**[DRINKING WATER MASTER SPECIFICATION]**

**Chloramine Boosting System**

**[PROJECT TITLE]**

**SECTION XXXXX**

**PART 1 – GENERAL**

1.1 SCOPE

This section covers the reservoir disinfection control system for potable water reservoirs. Each system will have the ability to function continuously on a year-round basis, regardless of drain and fill cycles. Each system shall consist of an amperometric reagentless probe-type analyzer capable of reading total chlorine and ORP, a PLC controller, and two peristaltic metering pumps for sodium hypochlorite and ammonia. All equipment shall be pre-wired and pre-plumbed on chemical-resistant skids with spill containment. System shall be Big Wave Water Technologies Model #CBS-2000.

1.2 THE REQUIREMENT

Supplier shall furnish a reservoir disinfection system together with all drives, motors, controls, and accessories necessary for a complete and operable system.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

Comply with the applicable reference specifications as specified in the General Requirements

1.4 CONTRACTOR SUBMITTALS

CONTRACTOR shall obtain from the equipment manufacturer and submit the following:

1. General equipment specifications and data sheets
2. Installation, startup, operation, and maintenance instructions
3. Factory-recommended maintenance schedule and list of recommended spare parts
4. Wiring diagrams specifying what electrical wiring needs to be done on-site during and prior to the installation, and by which responsible party
5. Test results certifying system is working prior to shipment

1.5 QUALITY ASSURANCE

Each reservoir disinfection system shall be tested prior to deployment according to standard engineering practices at the factory testing facilities.

* 1. WARRANTY

A. For the period of time beginning with shipment to buyer and ending at the timeframe listed below, the reservoir disinfection system is warranted to be free from defects in material and workmanship and to conform to manufacturer’s specifications.

One year parts and labor

B. Warranty does not cover damage due to: (i) lightning, flood or other acts of nature, or failure of or inappropriate application of peripheral devices including lightning or surge protectors; (ii) negligence of buyer or any third party; (iii) vandalism or any other misuse or mistreatment of the product; or (iv) installation by non-licensed contractor. Lightning protection is recommended in areas historically prone to lightning AND is the responsibility of the buyer for proper installation in accordance with local, state, and national code requirements.

**PART 2 – PRODUCTS**

2.1 GENERAL

Chloramine Boosting System consists of reagentless amperometric probe-type analyzer able to read total chlorine, ORP, and temperature simultaneously in single-probe housing assembly. Analyzer shall output (2) 4-20 mA signals for chlorine and ORP to a touch screen PLC control center. All set points, time overrides, and alarms shall be operator set at the touchscreen PLC control center. A sample recovery system shall be provided to capture analyzer sample flow and inject sample back into reservoir. Two programmable peristaltic pumps shall be controlled by the touchscreen PLC control center. The peristaltic metering pumps shall be sized to feed sodium hypochlorite and ammonia to maintain desired water chemistry within the reservoir. All equipment shall be skid mounted with integrated chemical containment.

2.2 CHLORINE RESIDUAL ANALYZER

A. General

1. The analyzer function, incorporated into the instrument, shall be designed for continuous measurement of as many as four parameters simultaneously.

2. The analyzer supports the following continuous measurements: free chlorine, total chlorine, ozone, chlorine dioxide, ORP, pH, fluoride, and conductivity.

3. The analyzer measurements chosen shall be displayed on the instrument’s display in numerical and graphical format.

4. This instrument shall be the Wallace and Tiernan Model Depolox 400.

B. Analyzer Function

1. The analyzer shall be designed for continuous measurement of the sample stream without the need for reagent addition and consist of the following measurement choices: free chlorine, total chlorine, ORP, pH, and conductivity. The free chlorine measurement shall be amperometric by way of a membrane-type sensor. Up to four measurements shall be analyzed within a single flow cell and displayed on the electronics. The continuous measurement options all include the following components: a measurement specific sensor, a sensor cable, and a pre-calibrated sensor input card specific to the measurement chosen.

