

## RODI EQUIPMENT

### DESIGN GUIDELINES

1. General
  - a. This guideline covers the detailed requirements for the installation of a High Purity Deionized Water System to provide 1 megohm water for laboratory use.
  - b. All RODI system parts are to be non-proprietary.
  - c. All new RODI generation equipment for new facilities/buildings or replacement systems shall match existing RODI systems in the other buildings/facilities remaining as specified below.
2. Deionized Water (RO/CDI) System for Water Equipment Rooms
  - a. Shall have prewired control panel
    - NEMA enclosure with hinged door or doors and gaskets, louvers, fans and durable finish to match the environment where it is located.
    - Control power transformer with primary and secondary fuses.
    - Pushbuttons, switches, liquid crystal display, and LED or pilot lights to indicate ON, OFF, speed or other appropriate information as specified for each piece of equipment.
    - Wiring diagram on the inside cover indicating terminals by number, wiring color to each control device both inside the panel and remote. Diagram shall be covered in plastic and affixed to the inside cover or box in a location easily readable after opening the front cover plate.
    - Panel shall contain motor starter as applicable for specific equipment to provide a complete and working system.
  - b. The system shall consist of:
    - Cold water reduced pressure backflow preventer
    - E-Z pressure booster pump system
    - Duplex alternating water softener
    - Duplex series carbon filters
    - RO unit
    - Polyethylene RO storage tank with 0.2 micron vent filter
    - Ultrasonic level sensor
    - Continuous electro-deionization unit (CDI)
    - RO duplex circulation pumps with VFD pump control panel
    - (1) polyurethane DI storage tank with a ultrasonic level sensor (plus extra unit for maintenance stock)
    - Duplex DI circulation pumps with duplex VFD pump control panel

- 1.0 micron prefilter canister (with spare filter cartridges)
- Ultraviolet sterilizer (UV) with spare lamps
- 0.2 micron final filter canister (with spare filter cartridges).

### 3. Design

#### a. Backflow Preventer

- Stainless steel/Noryl (modified polyphenylene oxide) check modules.
- Inlet and outlet bronze quarter turn ball valves
- Bronze test cocks
- Bronze primary and secondary check valves with double-seated primary check feature and vent port.
- Factory assembled and suitable for installation directly into water piping.
- Provide air gap assembly with drain connection to floor drain.
- Units 2 inch and smaller shall be constructed of all bronze.

#### b. Booster Pump

- Pump shall be sized to boost process water pressure to maintain an inlet pressure of 40 psig at the RO unit.
- MC shall field assemble with required piping and fittings.
- System to include the following:
  1. Booster pump
  2. Diaphragm tank.
  3. Controller
  4. Pressure sensor.

#### c. Water Softener:

- Automatic duplex alternating water softening system shall function based on volume initiation with timed override for backwashing during third shift.
- Capable of delivering unlimited gallons of soft water at a continuous flow rate to meet user requirements for RO feed service when properly backwashed and regenerated.
- Based on water having a compensated hardness of 11 grains per U.S. gallon, capable of operating on a 24 hour basis.
- Provide removable pipe sections at control head to allow for free spinning of head for servicing tank while in its static upright position.
- Shall consist of:
  1. (2) softener tanks
  2. Brine tank
  3. internal distributors
  4. upper distribution systems

