

	Standard Operating Procedure		SOP Number F-502	Revision 2
	Evoqua Purified Water System		Effective Date 11/10/22	Page 1 of 6
Written by/ Date  10/10/22		Reviewed by/ Date SAS 10/10/22		Approved by/ Date  10-10-22
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1.0 Purpose

This procedure describes the Evoqua water purification system and outlines procedures for its regular maintenance and performance monitoring.

2.0 Scope

This procedure applies to the Evoqua Purified Water System installed at Ion Labs.

3.0 Responsibility

- 3.1 Operations and Facility management are responsible for the operation of the Evoqua Purified Water system.
- 3.2 Maintenance of the Evoqua water purification system is carried out by Evoqua Water Technologies, Tampa, Florida under a service agreement.
- 3.3 Quality Control is responsible for monitoring the Evoqua Purified Water system.

4.0 Definitions

- 4.1 **RO** – Reverse osmosis, a process by which water passes through a porous membrane in the direction opposite to that for natural osmosis when subjected to a hydrostatic pressure greater than the osmotic pressure.
- 4.2 **Ultraviolet** – (UV); an electromagnetic radiation with a wavelength from 10 nm to 400 nm. UV radiation constitutes about 10% of the total light output of the Sun, and is thus present in sunlight. UV light is used to kill residual bacterial in the water system, without using chemicals
- 4.3 **PLC** – Programmable Logic Control

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- 4.4 **BOD** – Biochemical Oxygen Demand; the amount of dissolved oxygen needed by microbes to break down organic matter present in water. BOD is a measure of the level of organic pollutants present in a water sample.
- 4.5 **COD** – Chemical Oxygen Demand; the amount of dissolved oxygen that can be consumed by reactions in solution. COD is a measure of the level of organic pollutants present in a water sample
- 4.6 **ACF** – Activated Carbon Filter
- 4.7 **TDS** – Total Dissolved Solids
- 4.8 **UF** – Ultra-Filtration
- 4.9 **ISPE** – International Society for Pharmaceutical Engineering

5.0 References

- 5.1 IOQ-FAC-17-140, Protocol, Reverse Osmosis Water System Installation/Operational Qualification
- 5.2 PQ-FAC-17-140, Protocol, Reverse Osmosis Water System Performance Qualification
- 5.3 PRTCL-20-0006, Protocol, Evoqua Reverse Osmosis Water Purification System Performance Qualification
- 5.4 E-705, SOP, Water Use, Sampling, and Testing
- 5.5 E-705-F2, Form, Purified and Millipore Water Test Ticket – Microbial Limit/ pH/ Conductivity/ TOC
- 5.6 E-705-F3, Form, Conductivity Stage 2 Test Ticket

6.0 System Performance Monitoring and Maintenance

- 6.1 Water purified by the Evoqua Water Purification System is monitored to ensure compliance with USP standards for Purified Water used in manufacturing processes.
- 6.2 Purified water is tested regularly as outlined in SOP E-705 Water Use, Sampling, and Testing.
- 6.3 The water system is sanitized twice per year by Evoqua water systems.

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6.3.1 During sanitization, all Point of Use (POU) ports must be opened to allow solution to thoroughly flush these areas.

7.0 System Description

7.1 The Purified Water System purifies incoming city water and continuously distributes water that meets the requirements of the USP monograph for Purified Water (**Error! Reference source not found.**).

7.2 The water system has the following stages of purification, distribution and control:

7.2.1 Pre-treatment System

7.2.1.1 The objective of pre-treatment is to treat city water in a manner that reduces the load on the final purification system and maximizes the efficiency of the final purification stage.

7.2.1.2 Softener Unit

7.2.1.2.1 Two Softener units have been provided in the pre-treatment stage, in order to reduce the hardness of water to <5ppm.

7.2.1.2.2 These two softener columns work alternately, in order to provide a continuous flow of water, during regeneration of either one of the columns. Each softener column is regenerated in approximately 10 hrs. During regeneration of Softener - 1, the water is diverted to Softener – 2 by the operation of electrically operated valves.

7.2.1.2.3 The soft water, generated by the softener, is stored in a “Soft water Storage Tank”, in order to provide the necessary buffer required for the daily usage.

7.2.1.2.4 A brine tank is maintained for regeneration of the water softener tanks.

7.2.2 Generation system for Purified Water

- 7.2.2.1 The objective of generation system is to provide water to the Purified Water Storage tank.
- 7.2.2.2 Soft water is passed through an activated carbon filter (ACF) for the removal of chlorine, color, odor, BOD and COD.
- 7.2.2.3 ACF filtered water is further passed through 5 micron filter for removal of suspended particles and microbial contamination to extend the performance and lifetime of the RO system. Pressure Gauges across the “5-micron cartridge filter” have been provided, in order to identify the choking of cartridge filter and facilitate its replacement.
- 7.2.2.4 The pre-treated water is further passed through Reverse Osmosis (RO) module for reduction of salt content, suspended particulates, total organic carbon (TOC), and total dissolved solids (TDS).

7.2.3 Storage and Distribution System

- 7.2.3.1 Purified water generated by system is fed to a glass reinforced polypropylene storage tank. The storage tank capacities have been arrived at, keeping in mind the peak load & buffer volumes to be maintained.
- 7.2.3.2 Water level controller in the storage tank prevents overflow and safeguards the pumps from running dry.
- 7.2.3.3 Two vent filters have been installed to filter air entering the tank to displace water as it drains.
- 7.2.3.4 The purified water stored in the purified water storage tanks is supplied to various usage points in the plant by means of a piping/distribution network, which is a closed loop system maintained at ambient temperature.
- 7.2.3.5 An ultraviolet (UV) system has been provided as an additional safety measure, to control the microbial load in the Purified water. The

germicidal lamps are monitored for performance and replaced as needed.

