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Talisman Energy

Membranes filtration mobile unit

Operations and Maintenance manual

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TABLE OF CONTENT

INTRODUCTION

To keep the best performance of your system for a longer period of time, it's really recommended to read and follow the instructions about the operation and maintenance of the system and equipment written in this manual.

If you need help or more information about the system and the equipment, do not hesitate to contact us.

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YOUR SYSTEM

Each system has their own characteristics and has been designed to produce a defined flow. The following table gives you the information about your system:

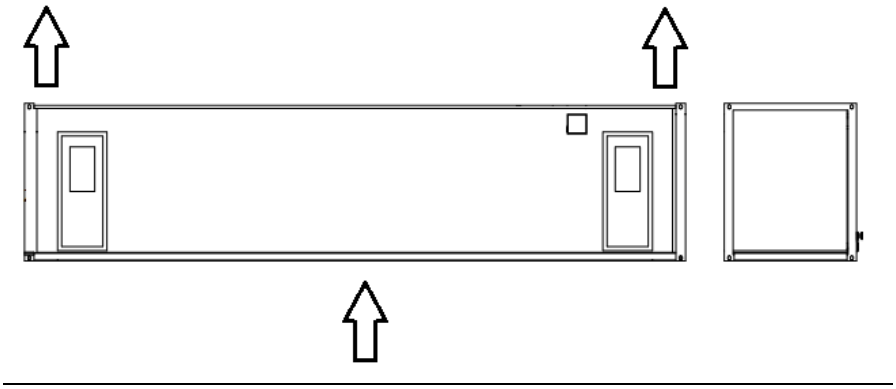
Project name	**Talisman Energy**
Number of membranes	Total of 16 membranes, 8 on first stage and 8 on the second stage.
Membranes model	First stage : Hydranautics CPA5-LD Second stage : Hydranautics SWC6 MAX
Permeat Flow	First stage : 20 USGPM Second stage : 17 USGPM Total : 37 USGPM
Concentrate Flow	13 USGPM
Feed flow	50 USGPM
Recovery rate	74 %
Membranes cleaning Frequency	Maximum every 3 months, depending on PEP calculations
Membranes cleaning products	Lavasol 1, Lavasol 7, Oxysan from PWT
Pumps voltage	480 Volts, 3 phases, 60 hz

1 - INSTALLATION

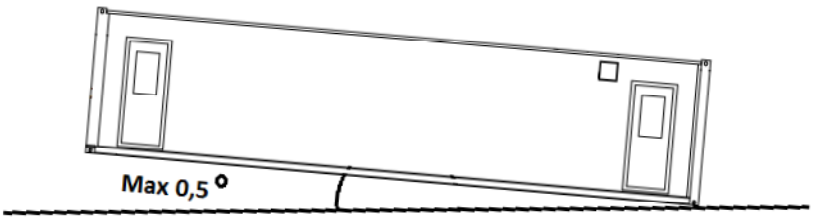
1.1 - HANDLING AND LEVELLING

The container has an anchor point on each corner of the roof. The container may be lift and handling by a crane. This operation must be assisted by a lift truck supporting the charge in the center point of the container.

Estimated weight : 25 000 lbs

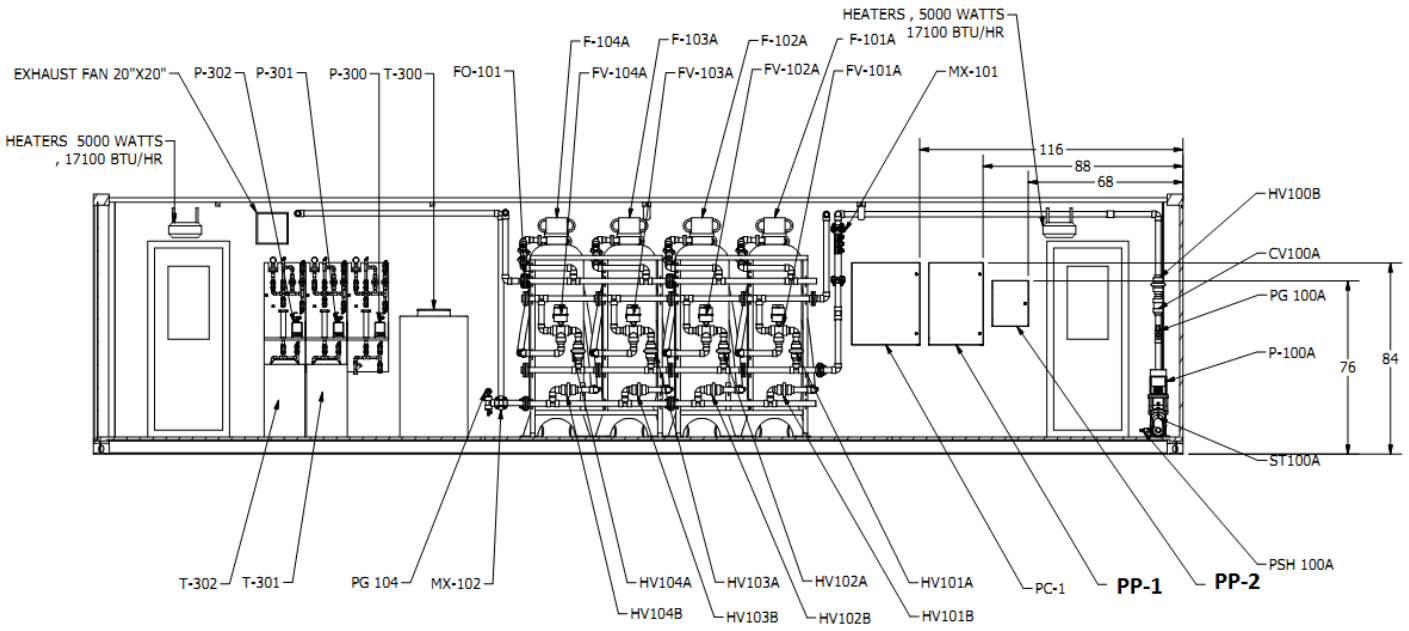


After the handling, it's really important to level the container. A slight angle of maximum 0,5 degree is recommended on the long side of the container to facilitate the draining of the container in case of a leak or any other damage. A 0,5 degree angle represent a shim of about 2 inches.



1.2 - ELECTRICITY

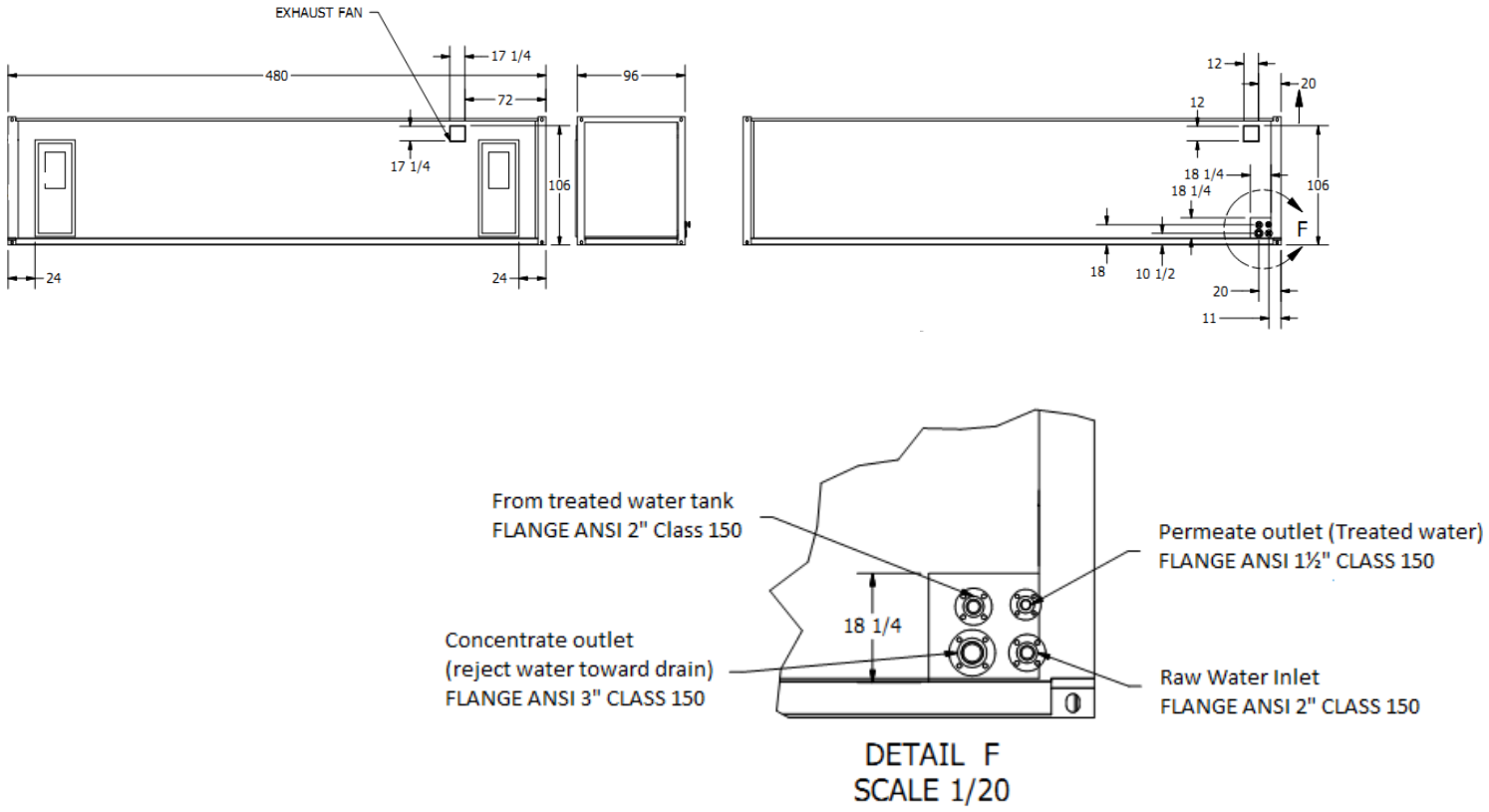
Electrical Connection	Pannel Tag	Requirements
Connect 480 Volts Power Pannel	PP1	125 Amps, 480 Volts, 60 Hz, 3 Phases
Connect 120 Volts Power Pannel	PP2	65 Amps, 120 Volts, 60 Hz, 1 Phase