2. The sensors shall be housed in a molded clear plastic flow cell.

3. The flow cell shall have built in:

a. A sample flow control device

b. A flow check valve

c. A sample flow alarm device

C. Total Chlorine Measurement – Membrane-Type Cell

1. Measurement ranges: 0–200 µg/l, 0–500 µg/l, 0–1.00 mg/l, 0–2.00 mg/l, 0–5. 00 mg/l, 0–10 mg/l, 0–20 mg/l

2. Accuracy: 50 µg/l or ±5% of full scale, whichever is greater

3. Sensitivity: 10 µg/l or ±1% of full scale, whichever is greater

4. Repeatability: 20 µg/l or ±3% of full scale, whichever is greater

5. Stability: ±5% of full scale per month

6. Response time: 90% change within 5 minutes of sample entry

7. Sampling rate: continuous @ 550 ml/min

8. Inlet pressure of flow cell: 3 to 60 psig

9. Inlet sample temperature: 41 to 113 degrees Fahrenheit

D. ORP

1. Measurement range: 0 to 1000 mV

2. Measurement sensitivity: 1 mV

3. Scaled in 100 mV increments

4. Sampling rate: continuous @ 550 ml/min

5. Inlet pressure of flow cell: 3 to 60 psig

6. Inlet sample temperature: 41 to 104 degrees Fahrenheit

E. Relays

The instrument shall incorporate four (4) digital outputs and four (4) analog outputs for instrument status.

2.3 CHLORAMINE BOOSTING SYSTEM CONTROLLER

1. Hardware
   1. The control panel shall be a fiberglass NEMA 4X wall-mount enclosure.
   2. The operator interface shall be a color touchscreen HMI with 65k color high definition TFT QVGA screen and RJ45 Ethernet port.
   3. The HMI shall have the ability to be programmed through the PLC communication port.
   4. The system shall utilize PLC control, and the hardware shall have scalability to include I/O module expansion.
   5. The PLC shall have the ability to be programmed in all 5 programming languages recognized by the IEC 61131-3 standards: function block diagram (FBD), ladder diagram (LD), structured text (ST), instruction list (IL), and sequential function chart (SFC).
   6. Modbus TCP/IP shall be used to communicate with SCADA
2. Software
   1. The PLC controller shall be programmed with all necessary parameters, interlocks, and alarms for individual analog signals to ensure reliable operation and prevent overfeed situations.
   2. The PLC and HMI shall be programmed with SoMachine™ software.
   3. Algorithms shall be programmed in structured text language recognized by the IEC 61131-3 standards.
   4. Alarm history and current display of alarms shall be viewable onscreen. At a minimum, the previous 100 alarms shall be shown in the alarm log.
   5. System shall have the ability to provide remote statuses and alarms to SCADA.
   6. Software shall include graphical display of pumps, tanks, mixer, and instruments. Simple boxes or only numeric displays will not be acceptable.
   7. Pop-up pump controls shall be provided onscreen for each pump.
   8. Run time hours for each pump shall be recorded and viewable onscreen.
   9. Field startup configurable settings on HMI shall include the following. All settings shall be password protected.
      1. Hypochlorite concentration percentage
      2. Ammonia concentration percentage
      3. Pump capacities (gph)
      4. Tank levels in gallons
      5. Selection between ORP sensor and ammonia analyzer
      6. Analog input scale and range parameters
   10. Field operator configurable settings on HMI shall include the following.
       1. Chlorine and ammonia ratio
       2. Hypochlorite feed rate (gph)
       3. Ammonia bypass feed rate (gph)
       4. Alarm set points
       5. Chemical feed control set points
       6. Automatic and manual chemical feed control mode selection
       7. Automatic and bypass ammonia pump feed rate control mode selection

2.4 SAMPLE RECOVERY SYSTEM

The sample recovery system shall consist of the following components.

