for 30 days of unattended operation and shall use only 473 mL of each reagent per month.
- E. The analyzer shall operate with an LED light source with a peak wavelength of 520 nm.
- F. The analyzer shall measure a sample blank before each sample measurement to provide automatic zero reference to compensate for sample color and turbidity, and changes in light intensity due to voltage fluctuations or light source aging.
- G. The analyzer shall provide a minimum detection limit of 0.035 mg/L; precision of $\pm 5\%$ or 0.005 mg/L as Chlorine, whichever is greater; and an accuracy of $\pm 5\%$ or 0.035 mg/L as Chlorine, whichever is greater.
- H. The analyzer shall be furnished with a sample inlet fitting and a drain fitting.
- I. The analyzer shall be microprocessor controlled and shall be housed in an ABS plastic enclosure designed for wall mounting. The enclosure shall have two clear polycarbonate windows for viewing the measurement readout and the reagent levels.
- J. The analyzer shall operate on 120 volts, 1 phase power and shall be furnished with a power cord.
- K. The analyzer shall output a 4-20mA dc signal proportional to the chlorine residual.
- L. The analyzer shall have two user-selectable relay output alarms which are selectable for sample concentration alarm, analyzer system warning, or analyzer system shutdown alarm.
- M. The chlorine residual analyzers shall be Hach Model CL17 Free Chlorine Residual Analyzers.

SCHEDULE

RANGE	LOCATION	SERVICE
0 – 4.0 mg/L	Well House	Potable water

2.5 PH METERS:

- A. The pH meter shall consist of a pH sensor, a pH transmitter and interconnecting cable. The pH meter shall continuously monitor the pH of the water.
- B. The pH sensor shall have a ring-shaped PTFE diaphragm and fixed electrolyte. The pH sensor shall have a glass electrode and shall utilize Memosens technology. The pH sensor shall have a built-in temperature sensor.

- C. The pH transmitter shall be microprocessor-based and shall be housed in a NEMA 4X polycarbonate enclosure suitable for wall mounting. The transmitter shall have a two-line display to simultaneously display the pH and the temperature.
- D. The transmitter shall have a pH range of -2 to 16.
- E. The transmitter shall have a resolution of 0.01 pH, and an accuracy of $\pm 0.5\%$ of range.
- F. The transmitter shall operate on 120 volts, 1 phase power.
- G. The transmitter shall output a 4-20mA dc signal proportional to the measured pH.
- H. The pH meter shall be Hach.

SCHEDULE

RANGE	LOCATION	SERVICE
3.0 – 10.0	Well House	Potable water

2.6 PRESSURE SWITCHES

- A. Pressure switches shall be industrial type consisting of a Belleville spring with a diaphragm sensor. Pressure switches shall have an aluminum body, a stainless steel port, and wetted materials suitable for potable water.
- B. Pressure switches shall have 5 ampere, 120 volt contacts, threaded electrical conduit connection opening, 1/4" NPT bottom connection type pressure line opening, and NEMA 4X watertight enclosure.
- C. Pressure switches shall be Ashcroft, Omega, Dwyer or approved equal.

SCHEDULE

RANGE	LOCATION	SERVICE	Description
0 to 150 PSI adjustable	Well House	Low potable water pressure	DPDT
0 to 150 PSI adjustable	Well House	High potable water pressure	3PDT

2.7 NAMEPLATES

- A. Provide a laminated phenolic nameplate for each instrument. The nameplates shall be black with white engraved letters, and they shall be mounted on the front of each instrument or instrument enclosure, or where applicable attached to the instrument with a plastic wire tie. An instrument nameplate schedule shall be submitted to the Engineer for approval prior to performing any engraving.

PART 3 EXECUTION

3.1 INSTALLATION ASSISTANCE AND INSPECTION

- A. Provide the services of manufacturer's service representatives to assist in installation for all instrumentation specified herein.
- B. Each manufacturer's representative shall inspect the installation of each of their instruments and shall issue an installation certificate to the Owner and the Engineer for each instrument certifying that the instrument has been installed in accordance with the manufacturer's recommendations.

3.2 CALIBRATION

- A. Provide the services of manufacturer's service representatives to calibrate all instrumentation provided. All calibration shall be performed in the presence of the Engineer. The calibration of each instrument shall be performed after the instrument installation certificate has been issued.
- B. Each manufacturer's representative shall issue a calibration certificate to the Engineer for each instrument certifying that the instrument has been calibrated and is ready to be placed into service. The calibration certificates shall indicate the calibrated range or setpoint for each instrument.

