SECTION 44 44 13.02

SODIUM HYPOCHLORITE GENERATION SYSTEM
04/08

PART 1 GENERAL

1.1 DEFINITIONS

a. FRP: Fiberglass reinforced plastic.

b. HDPE: High-density polyethylene.

c. ISC: Instantaneous short circuit.

d. OIT: Operator interface terminal.

e. PLC: Programmable logic controller.

f. SCR: Silicon controlled rectifier.

g. System Supplier: Entity responsible for furnishing equipment specified in this section as a complete operable system and for providing specified manufacturer's services.

h. THD: Total harmonic distortion.

i. XLHDPE: Cross linked high-density polyethylene.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(2004) Hypochlorites

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 519	(1992) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

installation

Detailed dimensional drawings for equipment, including mounting requirements, and piping connection sizes and locations

Piping drawings with identification of materials, including pipe, fittings, valves, specialties, hangers, supports, insulation, heat tracing and labeling

Schematic and wiring diagrams showing power, control, and instrumentation circuits, wiring identification, and field interconnection wiring between control panel and other components

Process instrumentation and flow diagrams (P&IDs) showing location of valves, instruments, and auxiliary equipment

Control panel arrangement drawings showing outline dimensions and front-of-door and internal backplane device location

SD-03 Product Data

Material and equipment requirement

List of proposed system components; bill of materials.

Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

Complete, developed catalog number of all instruments. ISA Data sheet for each instrument.

Performance data on blowers, pumps, and rectifier units.

Manufacturer's materials compatibility information, confirming compatibility of wetted parts with specified pumped chemicals.

External mechanical utility requirements, including water supply and drain for each component or compressed air. Specify acceptable range of utility pressure and temperature for proper system operation.

Manufacturer, model, weight, and rating(s) of each equipment assembly.

Complete motor nameplate data as defined by NEMA, motor manufacturer, and motor modifications included.

Electrical power supply requirements for rectifiers, control panel, and auxiliary electrical devices.

Functional description of internal and external instrumentation and controls including list of parameters monitored, controlled, or alarmed, at both system control panel and remotely.

Control panel bill of materials with manufacturer descriptive information.

Factory finish system.

Sample Special Guarantee.

Cell Performance Calculations: Data shall include electrode area measurements, and current flows. Electrode service factor shall be expressed in amperes per square inch of electrode surface.

PLC and OIT program listings in hard copy and electronic media formats. Documentation shall include complete data mapping of process parameters, and status and alarm variables required to provide for remote monitoring.

Suggested spare parts list to maintain the equipment in service for periods of 1 year and 5 years, with current pricing. Include a list of tools required for checking, testing, parts replacement, and maintenance, and specify if any of these are furnished with the equipment.

SD-04 Samples

Certified factory inspection and test reports on manufacturer's standard forms

SD-05 Design Data

Rectifier harmonics spectrum; harmonic calculations for transformer/rectifier unit in accordance with IEEE 519 and as specified. Nameplate current, voltage and power factor. Heat rejection to surrounding air, airflow (CFM) at pull load.

Calculations

The equipment anchorage structural calculations shall be stamped and signed by a registered Civil or Structural Engineer currently licensed in the State of California. Design criteria is as stated on Drawing G-10, Structural Construction Notes.

SD-06 Test Reports

test data

Field performance test procedures.

Field test reports for each functional and performance test of equipment.

SD-07 Certificates

certification

NSF 61 Certification

Manufacturer's Certificate of Proper Installation.

Executed Special Guarantee.

SD-08 Manufacturer's Instructions

instructions

Special shipping, storage and protection, and handling instructions.

Manufacturer's printed installation instructions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manual

Operation and Maintenance Manual as specified in Section 01 78 23, OPERATION AND MAINTENANCE DATA.

1.4 QUALITY ASSURANCE

Qualifications: System Supplier shall have at least 5 years' experience in furnishing similar equipment of similar capacity and service capability to equipment specified herein.

