SECTION 11250

chloramination system

# GENERAL

## SCOPE OF WORK

### This section includes the design, fabrication, installation, and testing of a chloramination disinfection system. The chloramination system includes hypochlorite solution storage tanks, solution metering pumps, VFD’s, piping, valves, static mixers, ammonia feed system, residual analyzer, control panel with PLC and SCADA interface, control equipment, and accessories and appurtenances as required for a complete system.

## Related Work Specified Elsewhere

### Section 01300 – Shop Drawings and Submittals

### Section 01783 – Operating and Maintenance Data.

### Section 15010 – Basic Mechanical Materials and Methods.

### Section 16010 – General Electrical Requirement.

### Section 16012 – Seismic Restraint for Electrical Equipment.

### Section 16260 – Variable Frequency Drives.

### Section 16480 – Low-Voltage Motor Control.

## general

### System supplier shall provide reference list of no less than three installations where fully integrated chemical metering pump systems were provided.

### Not all items incidental to the chloramination system are shown on the drawings or specified herein. The Contractor shall furnish and install all equipment and appurtenances as required to provide a complete, operational, and integrated system.

### Power is provided to the system control panels as shown on the drawings, the Contractor shall be responsible for providing all necessary conduit and wiring necessary for complete system operation. All wiring shall comply with the California Electrical Code, 2004 edition. All chemical systems shall be controlled through the system control panel.

## system description

[\*Note to the Engineer: Populate system description as required]

### Under normal operating conditions, 12.5% bulk sodium hypochlorite will be injected into the process at locations shown on the drawings for disinfection.

### Under emergency conditions, the system shall allow commercially available sodium hypochlorite (10%-12% solution) to be used in lieu of the generated sodium hypochlorite solution. A dilution assembly shall dilute 10%-12% solution to 0.8% solution.

### Ammonium hydroxide (19% solution) will be injected into the process at locations shown on the drawings.

## Submittals

### Submit drawings showing fabrication, assembly, installation and wiring diagrams. Wiring diagrams shall consist of, at a minimum, control schematics, including coordination with other electrical control devices operating in conjunction with the Sodium hypochlorite generator feed system. Submit electrical drawings showing wiring, controls, interlocks, terminals, and disconnects. Label each terminal and wire, showing which control or electrical power wire connects to each terminal.

### Submit manufacturer’s catalog data and descriptive literature for equipment. Submit dimensional and system layout drawings. Show materials of construction and applicable references and standards. Include connection points with orientation, coatings, appurtenances, anchor bolts, and tie down equipment and hardware. Submit process flow diagrams. The CONTRACTOR shall ensure compatibility between all parts of the storage tank and the chemical being stored, including compatibility of all coatings.

### Show wetted materials and coatings. Furnish a performance certification indicating head, capacity, and horsepower for each pump. The specified design discharge shall be when the pump is operating at 100% speed.

### Furnish a certified motor data sheet for each motor.

### Submit design calculations for structural and seismic design of tie-down lugs (number, size, and embedment length of anchor bolts) hypochlorite, and ammonia tanks signed and stamped by a structural or civil engineer registered in the State of California.

### Submit affidavits of compliance with referenced standards and codes.

### The sodium hypochlorite generation system manufacturer shall be experienced in the design and fabrication of systems described herein. Submit a list of no less than five successful installations of similar size to demonstrate experience and qualifications.

### Submit statement guarantee that system meets performance requirements stated in Part 2.C, including daily production capacity of chlorine equivalent, salt usage per pound of chlorine equivalent produced, and electricity usage per pound of chlorine produced. Provide the exact and particular numbers for these parameters.

## OPERATION AND MAINTENANCE MANUALS

### Submit Operation and Maintenance manuals in accordance with Section 01783.

## Manufacturer’s Services

### Provide equipment manufacturer’s services at the jobsite for the minimum labor days listed below, travel time excluded:

### Three labor days to check the installation and advise during start-up, testing, and adjustment of the sodium hypochlorite generation equipment.

### One labor day to instruct the DISTRICT’s personnel in the operation and maintenance of all equipment. The DISTRICT reserves the right to videotape any training sessions.