3.3 TRAINING

- A. Provide four (4) hours of training on the instrumentation provided.
- B. All training shall be performed by a representative from the manufacturer and shall be specific to the instruments provided. Training shall include theory of operation, maintenance requirements, calibration methods and function of instrument in the Process Control System.

END OF SECTION

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SECTION 16910
CONTROL DESCRIPTION

I. SYSTEM DESCRIPTION

The existing potable water well is being replaced with a new Well House. Additionally, some of the water lines and connections to the treatment plant buildings are also being replaced.

The Well House Control Panel and Distributed Process Control System (DPCS) HMI will be configured and programmed by the Owner.

- All code is to be written in ladder logic. Any other code types (Sequential Function, Function Block, Structured Text, etc.) will not be accepted unless approved by Process Control Group.
- If using AB ControlLogix PLC, all Tags must be scoped at the Global/Controller level.
- Use the Process Control Group supplied abbreviation list for tag naming and I/O identification.
- Any code written that deliberately tries to overly complicate the program flow and readability will not be accepted.
- All PLC controllable field devices (i.e., if the device has at a minimum an HOA switch, open/start command, and feedback status) will have its own device in ladder. Common device logic that passes and receives I/O statuses is Not acceptable.
- It should be assumed that any PLC supplied will be integrated into plant control system and customer permissives should be accommodated in logic.
- No software Remote / Local mode on OIT. There should be a mechanical HOA switch on front of control panel wired to PLC as input status.

A. WELL PUMPS

One low flow constant speed well pumps will supply potable water to the treatment plant via two (2) hydropneumatics tanks and one of (2) water softeners. Hypochlorite will be introduced for disinfection prior to exiting the well house and entering the potable water distribution network. During periods of high flow, the larger high flow variable speed pump will be operational, the two (2) smaller well pumps will cease operation, and the water softeners, along with the hypochlorite system, will be bypassed.

B. CHEMICAL FEED

The chlorine residual analyzer along with the potable water low flow transmitter will be used to regulate the speed of the sodium hypochlorite feed pump to maintain a predetermined chlorine residual.

II. EQUIPMENT AND DESIGNATIONS

A. Well Pumps	Two (1 low flow and 1 high flow)
B. Residual Chlorine Analyzer	One
C. pH Analyzer	One
D. Magnetic Flow Meters	Two (1 low flow and 1 high flow)

E. Level Transmitter	One (well level)
F. Sodium Hypochlorite Feed Pump	One

III. RELATED EQUIPMENT OPERATION

A. None

IV. POWER AND CONTROL CONFIGURATION

The Well House Control Panel will house the PLC that contains the control program.

Control and Monitoring will be available as follows:

CONTROL/INDICATION LOCATION	@ Equipment /Process	@ MCC	I/O to or from Well House CP
LOW FLOW WELL PUMP			
Local-Off-Remote (LOR) Select		X	
Remote Status			DI
Start-Stop			DO
Run Status		X	DI
Starter Overload		X	DI
HIGH FLOW WELL PUMP			
Local-Off-Remote (LOR) Select		X	DI
Start-Stop		X	DO
Speed Control		X	AO
Speed Indication		X	AI
Run Status		X	DI
VFD Failure		X	DI
INSTRUMENTS AND ANALYZERS			
Well Level Transmitter			AI
Potable Water High & Low Flow Transmitters	X		AI's
Potable Water Pressure Transmitter	X		AI
pH Indicating Analyzer	X		AI
Chlorine Residual Analyzer	X		AI
SODIUM HYPOCHLORITE FEED PUMP			
Local-Off-Remote (LOR) Select	X		
Speed Control			AO
POWER MONITORING			

CONTROL/INDICATION LOCATION	@ Equipment /Process	@ MCC	I/O to or from Well House CP
Power Failure		X	AI
Power Indication		X	AI
Surge Protection Failure		X	DI
Control Panel			
Power Failure			
Surge Protection Failure			AI
Power Supply 1 Failure			DI
Power Supply 2 Failure			DI
UPS Failure			DI
UPS Battery Replacement			DI
On UPS			DI

A. POWER DISTRIBUTION

The low flow well pumps will be powered from MCC-WH and the high flow well pump will be powered from a VFD also located in the Well House.

Low Flow Well Pumps Equipment Summary

The low flow well pumps will be Full Voltage Non-Reversing (FVNR) starters. The motor starters will have provisions for locking out the motors in the de-energized state with the following controls and indications.