The customer will have to install a mast or cut an hole, depending of the installation on site.

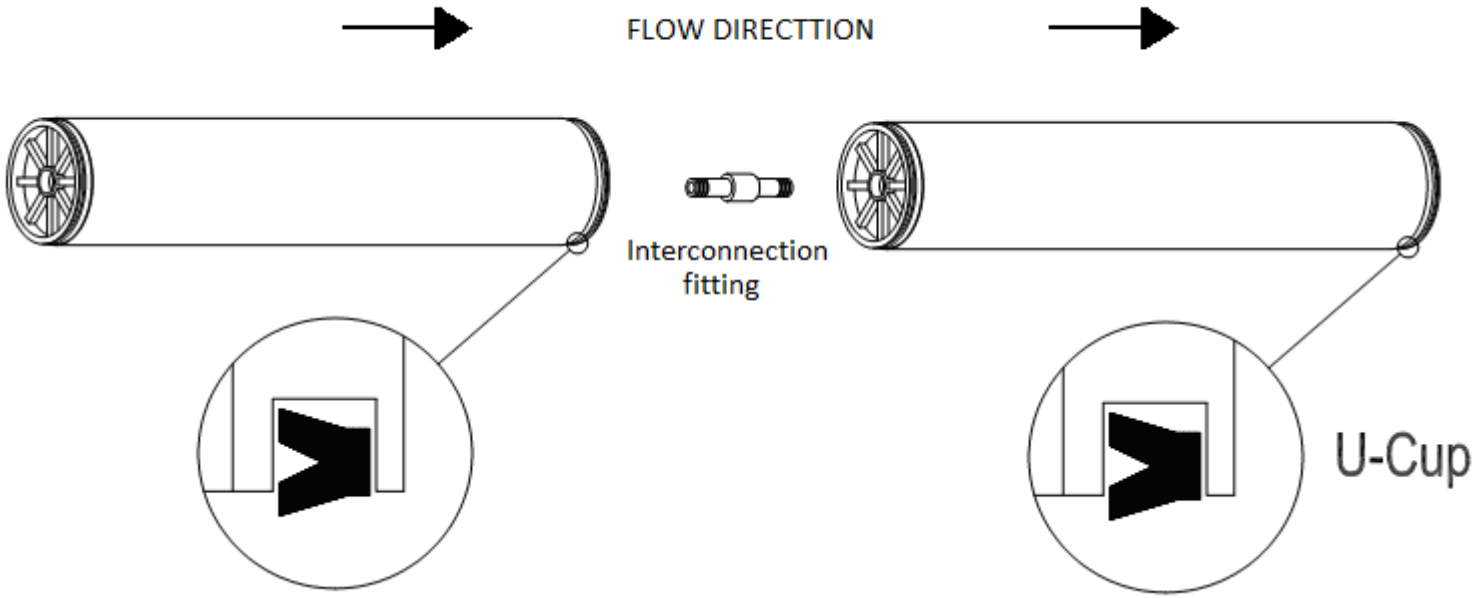
1.3 - PLUMBING CONNECTIONS

In / Out	Description	Process Connection
Permeat outlet	Water treated by the membrane, Ph adjusted	PVC FLANGE ANSI 1½" class 150
Raw Water Inlet	Raw water that needs to be treated	PVC FLANGE ANSI 2" class 150
Concentrate outlet	Concentrate water reject from membranes, Drain	PVC FLANGE ANSI 3" class 150
Treated Water Inlet	Treated water that we will use for GS filters backwash and flush	PVC FLANGE ANSI 2" class 150


EXHAUST FAN
480
17 1/4
72
96
17 1/4
106
24
24
12
20
12
18 1/4
18 1/4
106
F
18
10 1/2
20
11
From treated water tank
FLANGE ANSI 2" Class 150
Permeate outlet (Treated water)
FLANGE ANSI 1½" CLASS 150
18 1/4
Concentrate outlet
(reject water toward drain)
FLANGE ANSI 3" CLASS 150
Raw Water Inlet
FLANGE ANSI 2" CLASS 150
DETAIL F
SCALE 1/20

1.4 - INSTALLATION DE LA MEMBRANE ET SENS DU U-CUP

When it the time to change the membrane, we recommend, if it is possible, to insert or remove the membrane in the same direction of the flow to avoid to fight against the U-CUP. By pushing a new membrane in the feed side of the pressure vessel, an old one will come out at the other end. Be sure to insert the membrane in the good direction as shown on the image below.



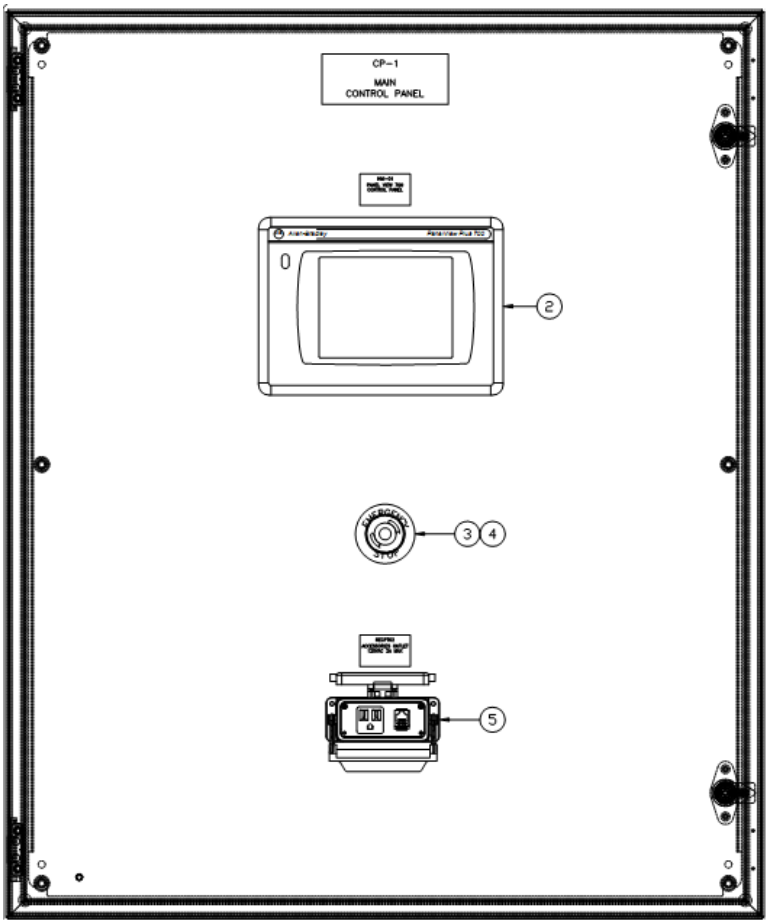
➥**Attention :** We suggest to put glycerin on the U-Cup for easier insertion of the membranes.

2 – OPERATION AND CONTROL PANEL

2-HMI (HUMAN-MACHINE INTERFACE)

3-EMERGENCY STOP BUTTON

5-AUXILARY LAPTOP CONNECTIONS



2.1 – EMERGENCY STOP BUTTON

This button instantly stops all the system and will not take consideration of its actual and shut off sequences.

