SECTION 22 67 22

MONOCHLORAMINE SECONDARY DISINFECTION SYSTEM AND WATER QUALITY MONITORS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide complete packaged systems for the production and controlled addition of Monochloramines and for control of free ammonia formation for secondary disinfection on domestic cold water (DCW) mains and domestic hot water system (DHW) in the facility. The systems shall produce Monochloramine in a specially designed flow through reactor by mixing NSF Std. 60 certified reagent chemicals. The system shall be equipped with a state of the art microprocessor which controls every aspect of system operation including the specified safety features of the system. The systems shall be remotely monitored by the VAMC Philadelphia Building Automation System. The systems shall be capable of remote monitoring and being operated via the Internet by an on-board dedicated web-server.

The Monochloramine systems shall be complete packaged units suitable for wall or stand mounting to include the Monochloramine generator, reagent dosing tanks, tank level monitoring, safety features and secondary containment. The systems shall be selected to produce up to 800 Grams/hr. of Monochloramines to maintain Monochloramines at a concentration of 2-4 ppm in the domestic cold and hot water systems based on flow rates and automatically adjusted for Oxidation Reduction potential (ORP). Systems shall have the ability to compensate for disinfectant decomposition and be engineered to reduce free ammonium produced from decomposition by means of precise control and adjustment of the reagent dosing pumps. All system components in contact with the drinking water are to be NSF Standard 61 certified. Manufacturer shall provide copies of certifications with submittals

B. Provide Multi I/O Potable Water Quality monitoring equipment and accessories for continuous measurement and tracking of temperature, pressure, pH, total chlorine, and system conductivity (dissolved solids) at locations indicated on the plans and as specified herein. All monitoring points shall be connected to the Building Automation System (BAS).

C. Provide the services to obtain the operating permit from the State of Pennsylvania for the secondary disinfection system. Obtain the forms, complete the applications and associated requirements, meet with the VA Engineering personnel to obtain required information, and submit the

forms to the State of Pennsylvania. Complete the process to receiving the operating permit.

D. Operate the systems for a period of two (2) years while training the VA Engineering personnel to become the full time operators.

1.2 RELATED WORK

A. Systems for service other than boiler plant make-up water, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

B. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATION

C. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

1.3 QUALITY ASSURANCE

Manufacturer shall have been engaged in the manufacture of Monochloramine systems for a minimum of ten years. Manufacture shall also provide a minimum of three third party publications validating the efficacy of the proposed system. Manufacture shall also supply a list of references with contact information for a minimum of 10 locations were the proposed Monochloramine equipment has been in use for a period of more than 1 year.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Manufacturer's Literature and Data:

1. Catalog cuts, complete description and specifications of all equipment and accessories.
2. Accessories including probes, product storage tank, analyzers and test kit.
3. Performance data including normal and maximum flow and grams/hour production rate. Certification that required performance will be achieved.
4. Piping.

C. Complete detailed site specific layout, setting, arrangement, and installation drawings including. Drawings shall also show all parts of the apparatus including relative positions, interconnections, dimensions, and sizes and general arrangement of connecting piping, electrical and data communications connections.

D. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

E. Sample wet chemistry water quality reports and sample trended water quality reports.

1.5 PROJECT CONDITIONS

A. Influent Water Analysis:

Source of supply (name of purveyor)	Philadelphia Water Dept.
Maximum Free Chlorine	4 ppm
Maximum Chloramine	4 ppm
Maximum pH (continuous)	8.3 units
Minimum pH (continuous)	6.8 units

Confirm the analysis with current samples and tests.

B. Design Parameters

Building 1 Service	
Avg. Flow (GPM)	60
Average Usage (GPD)	28,500
Daily hours of water demand	8

Building 2 Service	
Avg. Flow (GPM)	140
Average Usage (GPD)	66,500
Daily hours of water demand	8

Building 30 Service	8 Months	4 Months
Avg. Flow (GPM)	34	40
Average Usage (GPP)	12,000	24,000
Daily hours of water demand	8	10

1.6 APPLICABLE PUBLICATIONS:

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

B. National Sanitation Foundation (NSF)/American National Standard Institute (ANSI)

Standard 6o . . . . . Drinking water treatment chemicals

Standard 61 . . . . . Drinking water system components

C. ASTM International (ASTM):

D1785-06.....PVC, CPVC, PVDF Plastic Pipe, Schedules, 80, and 120.