1. Control power transformer.
2. I/O blocks.
3. LOCAL-OFF-REMOTE (LOR) three position selector switch.
4. RUN and STOPPED indicating lights.
5. STARTER OVERLOAD indicating light and reset pushbutton.

High Flow Well Pump Equipment Summary

The high flow well pump will be on a Variable Speed Drive (VFD). The VFD will have provisions for locking out the motor in the de-energized state with the following controls and indications.

1. Control power transformer.
2. I/O blocks.
3. LOCAL-OFF-REMOTE (LOR) three position selector switch.
4. RUN and STOPPED indicating lights.
5. LCD/LED VFD status, control, and diagnostics display.
6. % speed control.
7. % speed indication.

Low Flow DPCS Input/Output Summary:

The following information at a minimum will be transmitted to the DPCS system from the motor starters:

1. LOR selector switch status.
2. Run status.
3. Starter Overload.

The DPCS system will transmit to the starters the following:

1. Start-Stop command.

High Flow DPCS Input/Output Summary:

The following information at a minimum will be transmitted to the DPCS system from the VFD:

2. LOR selector switch in AUTO.
3. Run status.
4. VFD failure.
5. % speed indication

The DPCS system will transmit to the VFD/bypass starters the following:

1. Operate at % speed.
2. Start-Stop command.

V. DESCRIPTION OF OPERATION

A. WELL PUMPS

Control Modes:

Each well pump can be operated locally at the Motor Control Center (MCC), Variable Frequency Drive (VFD), or through the Distributed Process Control System (DPCS). A LOCAL-OFF-REMOTE selector switch will be provided on the MCC motor starter bucket and on the VFD.

Each of the well pumps will have the following control modes:

Local/Manual Mode:

In Local mode, an operator will select the Local position from the LOCAL-OFF-REMOTE selector switch to run a well pump. The high flow well pump will also allow an operator to adjust the speed of the pump from the front of the VFD. In the Off position, a well pump will not run. Local operations should only be used for testing and maintenance purposes.

DPCS Auto Low Flow Mode:

A well pump can only be operated in Auto Mode when the LOCAL-OFF-REMOTE switch is in the REMOTE position.

In software DPCS Auto, the low-speed pumps will operate when the potable water pressure drops below an operator-adjustable low pressure (initially set at 50 psi) and will shut off when the pressure increases to an operator-adjustable high pressure (initially set at 80 psi).

DPCS High Flow Mode:

High flow mode will be initiated when the potable water pressure drops to low-low pressure (initially set at 30 psi). The low flow pumps will shutdown and the high flow pumps will start with the speed adjusted to maintain a constant pressure (initially set at 80

psi). The pump will continue to run until the potable water flow drops to an operator adjustable flow (initially set at 100 gpm). The mode will then automatically switch back to low flow mode operation.

DPCS Manual Mode:

Not Used

Interlocks and Alarms:

Regardless of operating mode, a well pump will be shut down for any of the following abnormalities:

1. Motor overload
2. VFD failure.
3. High-high potable water pressure (initially set at 100 psi).

The DPCS will provide Alarms and Indications regardless of the operating mode:

1. Motor overload.
2. VFD failure.
3. Instrument or analyzer failure as indicated by an analog signal less than 4 mA
4. Potable water pressure high-high or low-low.
5. High flow pump operating.

B. SODIUM HYPOCHLORITE FEED PUMP

Control Modes:

The Sodium hypochlorite feed pump can be operated locally at the pump or through the DPCS. Operation of the pump locally will be through a graphical display on the pump.

Local/Manual Mode:

In Local mode, an operator can select Local operation through the graphical display and adjust the speed of the pump.

DPCS Auto Mode:

In software DPCS Auto, the pump will be flow paced from the low flow transmitter with feedback trim from the residual chlorine analyzer.

DPCS Manual Mode:

Not Used

Interlocks and Alarms:

Regardless of operating mode, the pump will be shut down for any of the following abnormalities:

1. None

The DPCS will provide Alarms and Indications regardless of the operating mode:

1. Low or high chlorine residual

END OF SECTION

SECTION 16920 CONTROL PANELS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Section Includes: Design standards and manufacturing requirements for control panels and enclosures..