1.5 SPECIAL GUARANTEE

a. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of anode plates found to be defective or failing to perform within the water, power, and salt consumption limits stated herein during a period of 7 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective equipment shall be as specified in the General Conditions. The manufacturer's responsibility for this extended warranty shall be:

1. Full anode replacement cost for the first 2 years following Substantial Completion.

2. Anode replacement cost on a prorated basis from the 3rd year through 7th year of operation.

1.6 EXTRA MATERIALS

a. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials, and have these lists stated in the Operation and Maintenance Manual.

1. One complete set of fuses for control panel.

2. One complete set of fuses for transformer/rectifier.

3. One electrolytic cell level and temperature switch assembly, or one level and one temperature switch if individual components.

4. One dilution water solenoid valve.

5. Brine Pump: One set of manufacturer recommended spare parts.

6. Sodium Hypochlorite Dosing Pump: One set of manufacturer recommended spare parts.

7. One airflow or differential-pressure switch assembly.

8. One complete electrolytic cell.

9. One complete set of special tools required to service equipment provided.

10. Provide greases and lubricants for 1 year of continuous operation for each system.

b. Pack spare parts in sturdy containers with clear indelible identification markings and store in a dry, warm location until transferred to Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

a. Materials, equipment, and accessories specified in this section shall be products of:

1. Severn Trent Services, Torrance, CA; ClorTec.

2. Siemens Water Technologies, Warrendale, PA (US), Dutch Netherlands; OSEC.

3. Or approved equal.

2.2 GENERAL

A. System shall be complete and, except for field installation and interconnection of components and assemblies, ready for operation.

B. System shall include, but is not limited to, electrolytic cell, transformer/rectifier, salt storage/brine saturator tank, hypochlorite solution storage tank, brine feed pump, water softeners, water heater, hydrogen dilution blower, cartridge filters, pressure regulator, piping, valves, control panel, on-skid wiring and conduit, instrumentation and control devices, and accessories as specified.

C. System components shall meet the material and equipment requirement.

D. Perform Calculations of equipment anchoring, harmonic for transformer and rectifier.

E. System Assembly and Interconnection: Provide as a skid-mounted assembly with various separate field-mounted devices or equipment, as specified.

1. Where the system includes field-mounted devices or equipment, provide for interconnecting piping and wiring by others, as specified.

2. The following equipment shall be factory-mounted on a common skid as sub-assemblies:

a. Rack assembly including electrolytic cells with temperature and level control, brine proportioning system, drain valve, acid cleaning by-pass valve, solenoid valve, pressure regulator and flow switch.

b. Control cabinet with color touch screen display, PLC blower control, communication protocol, all I/O points and safety interlocks.

c. Dual tank automatic regenerating water softener.

d. Vent stack hydrogen dilution system consisting of two blowers (one duty/one stand-by) with factory pre-assembled check valves.

e. Hypochlorite tank hydrogen dilution system consisting of two blowers (one duty/one stand-by) with factory pre-assembled check valves.

f. Skid shall have external connections or terminal blocks for: system power and control wiring, external control, monitoring and alarm circuit wiring, domestic water supply (in), hypochlorite (out), softened water to brine tank (out), process brine solution from brine tank (in), softener regeneration brine solution from brine tank (in), hydrogen gas vent (out), drain (out), and acid cleaning solution (in).

3. The following devices and equipment shall be furnished loose for field installation and interconnection with other system components:

a. Transformer rectifiers.

b. Water heaters.

c. Inline filter assembly.

d. Differential pressure switches for hydrogen dilution systems.

e. Hydrogen detectors and master panel for generator room.

f. Maintenance kit.

g. Spare parts.

2.3 SERVICE CONDITIONS

A. Site Conditions:

1. Location: Indoor.

2. Electric Power Supply: 480V ac, three-phase.

3. Water Supply Pressure (prior to regulator or booster pump): 90 psi.

4. Water Supply Temperature: 60 degrees F.

5. Water Hardness: _____

6. Water Iron Level: _____

7. Water Manganese Level: _____

8. Water Chlorine Level: _____

2.4 SODIUM HYPOCHLORITE GENERATION SYSTEM

2.4.1 General

1. Provide system capable of producing 450 pounds per day available chlorine (2) generators 450 lbs/day each.

2. Generate aqueous solution of a nominal concentration of 0.8 percent, plus or minus 0.05 percent, by weight sodium hypochlorite expressed as available chlorine.

