



P.O. Box 416
Shawnee Mission, KS 66201
Office: (913) 375-3483
Fax: (913) 432-0269
www.macwatertech.com

January 29, 2014



Reference: Company Introduction for Ultraviolet and Water Systems Audit Results

Dear Mr. [REDACTED],

[REDACTED] of your organization requested we provide a water systems audit focusing on the UV disinfection systems. We have done that and have included some potential issues with recommendations for your review.

MAC Water Technologies, Inc. is unique in that we are a global engineering based water and waste water treatment company. We have developed global OEM agreements with competing manufacturers, allowing our engineers to be technology focused, not influenced by manufacturers and yet still be competitively priced. The services utilized for this project are from our engineering division.

Additional services you may be interested in from this division are our engineering support agreements. What this entails is we will take the daily readings on your systems and an engineer will evaluate them every quarter and provide similar recommendations you will see in this report. What this does for you is helps you prevent unwanted downtime, it provides a return on investment by reducing unwanted chemical, water, and downtime costs, it monitors your current vendors to make sure they are performing as expected and providing the correct products you are paying for, and we can assist in making well educated decisions on how and when you should and should not spend money.

We are also helping other Pepsi facilities in a similar manner so we are familiar with the Pepsi way of making products.

Thank you for your trust and business,

Ryan A. McAfee, P.E., LEED AP
President & CEO
rmcafee@macwatertech.com

1/29/2014

**High Purity Water
Resource Conservation**

**Environmental Compliance
Wastewater Reuse**

**Process Improvement
GREEN Building Practices**



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Reference: Ultraviolet and Water Systems Audit Results

The purpose of this audit started on Pepsi's desire to evaluate their ultraviolet (UV) disinfection systems. We were also asked to evaluate their reverse Osmosis (RO) systems.

Lee Johnson and Ryan McAfee we onsite on 1/8/2014 to look at the equipment and met [REDACTED] and [REDACTED] on 1/9/2014 for a short meeting.

UV SYSTEMS AUDIT

We found four UV systems; Aquafine RO, CIP skid, National Filtered RO, and original RO systems. There is an attached sheet for each system.

The majority of potential problems exist in the ultraviolet intensity (UI) which is a measure of how well the UV is operating and the UV dose that kills the bacteria.

From our experience, [REDACTED] corporate recommended UI is 30 mJ/cm². PLEASE VERIFY THIS UI DOSE FROM CORPORATE ENGINEERING.

Every UV system was an Aquafine TrojanUVLogic series which is the industry standard for this application. These systems are quality, made in the California, and the repair component supply chain is strong in the Midwest.

UV system recommended maintenance is annual UV bulb replacement and bi-annual quartz sleeve replacement. ALWAYS replace the o-rings when replacing the quartz sleeves. The UI set point needs to be adjusted to 100% after new bulbs are installed and after 100 hours of operation. This is the number 1 item not done on these units during regular maintenance.



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CIP SYSTEM

This system was turned off and not currently in use. The unit appears to be in good condition and there were no problems reported.

FILTER'S UV SYSTEM

The system was operating with no apparent leaks or problems. The UI showed a reading of 16.5 mJ/cm². This is far less than the recommended 30 mJ/cm².

Recommendations are to:

1. Ensure all of the bulbs are on
2. Ensure the bulbs are under 1 year old
3. Ensure the quartz sleeves are under 2 years old
4. Ensure the UI was adjusted properly during new component installation

FILTERED UV SYSTEM

The system was operating with no apparent leaks or problems. The UI reading was not working.

Recommendations are to:

1. Check the dip switch settings
2. Reset the unit to see if it turns on
3. Replace the board

RO SYSTEM

The system was operating with no apparent leaks or problems. The UI showed a reading of 21.84 mJ/cm². This is less than the recommended 30 mJ/cm².