1.2 REFERENCES

- A. Underwriters Laboratory UL508A – Safety Standards for Industrial Control Panels
- B. National Electric Code Section 409 – Industrial Control Panels
- C. NEMA 250-2008 – Enclosures for Electrical Equipment

1.3 QUALITY ASSURANCE

- A. Include components shown on contract drawings and accessories and hardware not shown but necessary to meet manufacturer recommendations and/or WSSC specifications.
- B. Equipment: Installed following manufacturer's recommendations. Follow manufacturer's installation manuals for guidance and details not shown on contract drawings.

1.4 SUBMITTALS

- A. Submit for review following Section 01330. Drawings: AutoCAD format and may be electronically transmitted.
 - 1. Power distribution wiring diagram.
 - 2. Back panel and subpanel layouts showing location of panel-mounted equipment.
 - 3. Enclosure elevation drawing showing location of externally mounted equipment.
 - 4. Enclosure assembly diagram if applicable.
 - 5. Complete bill of materials.

PART 2 MATERIALS

2.1 ENCLOSURES

- A. NEMA Rating: Follow standards for NEMA type indicated on drawings or as specified herein.
 - 1. NEMA Type 12 dust-tight:

- a. Provided for indoor controlled environment locations as shown on drawings. Provide continuous gasket around door opening.
- b. Phosphate coating for rust proofing and white enamel panel interior finish.
 - 1) Exterior finish: Hoffman custom paint color #RAL7021 (T014) or ANSI-61 gray powder coat.
 - 2) Enclosures requiring legs: Paint color to match enclosure.
- 2. NEMA Type 4 watertight and dust-tight: Provided for indoor or outdoor locations as shown on Drawings.
- 3. NEMA Type 4X corrosion resistant: Provided for indoor and outdoor locations as shown on Drawings.
 - a. Door clamps and hinge pins: Stainless steel.
- 4. NEMA-rated enclosures for PLC and Remote I/O panels: Hoffman Brand or equal.

B. General.

- 1. Designed for connection to 120VAC branch circuits. Equipment that requires higher voltage sources, e.g. VFDs and uV reactor controls: Supplied in separate enclosures.
- 2. Enclosures that contain interlocked control circuits or circuit supplied from external power source which cannot be de-energized by panel disconnect: Furnish with following warning label;
CAUTION: THIS EQUIPMENT MAY HAVE MORE THAN ONE POWER SOURCE OR IS INTERLOCKED WITH OTHER EQUIPMENT.
- 3. Mounted outdoors or in unheated areas: Provide internal condensation and freezing protection with thermostat control.
- 4. Contain incandescent or LED light package equipped with manually operated switch. At least one GFCI-type duplex utility outlet: Provided on control panel.
- 5. Fully enclosed units with front and/or rear access doors, designed to fit in space available, as specified in contract drawings.
- 6. Enclosures which contain PLC processor and communication modules: Equipped with door-mounted factory window kits to enable viewing of status LEDs.
- 7. Vapor-phase protective corrosion inhibitors.
 - a. Inhibitor: Activated upon shipment to site.
 - b. Panels:
 - 1) Do not store with inhibitors inactive.
 - 2) Cover to reduce ventilation and prolong inhibitor life, if necessary.
 - c. Approved Manufacturers:
 - 1) Hoffman A-HC15E.
 - 2) 10E.
 - 3) Or Equal.
- 8. Front door-mounted nameplate that identifies panel inside, e.g., PLC-D, CHEM RIO-4.
 - a. Nameplates.
 - 1) As shown on contract drawings or listed in specifications.
 - 2) Laminated plastic having black letters on white background and attached using stainless steel screws.
- 9. Print pocket.

- a. Mounted inside door.
 - b. Include one copy of relevant as-built drawings prior to shipment.
- 10. Factory back panels for mounting control panel components and equipment.
 - a. Side panels may be used to increase amount of available panel space.
 - b. 24 inch deep or greater that contain back panel: Supplied with studs for future installation of full length side panels on both sides of enclosure.
- 11. Sufficient structural reinforcements to limit vibration and prevent distortion or damage to panel and components during shipment, installation and operation.

C. Free-Standing Steel Enclosures

- 1. Single door: 12-gauge sheet steel.
- 2. Multiple door: 10-gauge steel.
- 3. Back panels and side panels: Minimum 12-gauge steel.
- 4. Full size back panels: Equipped with stiffeners and heavy duty supports as needed to ensure rigidity.
- 5. Exterior welds: Ground and sanded to smooth finish free of burrs.
- 6. Surface: Free of ridges, nuts, bolt heads, and similar protrusions.
- 7. Removable lifting lugs on top of enclosure designed to facilitate rigging and lifting of enclosure during installation.
 - a. Plugs: Provided to fill the lifting ring holes after installation is complete.
- 8. Full-length door with handle-operated three point latch for front or rear access. Certain installations may require lockable door handles.
- 9. Floor stands or foot kits, when required, as shown on panel drawings.
- 10. Provide steel stiffeners as necessary to prevent deflection of back panels and doors due to heavy panel-mounted or door-mounted components.
 - a. Stiffener: Minimum 0.25 inches deep by 1 inch wide tack welded to back of the panel or door.

