PART 1 GENERAL

1.01 RELATED CORNELL DESIGN AND CONSTRUCTION STANDARDS

A. Section 230900 – Building Automation and Control System Guidelines

1.02 RELATED STANDARD DETAILS

A. Detail 3.4.5, Laboratory Water Purification System Detail

B. Detail 3.6.7, Quality Water System Monitoring Points

1.03 GENERAL

A. Reverse Osmosis (R.O.) systems are the preferred method to produce process water with low mineral content. It is typically utilized for central systems in laboratory buildings, humidification systems, and to produce feed water for steam-to-steam generators.

B. As a general rule, the central system shall be designed to treat to Type II standards (1 MΩ). Point-of-use equipment shall be included locally within each laboratory that requires treatment to Type I standards (18 MΩ) if needed.

C. The distribution system shall be designed in such a manner to minimize dead-end piping legs and incorporate constant re-circulation.

D. The RO Unit shall be provided with factory controls housed in a fully enclosed, lockable control enclosure with hinged access door. A panel mounted display shall be provided on the unit for local indication of system parameters including the following: visual system on / system off indicator lights, flow meters for product and waste, adjustable flow control for fine tuning, manual on/off switch, and water quality (conductivity) indication.

E. In addition to the local indicators provided all system water meters (system demand) and conductivity meters (quality) shall have the capability of providing an output to the BACS for monitoring, alarming, and trending.

F. The design consultant should evaluate if there is a use for the reject water from the RO unit. Typically up to 50% of the water feed to the RO unit could be reclaimed and re-used in a non-potable water system.
PART 2 PRODUCTS

2.01 SYSTEM COMPONENTS

A. Pre-treatment System: The function of pre-treatment is to reduce the suspended solids, chlorine and chloramines, and microbes from the feed water, which will impair the output of the RO unit and significantly lower the membrane life. The pre-treatment system shall consist of the following components:

1. Thermostatic Mixing Valve: To optimize the performance of the RO unit, the system shall be fed with domestic water mixed to a temperature of 77 °F. A mixing valve shall be installed with a bypass and ball valves on the feed, bypass, and discharge lines.
2. Multimedia Filtration: To remove suspended solids above 10 microns (aka sand and gravel filters, turbidity filters).
3. Water Softener: To remove calcium and magnesium hardness.
4. Carbon Filtration: To remove chlorine and chloramines, and reduce organics.
5. RO Pre-filtration: To remove suspended solids 3-5 microns in size.
6. UV Sterilization: To control microbial proliferation and reduce chlorides and chloramines.
7. Pre-treatment Recirculation: To prevent stagnant water conditions in the pretreatment devices.

B. Purification System:

1. Reverse Osmosis Unit: To remove dissolved mineral salts, organic molecules, and other impurities and feed deionizers with low dissolved solids feed water. The R.O. unit shall be sized to meet the maximum daily requirements of the facility with a 20% spare capacity.
2. Water Meter: Place in the discharge of the RO Unit to track consumption in the form of maximum hourly demand in gallons per hour and totalize the total gallons of usage per day.

C. Post-Treatment System:

1. Storage Tank: Design to store a day’s worth of process water demand, with 20% spare capacity. Minimum tank size shall be 250 gallons. The tank should be equipped with a 0.2 micron vent filter to assure that airborne particulate matter and/or bacteria are not drawn into the tank during tank drawdown. Provide an overflow line piped to the nearest sanitary drain.
2. Distribution pumps: For distribution of the processed water out to the facility. Pumps shall be skid mounted, pre-piped, with independent combination motor starters, variable frequency drives, disconnects, pressure transmitter, conductivity meter, flow meter, and vibration isolation.

3. Mixed Bed Deionizers: To produce high quality water by attracting ionic compounds contained within the water. This stage in the process can be performed centrally; however, it is preferred that the RO water be distributed and then polished at the local point of use in the laboratories where ultra-pure water is actually needed.

4. UV Sterilizer Pre-filter: To further remove suspended solids 1-5 microns in size.

5. UV Sterilizer: To further control microbial proliferation.

6. UV Sterilizer Post-filter: To remove suspended solids and bacteria down to 0.2 microns in size.

7. Conductivity/Resistivity Meter: Place after the final 0.2 micron filter to monitor water quality.

2.02 DISTRIBUTION PIPING

A. Ultra-Pure Water Systems, Type I (18 MΩ)

1. 2-inches and below: ASTM D4101 SDR 11 un-pigmented polypropylene; bead and crevice free (BCF) fusion fittings

2. 3-inches and larger: ASTM D4101 SDR 17.6 un-pigmented polypropylene; bead and crevice free (BCF) fusion fittings

B. Pure Water Systems, Type II (1 MΩ)

1. All Sizes: ASTM F 441/F 441M Schedule 80 CPVC; ASTM F 439 socket type fittings; ASTM F 493 solvent cement

C. For extensions to existing pure water distribution systems match existing materials.

PART 3: EXECUTION

3.01 GENERAL

A. The entire system shall be provided with start-up service by an authorized dealer.