5. exchange resin
  6. automatic electronic controller head to control all softening, backwash, brining and slow and fast rinse functions.
  7. Valve assembly shall be equipped to avoid hard water bypass.
- Softener Tanks:
    1. Molded fiberglass construction.
    2. Designed for 110 pound working pressure and tested at 1-1/2 times working pressure.
    3. Reinforced openings for pipe connections and rigid supports.
    4. Mineral tanks shall be National Sanitation Foundation (NSF) approved.
    5. There shall be adequate side shell height to allow for 50 percent bed expansion during backwash.
    6. Tanks shall utilize premium grade gel-type synthetic high capacity cation exchange resin of polystyrene type.
  - Brine Tank:
    1. Brine tank shall be constructed of polyethylene with removable plastic cover.
    2. Float operated fill valve shall ensure a constant supply of saturated brine for regeneration.
    3. Brine shall be made with soft water.
    4. Salt shall be used for regeneration and the amount shall not exceed 15 pounds per 270,000 grains of compensated hardness removed.
- d. Commercial Duplex Carbon Filters
- (2) large automatic backwashable carbon filter fiberglass tanks piped in series.
  - Size for required flow rate as described below.
  - Carbon filter tanks shall:
    1. Piped in series and set for timed backwash via the electromechanical timer and pretreatment lockout switch assembly to deactivate downstream equipment during backwash feed flow.
    2. Units shall provide adequate removal of chlorine before the reverse osmosis unit when piped in series for the required commercial service flow rate.
    3. Each filter shall provide the required flow rate for RO feed service.
    4. NOTE: Installing Contractor shall provide removable pipe sections at control head to allow for free spinning of head for servicing tank while in its static upright position.
- e. Reverse Osmosis (RO):
- Vertical style for product flow rates up to 10 gpm

- Horizontal styles for larger flows at 50 psig and 77 deg. F.
- 20 inch sediment prefilter with cellulose 5 micron cartridge shall be on the inlet to the unit.
- Double TFC membrane units:
  1. Can receive softened dechlorinated inlet water between 25 to 50 psi at 77 deg. F.
  2. Housing shall be mounted vertically (or horizontally)
  3. 304L stainless steel.
  4. Configuration of membrane housing caps shall allow for quick and easy changeout of membrane filters without removal of other existing components.
  5. The membranes shall have a 92 to 98 percent contaminant rejection rate and have no surface applied decals.
  6. Automatic low pressure shutoff to protect the 304 stainless steel quiet running submersible booster pump when inlet pressure is inadequate.
  7. Pressure indication for prefilter, postfilter, pump discharge, primary and final pressure gauges.
  8. Autoflush system with thermal motor protection and remote on/off capability.
  9. Mounted on non-corrosive stand with open style full skid mounted frame.
- Solid-state programmable controller:
  1. NEMA 4X enclosure
  2. audible and visible alarm system.
  3. conductivity sensor for both feed and product
  4. flow meter for product, reject and recycle flow rates.
  5. Controller shall be field-interlocked to shut down during timed regeneration cycling of carbon filters.
  6. Controller shall have liquid crystal display, multi- function keypad, visual and audible alarms, high/low pressure automatic reset, alarm silence, non-metallic NEMA 4X enclosure and be panel mounted.
  7. The controller for the new ultrasonic level sensor transducer head mounted on top of RO storage tank shall be powered by the new RO unit and field wired to start/stop new RO unit to maintain programmed operating level of RO water in storage tank.
  8. Mount level controller at tank.
- RO Storage Tank:
  1. Single high density polyethylene (HDPE) vertical cylindrical RO storage tank with dished or coned bottom for total gravity drainage of product water.
  2. 12 inch long 0.2 micron vent filter mounted on top of tank.