D. Wall-Mounted Steel Enclosures

- 1. 14-gauge steel.
- 2. Back panels and side panels: Minimum 12-gauge steel.
- 3. Doors: Equipped with rubber gaskets and continuous hinges.
- 4. Enclosures: Equipped with 2-point latching door handles.
 - a. In wet or corrosive environments screw clamps may be required around perimeter of door to ensure tight seal.
 - b. Certain installations may require lockable door handles.

2.2 PANEL WIRING AND TERMINATIONS

- A. Designed, manufactured and tested following latest standards listed herein.
- B. Back panel and side panel wire bundles.
 - 1. Run inside Panduit-style wire duct to facilitate tracing of circuits.
 - 2. Exposed wire bundles connecting door-mounted devices and side panels to back panel are allowed.
 - 3. Fastened down at suitable intervals, not to exceed 12 inches in length.

- C. Segregate AC control power and I/O wiring, and DC control power and I/O wiring within panel as much as possible.
1. Group wires and cables according to function. Run in separate wire ducts and/or bundles.
 2. Keep analog signals (4-20 mA and 0-10V) as far away from AC control power and I/O wiring as possible.
- D. Use flexible stranded copper wiring.
1. No solid conductor wire is permitted.
- E. 120VAC and 24VDC wiring in panel: Type MTW, rated for operation at 600V at conductor temperatures not to exceed 90 deg. C.
- F. Analog I/O and Instrumentation cable: No. 18 AWG, twisted, shielded single pair, instrumentation cable with minimum of six twists per foot and including continuous foil shield with drain wire. PVC-coated and rated for operation at 300V at conductor temperatures not to exceed 90 deg. C.
1. Individual Pair Shield: 1.35 mil, double-faced aluminum/synthetic polymer overlapped for 100% coverage.
 2. Outer Jacket: 45-mil nominal thickness.
 3. Dimension: 0.31 inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, 7-strand concentric, following ASTM B8.
 - b. 20 AWG, 7-strand tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Pair conductors: Color-code Red (+), Black (-).
- G. Minimum wire conductor sizing: Follow UL 508A standards for industrial control panels:
- AC line side power: No smaller than 14 AWG.
- AC line and control circuits: No smaller than 16 AWG.
- DC line, load and control circuits: No smaller than 16 AWG.
- Analog signal wiring: No smaller than 20 AWG.
- H. Panel wiring: Color coded as follows:

BLACK	AC line, load and control circuits operating at line voltage.
WHITE	AC neutral
RED	AC control circuits at line voltage which are controlled by a relay contact or other control element

BLUE	DC, line load and control circuits
BLUE WITH WHITE STRIPE	DC common or 0VDC
YELLOW	Interlocked control circuits or any circuit supplied from external power source which cannot be de-energized by control panel disconnect.
GREEN	Equipment grounding conductors with or without yellow stripe.

- I. Analog and instrumentation conductors: Color coded as follows:
 1. RED: Positive (+)
 2. BLACK: Negative (-)
- J. Wire:
 1. Run in continuous lengths from screw terminal to screw terminal.
 2. Provide wire service loops to simplify removal of panel components.
 3. Do not splice wiring.
 4. Identified at both ends with white machine printed, sleeve-type labels.
 - a. Hand lettered wire labels are not allowed.
- K. Wire numbering: Consistent with nomenclature used in sample drawings.
 1. All PLC I/O module wiring: Numbered according to I/O point base/slot/point assignments.
- L. 120 VAC Discrete Inputs: The Control panel will provide 120VAC to field equipment for signaling purposes only.
 2. Wires: Red.
 3. Field equipment: Equipped with 120VAC rated dry contacts and shall operate the dry contacts. All Emergency Stop and other alarm Inputs shall be wired Failed-Safe (normally closed), where the de-energized circuit represents an alarm.
 4. For each dry contact, a pair of wires shall be installed and landed from the Control panel to the dry contact.
 - a. One wire shall be hot (+) the other shall be used to return power back to the Control when the dry contact is closed.
 - b. Both wires shall be continuous home-runs from field equipment panel to Control panel with NO intermediate terminations or splices.
 - c. A sample drawing will be provided and followed.
- M. 120 VAC or 24VDC Relay Outputs: The Control panel will be Supplied with 120VAC or 24 VDC control power from the field equipment for control purposes only.
 1. Wires: Yellow to indicate foreign voltage.