D. American Water Works Association (AWWA):

B300-04.....Hypochlorites

B301-04.....Liquid Chlorine

E. National Electrical Manufacturers Association (NEMA): ICS-6-1993(R2001, R2006) Industrial Control and Systems: Enclosures

F. National Fire Protection Association (NFPA):
70- 08 .....National Electrical Code.

PART 2 - PRODUCTS

2.1 MONOCHLORAMINE SYSTEM

A. The Base Monochloramine systems shall be a complete packaged unit to include both the Monochloramine generator and the Reagent dosing tanks. The water shall be fed to the reactor chamber by a recirculation pump supplied with the system. The ammonium source shall be added to the reactor first, then the chlorine solution. Reagent chemical addition shall be by electromagnetic membrane pumps which are synchronized to reach the optimum mixing rate in the reactor chamber. The Monochloramine shall be produced and exit the reactor within the water flow, which is then introduced in the water in direct proportion to flow and Oxidation Reduction Potential (ORP). An ORP probe placed on a recirculation sampling loop shall act to control the level of Monochloramine by adjusting the dosage to maintain it in the specified range.

B. Performance Requirements:

1. Electronic Control Unit

a. The system shall be controlled by a single electronic PLC or microprocessor control unit. The controller will have single screen to display all aspects of operation of the system. A keypad shall provide access to the control parameters. The shall be separate keys to perform the following functions:

Production On/Off - to start/stop production
Information key – to enter overview menu
Arrows up and down – to scroll lines and pages
Enter – to edit, acknowledge, confirm parameters
Alarm – alarm management selection
BAS Connection – provide LONWORKS or BACNET or other means of communication interface for the Building Automation System to monitor operation, set points, status indicators, and alarms.

2. Flow Sensors

The system shall equipped with flow sensors in each reagent dosing pump discharge to avoid improper mixing of the reagents. The system shall also have a predilution flow meter to input to the

microprocessor to maintain proper synchronization of the reagent pumps and insure accurate mixing of reagents. A flow fault switch will alarm the system to low or lack of water flow to the pre-dilution flow assembly and disable the system and send an alarm notification via the Building Automation System.

3. Reagent chemicals

The reagents chemicals shall be NSF/ANSI Standard 60 certified drinking water additives and be so certified by The National Sanitation Foundation (NSF). Products certified by other third party certifications agencies are not acceptable. The Chlorine source reagent chemical shall be a minimum 10% solution manufactured from a high purity, electrochemically produced and pH stabilized sodium hypochlorite. Total metals shall be less than 1% and pH shall properly adjusted to maintain maximum stability after delivery. The Ammonia source reagent chemical shall be a maximum 7% ammonium chloride manufactured from food grade ammonium chloride to insure stability and safe handling. Ammonium Hydroxide, Ammonium Sulfate or other aqueous ammonia source reagents are not acceptable as these could pose and unnecessary hazard in the facility. Reagent chemicals shall be manufacture locally under license to the Monochloramine equipment manufacturer to insure compatibility and proper selection for system. Reagents shall be manufactures in a facility with 25 miles of the application facility to insure freshness and stability at time of delivery. Reagent Chemicals are to be delivered and transferred directly to properly labeled on site tanks with secondary containment by trained and certified chemical handling personnel. Delivery of Reagents shall be made within five (5) days of properly placed orders. Use of commercial or commodity chemical reagents not authorized by the manufacture are prohibited.

4. Reagent dosing pumps

Reagent dosing pumps shall be precision metering pumps capable of accuracy + or - 1 ml/min. Pump shall feature a stroke length only adjustment to avoid the possibility of frequency or input changes. Liquid end assemblies shall have acrylic heads with all Teflon diaphragms. Check valve assemblies are to be Teflon with Viton or Teflon O-rings and ceramic check balls.