### One labor day to inspect, test, calibrate and adjust the sodium hypochlorite solution metering pumps. Conduct a training seminar at the site to instruct the DISTRICT’s personnel in the operation and maintenance of the metering pumps.

### One labor day to inspect, test, calibrate and adjust the ammonium hydroxide solution metering pumps. Conduct a training seminar at the site to instruct the DISTRICT’s personnel in the operation and maintenance of the metering pumps.

## warranty requirements

### The chlorine generation system manufacturer will function as the chloramination system integrator taking complete responsibility for every aspect or component of the system regardless of the source or manufacturer. The chloramination system integrator will fully warrant the entire system as if all components were of its own manufacture.

# MATERIALS

## METERING PUMPS

[\*Note to the Engineer: Populate highlighted and/or bracketed fields below, edit as necessary\*]

### Service Conditions and Performance:

#### Sodium Hypochlorite (SHC) Metering Pump System

##### **Location:** As shown on Drawings

##### **Equipment Identification Numbers:**

###### Sodium Hypochlorite Metering Pump No. 1: P-

###### Sodium Hypochlorite Metering Pump No. 2: P-

##### **Service Chemical:** [12.5% ]Sodium Hypochlorite

###### **Specific Gravity:** [1.16]

###### **Temperature:** [50 to 90] deg F

##### **Flowrate Range:**

###### P-201:

###### P-202:

##### **Rated Pressure:** [120]-psig

##### **Minimum NPSHa:** [32] FT

##### **Piping/pump arrangement:** Reference Drawings.

#### Ammonium Hydroxide (NH3) Metering Pump System

##### **Location:** As shown on Drawings

##### **Equipment Identification Numbers:**

###### Aqua Ammonia Metering Pump No. 1: P-

###### Aqua Ammonia Metering Pump No. 2: P-

##### **Service Chemical:** [19% Ammonium Hydroxide]

###### **Specific Gravity:** [0.93] at 60 deg F

###### **Temperature:** [50 to 90] deg F

##### **Flowrate Range:**

###### P-120:

###### P-121:

##### **Rated Pressure:** [120] psig

##### **Minimum NPSHa:** [32] FT

##### **Piping/pump arrangement:** Reference Drawings.

### **System Assembly:**

#### Chemical Metering Pump System supplier shall provide completely assembled, skid-mounted Chemical Metering Pump Systems.

#### The Chemical Metering Pump Systems shall not include any loose-shipped parts. It shall be completely shop or factory assembled and shall require no field assembly other than field connections of piping and wire.

#### The Chemical Metering Pump Systems shall be designed in accordance with the drawings.

#### **Skid-Mount:** Each Chemical Metering Pump System shall be completely assembled, calibrated, tested mounted and shipped on a single skid.

##### Components to be mounted include metering pumps, piping, valves, and all piping appurtenances specified herein. Vertical back panels and frame-mounted enclosures shall be provided as required to fully support all equipment and appurtenances.

##### Forklift truck cut-outs shall be provided.

##### The strength of the skid and supporting frame shall be suitable for shipping, offloading, installation and long-term support of the metering pumps.

##### Frame or rack shall have accommodations for concrete floor mounting.

##### Piping shall not be monolithic. Piping must be able to be broken apart as reviewed and approved by the Owner.

##### No bare metal parts shall be allowed.

### **Metering Pumps:**

#### Positive Displacement, motor driven, hydraulically actuated diaphragm type.

##### Simplex pumping head with double suction and discharge valves.

##### Pumps shall include integral motor, oil-lubricated or permanent grease lubricated bearings gear reducer and cam-and-spring drive mounted in aluminum housing. Aluminum housing shall be sealed into an outer corrosion resistant housing with heat sink fins.

##### **Features:**

###### The liquid end shall be fully separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the drive if the primary diaphragm fails. Pumps shall have integral design features to prevent the build-up of vapor in the pump head.