3. Use 99.7 percent pure dry weight solar salt containing no organic binders, flow control agents, or resin cleaning material.

4. Process shall operate on a batch basis, providing consistent hypochlorite concentrations and greatest efficiencies.

5. System shall have no waste products associated with system's use other than hydrogen gas which shall vent to the atmosphere, and water softener regeneration brine which shall be routed to a drain.

6. Sodium hypochlorite generator's utility requirements shall not exceed the following per pound of available chlorine equivalent produced:

   a. Electrical Energy: 2.0 kilowatt-hours (kWh) (ac).

   b. Water: 15 gallons.

   c. Salt: 3.0 pounds.

7. Skid-mounted Generation System:

   a. Those portions of the system specified herein shall be skid-mounted, or shown on Drawings to be mounted on a skid, shall be factory wired, plumbed, and assembled on a common skid and tested prior to shipment as a complete functioning system.

   b. Skid frame shall be carbon steel, coated as specified under Paragraph Factory Finish.

   8. Acid Cleaning Provisions:

   a. Provide valving suitable for allowing brine proportioning pump or an eductor to blend muriatic acid into cell for cleaning purposes.

   b. Provide a separate, portable, 120V ac cord-and-plug connected feed pump suitable for pumping acid from a pail or other container.

   c. Provide a portable cart-mounted acid feed system with a tank, 120 volt single-phase self-protected feed pump with cord and plug, ON-OFF switch, hoses and quick couplings for connecting to generation system piping, and cart with wheels and a handle.

   d. Acid shall be manually added to the cell and manually drained.

2.4.2 Feed Points

1. Normal Operating Conditions: Site generated sodium hypochlorite injected into process at location(s) shown on Drawings.

2. Emergency Conditions: System shall allow commercially available sodium hypochlorite, 12 percent to 15 percent solution, to be used via a suction connection at sodium hypochlorite dosing pump in lieu of the onsite generated sodium hypochlorite solution.

2.4.3 Sample Points

Provide the following valved sample points as a minimum:

1. Brine solution.

2. Sodium hypochlorite product.

3. Softened water product.

4. Provide permanent piping and supports from sample point valve to convenient sample collection point, suitable for obtaining a sample without spill or dripping onto equipment or skid. No higher than 48 inches above base.

2.4.4 Flow Control Metering Panel

Provide with throttling valves and rotameters, or other flow measuring devices, to dilute concentrated brine with softened water to produce a 3 percent solution to be delivered to electrolytic cell.

2.4.5 Electrolytic Cell

1. Constructed of acrylic or PVC materials, with the tube itself constructed of clear material allowing for full visual inspection of electrodes during normal operation.

2. Tubular construction, allowing for electrodes to be removed as a single assembly.

3. Cells shall be constructed of a single PVC or Acrylic tube. No joints or flanges in the cell are allowed.

4. Acrylic cell tube shall be free of nozzles to avoid mechanical stress and prevent cell cracking. All cell nozzles should be installed at the end caps.

5. Joining of cell materials shall be by solvent welding or mechanical compression. Thermal welding shall not be allowed.

6. Electrodes:

a. Titanium with anodes coated with a mixed metal oxide catalytic coating for electrical efficiency and maximum longevity.

b. Vertically oriented, solid flat plate construction to maximize high velocity gas lift between electrodes and minimize scaling.

c. Expanded metal electrodes shall not be allowed.

7. Cell Current Density: 1.2 amps per square inch maximum.

8. Cells shall operate at low voltage less than 60 volts DC to minimize

electrical hazard to operators.