D. Manual Valves:
   1. Monochloramine unit reactor or predilution flow assembly: Schd. 80 CPVC or PVDF, true union ball valves, Viton or Teflon O-ring, socket glued.
   2. Sample Valve, Product Water Sample Valve: PVC, Teflon or CPVC needle valve with viton seats and seals.
E. Field Piping from unit to point of injection:
   1. All: Schd. 80 CPVC or PVDF socket glued
F. Controls:
   1. Electronic PLC or microprocessor controller providing automatic control for all operating functions. NEMA 4. All wiring factory-installed and tested. Comply with Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW) and NFPA 70.
   2. Alarm indicator and silence button.
      a. Warning Alarms: inproper reagent feed, minimum reagent level, analysis flow fault.
      b. Automatic Shutdown and Alarm: regent flow fault, empty reagent tank, loss of predilution flow, reading Error(loss of input signal).
   3. Status Indicators: Controller operting screen shall display the following functions during normal operation
      Regent pump flow validation
      ORP and Free chlorine reading
      Operating Mode
      Delta time differential of reatgent pumps stroke
      Water flow rate
      Monochloramine prodution rate in grams/hr
      Monochloramine set point
      Water or enclosure ambient temperature
   4. Reagent tank level co
G. Instrumentation and Displays:
   1. All instrumentation readouts panel-mounted in FRP enclosures rated NEMA 4. All factory wiring. Comply with NFPA 70.
   2. Flow indicators for water and reactor flow rate
   3. ORP indicator measuring water quality with digital displays, alarm relays and automatic temperature compensation.
   4. LonWorks or BACNET interface for the Building Automation System to read and record information.

H. The basis of design system is Sanipur Sanikill System and shall be the system provided or approved equal.

2.2 WATER TESTING EQUIPMENT

A. Furnish water testing equipment in a portable case specially made for the installed equipment. Include sufficient materials for 6 months of normal testing procedures.

B. Test kits to measure Monochloramine, free ammonia, total and free chlorine.

2.3 MULTI I/O WATER QUALITY MONITORS

A. Multi I/O water quality monitor

1. The multi I/O water quality monitor system shall be a capable of measuring system conductivity, pH, total chlorine, temperature, and pressure. The conductivity sensors shall be an electrodeless style. All sensors shall have integral signal conditioning. Additional inputs shall include a flow switch, twelve digital inputs, eight 4-20 mA inputs. Outputs shall include eight mechanical relays, and four 4-20 mA outputs. Digital communications shall be via USB, Ethernet. Up to 16 controllers may be networked together over Ethernet. Integration with building energy management systems shall be possible using the optional Modbus TCP/IP feature. The controller shall be accessible via the Internet for configuring, data logging, and control of relay outputs. The controller shall provide notification of alarm conditions via dry contact closure, pager, and/or email. All water quality parameters shall be datalogged in real time and the datalogs provided to the user as raw and visualized data.
2. Control Module
   a. Enclosure: Fiberglass, NEMA 4X, lockable hinged door with clear window.
   b. Power:100-240 VAC ± 10%, 50/60 Hz
3. Inputs
   a. Water meter Contactor: Isolated dry contact (relay, reed switch or Hall Effect) 0-10 Hz, 50 msec minimum width Paddlewheel Water Meter: Isolated dry contact (relay, reed switch or Hall Effect) 0-300 Hz, 1.5 msec minimum width
   b. Flow switch: Isolated dry contact (relay, reed switch or Hall Effect) 0-10 Hz, 50 msec minimum width
   c. Digital Inputs (1-4) Isolated dry contact (relay, reed switch or Hall Effect) 0-10 Hz, 50 msec minimum width

d. Digital Inputs (5-6) Isolated dry contact (relay, reed switch or Hall Effect) 0-300 Hz, 1.5 msec minimum width
e. Point Level Switch: Isolated dry contact (relay, reed switch or Hall Effect)
f. Flow Feedback: Isolated dry contact (relay, reed switch or Hall Effect)
g. Analog Inputs (1-8) 4-20 mA: 2-wire or 3 -wire, internally powered by 24 VDC, 25 ohm input resistance, 1000 ohm maximum load.
h. Sensors (4) Signal (isolated) ±1.5V, Temp (isolated) 1K or 10K or 100K Temp