###### Diaphragm shall be Teflon.

###### Liquid end shall be PVC.

###### Pump Base shall be cast iron conforming to ASTM A48, Class 30 or higher.

###### Stainless steel shall be AISO Type 316.

###### Suction and discharge check valves shall be PVDF with PTFE faced Viton gaskets and ceramic ball valves.

###### The solution metering pumps shall be suitable to operate 24 hours a day.

###### Pumps shall provide the maximum flowrate of the design flowrate range when at 50% of the pump stroke speed.

###### Pumps shall have integral design features to prevent the build-up of vapor in the pump head.

###### A manually actuated bypass feature shall be provided to allow gas purging and instantaneous priming.

###### Power input shall be three phase 208V, 60 hz.

###### Pumps shall be controlled by AC variable frequency drives (VFDs) per Section 16260, Variable Frequency Drives.

###### Remote Input/Output signal shall be 4-20 mA.

###### **Control:** Pump shall be capable of both AUTO and MANUAL stroke length and stroke speed adjustment. Provide each pump with a micrometer for manual strike length adjustment. The micrometer shall allow 0% to 100% delivery adjustment while the pump is operating and shall provide positive repeatable settings within ± 1%.

###### Minimum guaranteed accuracy shall be ±1% at 3:1 turndown to steady state accuracy of the pump, and ±2% over 50:1 turndown.

###### Maximum NPSHr shall be 3 psi

###### Speed Reducer

The speed reducer shall be integral with the pump. It shall be total enclosed and self-lubricating with worm gearing. The terminal rating shall equal or exceed the mechanical rating.

Drive housings shall be constructed of steel (ASTM A36 or A108), aluminum (Alloy 6061-T6), or cast iron (ASTM A48, Class 30 or higher) and shall be full stress relieved prior to machining. Drives shall be test run at the factory for one hour while filled with oil.

Minimum AGMA rating shall be 1.5 continuous 24-hour-per-day service.

Bearings shall be of the antifriction type with an AFBMA L-10 rating of at least 24,000 hours.

##### Products: Milton Roy M-Roy Series.

##### Pump materials of construction shall be as follows:

|  |  |  |
| --- | --- | --- |
| **Wetted Parts of Pump Excluding Diaphragm** | Diaphragm, Seals | **Base** |
| PVC | Teflon | Cast iron |

##### Each metering pump shall include a backpressure valve and a pressure-relief valve on the discharge side and double ball check valves in the suction and discharge ends. Pressure-relief valve shall be integral with the pump wherein the hydraulic fluid that flexes the diaphragm is relieved to a reservoir. Material of construction of relief valve shall be the same as the wetted parts of the pump.

## COMPONENTS

### **General:** All wetted materials shall be specifically selected for resistance to specified service chemical.

### **Piping:** Refer to Section 15000.

### **Calibration column:**

#### Provide calibration column on the common suction header for each pump skid assembly.

#### Column shall be sized for a minimum 30-second draw down test.

#### Scale shall indicate both milliliters and gallons in 0.01-gallon increments printed on the side of the column.

#### Calibration chamber shall be piped and valved such that each pump may be calibrated without interfering the operation of other pumps.

#### Column to be clear PVC or equal translucent material suitable for specified service chemical.

### Provide threaded connection at top of column for connection to common vent.

#### **Strainer:** Provide y-strainers as shown on the drawings.

#### 100-mesh basket, all PVC construction.

#### Hex cap clean-out

#### Minimum Pressure Rating: 150 psi

#### FPM seals

#### **Manufacturer:**

##### Hayward Flow Control Systems

##### Or Equal

### **Pressure Gauge:** Provide pressure gauges for the pump discharge as shown on drawings.

#### Pressure gauge shall indicate pressure in psi.

#### Gauge shall accurately indicate pressure from 0 to 150 psi.

#### Gauge shall have diaphragm seal isolation.

### **Pressure Relief Valve:** Provide adjustable pressure relief valve as shown on drawings.

#### Pressure-relief bypass shall automatically release chemical to pump suction when discharge pressure exceeds the value indicated in the drawings. Alternatively, provide a design in which the pump ceases its stroking action when the backpressure exceeds the strength of the magnetic force developed by the power coil.

#### Sized for the maximum pump flow and initially set at pressure recommended by pump manufacturer.

### **Pulsation dampeners:** Provide pulsation dampener as shown on drawings.

#### PVC pulsation dampener of the appendage type having a Viton bladder and Schraeder air valve fitting at the fill port.