3. Support frame shall allow for gravity sloped piping to inlet manifold of circulation pumps.
- f. Continuous Electro-deionization (CDI):
- Continuously produce an uninterrupted supply of high purity water by handling an inflow of RO feedwater and take to a higher level of purity (nominal 14 megohm-cm) without the need for regeneration chemicals.
  - The packaged corrosion resistant skid mounted frame shall house a single or double 24 or 30 cell pairs CDI module to meet product water flow rate requirements.
  - Unit shall have main control panel with power supplies, controllers, complete factory CPVC Schedule 80 piping, sample valves, cleaning connections, product flow monitoring and product resistivity meter both with LED readout on control panel.
  - The product low quality divert valves will not be piped/used at this location.
  - Unit shall be Siemens Model CDILX.
    1. The system recovery rate shall be a minimum of 90 percent with range from 6.25 gpm minimum to 18.75 gpm maximum flow rate and respective pressure drop from 10 psi to 50 psi as an example for the 24 cell pair modules. Unit shall operate with feedwater ranging from 4 to 11 pH and hardness less than 1.0 PPM. The feed and product connections shall be 1 inch with reject at 1/2 inch size. Power required shall be 208 volts/single phase or 480 volt/3 phase as required.
    2. Resistivity System: Function is to monitor final product quality from CDI unit and recirculating water in DI storage tank for laboratory deionized water distribution system. System shall utilize the Thornton 200CR monitor supplied with the CDI unit. Contractor shall connect new 50 ft. long sensor patch cord (Part No. ZCOR1050-66) to the "spare" sensor "B" terminal on monitor with other end connected to the new sensor (Part No. ZCEL240-201) field installed upstream of DI circulation pumps intake manifold piping. Controller has two (2) analog outputs, two (2) SPDT mechanical relays and uses 120 VAC (24 VDC) power. Resistivity range from 1.0 ohm per cm to 50.0 Megohm per cm with performance accuracy of  $\pm 0.5$  percent of reading and repeatability of  $\pm 0.1$  percent of reading.
  - DI Storage Tank:
    1. Single high density polyethylene (HDPE) vertical cylindrical DI storage tank with dished or coned bottom for total gravity drainage of product water.
    2. 12 inch long 0.2 micron vent filter mounted on top of tank.
    3. Support frame shall allow for gravity sloped piping to inlet manifold of circulation pumps.
- g. Ultrasonic Level Sensor/Controllers:
- Level sensor head (transducer Part No. DST- 2421-CX50) shall be mounted on top of both the RO and DI storage tanks.

- Transducer head shall have a PVC housing, ceramic transducer (NEMA 6P rating), have internal temperature compensation, with accuracy being 0.25 percent of range and come with 50 ft. coax cable.
  1. The controller (Part No. DCR1006) shall be mounted on and powered from the RO unit with polycarbonate NEMA 4X housing located next to RO main control panel. Contractor shall select voltage and signal outputs to minimize wiring on RO unit.
  2. Controller shall have LED digital display, programmable response time, 1 inch resolution, and have sample rate range of 80 milliseconds to 10 seconds. NOTE: Contractor shall field wire/interlock motor starters for RO and/or DI circulation pumps to shutdown when an ultrasonic level controller senses a “low level” condition in their related storage tanks.
  3. Manufacturer to be Scientific Technologies Inc., 1-888-525-7300 ext. 1034, or approved equal.
  4. NOTE: Contractor shall provide extra/spare ultrasonic level sensor/controller as described above and deliver to WUSM Maintenance Department Contact: Nick Dochwat at (314)747-2906.
- h. Duplex Pumps and Control Panel:
  - Pumps shall be 316 stainless steel Grundfos vertical multistage centrifugal “CR” pumps or Webtrol end suction pumps, base plate mounted with motor and flex drive coupling. Size as required.
  - The control panel shall control the new duplex circulation pumps for either the RO or DI water loop systems.
  - The duplex control panel shall have a single point power connection, one Toshiba frequency drive (VFD) for each pump which will automatically alternate running by means of an adjustable time clock, which shall be field changeable (initial running time shall be set at 24 hours).
  - The pump speed shall be controlled by a pressure transducer (supplied with panel) field installed in the common discharge piping of the pumps to maintain a system pressure required by the project requirements.
  - The panel enclosure shall be fiberglass, NEMA 3R, with nominal size of 24 inch wide by 30 inch tall by 10 inch deep.
  - There shall be a thru the door disconnect handle, a pump selector switch, a pump running light (push to test style) for each pump, and a hand-off-auto switch for each pump.
  - In the “auto” position the selected pump will be controlled by the pressure transducer.
  - In the “hand” position the selected pump shall run at a “field tested” preset speed and shall not have a “by-pass” around the VFD to insure that the specific operating pressure of the loop piping is not exceeded. If the transducer fails, the selected pump will run in the hand position.