Recommendations are to:

1. Ensure all of the bulbs are on
2. Ensure the bulbs are under 1 year old
3. Ensure the quartz sleeves are under 2 years old
4. Ensure the UI was adjusted properly during new component installation



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RO SYSTEM'S AUDIT

FILTER RO SYSTEM

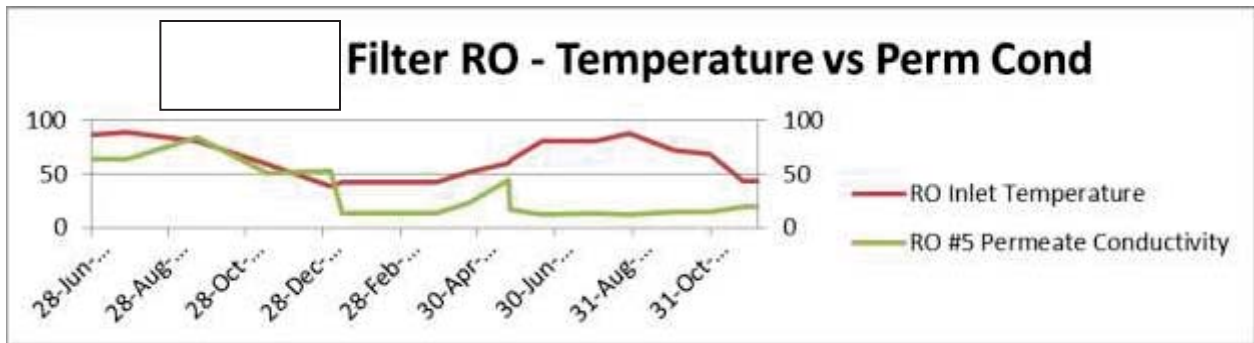
I am assuming an operator adjusted the valves on January 13, 2014 to make more water because the permeate quality increased and the pressure increased. This can be dangerous because when the water's temperature goes down the production rate decreases. By adjusting the valves to put more pressure on the system leads to fouling. It does not appear to be caused by a VFD on the motor because the pressure is not increasing proportional to the temperature change.

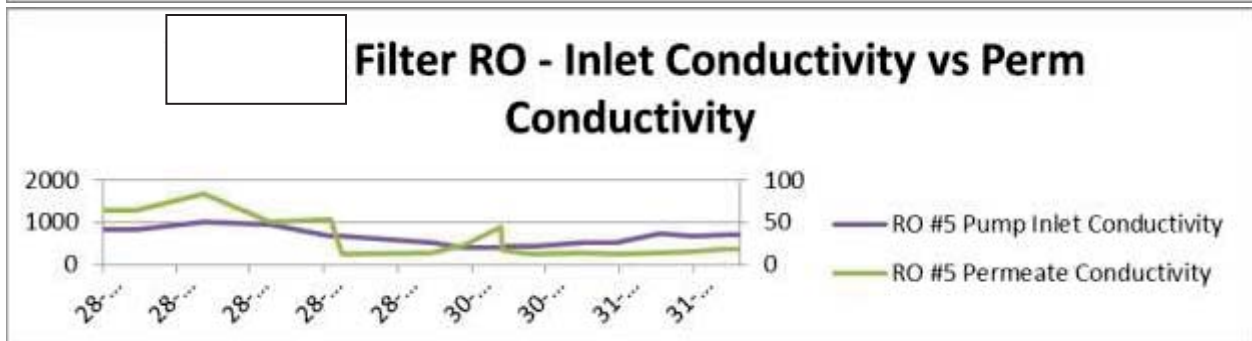
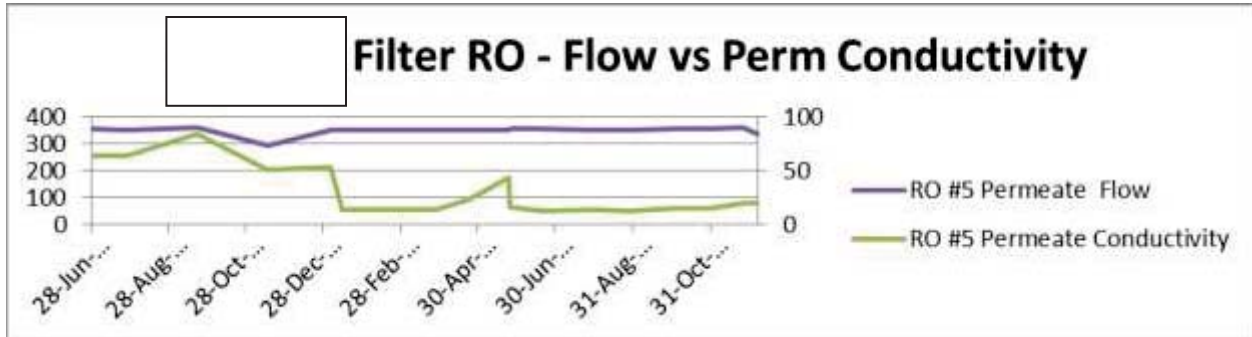
The membrane shows some fouling over the year because the flow rates and pressures do not match similar temperatures from the previous year. This may also be due to not adjusting the valves over the change in seasons.