- Stop the actual sequence
- Stop all pumps
- Actuating valves will stay in positions
- Solenoids valves will close

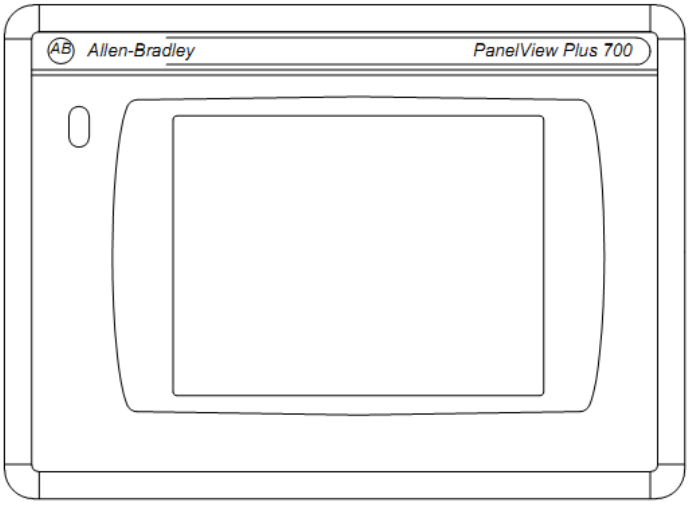
2.2 – AUXILARY CONNECTIONS

The control panel is equipped with a 120V auxiliary outlet and an Ethernet connection port on the front side. A laptop can be connected to the control panel without opening it.

- Auxiliary outlet : 120V, 1 phase, 60 Hz, **2 Amps Max**
- Ethernet : Standard RJ45 connector

2.3 – HMI

The HMI (Human-Interface Machine) is a PanelView Plus 700 from Allen-Bbradley. You can navigate through it and control the system by using the touch screen.



The HMI is composed of 6 different screens.

1- MAIN SCREEN

2- GREEN SAND FILTERS SCREEN

3- REVERSE OSMOSIS SCREEN

4- PARAMETERS

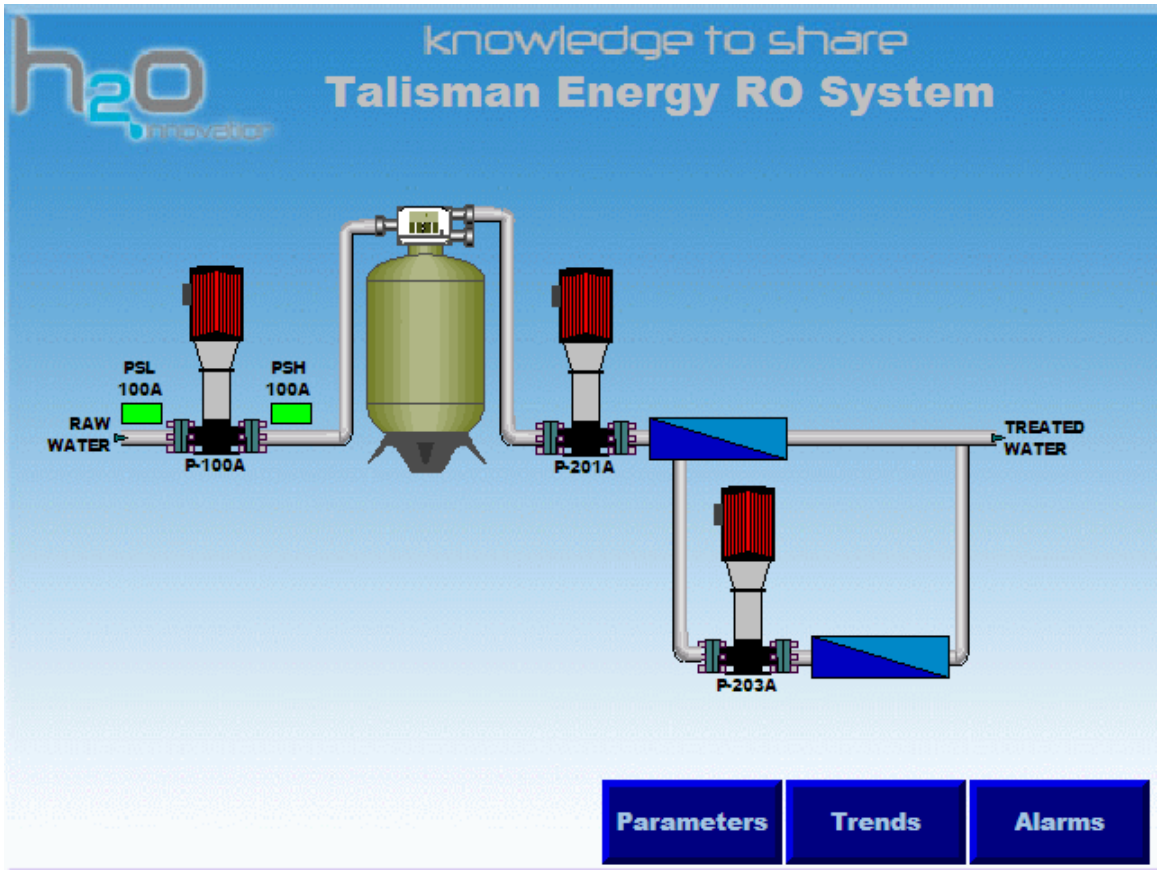
5- TRENDS

6- ALARMS

2.3.1– MAIN SCREEN

Main screen utilities:

- Access all other screens
- Control and read status of feed pump and its low/high pressure switches
- General state of the rest of the system



NAVIGATION :

- Push on the green sand filter to access pretreatment screen.
- Push on membrane vessels to access reverse osmosis screen.
- Push on parameters, trends or alarms buttons to access these pages.

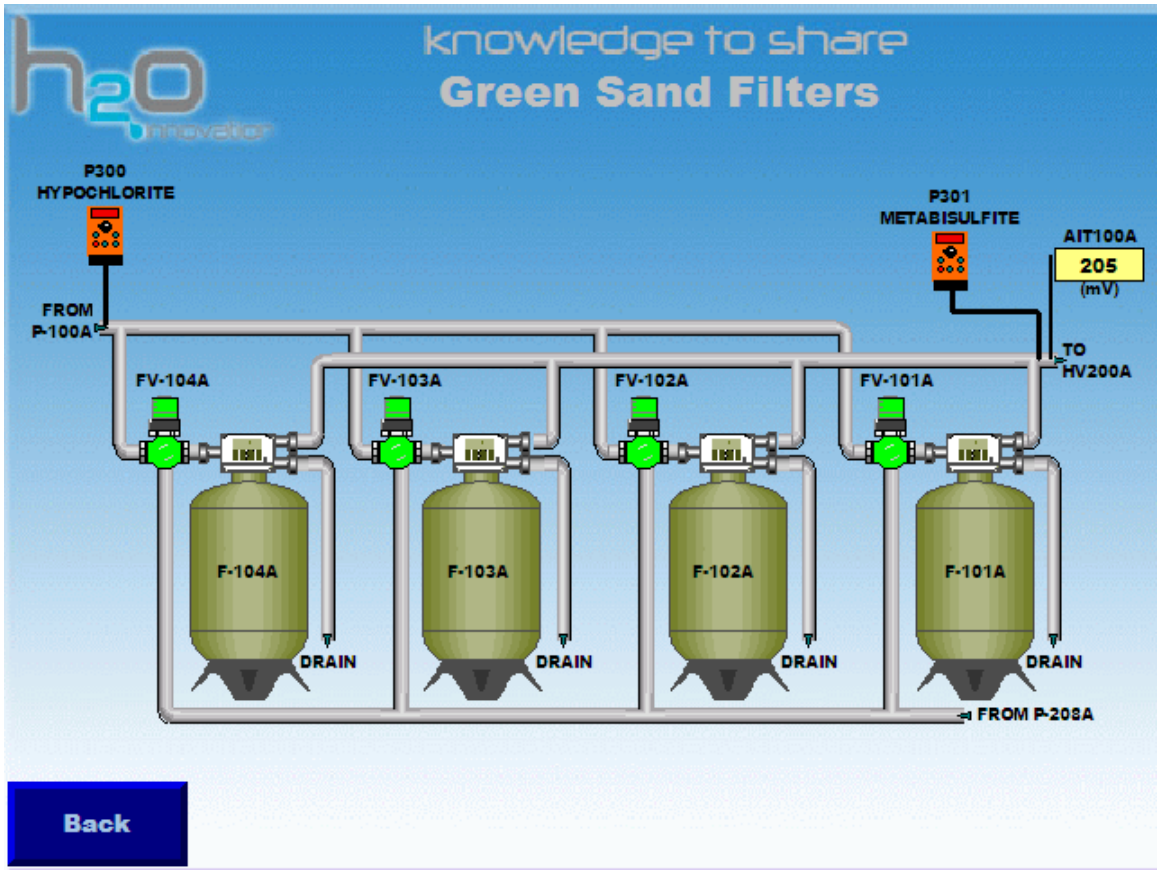
STATUS :

- Low and High Switches :
  - Green : good conditions
  - Red : Fault
- Pumps :
  - Green : ON
  - Red : OFF
  - Flashing red : FAULT

2.3.2– PRETREATMENTS SCREEN

Green Sand Filters screen utilities:

- Control and read status of green sand filters and its valves.
- Control and read status of dosing pumps on green sand filters
- Read the ORP (Oxidation reduction potential) of the water coming out of pretreatments.