9. Cells shall be factory pressure-tested to 55 psi, for a period of 15 minutes, prior to final assembly and shipment.

2.4.6 Transformer/Rectifier Unit

1. Unit shall provide dc power to each electrolytic cell.

2. Enclosure:

a. NEMA Type 1, with provision for anchoring to floor or to generator system skid.

b. On front panel of enclosure, provide means to monitor rectifier current and voltage output.

3. Transformer:

a. Suitable for full-wave rectifier connection.

b. Rated to operate at elevation and ambient temperature specified.

c. Frame mounted in a NEMA 1 enclosure, air cooled; with Class H insulation and 80 degrees C temperature rise.

4. Output and kVA Rating:

a. As required for operation of sodium hypochlorite generation system.

b. Equipped for termination of the required number of conductors with compression spade lugs at each dc connection.

5. Duty Cycle: Continuous.

6. Cooling: Air.

7. Overall Rectifier System Efficiency: 90 percent minimum at rated output.

8. Power Supply:

a. 480V ac, three-phase, 60 Hz, with maximum load of 85 amps.

b. Equip with built-in dc volt and amp display, emergency shut-off switch, and disconnect switch.

9. Disconnect:

a. Nonfused disconnect switch or circuit breaker on each separate power supply to simultaneously open incoming ungrounded circuit conductors.

b. Operating handle accessible through enclosure door. Incorporate interlock to prevent opening door when switch is in ON position. Provide pad lockable operating mechanism handle.

10. Metering:

a. Provide metering of output voltage and output current.

b. Sensing devices and displays shall have overall accuracy of 0.5 percent or better.

11. Harmonics:

a. In accordance with IEEE Std 519, compute normal source individual and total current harmonic distortion at input terminals of transformer. Assume fault current (ISC) available at that location is 20,000A rms symmetrical. Individual current harmonic distortion expressed as a percentage of the maximum demand load current (IL, maximum rated input current of transformer) shall not exceed values specified in the following table:

Individual Harmonic Order (odd harmonics)	Harmonic Current Distortion (maximum) Percent of IL
h<11	12.0
11.h<17	5.5
17.h<23	5.0
23.h<35	2.0
h.35	1.0
Total	15.0

b. In accordance with IEEE 519, compute normal source voltage harmonic distortion at the transformer terminals. THD shall not exceed 5 percent, and individual voltage harmonic distortion values shall not exceed 3 percent.

c. Furnish series reactors, capacitors, harmonic filters or other devices necessary to achieve these harmonic distortion limits.

2.5 STORAGE TANKS

2.5.1 Salt Storage/Brine Saturator Tank

Provide covered FRP salt storage/brine saturator tank capable of holding 50,000 pounds of salt, with stainless steel pneumatic salt fill line, dust bag, ladder and handrails on top of the tank, in accordance with Section 43 40 02 FIBERGLASS REINFORCED PLASTIC (FRP) TANK.

Tank shall be approximately 9 feet in diameter by 15 feet tall.

2.5.2 Sodium Hypochlorite Storage Tank

Provide a 7,000 gallon covered FRP sodium hypochlorite storage tank in accordance with Section 43 40 02 FIBERGLASS REINFORCED PLASTIC (FRP) TANK.

2.6 WATER SOFTENER

a. Water softener shall use brine from brine saturator tank for regeneration.

b. Features:

1. Dual tank, continuously operational (one tank in operation while other tank regenerates).

2. Capable of automatically regenerating without use of electric

timers or gear motors.

3. Regeneration cycles shall be flow dependent only.

4. Sized to regenerate not more than once every 8 hours based on system operating continuously at rated capacity.

5. Rated for 125 psig maximum working pressure and tested at 300 psig.

6. NSF 61 approved.

c. Valving:

1. Provide isolation valves on inlet and outlet for water softener.

2. Provide bypass valve around water softener.

d. Manufacturer: Kinetico with automatic switchover and bypass valve assembly.

2.7 HYDROGEN DILUTION BLOWERS

a. Provide one main and one standby hydrogen dilution blower as shown on Drawings for designated equipment.

b. Features:

1. Sized to reduce concentration of hydrogen gas in storage tank to less than 1 percent in air on a volumetric basis; 25 percent of lower explosive limit (LEL).