The membrane were either replaced or cleaned on January 13, 2013 and May 13, 2013. Membrane should last 3 to 5 years.

Recommendations:

- When the water temperature increases into Spring and especially Summer seasons re-adjust the valves back. DO NOT keep making higher volumes of water because the pores will open and the RO system will begin making more water, if no changes are made the membrane will foul relatively quickly leading to downtime and expense.
- The data ended in December 2013. The conductivity and pressure is starting to rise and the flow is starting to decrease. Another cleaning may need to be scheduled.





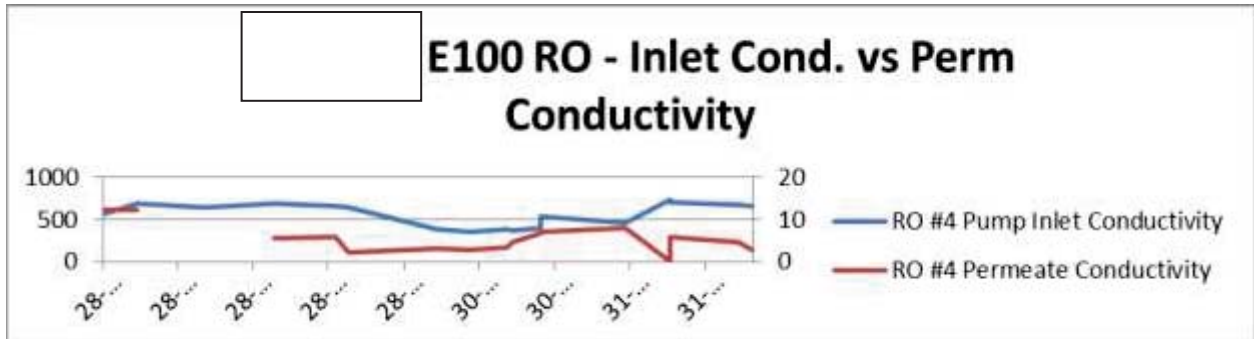
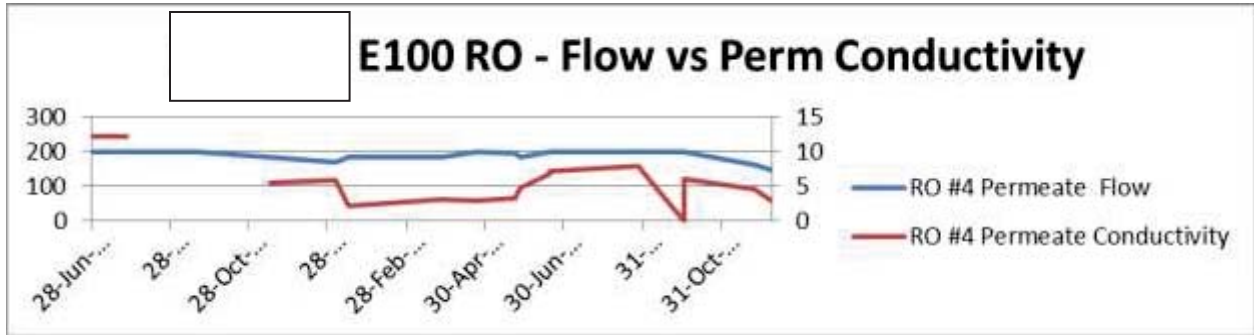
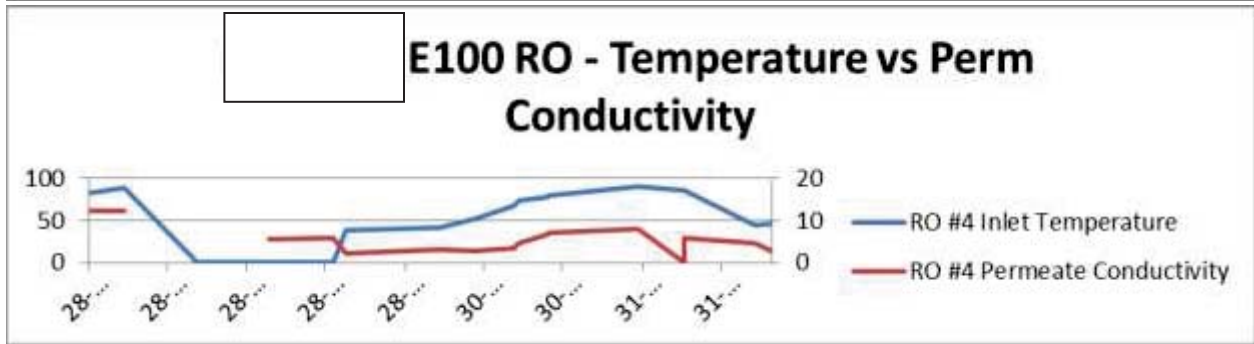
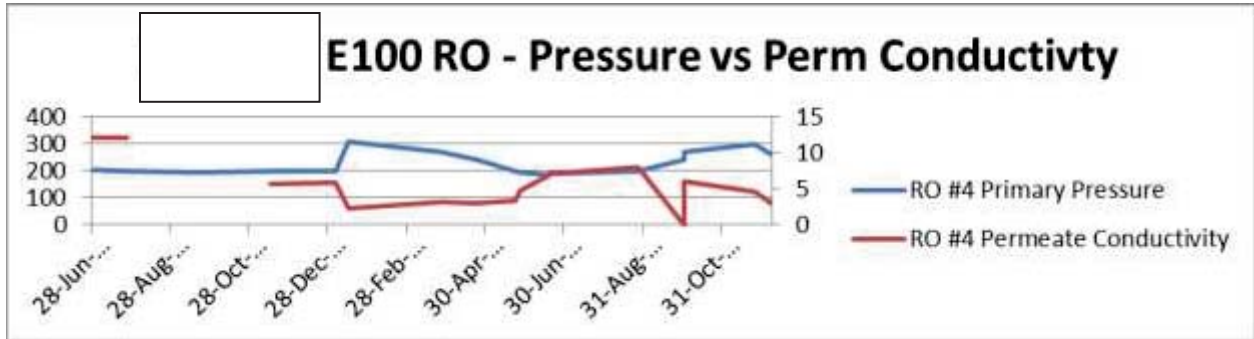
RO SYSTEM