NAVIGATION :

- Push Back button to come back to the main screen.

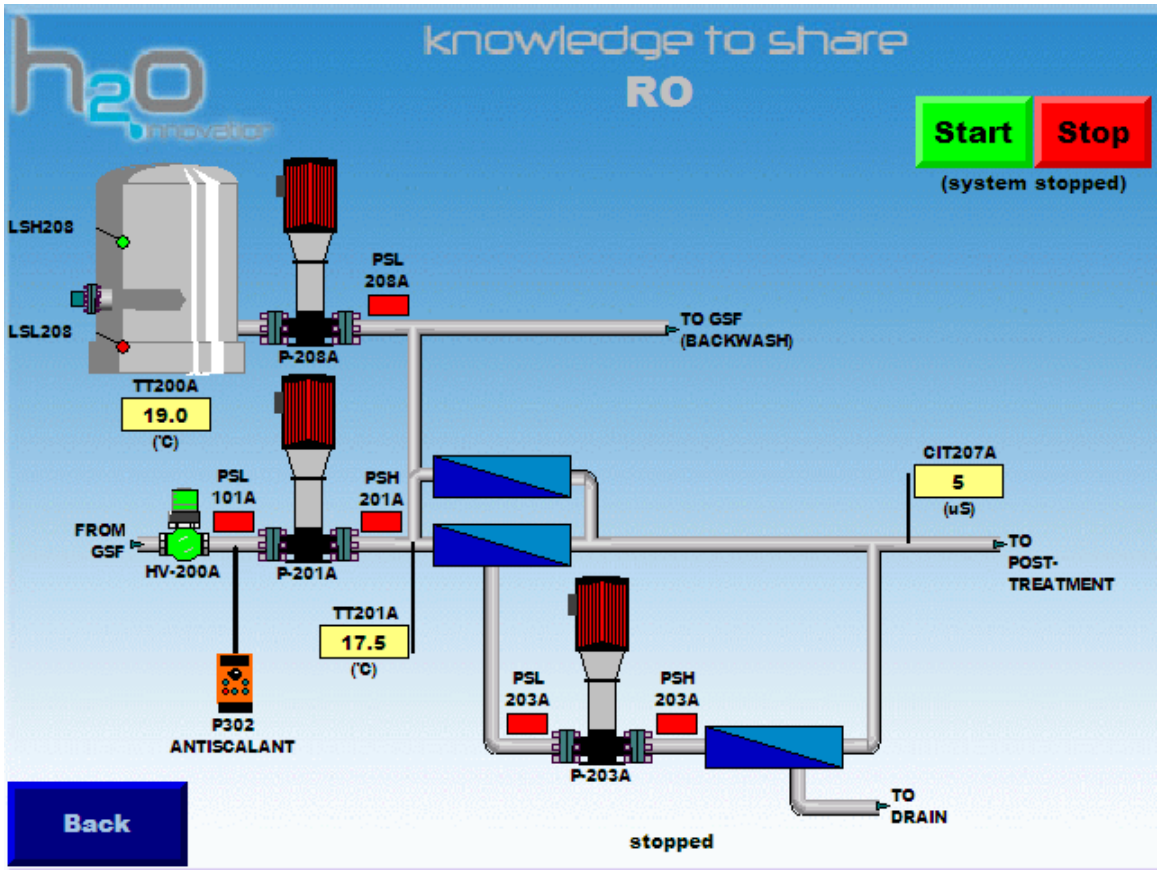
STATUS :

- Valves and filters:
  - Green : in treatment
  - Red : In backwash mode
  - Flashing red : FAULT
- Dosing pumps :
  - Green : ON
  - Red : OFF
  - Flashing red : FAULT

2.3.3– REVERSE OSMOSIS SCREEN

RO (Reverse Osmosis) screen utilities:

- Start and Stop the whole system
- Control and read status of equipment on RO system
- Read water temperatures and the permeate conductivity



STATUS :

- Low/High Pressure Switches and Low/High level Switches :
  - Green : good conditions / Activated
  - Red : Fault / Deactivated
- Pumps :
  - Green : ON
  - Red : OFF
  - Flashing red : FAULT
- Dosing pumps :
  - Green : ON
  - Red : OFF
  - Flashing red : FAULT

CONTROL :

- Start Button : Start the whole system by following the Start sequence
- Stop Button : Stop the whole system by following the shut-off sequence

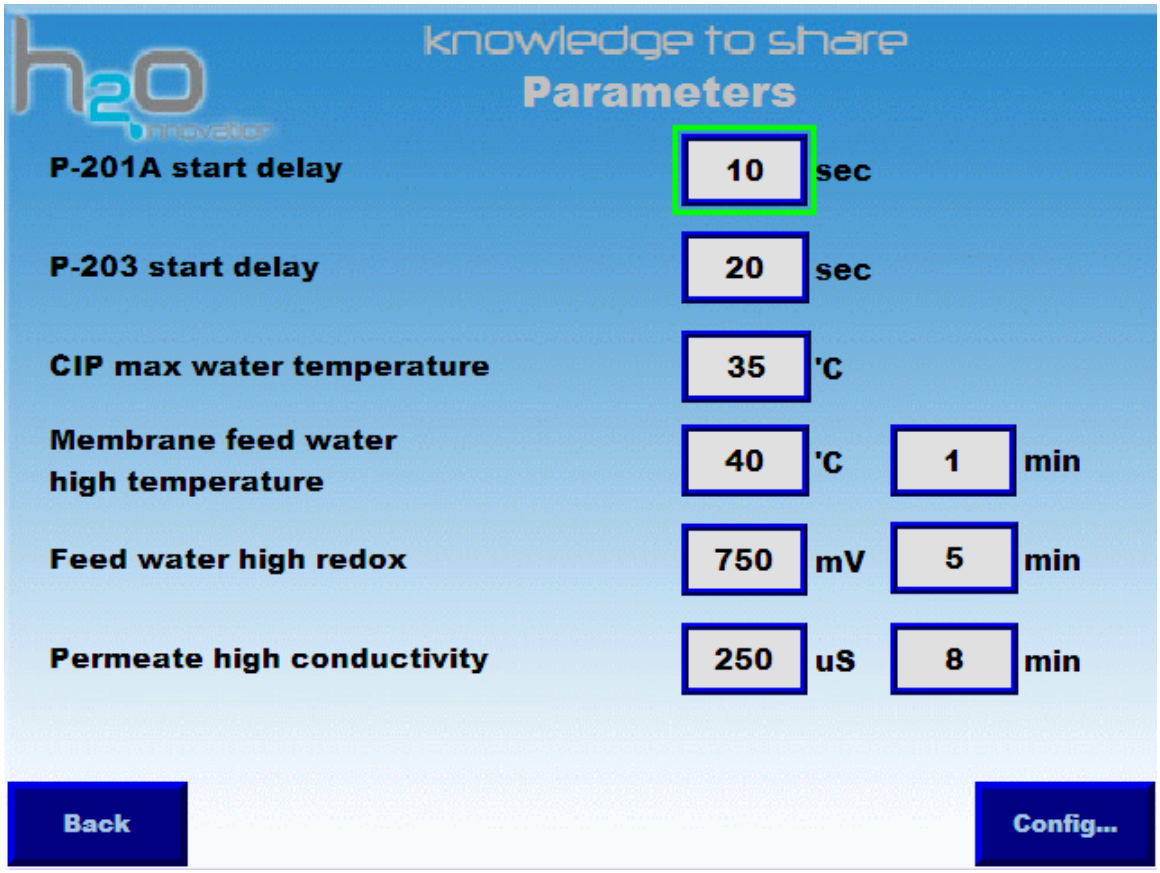
NAVIGATION :

- Push Back button to come back to the main screen.

2.3.4– PARAMETERS SCREEN

RO (Reverse Osmosis) screen utilities:

- Set the adjustable parameters of the whole system



NAVIGATION :

- Push Back button to come back to the main screen.

PARAMETERS DESCRIPTION :

- P-201 start delay : On start-up, time delay between the start of the feed pump P-100A and the first pressure pumps P-201A.

- P-203 start delay : On start-up, time delay between the start of the first pressure pump P-201A and the second one P-203A.

- CIP max water temperature : Setpoint for the heater in the CIP tank. When the temperature transmitter TT-200A in the CIP tank will read this value, it will turn off the heater.

- Membrane feed water high temperature : the first entry is the setpoint for the high temperature alarm. The second one is the delay before the alarm is activated. For exemple, default values are 40 C and 1 min. It means to get an alarm; the temperature on TT-201A must be higher or equal to 40 C and keep it for 1 minute.