7.2.3.6 An Ultra-filtration (UF) system is used for removal of microbial contamination. The Ultra-filtration system consists of two 0.2 micron filters piped in parallel to insure the water flow is uninterrupted if one of the filters becomes clogged. Two pressure differential gauges are installed upstream and downstream of the filters to monitor performance of the filters.

7.2.3.7 A distribution loop for purified water has been provided for the liquid manufacturing and packaging block. It is constantly circulated and is designed with minimal dead legs. The only areas where the circulation is not present is at the POU ports. These ports must be thoroughly flushed (recommended 3 minutes) prior to use. A minimum velocity of water is maintained in the entire loop. Storage and Distribution system have been designed as per the guidelines of ISPE for minimum velocity in the loop as well as turn-over in storage tank.

7.2.4 Control System

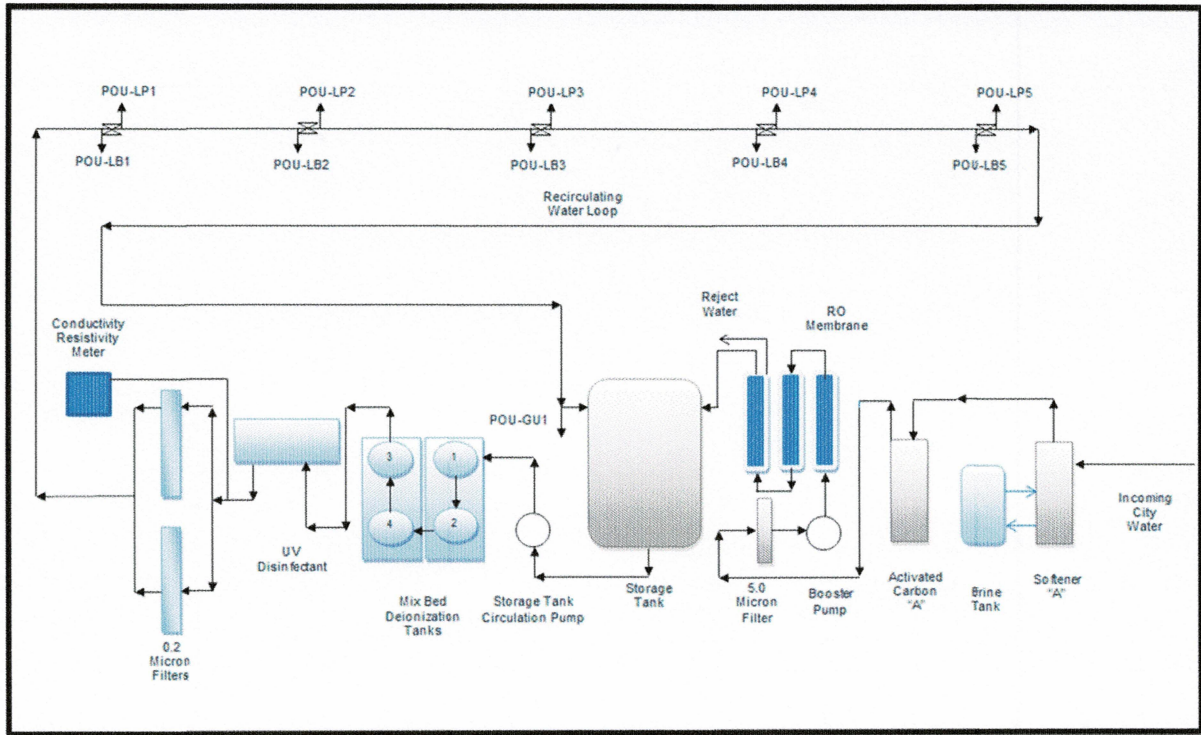
7.2.4.1 The control system is comprised of an enclosure housing a programmable logic controller (PLC) for integral control of the RO unit as well as discrete inputs and outputs for communicating with the pretreatment and post treatment equipment. The Control Panel also houses a contactor motor starter for each RO sub-system.

7.2.4.2 The Control Panel is mounted to the RO's aluminum frame to allow easy access to the conductivity monitor and control devices. The RO unit comes standard with a multi-function quality monitor. The monitor will display the system alarms and product conductivity. One alarm from the monitor will shut down the system on low quality.

7.2.5 Monitoring System

7.2.5.1 A monitor is installed immediately after the UF system to continuously measure TOC and conductivity of the purified water to ensure compliance with USP requirements for purified water.

Figure 1: Schematic of Evoqua Water Purification System



8.0 Revision History

Revision	Date	Description of Changes	CCR #	By
0	08/23/17	New SOP, replaces all previous versions	17-1203	J. Coyle
1	07/27/20	Re-write of procedure to simplify technical description of the water system. Add references to IQ-OQ-PQ protocols and associated procedures. Add section to describe required performance monitoring and maintenance. Remove second figure which provides the same information as the first figure.	CC-20-0529	S. Sassman
2	09/30/22	Per CAPA-22-0024, Added additional requirements for sanitization. Clarified dead leg areas.	CC-22-0396	J. Sassman