2. Blower Wheel and Housing: Aluminum or FRP.

3. AMCA Type B spark resistant construction.

4. Provide flanged inlet and outlet connections, scroll drain port with plug, and belt guard if belt driven.

5. Provide backdraft damper or check valve in blower discharge.

6. Power Supply: 120/240VAC, single-phase, 60 Hz supplied from motor controller located in system control panel.

7. Monitor blower operation and coordinate with operation of air flow or differential pressure switch(es) to provide safety interlocks, and alarm indication. Monitoring functions shall be powered, controlled, and monitored by system control panel.

8. Blower shall start upon system startup and shall continue to operate for 15 minutes after system shuts down.

9. Standby blower shall start automatically if main blower fails.

10. Motors shall be TEFC.

c. Manufacturers:

1. New York Blower Co.

2. Cincinnati Fan.

3. Or approved equal.

2.8 CARTRIDGE FILTER

Features:

1. In-line orientation.

2. Reinforced clear PVC housing.

3. Rated for particle removal at design flow rate. Manufacturer shall define particle retention and flow rate.

2.9 SYSTEM PRESSURE RELIEF

a. Provide pressure relief valve or rupture disc, or both, to protect the electrolytic cells from excess pressure.

b. There shall be no isolation valves between the cells and the system pressure relief device.

c. Provide flow switch in relief valve discharge or a reed or proximity switch to sense operation of the pressure relief device, and if activated, initiate an alarm and shut the system down.

2.10 HYDROGEN GAS MONITOR

a. Provide self-contained gas analyzer(s) and transmitter(s) suitable for monitoring hydrogen gas concentration in ambient room air.

b. Output shall be 4 mA to 20 mA dc analog signal to control panel for continuous monitoring. Unit shall be two-wire type or, if requiring an external power supply, suitable for power supply provided at system control panel. Provide monitoring of room hydrogen concentration, and alarm and system shutdown if gas concentration exceeds 25 percent of the LEL for hydrogen gas. Minimum of 2 detection units shall be supplied.

c. Manufacturer and Product: Thermo Scientific Safe T Net 210 or ATI D12.

2.11 SALT LEVEL TRANSMITTER

a. Type: Retractable weighted cable on motorized pulley. During measurement, cable is released and encoder measures length of dispensed cable. At material surface, length of cable is recorded and motor activated to retrieve cable.

b. Interface: Control unit to allow automatic operation from PLC. Output 4 to 20 mA signal in proportion to measured level range.

c. Power: 120 V ac, single-phase, 60 Hz.

d. Manufacturer and Product: BinMaster SmartBob II.

2.12 BRINE AND SODIUM HYPOCHLORITE LEVEL TRANSMITTER

a. Type: Direct pressure sensing, Component L10 as specified in Section 40 95 00, PROCESS CONTROL.

b. Mounting: Flanged or threaded to tank fitting, with isolation valve.

c. Interface: Output 4 to 20 mA signal in proportion to measured level range.

d. Power: Loop-powered, two wire.

e. Manufacturer: Emerson Process Rosemount.

2.13 AIRFLOW SWITCH FOR HYDROGEN DILUTION VENT PIPE

a. Vane operated flow switch, differential pressure switch, or orifice with differential pressure switch. Wetted parts shall be stainless steel or nonmetallic. Provide fail-safe operation, generating a system alarm and shutting off system if airflow falls below required minimum. Switch contacts shall be SPDT with 5 Amp, 120 volts AC or DC rating.

b. Manufacturers:

1. W.E. Anderson.

2. Dwyer.

3. Or approved equal.

2.14 VALVES AND PIPING

Provide required valves, piping, and tubing for manufacturer-assembled system.

2.15 CONTROL SYSTEM

2.15.1 General

1. Provide a complete PLC-based control system for the sodium hypochlorite generation system, in accordance with requirements in Section 40 99 90, Package Control Systems. Provide Operator Interface Terminal (OIT) for system monitoring, alarms, and control.