A. 40-gallon polyethylene tank with lid

B. Level control device with pump controller

C. Sample return pump sized for sample return to the reservoir

2.5 PERISTALTIC METERING PUMPS

1. Metering Pump – Shall be a positive displacement, peristaltic-type tubing pump with a brushless variable speed motor, non-spring-loaded roller assembly located in the pump head, integral tube failure detection system, and flexible tubing with attached connection fittings. Metering pumps shall be Blue-White Industries Model M-324-SNGG. No alternatives shall be used.
   1. There shall be no valves, diaphragms, springs, or dynamic seals in the fluid path. Process fluid shall contact the pump tubing assembly and connection fittings only.
   2. Capable of self-priming at the rated maximum pressure of 110 PSI (8.6 bar).
   3. Capable of running dry without damage.
   4. Pump rollers shall be capable of operating in either direction at the maximum-rated pump pressure.
   5. Pump rollers shall be capable of operating in either direction without output variation.
   6. Suction lift shall be 30 feet of water.
   7. Repeatability: +/- 0.5 percent.
   8. Accuracy: +/- 0.5 percent.
   9. Pump shall have a 5-year manufacturer’s warranty that includes chemical damage to the pump head and roller assembly caused by a ruptured pump tube assembly.
2. Pump Head – Shall be a single, unbroken track with a clear removable cover.
   1. Tube-failure detection sensors shall be wholly located in the pump head. Tube failure detection system shall not trigger with water contact. Float switch-type switches shall not be used. Process fluid waste ports or leak drains shall not be provided.
   2. Squeeze rollers with encapsulated ball bearings shall be directly coupled to a one-piece thermoplastic rotor. Four polymeric rollers shall be provided: two squeeze rollers for tubing compression shall be located 180 degrees apart, and two guide rollers that do not compress the tubing shall be located 180 degrees apart. The roller diameters and occlusion gap shall be factory set to provide the optimum tubing compression; field adjustment shall not be required. Spring-loaded or hinged rollers shall not be used.
   3. Rotor assembly shall be installed on a D-shaped, chrome-plated motor shaft and removable without tools.
   4. For tubing installation and removal, rotor assembly shall be rotated by the motor drive at 6 RPM maximum when the pump head cover is removed. Hand cranking of the rotor assembly shall not be required.
   5. Pump head and tubing compression surface shall be corrosion-resistant Valox thermoplastic.
   6. The pump head cover shall be clear, annealed acrylic thermoplastic with an integral ball bearing fitted to support the overhung load on the motor shaft. Cover shall include an imbedded magnetic safety interlock which will limit the motor rotation speed to 6 RPM when removed.
   7. Cover shall be positively secured to the pump head using four thumb screws. Tools shall not be required to remove the pump head cover.
3. Pump Tube Assembly
   1. To ensure pump performance and accuracy, only tubing provided by the manufacturer is acceptable.
   2. Pump tube shall be assembled to connection fittings of PVDF material.
   3. Connection fittings shall be permanently clamped to the tubing with stainless steel clamps. To prevent tubing misalignment and ensure accuracy, fittings shall insert into keyed slots located in the pump head and secured in place by the pump head cover.
   4. Connection fittings shall be for 1/4” ID x 3/8” OD flexible tubing.
   5. Tube sizes and connections shall be measured in inches.
   6. Tube assembly shall be (***Engineer to specify***).
   7. Pump shall have NSF 61 certification.