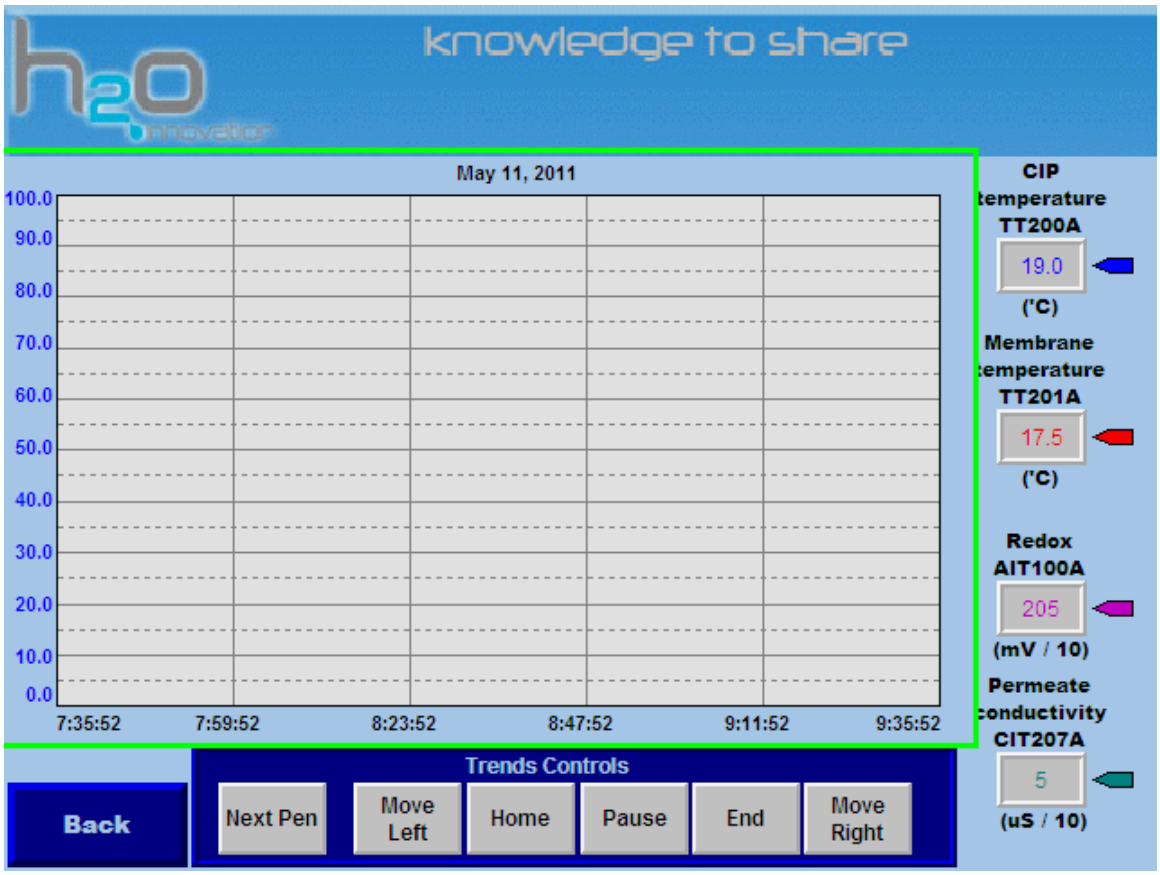
- Feed water high redox : the first entry is the setpoint for the redox alarm. The second one is the delay before the alarm is activated. For exemple, default values are 200 mV and 5 min. It means to get an alarm; the redox on AIT-100A must be higher or equal to 200 mV and keep it for 5 minutes.

- Permeate high conductivity : the first entry is the setpoint for the conducticity alarm. The second one is the delay before the alarm is activated. For exemple, default values are 250 µS and 8 min. It means to get an alarm; the conductivity on CIT-207A must be higher or equal to 250 µS and keep it for 8 minutes.

2.3.5– TRENDS SCREEN

Trends screen utilities:

- Recording last readings of the system on a graph.



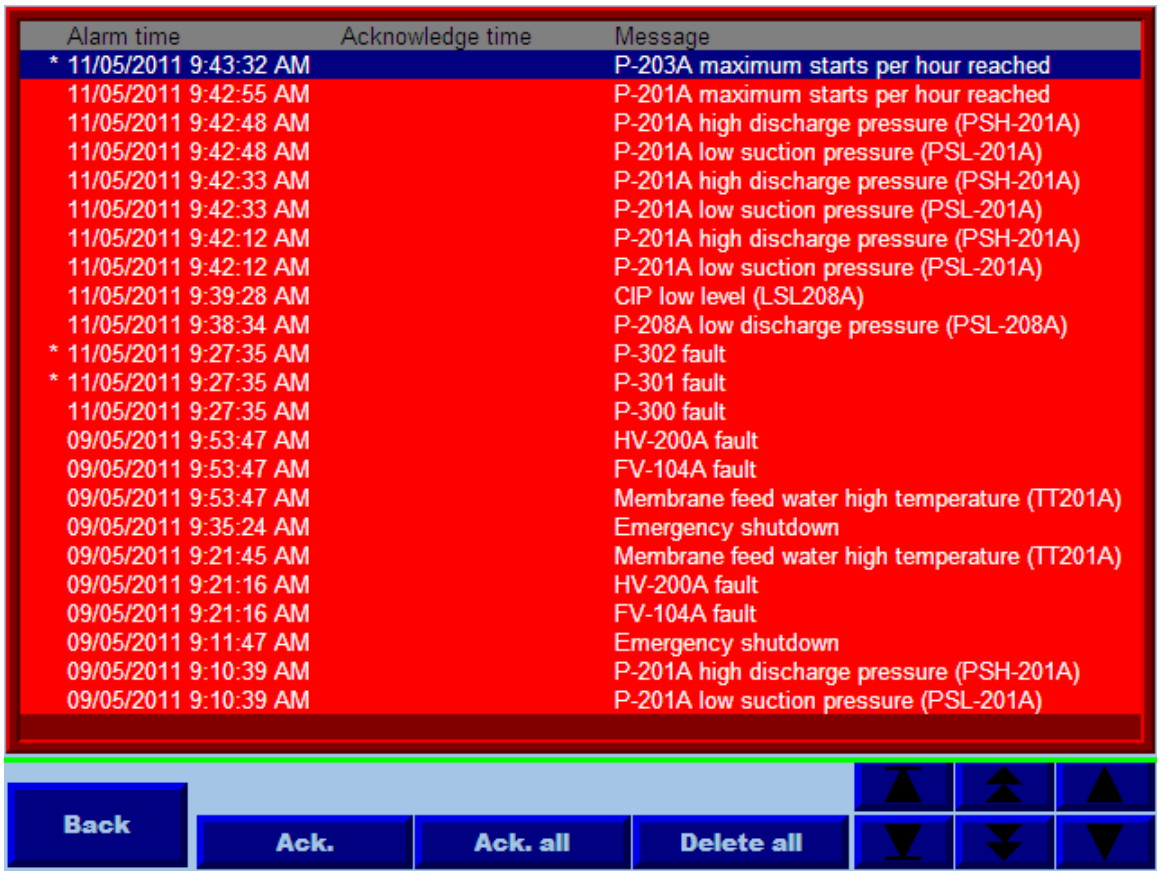
NAVIGATION :

- Push Back button to come back to the main screen.
- Trends controls Button : Navigate through the trends.

2.3.6– ALARMS SCREEN

Alarms screen utilities:

- Read and acknowledge the alarms coming from the whole system.



NAVIGATION :

- Push Back button to come back to the main screen.

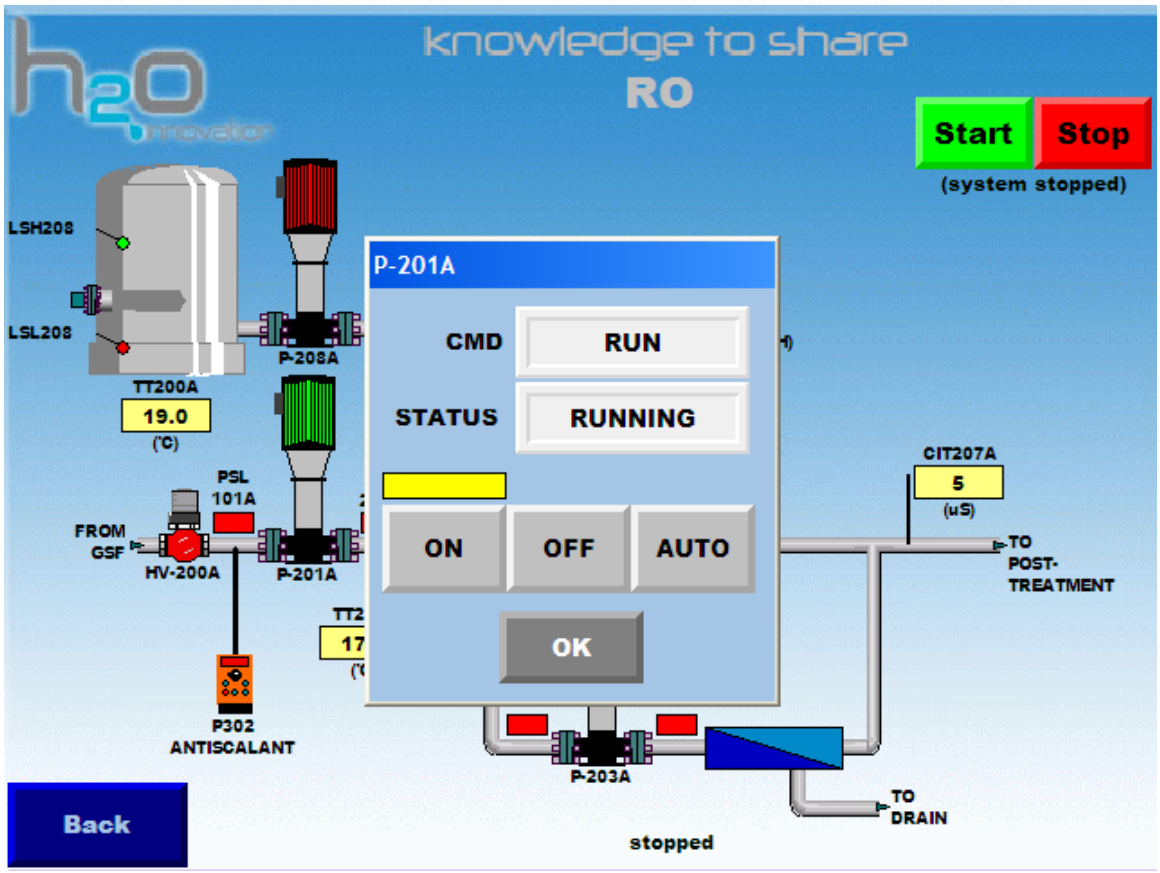
ALARMS CONTROL :