#### Pulsation dampener shall be sized by the Manufacturer to reduce pulsation by a minimum of 97%. The dampener volume shall be a minimum of 26 times the stroke displacement volume.

#### The Manufacturer shall provide calculations to the Engineer showing the method used to calculate the pulsation dampener volume.

#### **Manufacturers:**

##### Blacoh Sentry,

##### Pulsafeeder Pulsatrol,

##### Or Equal.

### **Backpressure Valves:** Provide adjustable diaphragm backpressure sustaining type.

#### Valves shall be of PVC or 316 stainless steel. Valves for caustic and hypochlorite shall have flanged connections only. Valves shall be field adjustable.

#### Initial setpoint shall be as recommended by pump manufacturer.

#### **Manufacturers:**

##### JESCO America Corporation,

##### Wallace & Tiernan,

##### Or equal.

### Provide four-function valve that includes an anti-siphon check valve, a backpressure valve, and a pressure-relief valve for the discharge point, as well as a discharge line continuous bleed valve, manually adjustable from off to full flow.

#### **Manufacturers:**

##### LMI LiquiPro Bleed/4-Function Valve, Part No. 38004

##### Or equal

### **Lifting lugs:** Provide for equipment weighing over 100 pounds.

### **Anchor Bolts:** Provide all anchor bolts necessary for proper installation of the metering pump system frame or rack.

#### All metals shall be Type 316 stainless steel

#### Sized by equipment manufacturer

### Pressure housings, check valves, and discharge pieces shall be pressure tested at the factory at 1.5 times the maximum discharge pressure for a 10-minute duration. Repair or replace leaking parts.

### **Diaphragm Valves:** Provide diaphragm valves for all shut-off, isolation, and flow control applications. Ball valves will not be accepted.

#### **Features:**

##### PVC body and bonnet

##### Flanged or true union as shown on the Drawings

##### Diaphragms shall be three-piece:

###### PTFE

###### PVDF gas barrier

###### EPDM backing

##### EPDM o-rings

##### Bubble-tight sealing

##### Travel stop for over-tightening prevention

##### Position indication

##### 115 psi minimum pressure raiting

#### Manufacturers

##### Asahi/America Inc. Type 14

##### Or equal.

## IN-LINE STATIC INJECTION RING MIXERS

### Provide PVC static mixers at the sodium hypochlorite and ammonium hydroxide injection points.

### Mixers shall be as manufactured by Westfall Manufacturing Model 2800, Komax Series A, or equal.

### The static mixer shall be of a compact ring body design for mounting between two pipe flanges. The ring body shall have a minimum thickness of 0.875 inch. Mount the mixing plate in a cavity on the upstream side of the ring body. The mixing plate shall have a minimum thickness of 0.175 inch. Provide ring-type gaskets (minimum 1/8-inch thick) adhered to both sides of the mixer body. The body shall include one or more injection fittings.

### Design the mixer plate to provide a geometric shape that will create the mixing vortices to effectively mix the injected fluid(s) with the main process fluid. The average variation in the concentration of the injection fluid shall be within ±1% of the mean 10 pipe diameters downstream from the mixer at design flow.

### Injector connection smaller than 1 inch shall be threaded, ASME B1.20.1. Injector connections 1 inch and larger shall have a connecting flange.

### **Injectors:**

#### Provide one (1) injector for each chemical feed point (2 total). Injectors shall include a ball valve type corporation stop with quill or solution tube, diaphragm in the solution tube, solution tube adapter, and packing nut and chain.