- The installing Contractor shall set high and low alarm contact settings on VFD to alert building automation system (BAS) of an irregular output pressure.
  - Richards Electric Motor Company, 1-800-292-2535.
- i. Ultraviolet Sterilizer (UV Light):
- Assembly shall generate the UV energy (254 nm) to act as the final polishing step by destroying bacteria in the product water from the CDI unit.
  - In addition to the quartz sleeves, all wetted parts are fabricated from 316L stainless steel that is passivated and electropolished.
  - The unit has a 304 stainless steel ballast enclosure and a non-resettable 99,999 hour timer.
  - Inlet and outlet connections shall have 150 pound flanges with sanitary clamp connections sized for the required process flow rate requirements.
  - Provide complete set of both new and spare 254 nm lamps in protective case.
  - Contractor shall field wire/interlock power for UV light to energize only when related circulation pumps are operating.
- j. Duplex Final Filters:
- The multi-cartridge filter housings shall be made of cast 316 stainless steel and include 316 stainless steel shell.
  - MC shall install new filter cartridges and provide spare set for maintenance department.
  - Quantities shall vary to minimize initial clean pressure drop to no more than 3 psig with 1.0 micron size prefilters (polypropylene depth media filter cartridges), and 0.2 micron size final filters (polysulfone membrane filter cartridges).
4. Capacity
- a. Provide 20 percent spare capacity.
5. Related Sections
- a. Piping

## EQUIPMENT and PRODUCT REQUIREMENTS

1. RODI System Manufacturers
- a. Approved Manufacturers: *(in order of preference)*
    - Siemens Water Technology (previously U.S. Filter Corp.), Hazelwood MO., (314) 731-1462
    - Schaefer Water Centers, Herculaneum MO., (636) 931-2268
  - b. Manufacturer Equipment Requirements
    - Backflow Preventer

1. Wilkins series 975XL or equivalent by Watts, Cla-Val, Conbraco, or Febco
- Booster Pumps shall be
  1. Grundfos E-Z Boost System with BMQE booster pump
  2. Industrial Process Equipment, (314) 534-3100.
- c. Construction to comply with
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- d. Field Quality Control - Manufacturer's Field Service
  - Factory-authorized competent service representative shall supervise the field assembly of components and installation of all Deionized Water (RO/CDI) systems. This shall include all piping and electrical connections, changing lamps and filter membranes and cartridges in all new equipment, and to report results in writing.
  - Inspect the completed installation
  - Start the water softening system in operation.
  - Test and adjust controls and safeties.
  - Acquaint the operators with the proper operation and maintenance of the equipment.
  - Replace damaged and malfunctioning controls and equipment as required.
- e. Demonstration and Startup Services
  - Factory-authorized, competent supervising agent/service representative from the water softening mnfg. to perform startup services and to demonstrate and train Owner's maintenance personnel as:
    1. Train maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
    2. Schedule training with at least 7 days' advance notice.
    3. A complete set of operating instructions covering the installation, maintenance and operation of the softener system shall be furnished bound in booklet form.
- f. Guarantee: The manufacturer shall Guarantee that:
  - Under actual operating conditions, the effluent shall contain 0 grains per gallon (gpg) hardness as determined by soap test
  - The loss of ion exchange resin through attrition during the first three years of operation shall not exceed 3 percent per year
  - The resin shall not be washed out of the system during the service run or backwashing period
  - The turbidity and color of the effluent, by reason of passing through the softener system, shall not be greater than the incoming water.



- Any and all mechanical equipment proving defective in workmanship or materials within one year after installation shall be replaced F.O.B. factory.

END OF SECTION

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