- Ack Button : Acknowledge the selected alarm
- Ack All Button : Acknowledge all the alarm in the list
- Delete All : Delete all the alarms in the list

2.3.7– EQUIPMENTS CONTROL SCREEN

If you select any equipments on the touch screen (Pumps, dosing pumps, actuating valves and heaters), you will open the control window of this equipement. From this window you can :

- Read command and status of each equipement
- Select the operating mode of this equipement.



READINGS

- CMD : Actual command on this equipment
- Status : Actual status of this equipment
- Yellow rectangle indicates which operating mode is activated.

CONTROLS

- **ON :** Manually start/open this equipment. This equipment is no longer controlled by PLC sequeneces. This equipment will stay ON until the operator stops it.
- **OFF :** Manually stop/close this equipment. This equipment is no longer controlled by PLC sequeneces. This equipment will stay OFF until an operator changes its operating mode.
- **AUTO :** This equipment is now in automatic operating mode. It means this equipment will START/STOP depending on the PLC sequences.

➥**Attention :** For a good operation, we recommend to always leave all the equipements in the atomatic operating mode

2.4 – PLC SEQUENCES

2.4.1 - REVERSE OSMOSIS START-UP SEQUENCE

1. Permeate Flush (2.4.3)
2. Check for PSL-100A signal
3. Open Valve HV-200A
4. Open Valve HV-203A
5. Start P-100A pump
6. Start Hypochlorite Dosing pump P-300
7. Start Metabisulfite Dosing pump P-301
8. Start Antiscalant Dosing pump P-302
9. Wait for PSL-201A signal
10. Time delay (“P-201 start delay” adjustable parameter)
11. Start P-201A pump
12. Wait for PSL-203A signal
13. Time delay (“P-203 start delay” adjustable parameter)
14. Start P-203A pump
15. Enable minor faults

2.4.2 - REVERSE OSMOSIS SHUT-DOWN SEQUENCE

1. Disable minor faults
2. Stop P-203A & P-201A pumps
3. Wait 10sec.
4. Stop P100A pump
5. STOP Dosing pump P-300, P-301, P-302
6. Close HV-200A
7. Permeate Flush (section 2.4.3)

2.4.3 – REVERSE OSMOSIS PERMEATE FLUSH SEQUENCE

1. Disable minor faults
2. Open valves HV208E, HV203B, HV204C
3. Close valve HV203A
4. Start P-208A
5. Wait XX seconds
6. Stop P-208A
7. Close valves HV208E, HV203B, HV204C
8. Open valve HV203A

2.4.4 – GREEN SAND FILTER BACKWASH SEQUENCE

1. When we have a confirmation that FV101A or FV102A or FV103A or FV104A is in position BW, Start pump P-208A.

2. When we lose the BW position confirmation from FV101A or FV102A or FV103A or FV104A, Stop pump P-208A.

2.5 – ALARMS LIST

ALARMS	CAUSES	CORRECTIONS / VERIFICATIONS
P-XXX low suction pressure	Pump P-XXX have a low suction pressure. The suction pressure of the pump is not high enough to operate and can run out of water soon. These alarms are activated by PSL-XXX Low pressure switch	1. Be sure every valves before the pumps are open. 2. Be sure that all pumps place before pump P-XXX are running fine. 3. Be sure you still have water in your supply tank. 4. Be sure PSL-XXX is working fine
P-XXX high discharge pressure	The outlet pressure of pump P-XXX is abnormally high. You probably do not have any flow. These alarms are activated by PSH-XXX high pressure switch.	1. Be sure every valves after the pumps are open 2. Check the plumbing to be sure nothing is stocked inside.
P-XXX motor fault	The overload of the pump P-XXX has tripped out.	1. Open the power panel and turn the overload of P-XXX back on. If the problem persists try to check the amps of the pump during its operation. 2. Contact H2O Innovation support.

ALARMS	CAUSES	CORRECTIONS / VERIFICATIONS
Membrane feed high temperature (TT-201A)	It means the water reach the setpoint for high temperature alarm.	1. Check the adjustable parameter "Membrane feed water high temperature". It supposed to be around 40 C. 2. Let the water cool down few minutes. Restart the system, if the problem persists, contact H2O Innovation support.
Feed water high redox (AIT-100A)	It means the water reach the setpoint for high redox.	1. Check the adjustable parameter "Feed water high redox". It supposed to be around 200. 2. Be sure the sodium metabilsulfite dosing pump is working fine. You can raise its dosing rate. 3. Contact H2O Innovation support.
Permeate high conductivity (CIT-207A)	It means the water reach the setpoint for high conductivity.	1. Check the adjustable parameter "Permeate high conductivity". It supposed to be around 250. 2. Calibrate the sensor. 3. Check the installation of the membranes. It can be an O-ring leaking. 4. If the problem persist contact H2O Innovation support.
dosing fault (P-XXX)	Dosing system P-XXX is in fault	1. Be sure you still have dosing solution in the dilution tank. 2. Check the electrical connection of the dosing pumps 3. Contact H2O Innovation support.

3 – MAJOR COMPONENTS OF THE SYSTEM

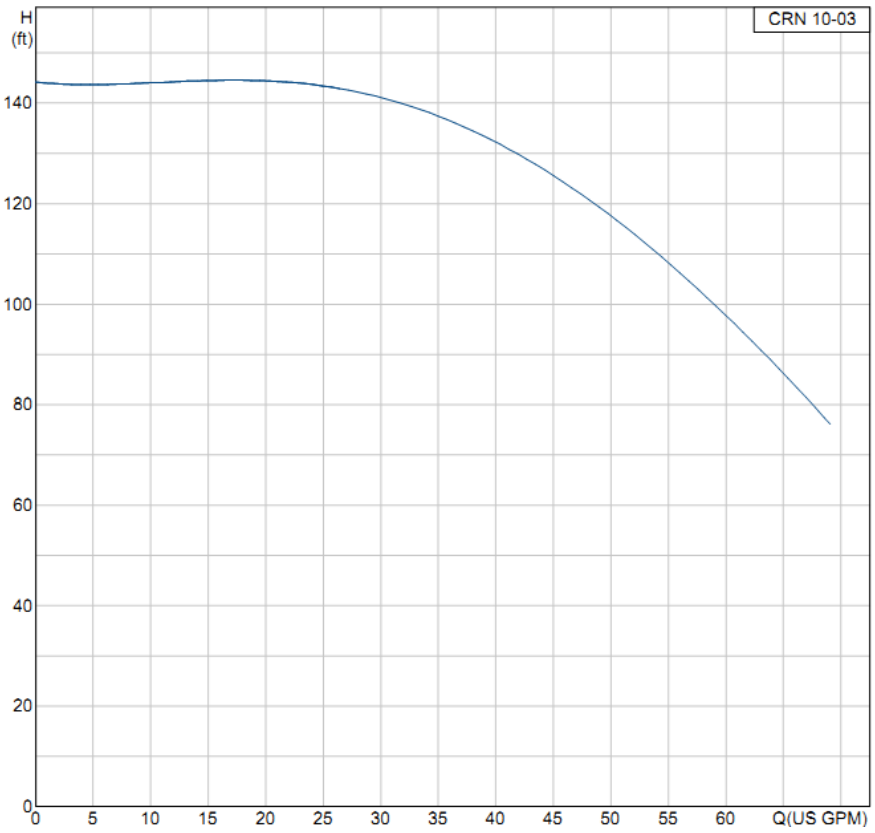
In this section, each major component is briefly defined. Refer to other sections of this manual to get the complete description and the O&M manual of each component.