4. Drive System – Shall be factory installed and totally enclosed in a NEMA 4X, (IP66) wash-down enclosure. Capable of operating on any input power from 110 VAC to 240 VAC, 50/60 Hz single-phase supply without user configuration or selection switches.
   1. Motor
      1. Reversible, brushless DC gearmotor rated for continuous duty.
      2. Motor shall include overload protection.
      3. Gear ratio shall be 125 RPM.
      4. Metering pump shall have a 10,000 to 1 turndown capability.
   2. Enclosure
      1. Pressure-cast aluminum with acidic liquid iron phosphate three-stage clean and coat pretreatment, and exterior grade corrosion-resistant polyester polyurethane powder coat.
      2. Rated NEMA 4X (IP66).
      3. Provided with 316SS floor/shelf level mounting brackets and hardware. Optional: provide extended height brackets for mounting pump 4.5 inches above grade level. (***Engineer to specify***)
      4. Provide six-foot length power supply cord with NEMA 5/15 U.S. 115 VAC attachment plug. Optional: power supply cord with NEMA 6/15 U.S. 230 VAC attachment plug. (***Engineer to specify***)
      5. A wiring compartment shall be provided for connection of input/output signal wires and alarm output loads. Conduit hubs, liquid-tight connectors, connector through holes, and tapped holes shall be sized in U.S. inches.
   3. Control Circuitry
      1. Provide front-panel user touchpad controls for stop/start, configuration menu access and navigation, operating mode selection, auto priming, and reverse direction.
      2. Provide VGA graphic LCD display for menu-driven configuration settings, pump output value, service alerts, tube failure detection (TFD) system and flow verification system (FVS) alarms status, remote input signal values, and tubing life timer value.
      3. Provide for manual control of pump output volume via speed percentage, cycle timer, manual dispensing, and parts per million (PPM) calculator operating modes.
      4. Provide for remote control of pump output volume via 4-20 mA, 0-10 VDC, 0-1000 Hz pulse, contact closure pulse batching, and parts per million (PPM) calculator operating modes.
      5. Provide for remote stop/start pump via 6-30 VDC powered loop or contact closure loop.
      6. Provide a 4-20 mA or 0-1000 Hz output signal, scalable and proportional to pump output volume.
      7. Provide four contact closure alarm outputs: three rated at 1A-115 VAC, 0.8A-30 VDC and one rated at 10A-250 VAC, 8A-30 VDC. Each alarm output shall be assignable to any of the following pump functions: TFD system, FVS system, motor run/stop, motor failed to respond to commands, input signal failure, or output signal failure.
      8. Provide a four-digit password protected configuration menu.
      9. Provide a flow verification system with programmable alarm delay time from 1-255 seconds. FVS system shall monitor the FVS flow sensor while pump is running only. System shall not monitor pump while not running.
5. SAFETY
   1. The pump shall be listed to UL standard 778 as a motor-operated pump and CSA standard C22.2 as process control equipment.
   2. Tube Failure Detection (TFD) system sensors shall be wholly located in the pump head. TFD system will stop the pump within three seconds of leak detection. To prevent false alarms due to rain, wash-down, condensation, etc., tube failure detection system shall not trigger with water contact. Process fluid waste ports or leak drains shall not be provided.
   3. Pump head cover shall include an imbedded magnetic safety interlock which will stop the pump when removed. Pump rotor speed shall be limited to 6 RPM when cover is removed.
   4. Secondary user confirmation input required for motor reversal, tube life timer reset, and factory default configuration reset.
   5. Quick disconnects with integral check valves shall be used with the pump to prevent leaking of chemicals while changing out hoses.