It appears something happened around January, 13, 2013. The inlet conductivity decreased which should have made the permeate quality increase but the permeate quality decreased.

Another phenomenon happened around May 23rd, 2013. It appears perhaps the pressure valves were adjusted. Now the pressure has steadily increased and the flow is decreasing. This shows signs that the membrane are fouling.

Recommendations:

- Check the antiscalant dosing. Perhaps it needs to be increased.
- Check the UV
- Make sure the prefilters are installed correctly
- Check to make sure there is an appropriate pressure drop across the sand per-filters





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RO SYSTEM

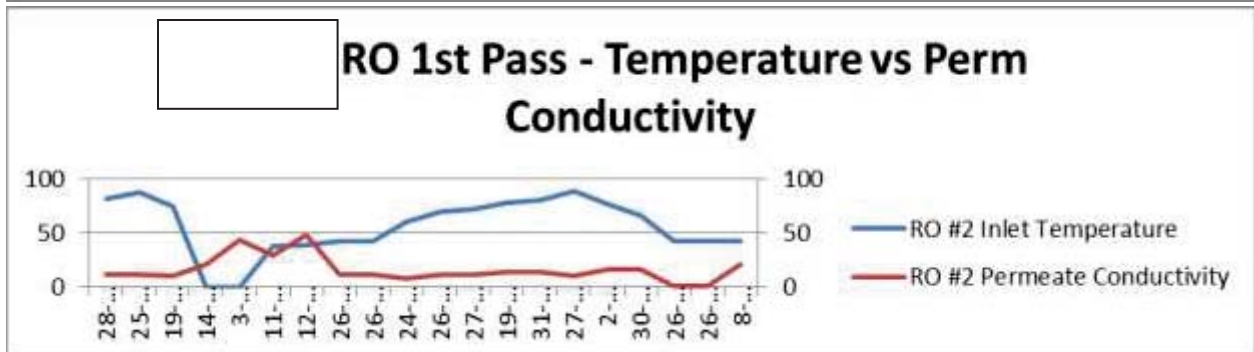
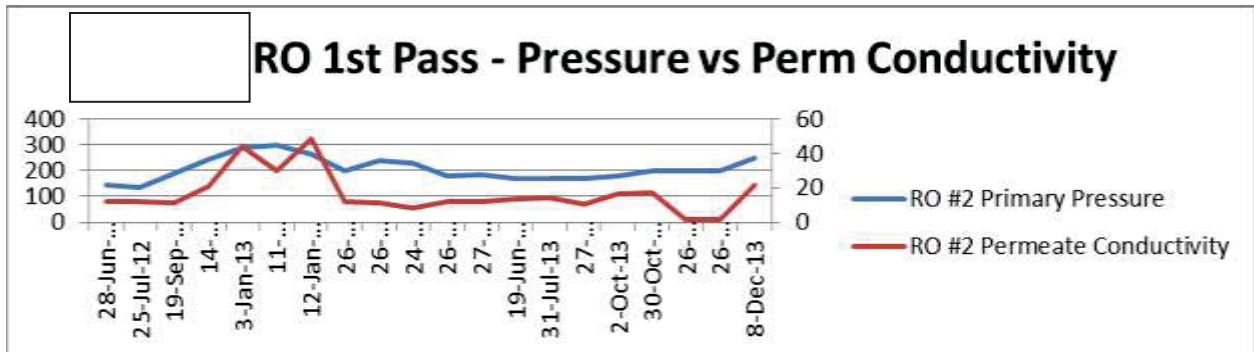