2. Control Discrete Output card will provide a dry contact to switch power on and off. Each dry contact will only have one function and serve only one piece of field equipment (for example, a single dry contact cannot be used to turn on a pump and used to illuminate a panel light).
3. For each dry contact, a pair of wires shall be installed and landed from the Control panel to the field equipment.
 - a. One wire shall be hot (+) the other shall be used to return power back to the field equipment when the dry contact is closed.
 - b. De-energizing field equipment shall consequently de-energize the 120VAC or 24VDC control power.
 - c. Both wires: Continuous home-runs from field equipment panel to Control panel with NO intermediate terminations or splices.
 - d. A sample drawing will be provided and followed.
4. In general, the current for Allen Bradley 1756 output modules shall not exceed 2 Amps and never exceed the manufacturer's limitations. The A-B relay output module (1756-OW16I) used on Control panels does not have on board fusing, therefore one of the 2 terminals provided for field connections, typically the line side, shall be equipped with a 2A rated fast blow fuse.
5. In general, the current for CTI output modules shall not exceed 5 Amps and never exceed the manufacturer's limitations. The CTI relay output module (#2534) used on Control panels is equipped with on board fusing; therefore standard thru terminals may be used for field connections.

2.3 TERMINAL BLOCKS

- A. Factory assembled on standard 35mm din rail mounted on standoffs to provide easy access to terminal screws.
 1. Prefabricated terminal strips are not allowed.
- B. Screw type with pressure plate (compressor type) requiring no lugs on connecting wires.
 1. Rated for wire size 12 AWG or smaller.
 2. Rated for 600 volt service.
 3. Cage clamp style terminals are not allowed.
- C. Furnished with engraved plastic markers displaying wire numbers or alphanumeric designation shown on drawings and/or on the I/O point list.
 1. If connected to PLC I/O modules: Numbered according to I/O point base/slot/point assignments.
- D. Reserve one side of each terminal block assembly for incoming field wiring.
 1. Common connections and jumpers required for internal wiring on field side of terminal is not allowed.
 2. No more than two wires terminated at any single screw terminal.
- E. Through terminals and fuse terminals ganged together to create common voltage buses: Utilize internal screw jumpers.

1. Wire jumpers and comb jumpers are not allowed.
- F. I/O module points, including unused spares: Connected to terminal blocks.
1. Terminal block assemblies for power distribution: Include minimum 25 percent spare fuse terminals, connected to AC or DC bus via internal jumpers.
- G. Fused terminal blocks.
1. Follow typical wiring diagrams for power distribution and I/O modules.
 2. Required for overcurrent protection of analog input modules and discrete output modules not equipped with internal fuses or protected by interposing relays.
 3. Provided with blown-fuse indicator and fast-acting, 5 x 20mm fuses, unless approved otherwise.
 4. Cross section not greater than 8mm.
- H. Terminal block assemblies for analog input and output channels.
1. Include ground terminals that connect directly to panel ground through din rail.
 2. Ground terminals: Green and yellow in color.
- I. Feed through terminal blocks: High density with cross section not greater than 2.5mm.
- J. Approved Manufacturer.
1. Weidmuller brand
 2. Or equal.

<u>Terminal Type</u>	<u>Wiedmuller Cat. No.</u>
Analog input (+), fused	WSI6
Analog input (-)	WDU2.5
Analog input shield	WPE2.5
Analog output (+)	WDU2.5
Analog output (-)	WDU2.5
Analog output shield	WPE2.5
Discrete input	WDK2.5*
Discrete output	WDU2.5
Digital output, fused	WSI6
All others	WDU2.5 or WSI6

*Note: Discrete input terminal block assemblies require 2-tier terminals. The top tier is used for the individual inputs. The terminals on the bottom tier are ganged together using internal screw jumpers to form a voltage bus for wetting of field contacts.