2.6 SYSTEM SKID

A. Skid – Two single pump systems shall be constructed of marine grade high density polyethylene with a tensile strength greater than 4100 psi.

* 1. There shall be two side walls, a partial height center wall, a pump mounting base, and one rear back plate.
  2. Two 316 stainless steel pump mounting brackets with four mounting slots shall be provided per pump. Pump mounting brackets shall be secured to the skid structure with stainless steel hardware.
  3. Chemical containment shall be built into the chemical feed skid for each chemical.
  4. Piping shall be ½” diameter schedule 80 PVC
  5. True union ball valves shall be PVC with PTFE shaft bearings and seals. Seals and O-rings shall be selected by the skid fabricator to be compatible with the chemical being used.
  6. Unions shall be schedule 80 PVC.
  7. Seals may be specified as Viton, Hypolon or EPDM with Viton seals as the default selection.
  8. One chemical inlet port shall be provided.
  9. One chemical outlet port shall be provided.
  10. All socket weld joints shall be glued with gray CPVC 724 industrial pipe cement for chemical applications with the use of P-70 industrial primer.
  11. System shall have a five year manufacturer’s warranty on all glued and welded joints. All skid components shall carry the manufacturer’s standard warranty not less than one year.

B. Check valve shall be located at the discharge side of each peristaltic pump to prevent the back flow of fluid through the pump.

1. The check valve shall be PVC with a 1.0 – 1.5 PSI cracking pressure.

2. The maximum inlet working pressure shall be 150 PSI.

3. Seals may be specified as either Viton or EPDM with Viton seals as the default selection.

4. Check valve shall be manufactured by Plast-O-Matic

C. Pressure relief valve (PRV) shall be located on the discharge side of each pump to prevent excessive pressure in the system. Fluid shall be returned to the inlet side of the system if the preset maximum system pressure is exceeded.

1. The PRV shall be PVC, CPVC with a PTFE diaphragm seal.

2. The PRV shall have a convenient high-density plastic pressure adjustment knob molded onto a stainless-steel threaded shaft with a stainless-steel lock nut.

3. The PRV shall have infinite adjustment increments from 15 to 150 PSI.

4. The PRV shall have a 1-year manufacturer’s warranty.

5. Pressure relieve valve shall be manufactured by Griffco.

D. Calibration cylinders shall be located in the inlet side of the system to permit metering pump output volume calibration.

1. Valves shall permit the cylinder to be filled by gravity if possible. If gravity fill is not available, a bypass line shall be provided to allow the metering pump to be used to fill the calibration cylinder.

2. The cylinder shall be clear PVC with PVC socket-weld end caps.

3. Calibration cylinder shall have a 1-year manufacturer’s warranty.

4. Calibration cylinder shall be by Griffco

2.7 ACCEPTABLE MANUFACTURERS

Big Wave Water Technologies (Oceanside, California)

Contact: 667-244-9283 or via [www.bigwavewater.com](http://www.bigwavewater.com)

2.8 SUBMITTALS

Submittals shall be in accordance with section XXXX, contractor submittals, and the following.

A. Descriptive product literature with manufacturer, type, and model number clearly identified.

B. Equipment installation drawings shall provide all necessary information for the safe and proper installation of the reservoir control system. The drawings shall include, but shall not be limited to:

1. Mechanical equipment installation drawings, including all dimensions, complete with anchor-bolt layout and sizing.

2. Detailed piping drawings with complete lists and specifications for required materials to complete the installation. Piping drawings to include all piping connections, locations, sizes, and detail fittings.

3. Electrical diagrams, detailed electrical conduit routing plans, wiring diagrams, and control schematics with bills of material required for all electrical equipment and instrumentation. Wiring diagrams to include component designations and ratings.

4. Instrument installation drawings and schematics.

2.9 OPERATION AND MAINTENANCE INSTRUCTIONS

A. An interim set of operation and maintenance instructions, including safety precautions to be followed, shall be submitted in triplicate to the District prior to initial startup of the equipment.

B. Within sixty (60) days following formal acceptance of the work, the supplier shall prepare and supply three (3) copies of the operation and maintenance manuals, modified as necessary, for the actual work startup and operating experience. Such manuals shall be completely indexed and shall include step-by-step procedures for the operation and maintenance of the Chloramine Boosting System installed. The maintenance portion of the manual shall include a preventive maintenance, troubleshooting, and lubrication program for the entire system.

**PART 3 – TRAINING**

Big Wave Water Technologies or authorized personnel will instruct designated UTILITY personnel in the safe and proper operation of the chloramine boosting system. This training will reference the operation and maintenance manual provided with equipment.

Three days of startup and training services shall be provided by the system manufacturer.