4. Outputs
   a. Mechanical relays, 8 total: At 115 VAC, 10 amp (resistive), 1/8 HP At 230 VAC, 6 amp (resistive), 1/8 HP, R1-R4 are fused together as one group, total current not to exceed 5.5A, R5-R8 are fused together as one group, total current not to exceed 5.5A
   b. Four Relays shall be dry contact and four relays shall be frequency pulse contacts. The frequency pulse contacts shall operate at a maximum of at least 500 Hz.
   c. Four analog outputs shall be, 4-20 mA: Isolated, 500 ohm maximum resistive load, internally powered
5. Software features
   a. A self test shall be available to verify the integrity of the control module’s sensor input circuitry.
   b. A reminder for electrode calibration shall be available.
   c. The controller shall display an evaluation of the pH sensor’s slope versus theoretical after each two point calibration.
   d. Manual activation of the relays shall be easily accomplished via the keypad, or a PC.
   e. A maximum output on-time shall be available on the control relays to prevent runaway control.
   f. The analog inputs shall be configurable for level sensors, corrosion monitors, or any other type of transmitter, providing appropriate units of measure and scaling.
   g. The optional digital inputs shall be configurable for level switches, verification switches or generic interlock operation.

h. Status reports and data files shall be sent automatically via email on either a cyclical basis or for a specific date range.
i. The controller configuration may be entered by downloading them from one controller, and uploading them into another controller.
j. Access to the controller shall be possible using an USB connection, Ethernet, direct modem-to-modem, via the Internet, or via the local display and keypad, simultaneously if desired.
k. No proprietary software shall be required on the user's computer to communicate with the controller, or to view or change configuration.
l. The controller software shall be able to be upgraded remotely via the Internet.

6. Sensors
   a. Electrodeless Conductivity and Temperature
      i. Operating principle: The conductivity sensor shall be driven with a low voltage AC signal, which induces a current in the surrounding liquid which varies in intensity with the conductivity of the liquid, which is picked up by the sensor and transmitted to the controller. The temperature sensor within this sensor compensates for the effect of temperature on the conductivity signal.
      ii. Materials of construction: CPVC, FKM
      iii. Process connections: ¾" NPTF
      iv. Temperature range: 32-158 F, 0-70 C
      v. Pressure range: 0-150 psi
   b. pH
      i. Operating principle: The pH sensor shall consist of a replaceable cartridge containing a pH sensitive glass and silver/silver chloride reference. Voltage signals from these shall be measured against the solution ground, and the differential voltage measurement sent to the control module. The temperature signal from the conductivity sensor shall be used to compensate the pH reading as well.

ii. Materials of construction: Glass-Filled Polypropylene, CPVC, HDPE, FKM, Glass
iii. Process connections: ¾″ NPTF
iv. Temperature range: 50-158 F, 10-70 C
v. Pressure range: 0-100 psi

c. Total Chlorine
i. Operating principle: The oxidizer molecules diffuse through a membrane and in the acidic environment of the electrolyte fill solution, a redox reaction occurs at the electrodes in the sensor. The current generated by this reaction is converted to a robust voltage signal that is linear with the concentration of the oxidizer. The wetter materials of construction: PVC, Polycarbonate, Silicone rubber
ii. Process connections: ¾″ NPTF
iii. Temperature range: 41-113 F, 5-45 C
iv. Pressure range: 0-14.7 PSI (discharge directly to atmospheric drain)
v. Flow range: 0.13-0.44 GPM
vi. pH operating range: 6.8-8.0
vii. Response time: 30 seconds

d. Pressure
i. The sensor shall be constructed of a PVDF body, ceramic diaphragm, with a Viton seal.
ii. The sensor shall be equipped with 3/4" NPT threads on both ends for in-line or submersion installations or 1/2″ Male Union on one end.
iii. The sensor shall be supplied with 15 foot standard, maximum allowable cable 200 feet.
iv. Temperature range: 0-122 F, 0-50 C
v. Pressure range: 0-175 psi.

e. Controller and Sensor Performance

f. Range: 0 to 10,000 μS/cm conductivity, -2 to 16 pH, 0-8ppm total Cl, 32-190 deg F Temperature, 0-250 PSI pressure

g. Accuracy: ± 1 μS/cm conductivity, ± 0.01 pH, ± 0.01ppm total Cl, ± 1 Deg F Temperature, ± 2.5 PSI pressure

h. Resolution: 1 μS/cm conductivity, 0.01 pH, 0.01 ppm total Cl, 1 Deg Temperature, 1 PSI pressure

i. Maximum separation between controller and sensor shall be 1000 feet for pH, 20 feet for total Cl, 250 feet for conductivity and temperature, 200 feet for pressure.