This system is a two pass system. This means the RO quality water from the first pass is treated again in the second pass.

First Pass:

There are some interesting readings during the winter of 1013 so I will begin analyzing around March 13, 2013. All signals look pretty good. I am assuming the membrane were exchanged or perhaps a cleaned around November 13, 2013. However the conductivity and pressure appears to be increasing at an alarming rate.

Recommendations:

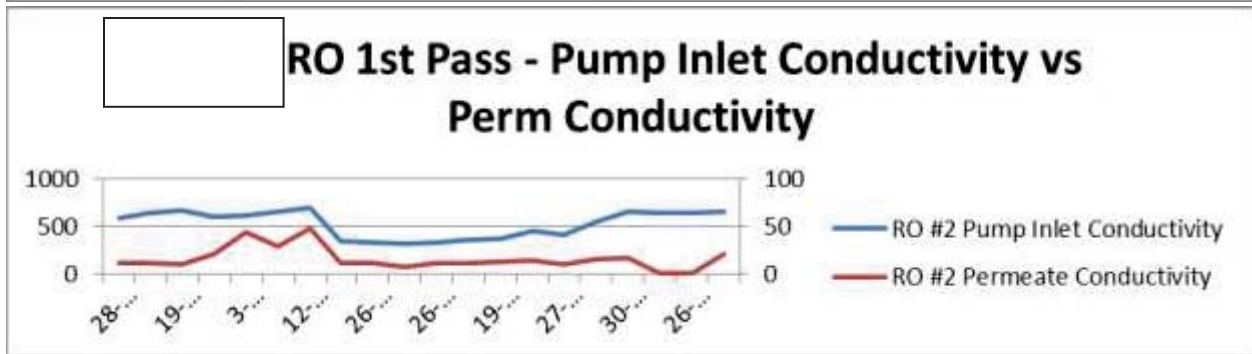
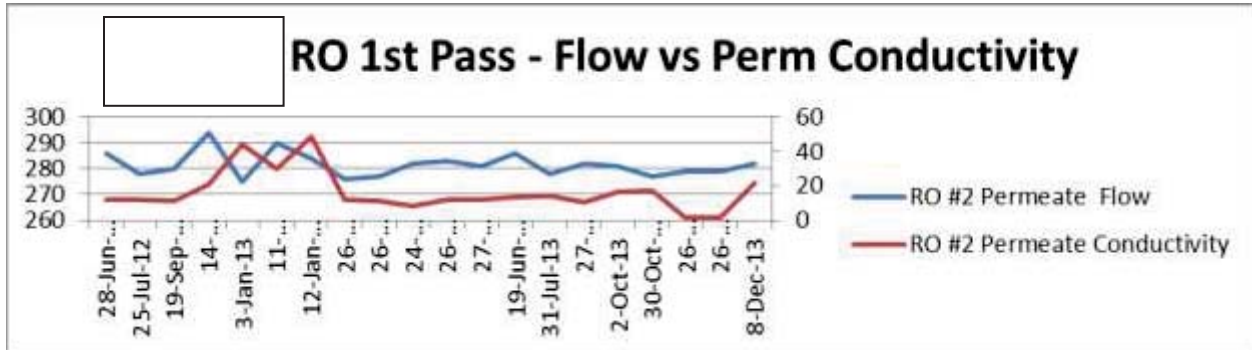
- The conductivity and pressure appears to be increasing starting November 2013. This shows the membrane are fouling at a high rate.
- Check the antiscalant dosing. Perhaps it needs to be increased.
- Check the UV
- Make sure the prefilters are installed correctly
- Check to make sure there is an appropriate pressure drop across the sand per-filters