2. Generation System Supplier shall provide complete control software, fully functional and debugged, as required for system operation.

3. Equip PLC with Ethernet TCP/IP interface for connectivity with plant-wide process control data network system.

4. Deliver system with fully debugged and annotated application software, for both PLC and OIT. Software application to be delivered in electronic file format compatible with plant programming software.

2.15.2 Control Panel

1. Panel Number: MCP-300.

2. Enclosure: NEMA Type 4X, 304 stainless steel.

3. Features:

a. Main power disconnect.

b. Combination motor starters for blowers.

c. PLC system including power supply, processor, communication modules, and input/output modules for discrete and analog signals.

d. OIT mounted on front of panel.

e. UPS, installed within control panel enclosure, sized to power PLC and communication equipment for 5 minutes for proper PLC shut down.

4. Generation system control logic provided by PLC, where operating parameters are measured, scaled, reported, and controlled. Safety functions shall be fail-safe and hard-wired.

2.15.3 Operator Controls and Indicators

1. Local audible and visible alarm with alarm silence switch.

2. Power ON indicator light.

3. Master Control ON-OFF selector switch.

4. Display operating parameters, modes, status, and alarm conditions on a color graphic OIT mounted on front door of panel. OIT to be touch-screen type, or include membrane keypad.

5. System Control Functions:

a. Electrolytic cell safety device.

b. Rectifier control.

c. Blower control.

d. Generator operating mode, including FAIL/ON/RUN/LOW LOW controls and status indications.

e. Alarm history.

f. Security protection.

6. Indicate and log the following alarm conditions:

a. System shut down in the event of cell liquid low level and high temperature, rectifier improper voltage or current, hydrogen dilution blower low air flow, hydrogen level in the room or relief valve or rupture disc operation.

b. Cell low liquid level.

c. Cell high temperature.

d. Low brine or water flow.

e. Rectifier improper voltage or current.

f. Rectifier fault.

g. Hydrogen dilution blower low air flow.

h. Relief valve or rupture disc operation.

i. Hydrogen level in the room.

1) Provide fail-safe monitoring and alarm indication.

2) Provide visual and audible alarm.

j. Low-low level for storage tank.

k. High-high level for storage tank.

l. Low brine temperature.

7. Display the following parameters locally at OIT:

a. Salt and brine levels.

b. Salt level LOW, indicating need to add salt.

c. Rectifier status.

d. Rectifier dc amperage and voltage.

e. Dilution blowers status.

f. Hypochlorite tank level.

g. Water solenoid valve status.

2.15.4 External Interfaces

1. Provide an Ethernet network switch for interconnection of PLC, OIT, and plant network, and to allow connection of programming equipment. Interface to plant network shall be by multi-mode fiber optic cable. Provide fiber patch panel and fiber network port on Ethernet switch for plant network connection.

2. Coordinate IP addresses with Owner and plant control system programmer to ensure compatibility with other control system network components.

3. Make available, through the Ethernet communication network, key process parameters, status and alarm conditions for monitoring by a separate plant control system.

4. Provide parameters stored in an array format, or in a single user-defined data structure, to allow data to be read by a single message request. For each parameter, document data type (Boolean, integer, floating point), scale range and engineering units, and active state.

5. Communicated Parameters:

a. All alarm conditions.

b. Salt and brine levels.

c. Salt level LOW.

d. Generation system and rectifier status.

e. Rectifier dc amperage and voltage.

f. Dilution blowers status.

g. Hypochlorite tank level.

h. Water solenoid valve status.

i. Other parameters as recommended by Generation System Supplier.

2.15.5 Functional Requirements

1. Perform required functions, including generator operation, hydrogen blower control, tank level control, brine feed control, and system monitoring, alarms and safety shut down.

2. Generation System Master ON-OFF Control:

a. In OFF position, rectifier and generation system is shut down.

b. When switch is in ON position, generation system shall operate based on high and low levels in sodium hypochlorite tank.