7. Indication
   a. Graphic User Interface
   b. A 64 x 128 Pixel Backlit LCD Graphics Module display shall indicate the process values, and the status of outputs and alarms.
   c. Eight LED lamps shall indicate the on/off status of the control outputs.
8. Communications
   a. The primary communications shall be LonWorks or BACNET connection to the VAMC Philadelphia Building Automation System.
   b. The water quality monitor shall include an embedded web server utilizing standard TCP/IP Internet communications.
   c. Multiple users can access the controller simultaneously.
   d. The water quality monitor shall have the capability of communicating with other water quality monitors in a master/slave configuration
   e. Modbus TCP connectivity shall be standard
9. Datalogs and Reporting
   a. The water quality monitor shall datalog all water quality parameters not less than once every 60 seconds
   b. Water quality reporting feature shall be cloud-based to provide out of limit alarms via email or text, in real-time, to alert on site operators of abnormal or dangerous conditions immediately
   c. Controller data storage shall not expire
   d. Out of limit alarms shall be generated in real-time
   e. Alarms and emails are generated in real-time as operator logs and service reports are recorded
   f. Alarms are in plain text message format to ensure compatibility with all devices
10. The reporting software shall have the following capabilities
   a. Trending wet test data against controller data
   b. Storing controller data for extended periods of time
   c. Automatically emailing reports

d. Provide data visualizations for fast and easy identification of alarm conditions including green, yellow, orange, and red colored alarms

11. Calibration

a. The electrodeless conductivity sensor calibration shall be a two point calibration (in air and at the process value), or a one point process calibration.

b. The pH electrode calibration shall be either a one or two point calibration utilizing standard pH buffer solutions or a single point process calibration.

c. The total chlorine electrode calibration shall be either zero calibration utilizing clean, oxidizer-free water or a single point process calibration utilizing a DPD test.

d. All programming shall be set through the 12 button keypad, or via a PC connected either locally via USB or Ethernet, or remotely via modem or Ethernet.

e. Three levels of access codes shall be available to protect all set points and calibrations, while allowing the user to view any set point.

PART 3 – EXECUTION

3.1 REQUIRED TECHNICAL SERVICES:

Provide services of a qualified manufacturer's representative to check complete installation for conformance to manufacturer's recommendations, put system into service, make all adjustments required for full conformance to design and specified requirements, and perform all demonstrations and tests. Train operators in proper operation of the system in accordance with all federal, state and local regulatory requirements. Trainer shall be a license water plant operator licensed by the State agency having primacy to opertor a water treatment faciliy of this type.

3.2 FLUSHING AND DISINFECTING:

A. Flush and disinfect new water lines and Monochloramine generator pre-dilution piping flow assembly in accordance with AWWA C651.

B. Material:

1. Liquid chlorine: AWWA B301.
2. Hypochlorite: AWWA B300.

3.3 STARTUP AND TESTING:

A. Operation: Tests shall be run in presence of Contracting Officers Technical Representative (COTR) or Resident Engineer (RE).

B. Procedure:

1. Operate system at constant maximum required capacity for one hour after product is produced. When necessary, waste product water to sewer to maintain above flow rate.
2. Demonstrate all features of the control system including diagnostics and flow and cycle indications.

C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior to notice.

3.4 COMMISSIONING:

A. Provide commissioning documentation accordance with the requirements of Section 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.

B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.5 DEMONSTRATION AND TRAINING:

A. Provide services of manufacturer’s technical representative for four hours to instruct VA Personnel in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

3.6 CONTINUED OPERATION AND CHEMICAL SUPPLY:

A. For a period on one (1) year following acceptance by the owner the manufacture of the Monochloramine systems or their authorized agent shall supply and deliver sufficient quantities of chemical reagents for continuous operation of the systems under the design conditions as provided. Delivery of Reagents shall be made within five (5) days of properly ordered material.

B. Factory trained and certified technicians shall service, test and inspect the all systems monthly. At a minimum all wetted components of the chemical dosing pumps and injection assemblies shall be removed, cleaned and replaced and dosing pump factory calibrated quarterly. The full factory recommended service kit and labor to replace manufactures specified parts and components shall be performed and documented at a minimum of annually. Following each site visit an electronic service report shall be emailed to designated VHA personnel and a permanent record of the reports keep by the manufacturer for a minimum of 5 years.

C. The manufacture of the Monochloramines systems shall have on staff engineering personnel to provide guidance and consultation for the proper operation of the systems and shall provide written recommendations on correcting any system or operational deficiencies upon written request by the VHA contracting officer. All system components shall remain under full factory warranty during the continued operation period.

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