#### Acceptable manufacturers:

##### Primary Fluid Systems, 1050 Cooke Boulevard, Burlington, Ontario, Canada LK7T4A8, 1-800-776-6580.

##### Neptune Chemical Pump Co., Inc., P.O. Box 247, Lansdale, Pennsylvania 19446, 1-888-3NEPTUNE.

##### LMI/Milton Roy, 8 Post Office Square, Acton, Massachusetts 01720, 1-978-263-9800.

##### Saf-T-Flo Industries Corp., 4071 East La Palma Avenue, Suite L, Anaheim, California 92807, 1-800-957-2383.

##### Stranco/U.S. Filter, 595 Industrial Drive, Bradley, Illinois 60915, 1-800-882-6466.

## Chlorine RESIDUAL ANALYZER

### Provide colorimetric-type chlorine residual analyzers for measurement of both free and total chlorine residual. The unit shall receive a sample of chlorinated water and produce a 4- to 20-mA d-c output signal proportional to the chlorine residual present. Chlorine residual analyzer shall employ a U.S. EPA-approved DPD colorimetric method of measurement using DPD indicator and a buffer solution and be capable of measuring free or total residual chlorine by changing the indicator and buffer solutions.

### Chlorine analyzer shall have the following features:

#### The analyzer shall be microprocessor controlled and provide dry contacts for alarming and 4- to 20-ma recorder outputs. The microprocessor shall monitor analyzer functions and activate a system warning for minor variations in analyzer performance or a system alarm for major variations. A system alarm shall shut down the analyzer until corrective action is taken. The microprocessor also shall provide self-diagnostic functions accessible through the keyboard. Provide two fully adjustable sample concentration alarms. Provide a local LED indicator and SPDT normally open/normally closed dry contact relay rated at 5-ampere resistive load at 230-volt a-c for each system and sample concentration alarm.

#### Provide the analyzer with reagents for the measurement of total available chlorine (free available chlorine plus chloramines) and reagent feed pumps. The analyzer shall take a measurement every 2.5 minutes and results displayed by a three-digit LED readout in the range of 0 to 5 mg/L. Design the analyzer for 30-day unattended operation and use only 1 pint of each reagent per month.

#### Construct the analyzer to 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 lamp aging. The instrument shall provide resolution of 0.01 mg/L, repeatability with ±0.05 mg/L, and accuracy better than ±5% of reading or ±0.04 mg/L, whichever is greater.

#### Input power supply shall be 115 volts, 60 hertz, single phase. Output signal shall be an isolated, linear, 4- to 20-mA d-c signal proportional to the chlorine residual present.

#### Analyzer shall be housed in a IP 62 wall-mounted enclosure with clear polycarbonate windows for viewing reagents and system status messages.

#### Provide one reagent kit.

### The chlorine residual analyzers shall be Hach Model CL17sc; no equal.

## Ammonia Residual Analyzer

### Provide colorimetric-type ammonia residual analyzers for measurement of free and total ammonia residual along with monochloramine. The unit shall receive a sample of chloraminated water and produce a 4- to 20-mA d-c output signal proportional to the ammonia residual present.

### Ammonia analyzer shall have the following features:

#### The analyzer shall be microprocessor controlled and provide dry contacts for alarming and 4- to 20-ma recorder outputs. The microprocessor shall monitor analyzer functions and activate a system warning for minor variations in analyzer performance or a system alarm for major variations. A system alarm shall shut down the analyzer until corrective action is taken. The microprocessor also shall provide self-diagnostic functions accessible through the keyboard. Provide two fully adjustable sample concentration alarms. Provide a local LED indicator and SPDT normally open/normally closed dry contact relay rated at 5-ampere resistive load at 230-volt a-c for each system and sample concentration alarm.

#### Provide the analyzer with reagents for the measurement of free ammonia (based on total available ammonia and monochloramines) and reagent feed pumps. The analyzer shall take a measurement every 5 minutes and results displayed by a three-digit LED readout in the range of 0 to 2 mg/L, as Nitrogen. Design the analyzer for 30-day unattended operation and use only 1 liter of reagents per month.

#### The instrument shall provide resolution of 3% or 0.01 mg/L, repeatability, whichever is greater, with accuracy of ±5% or 0.01 mg/L as Nitrogen for 41° to 104°F and ±10% or 0.02 mg/L as Nitrogen for 104° to 122°F, whichever is greater.

#### Input power supply shall be 120 volts, 60 hertz, single phase. Output signal shall be an isolated, linear, 4- to 20-mA d-c signal proportional to the chlorine residual present.

#### Analyzer shall be housed in a wall-mounted enclosure with clear polycarbonate windows for viewing reagents and system status messages.