3. Water softener resin shall automatically be regenerated with salt solution from brine tank based on totalized water flow.

4. Feed water solenoid valve automatically controlled to maintain brine level.

5. Rectifier Protection and Alarms:

a. Provide control circuits to shut down rectifier system in the event of a fault.

b. Display type of fault that caused shutdown.

6. Provide detection of the following faults:

a. Input power phase failure or voltage imbalance.

b. Transformer winding high temperature.

c. SCR heat sink high temperature.

d. Cooling fan failure.

e. dc current and voltage limits.

f. Door interlock switch.

2.15.6 Power Requirements

Control Panel Power Supply: 120/240 V ac, single-phase, power for controls and supply to blowers, with fuse-protected control power transformer, if necessary. Provide a separate disconnect switch for each blower, located adjacent to the blower.

2.15.7 Special Requirements

1. Hazardous Areas: Electrical circuits in Hazardous Areas shall be intrinsically-safe, suitable for area class and division.

2. Software shall include security measures to prevent unauthorized modification of PLC code or parameters. Provide passwords and other security system logon requirement upon completion of system commissioning.

2.16 RACEWAYS AND CONDUCTORS

2.16.1 Raceways, General

1. Route wiring external to devices and other enclosures in conduit, including DC power cables to generation cells.

2. Conduit and fittings shall be listed products.

3. Enclosure penetrations shall maintain rating of enclosures, conduit hubs are required.

4. Make final connection to motors, devices with process connections, or devices that may require removal or adjustment with flexible conduit.

5. Use PVC Schedule 80 conduit where corrosion resistance is required and where protection from physical damage and support are provided.

2.16.2 Wiring, General

1. Terminate wiring that interconnects devices, enclosures, and other system components on numbered terminal blocks.

2. Wire and cable shall be listed products.

3. Power and discrete control circuits shall include a code-sized equipment grounding conductor routed with the circuit conductors.

4. Instrumentation signal circuits shall use jacketed shielded cable with required conductor make-up.

5. Ground cable shields at one end only.

6. Identify wires and cables using permanent-labeled wire markers and a consistent naming system.

2.16.3 Conduit

Provide code-sized rigid PVC coated aluminum, or Schedule 80 PVC in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM.

2.16.4 Cable and Conductors

Discrete conductors shall be stranded copper wire with Type THW or THWN insulation for circuits operating at greater than 50 volts in accordance with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM. Multi-conductor cables shall be manufacturer's standard product and assembly.

2.17 FACTORY FINISH

a. Shop prime and finish coat exposed metal surfaces, except stainless steel, brass, and bronze, of equipment and accessories.

b. Equipment, accessories, and skid fabricated of carbon steel shall be epoxy coated. Epoxy coating shall be as specified in Section 09 90 00.00 40, PAINTING AND COATING.

2.18 ACCESSORIES

a. Furnish initial supply of greases and lubricants required to start operations.

b. Provide initial charge of salt to fill the brine tank to capacity.

c. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.

d. Equipment Identification Plates: Provide 16 gauge 304 stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8 inch high engraved block type black enamel filled equipment identification number and letters indicated in this Specification and as shown on Drawings.

e. Device Nameplates: Provide devices, including front or door-mounted operator interface devices with engraved plastic nameplates. Attach nameplates by adhesive or stainless steel panhead screws.

f. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, 1/2 inch minimum diameter.

2.19 SOURCE QUALITY CONTROL

2.19.1 General

1. Perform manufacturer's standard factory inspections and tests prior to packaging and shipment. Provide Certified factory inspection and test reports on manufacturer's standard forms.

2. Testing procedures shall ensure proper operation of functions and demonstrate specified performance.

3. Perform testing according to manufacturer's standard procedure and forms.

2.19.2 Functional Tests

Test start-up, operating, control, interlock, monitoring, safety and alarm, and shutdown functions. Testing shall include as a minimum:

1. Start-up sequence.

2. Hypochlorite concentration test (titration).

3. Generation capacity (lb/day) test.

4. Shut down sequence.

5. Simulation of critical alarms.

2.19.3 Performance Tests

Demonstrate operation in accordance with system design parameters, including specified design capacity. Minimum capacity shall be demonstrated to be equal to specified capacity and sodium hypochlorite concentration, while not exceeding maximum raw material and utility input quantities.