3.1 - PUMPS

3.1.1 – FEED PUMP

- *PID TAG : P-100A*
- *MODEL : CRN 10-3*
- *MOTOR : 3 HP, 600 volts, 3 phases, 60 Hz, 3500 RPM*
- *PROCESS CONNECTION : 2" ANSI Flange, Class 300*
- *MANUFACTURER : Grundfos*

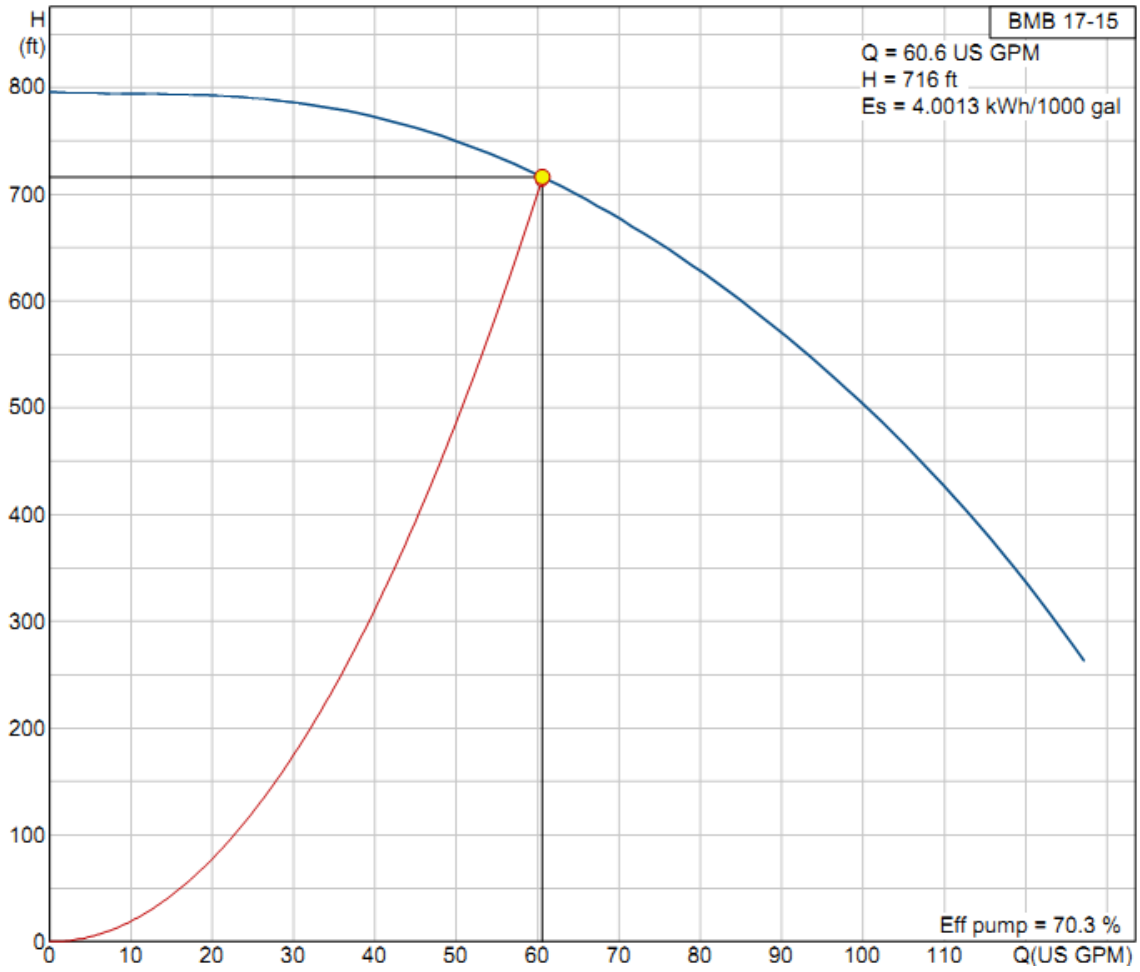
This pump raises the water to the needed pressure to go through the green sand filters (About 70 PSI)



3.1.2 – 1ST STAGE PRESSURE PUMP

- *PID TAG : P-201A*
- *MODEL : BMB 17-15, 6 inches diameter Booster modules*
- *MOTOR : 17.5 HP, 600 volts, 3 phases, 60 Hz, 3500 RPM*
- *PROCESS CONNECTION : 3½" grooved end*
- *MANUFACTURER : Grundfos*

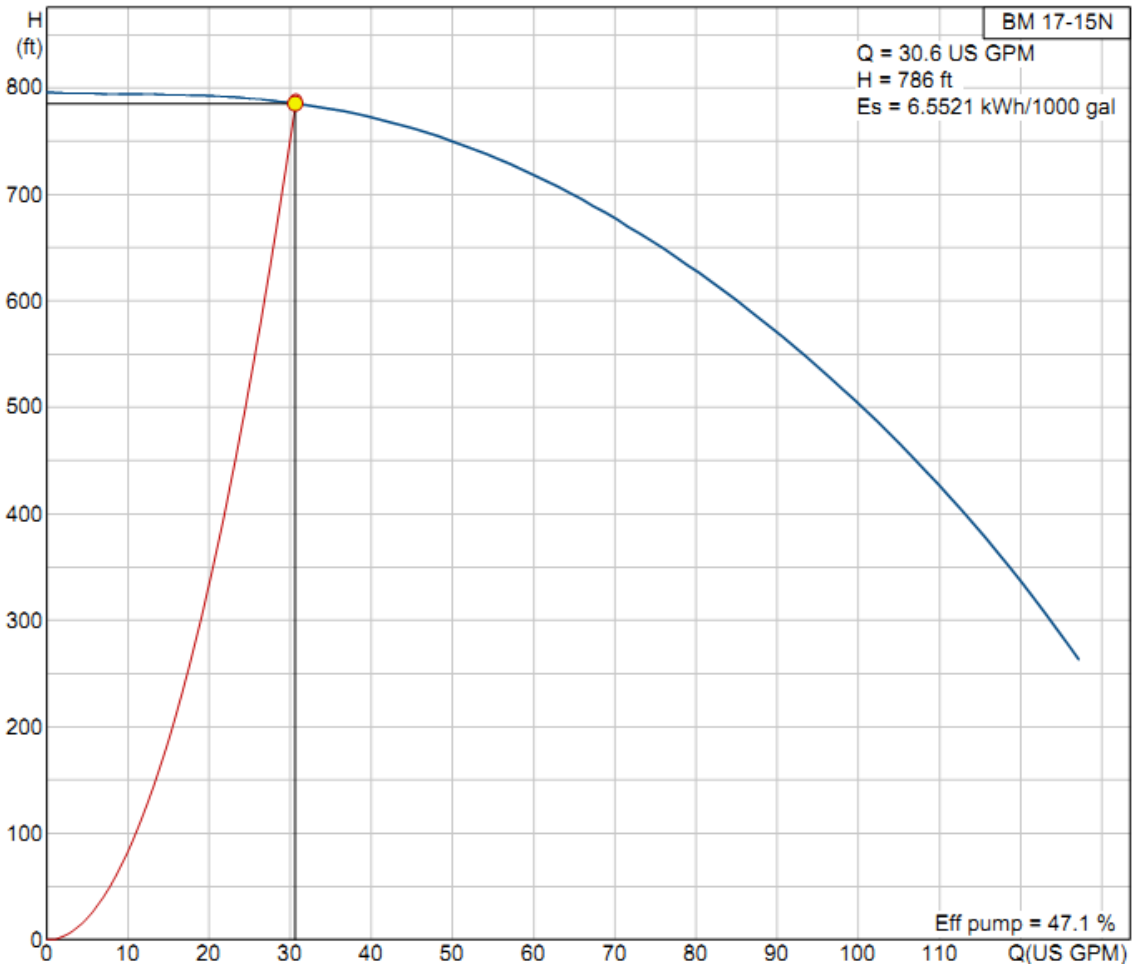
This pump raises the water to the needed pressure to go through the first stage of membranes. (About 325 PSI)



3.1.3 – 2ND STAGE PRESSURE PUMP

- *PID TAG : P-203A*
- *MODEL : BM 17-15, 6 inches diameter Booster modules*
- *MOTOR : 17.5 HP, 600 volts, 3 phases, 60 Hz, 3500 RPM*
- *PROCESS CONNECTION : 3½" grooved end*
- *MANUFACTURER : Grundfos*