#### Provide one reagent kit.

### The ammonia residual analyzers shall be Hach Model APA5500sc; no equal.

## ultrasonic level system

### The system shall use ultrasonic ranging to measure the level of liquid in the sodium hypochlorite and ammonia chemical storage tanks.

### Transmitter shall be microprocessor based.

### Level sensing shall be automatically compensated over the system temperature range of at least 0 °C to 50 °C and shall incorporate digital algorithmic echo extraction and filtering signal to noise discrimination using common mode noise rejection.

### Synchronization capability shall be provided. When synchronized, no transmitter shall transmit a signal within a certain time interval of the prior one.

### Application parameters shall be stored in non-volatile EEPROM. Calibration shall require no reference targets.

### Accuracy shall be +/-0.25% or better.

### Output shall be 4 mA to 20 mA proportional to the range of level sensing.

### The transducer shall be UL listed and FM approved for Class I, Division 1 and housed in a NEMA 4X enclosure.

### The ultrasonic unit shall be loop powered by a 4-20mAdc signal.

### Ultrasonic unit shall be Siemens SITRANS Probe LU, or equal.

## Control System

### The chemical metering pumps shall be controlled by AC variable frequency drives per Section 16260. The VFDs shall be mounted separately from the chemical metering skids.

### Provide all cables, connectors, and a terminal junction box for termination of remote signal circuits.

### Provide gas detectors per Section 17xxx.

### The PLC and operator interface shall control and monitor all functions and operational parameters including, but not limited to, the following:

#### Sodium hypochlorite and ammonia tank levels.

#### Chlorine residual.

#### Sodium hypochlorite and ammonia metering pumps flow pacing and dosing.

#### Alarm history.

#### Maintenance log.

#### Security protection.

### SCADA Interface:

#### The chloramination PLC shall interface with the District’s telemetry system via an Ethernet network.

#### Coordinate interfacing requirements with the District’s SCADA System supplier, including the communication protocol, PLC program registry addressing, etc. Provide the District with the PLC source code on CD disk for RS Logix 5000. Provide the District with a copy of the PLC program with annotated comments on CD disk.

#### Provide required assistance to the SCADA System supplier in developing specific SCADA screens associated with the chemical feed system.

## Tools, Spare Parts, and Maintenance Materials

### Furnish one set of the following spare parts:

#### One complete set of fuses.

### For each electronic-actuated metering pump, provide one diaphragm, two ball check valve assemblies, and one seat and seal ring assembly.

### Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the District at the completion of the contract.

### Furnish an initial supply of all greases and lubricants required to start operations. Supply an amount of these materials equivalent to one year of continuous operation for each system.

## CHLORAMINATION SYSTEM Operation

### The PLC shall automatically switch to the standby metering pump upon receiving a “Pump Fail” signal.

### Level Sensors:

#### See Sections 2.06.

#### Monitor and send the following sodium hypochlorite level conditions to the operator interface system:

##### One low level alarm.

##### One high level alarm.

#### Monitor and send the following ammonia tank level conditions to the operator interface system:

##### One low level alarm.

##### One high level alarm.

### The system supplier shall be responsible for programming the system control panel.

# EXECUTION

## Shipment and Inspection

### Store and handle equipment in accordance with manufacturer’s recommendations.

### Thoroughly clean tank interiors to remove dirt, grease, etc., prior to shipment.

### Thoroughly inspect equipment upon arrival. Check that equipment has not been damaged and that components are in operating condition. Equipment and materials damaged or not meeting requirements of the approved Shop Drawings will be immediately returned and shall be replaced or repaired to the satisfaction of the DISTRICT at no additional cost to the DISTRICT.

## Installation

### All equipment units, tanks, and assemblies shall be installed on 18-inch minimum thickness concrete bases and secured with anchor bolts in accordance with UBC seismic requirements and as indicated herein. The concrete bases shall be poured up to 1-inch below the metal bases, legs or soleplates. Equipment legs or base plates shall be accurately shimmed to grade and the spaces between filled with an approved non-shrink grout. After the grout has reached its initial set, exposed edges shall be cut back 2 inches and the edges neatly finished with cement mortar (1 part cement to 2 parts sand). Where channel base plates are used, the void inside the channel shall be filled with non-shrink grout and the open ends plastered with 1 to 2 cement mortar.