2.19.4 Continuous Operation Test

Test generator assembly for a minimum of 8 continuous hours and confirm proper operating parameters.

2.19.5 Factory Test Reports

Provide certified test reports; include test data sheets.

PART 3 EXECUTION

3.1 INSTALLATION

a. Install in accordance with manufacturer's printed instructions.

b. Anchor Bolts: Accurately place using equipment templates.

c. Grout or shim tie-down lugs for tanks to prevent excessive loads being transferred to tank shell.

d. Complete system mechanical connections, including water supply and drain for each piece of equipment.

e. Apply initial supply of salt and lubricants.

f. Complete electrical connections in conformance with requirements of Division 26, Electrical.

g. Provide certification of proper installation.

3.2 FIELD FINISHING

Field finish equipment as specified in Section 09 90 00.00 40, PAINTING AND COATING.

3.3 FIELD TESTING

3.3.1 Hydrostatic Test

1. Perform hydrostatic test on tanks after installation, but before piping connections are made.

2. Block outlets and fill each tank with water to check for leaks.

3. No leakage shall be permitted.

3.3.2 Functional Test

1. Prior to plant startup, inspect equipment for proper installation,

quiet operation, and proper connection.

2. Confirm system is operating.

3. Verify structures, equipment, pumps, and motors are compatible for an efficient system.

4. Make equipment adjustments required to place system in proper operating condition.

5. Demonstrate system functions, including control, interlock, safety and alarm, monitoring, and remote interface in presence of Engineer.

3.3.3 Performance Test

1. Conduct in presence of Engineer.

2. Perform under actual or approved simulated operating conditions for a continuous 8 hour period without malfunction.

3. Verify calibration of metering pumps using installed calibration columns.

4. Verify calibration of sodium hypochlorite and brine tank level transmitter.

5. Verify sodium hypochlorite concentration with samples taken at generator outlet once each half hour.

a. Analyze Samples for available chlorine per AWWA B300.

b. Average of the concentrations of the Samples shall be in the range of 0.75 percent to 0.85 percent.

6. Verify chlorine generation capacity.

a. Calculate on the basis of the average available chlorine concentration and volume of the produced sodium hypochlorite.

b. Capacity shall be reported in pounds per day and shall equal or exceed capacity of system specified.

7. Verify salt consumption.

a. Take brine sample once each half hour and measure temperature and specific gravity to determine salt concentration.

b. Multiply average salt concentration by brine feed rate, based on brine pump calibration, and elapsed time of test period. Divide total salt consumption by total chlorine generated to determine pounds of salt used per pound of available chlorine produced.

c. Salt consumption shall not exceed 3 pounds per pound of chlorine.

8. Verify power consumption.

a. Furnish and connect power meter for test.

b. Measure load in kilowatts at input to transformer/rectifier,

including harmonic control or filter apparatus, during test period. Also control panel.

c. Take power reading once per hour during test period.

d. Total energy consumed shall be determined by multiplying the average of the hourly power reading times test duration in hours. Total chlorine produced in pounds shall be calculated from the above generation capacity. Total chlorine produced shall be divided by total energy consumed.

e. Result shall not exceed 2.0 kWh per pound of chlorine.

f. Measure and record hourly harmonic spectrum at incoming terminals of system under test. Record harmonic currents and voltages, THD and TDD for all harmonics up to 50th.

9. If sodium hypochlorite system fails to meet specified performance requirements, modify or replace equipment. Adjust and retest system until test results verify satisfactory operation.

3.4 MANUFACTURER'S SERVICES

a. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. 2 person-days for installation assistance and inspection.

2. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.

3. 2 person-days for prestartup classroom or Site training.

-- End of Section --