2.4 PANEL MOUNTED DEVICES

- A. Analog signals.
 - 1. Sent to and received from the field: 4-20mA
 - 2. Analog I/O modules: Configured for 4-20mA signals.
 - 3. Include signal converters necessary to make Control panel compatible with field equipment on panel.
- B. Panel and enclosure.
 - 1. Equipped with ground lugs for connection to external ground.
 - 2. Screw terminal-type ground bus bolted to back panel: Provided for grounding electrical equipment and instrumentation.
- C. Instruments, pilot devices or operator panel mounted on outside of enclosure:
 - 1. Suitable for flush mounting.
 - 2. Match the NEMA rating of enclosure.
 - 3. Located between 30" and 62" from floor.
- D. Panel mounted devices:
 - 1. Mounted on din rail whenever possible
 - a. Din rail segments: Extended to include unused panel space.
 - 2. Designed to facilitate removal and maintenance of equipment after installation.
 - 3. Identified by markers placed adjacent to, but not on, given device.
 - 4. Markers:
 - a. Display device tagnames and/or descriptive names.
 - 1) Engraved plastic nameplates or labels printed with indelible ink. Hand lettered markers are not allowed.

2.5 PILOT DEVICES

- A. Selector switches, pushbuttons, and indicating lights: Heavy duty, oil-tight, 30mm, NEMA 13-rated.
- B. Selector switches and pushbuttons.
 - 1. Supplied with operator mechanisms, appropriate number of contact blocks, and any necessary legend plates bearing pertinent information.
 - 2. Contact block terminals: Labeled for identification purposes and contain no less than one single-pole, double-throw contact.
 - 3. Contact blocks: Heavy duty type rated for 10A breaking current at 120V.
- C. Stop and emergency stop pushbuttons: Red in color unless approved otherwise.
 - 1. Other pushbuttons: Black unless approved otherwise.

- D. Pushbuttons.
 - 1. Operation: Momentary.
 - 2. Switch operation for local-remote, auto-manual, and computer-manual selection: Maintained in all positions.
 - 3. Provided with flush head bezels.
- E. Spring return selector switches: Required where indicated on Contract drawings.
- F. The following color code shall be used for the lenses of all indicating lights:

<u>FUNCTION</u>	<u>COLOR</u>	<u>FUNCTION</u>	<u>COLOR</u>
ON	Red	HIGH	White
OFF	Green	AUTOMATIC	White
CLOSED	Green	MANUAL	Blue
OPEN	Red	LOCAL	Blue
LOW	White	REMOTE	White
FAIL	White	POWER ON	White
TRIPPED	White		

- G. Indicating lights: Push-to-test LED-type, rated for 120V operation.
- H. Selector switches, pushbuttons, and indicating lights: Allen-Bradley Series 800, Siemens Class 52, or equal.

2.6 INTERPOSING RELAYS

- A. Used in conjunction with discrete inputs when field equipment being monitored is not compatible with 120VAC.
- B. Discrete outputs: Energize interposing relays interlocked with field control circuits, unless approved otherwise.
 - 1. Relays.
 - a. Coils rated to match field equipment.
 - b. Contacts rated for no less than 5A.
 - c. Only one Form C contact per relay.
 - d. LEDs to indicate when coil is energized.
 - e. Manual override switches for testing.
 - f. Turck/Releco type C12-A21X or equal.
- C. Provide surge suppressors on DC operated relay coils to reduce high transient voltage generated when circuit to operating coil is opened.
- D. May be required when using unfused PLC relay output modules.

2.7 POWER DISTRIBUTION

- A. Control panels: Furnished with two 120VAC, 20A-rated circuits.
 - 1. Line filtered circuit for powering the PLC, relay outputs, field contacts for digital inputs, 24VDC power supply, instrumentation, etc.
 - 2. Panels that contain the PLC processor and communication modules: Furnished with 120V receptacle on line filtered circuit for powering transceiver.
 - 3. Auxiliary circuit for powering enclosure lights and utility receptacle.
- B. Provide master disconnect switch and auxiliary branch circuit protectors (miniature circuit breakers).
 - 1. Circuit breakers: Used on AC inputs to power supplies and auxiliary circuits.
 - 2. Provide fused terminal blocks for 24VDC-powered devices and for connecting power to bottom tier of digital input terminal block assemblies.
- C. Input terminals, branch circuit protectors, and fuse terminals: Mounted on din rail and grouped according to function.
 - 1. Fuse terminals for digital input terminal block assemblies: Mounted next to digital input terminals.
- D. Auxiliary Branch Circuit Protectors: Siemens Series SY with trip characteristic C, or equal.
- E. Control Panel Power Supply
 - 1. Provide Control panel with 24VDC power supply rated for either 5A or 10A.
 - 2. Power supplied: Meet or exceed the following specifications;