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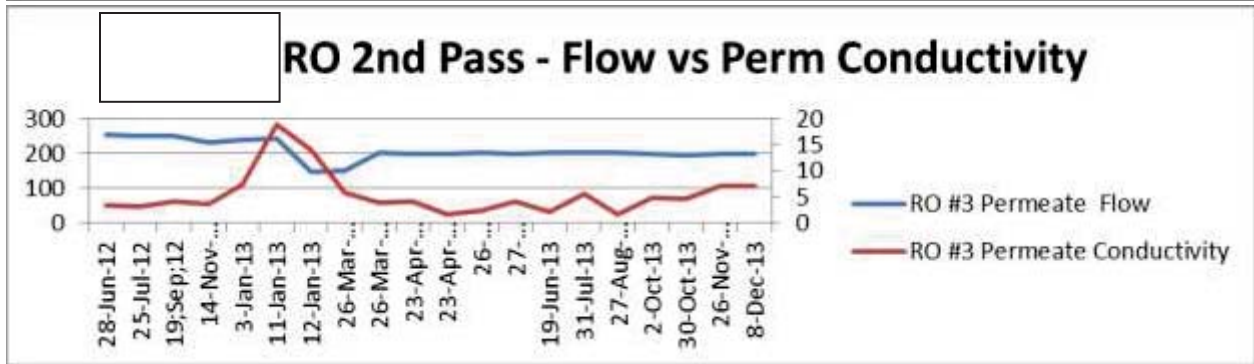
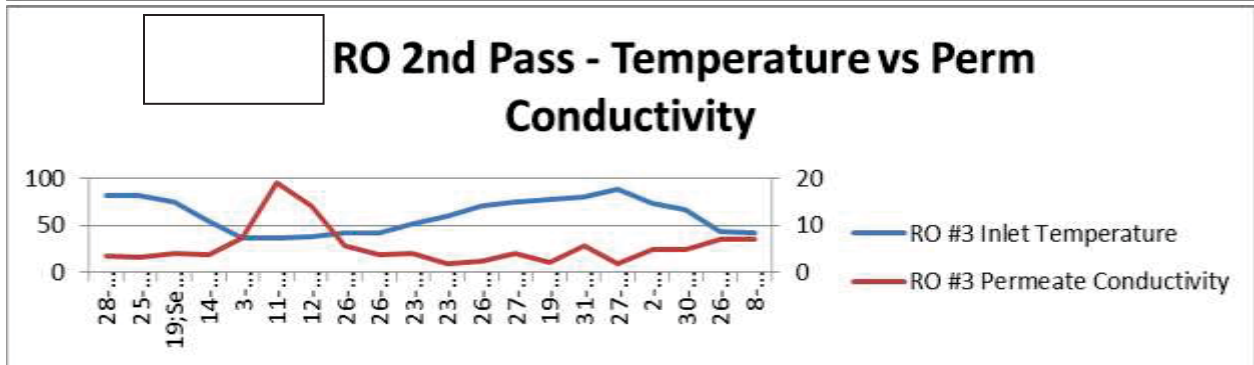
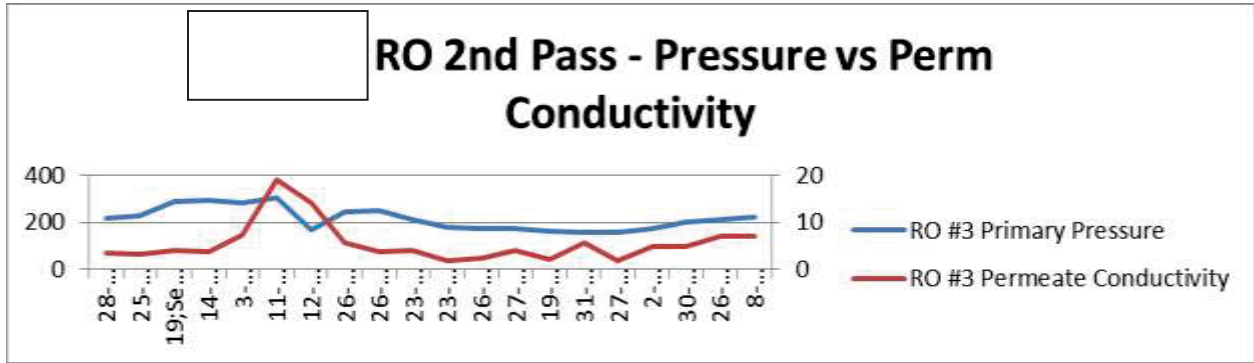
Second Pass:

It is somewhat uncommon for the second pass to foul. The permeate quality is semi-closely following the inlet water quality which is a good sign. This system appears to be on a VFD. As the temperature is decreasing the pressure is increasing to keep the permeate flow rate constant.

The permeate quality is decreasing. So far I believe this is in proportion to the first pass' permeate quality.

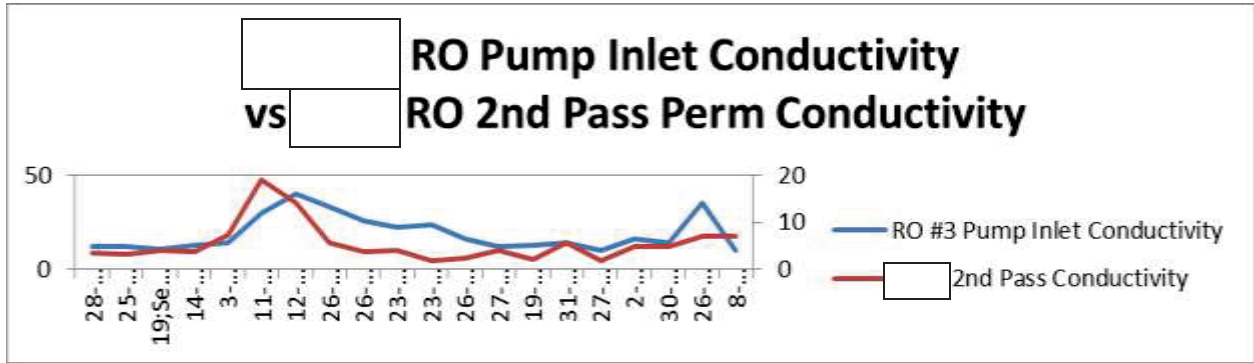
Recommendations:

- I would consider leaving this pass alone and concentrate on the first pass.





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CONCLUSIONS

The UV systems appear to be in good condition. The low UI signals are easily fixed depending on when bulbs and sleeves were last replaced. We also find that most of the time the UI controls are never adjusted as this step is easily overlooked.

The RO systems are working well but there are some preventative steps that should be taken to reduce future costs and downtime.

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