### Discharge connections to chemical tanks shall be installed a minimum of 18-inches above chemical pumps to provide sufficient suction head. Pumps shall be installed outside of single containment walls, but can be installed adjacent to tanks within a dual containment system. Pumps shall be installed on housekeeping pads.

### Set each piece of equipment in place, plumb, level, and securely anchored.

### Install ~~generator,~~ metering pumps, tanks and appurtenances in accordance with manufacturer’s recommendations.

### Furnish and apply an initial supply of lubricants.

### Install piping, fittings, and valves in accordance with manufacturer’s recommendations.

### Piping shall be supported independent of equipment. Equipment shall be free from all loads and stresses induced by the piping.

## Labeling and Marking

### Label each metering pump and sodium hypochlorite ~~generator~~ and ammonia system equipment. Labels shall indicate the equipment tag number, capacity, motor horsepower, speed, voltage, phase, manufacturer, model number, and serial number. Labels shall be 1-1/2 inches (minimum) by 4 inches (minimum) 1/8-inch-thick fiberglass tags: Brady B120 Fiber-Shield, Seton Style 2065, or equal.

### Label each tank with a weather- and UV-resistant sign. Labels shall be Brady B-946, Seton Name Plate Corporation PSPL, or equal. Minimum size shall be 7 inches by 10 inches. Provide a sign on each tank bearing the tank tag number and the name of the liquid stored.

### Provide each valve with a 2-inch-square or circular 1/16-inch-thick fiberglass tag: W. H. Brady B-60, Seton Name Plate Corp. Series SVT, or equal. Tag shall show the valve tag number and/or name or designation as given in the drawings.

#### Attach labels to the valve with Type 316 stainless steel chains or wires.

#### Attach valve labels to the valve handwheels. If the valve has no handwheel, attach the label to the valve by tying the tag wire or chain around the operating shaft or nut.

### Labels for piping shall bear the full name of the fluid conveyed. Provide separate flow directional arrows next to each label. Color, size, and labeling shall conform to ANSI A13.1 and Z535.1. Colors shall be consistent with DISTRICT approved standard chemical colors. Labels for piping inside buildings shall be vinyl cloth: W. H. Brady Co. B-500 vinyl cloth, Seton Name Plate Corporation Pipe Markers, or equal. Labels for piping located outdoors shall be weather- and UV-resistant acrylic plastic and shall be W. H. Brady Co. B-946, Seton Name Plate Corporation Pipe Markers, or equal.

#### Provide label and flow arrow at each connection to the sodium hypochlorite generator equipment, ammonia equipment, metering pumps, injectors, and tanks, at wall boundaries, at tees and crosses, and at 10-foot centers on straight runs of piping. Also include labels on injection and sample locations in the process piping. Indicate chemical injected or destination of sample stream.

#### Provide full-band pipe markers, extending 360 degrees around pipe at each location.

## Service Conditions

### The following chloramination system performance conditions and design data shall be as shown on the drawings:

#### Sodium Hypochlorite Storage Tank:

##### Tank tag number.

##### Capacity in gallons.

#### Ammonia tank size in gallons.

#### Sodium hypochlorite feed capacity (maximum) in mg/l.

#### Ammonia feed capacity (maximum) in mg/l.

## Field Testing

### Start-up and testing shall comply with Section 01810.

### Notify the DISTRICT at least fourteen days before the scheduled date for field testing and coordinate testing requirements and scheduling with the DISTRICT.

### Furnish all testing equipment and devices required.

### Operate the unit under design conditions for 72 hours. Correct any deviations from normal operation such as vibrations, noise, or other abnormal operation at no additional cost to DISTRICT. Re-test system to the satisfaction of the DISTRICT.

### Demonstrate control system and SCADA interface function.

### Make adjustments to equipment as required.

### There shall be no leakage from the system.

### Demonstrate the accuracy of each metering pump using project-supplied calibration columns.

END OF SECTION