Input Power:	85 to 132 VACS, 47 to 63 Hz
Minimum Efficiency:	90%
Overload Rating:	150% I (out) rated up to 5 s/min
Protection:	Internally fused, preset current limit
Operating Temp. Range:	0 to 60 deg. C
Mounting:	Din rail mount
Output Voltage:	22.8 to 28V, adjustable
Output Voltage Regulation:	Typical 0.3% V (out)
Ripple and Noise:	<50 mV, pp
Temperature Coefficient:	0.02 percent per degree centigrade
Manufacturer:	Siemens 6EP1333-2AA01 (5A)
	Siemens 6EP1334-2AA01 (10A)
	Siemens 6EP1961-3BA20 (Redundancy)
 - 3. Control panels that contain PLC processor:
 - a. Equipped with redundant power supplies and redundancy module that can switch to backup unit in case of failure.
 - 1) Redundancy module status contact: Wired into PLC digital input.

F. Power Line Transient Protection.

1. Provide panels containing solid state electronic equipment with line voltage surge suppressor provided with;
 - a. Surge arrester.
 - b. RFI filter.
 - c. Voltage clamp.
 - d. Terminals for incoming and load wires that shall trip power feed circuit breakers.
 - e. Automatic device reset.
 - f. Din rail mountable.
2. Approved Manufacturers;
 - a. Islatrol brand IE-120.

G. Uninterruptable Power Supply: Ferrups style with MBB bypass transfer switch, quick disconnect cables with twistlock connectors, and caster kit.

H. Exhaust Fan Motor Starter

1. The exhaust fan motor starter shall be across-the-line magnetic type rated in accordance with NEMA standards, sizes and horsepower ratings. The motor starter shall have a 120 volt coil. The motor starter shall be located in the Control Room Exhaust Fan Control Panel. The motor starter shall be furnished with an overload relay. Provide a heater element in each phase of the relay sized for the motor nameplate full load amps.
2. The exhaust fan motor starter shall be Allen-Bradley Bulletin 509 or Square D Class 8536.

PART 3 EXECUTION

3.1 FACTORY TESTING.

- A. Equipment: Inspected and tested prior to being shipped to field.
- B. Each piece of hardware: Energized and tested to verify components function following manufacturer specifications.
- C. Factory testing: Include integrated system test to demonstrate proper functioning of CPU, local I/O modules, remote I/O network and remote I/O modules. Conduct test using minimally configured system.
- D. Personal computer and software necessary to create PLC hardware configuration for testing: Provided by factory
 1. WSSC will provide CPU rack for testing remote I/O panels upon request.
- E. Test Each I/O point following procedures outlined below. For purposes of factory testing;

1. "Field terminals" shall mean the terminal blocks on the Control panels meant to receive field wiring
2. "Console" shall mean the personal computer used to configure PLC and verify I/O test.

Digital Inputs: Jump each digital input field terminal to 120VAC or 24VDC, according to module type. Observe change of state at console.

Digital Outputs: For relay output modules with field connections to both line and load, force each output on at the console and measure the change of state at field terminals with continuity tester. For relay output modules connected to interposing relays on Control panel, verify proper output voltage and operation of interposing relays.

Analog Inputs: Introduce 4 to 20 mA DC signal at field terminal and observe changing value at console. Test response at 4 mA, 12 mA and 20 mA.

Analog Outputs: Force each output at console with values corresponding to 4 mA, 12 mA and 20 mA, and measure results at field terminals.

- F. Provide 5 working days notice prior to starting factory testing. WSSC will typically witness testing, but may waive this requirement on case-by-case basis.
- G. Patent defects in equipment: Repaired or replaced, as required, at no cost to the Commission, until substantial completion.
 1. If Latent defects are found notify the Commission immediately.
- H. Any factory modifications to Control panels shall be approved, tested, and documented prior to final acceptance.

3.2 POST TESTING

- A. Submit following documentation within 14 days of finishing factory panel testing.
 1. As-built versions of shop drawings listed herein.
 2. Fully annotated PLC logic backed up on CD-ROM.
 3. OIT configuration, tags and screens backed up CD-ROM.
 4. Complete I/O list following Process Control Group format.
- B. Submit final as-shipped drawings prior to shipment for approval and provide one copy within enclosure(s) to be shipped.
- C. Provide for protection, insurance and proper storage of equipment until received and inspected by the owner.
- D. Deliver spare parts for Control panels, as specified in contract drawings and documentation, prior to panel installation.

END OF SECTION

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