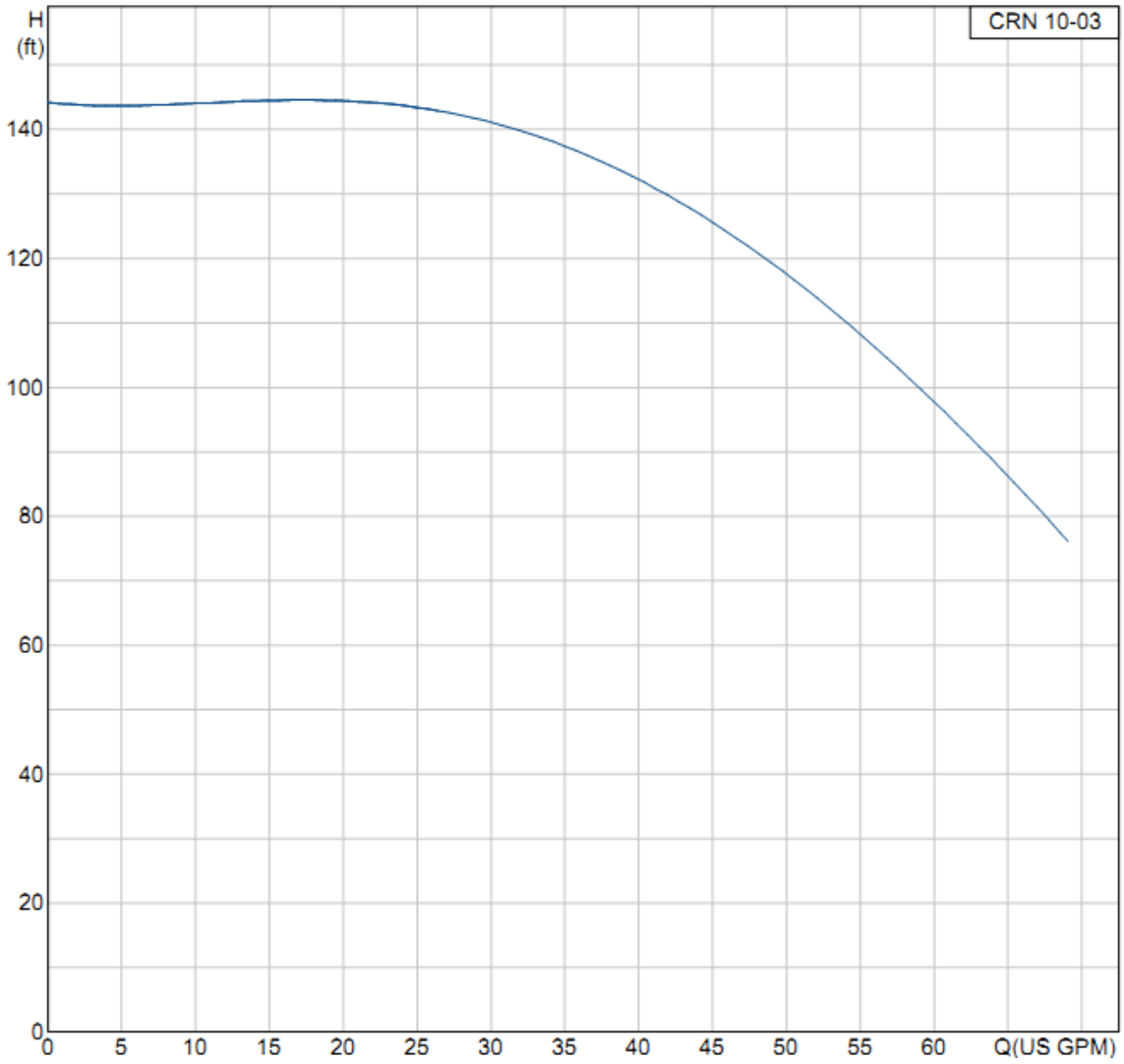
This pump raises the water to the needed pressure to go through the second stage of membranes. (About 550 PSI)



3.1.4 – CIP PUMP

- *PID TAG : P-100A*
- *MODEL : CRN 10-3*
- *MOTOR : 3 HP, 600 volts, 3 phases, 60 Hz, 3500 RPM*
- *PROCESS CONNECTION : 2" ANSI Flange, Class 300*
- *MANUFACTURER : Grundfos*

This pump raises the water to the needed pressure for a cleaning membranes procedure (about 65 PSI).



3.2 - PRETREATMENTS

3.2.1 – GREEN SAND FILTERS

- *PID TAG: F-101A, F-101B, F-101C, F-101D*
- *MODEL : KS1M2937422472*
  - *C-298-742-UWB (Head filters)*
  - *T-TCS2472-4T (composite tank)*
- *MEDIA:*
  - *Gravel 20*
  - *Green Sand plus*
- *FLOW ORIFICE CAPACITY : 30 USGPM*
- *MANUFACTURER : Pentair*

GreensandPlus is a purple-black filter media used for removing soluble iron, manganese, hydrogen sulfide, arsenic and radium from well water supplies.

➥**Maintenance :** A backwash is required when the differential pressure between inlet and outlet is higher than 15 PSI.

➥**Yearly :** Check the level of media inside. The filter tank must be 2/3 full of media.

3.2.2 – CARTRIDGE FILTERS

- *PID TAG : F-200A*
- *MODEL :*
  - *Housing : 5FOS4-316*
  - *Cartridges : PolyKlean (Cartridge 5 micron 40")*
- *DESIGN FLOW : 105 USGPM*
- *PROCESS CONNECTION : 2" MNPT*
- *MANUFACTURER :*
  - *Housing : SHELCO*
  - *Cartridge : 3M-Cuno*

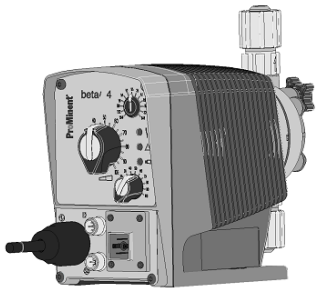
The cartridges filter blocks every solid with a diameter over 5 microns. It helps to decrease the membranes cleaning frequency and protects the membranes from any media coming from green sand filters.

➥ **Maintenance :** Change the cartridge when the differential pressure between inlet and outlet is higher than 10 PSI.

3.3 – DOSING SYSTEMS

3.3.1 – SODIUM HYPOCHLORITE DOSING PUMP

- *PID TAG : P-300*
- *MODEL : BT4A1005NPB960UD11000*
- *ELECTRICITY : 120 V, 1 phase, 60 Hz*
- *I/O : 1 DI, 1 DO*
- *TANK MODEL : CT-150*
- *MANUFACTURER :*
    - *Dosing Pump : Prominent*
    - *Tank : Aco Container*

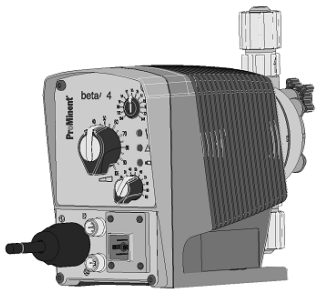


Injection of sodium hypochlorite is needed on the inlet of the green sand filters to regenerate the media. The sodium hypochlorite also avoids having any bacteria development inside the filters.

➥ **Maintenance :** Every day, check if the pump is primed and make sure it still have enough solution in the dilution tank.

3.3.2 – SODIUM METABISULFITE DOSING PUMP

- *PID TAG : P-301*
- *MODEL : BT4A1601PPE200UD110000*
- *ELECTRICITY : 120 V, 1 phase, 60 Hz*
- *I/O : 1 DI, 1 DO*
- *TANK MODEL : CT-35*
- *MANUFACTURER :*
    - *Dosing Pump : Prominent*
    - *Tank : Filtraqua*

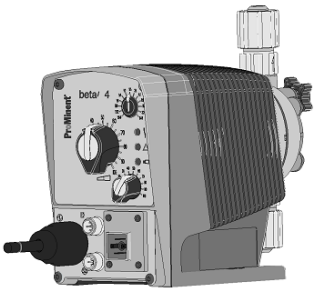


Sodium metabisulfite remove all the sodium hypochlorite remaining in the water. Remaining sodium hypochlorite in the water can damage and reduce life of the membranes.

➥ **Maintenance :** Every day, check if the pump is primed and make sure it still have enough solution in the dilution tank.

3.3.3 – ANTISCALANT DOSING PUMP

- *PID TAG : P-302*
- *MODEL : BT4A1601PPE200UD110000*
- *ELECTRICITY : 120 V, 1 phase, 60 Hz*
- *I/O : 1 DI, 1 DO*
- *TANK MODEL : CT-35*
- *MANUFACTURER :*
    - *Dosing Pump : Prominent*
    - *Tank : Filtraqua*

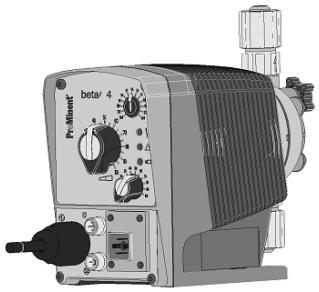


Injection of Spectraguard antiscaling solution on the inlet of the membranes prevents from any scaling on the membranes. Antiscalant decrease the membrane cleaning frequency and help to increase life of the membranes.

➥ **Maintenance :** Every day, check if the pump is primed and make sure it still have enough solution in the dilution tank.

3.3.4 – CAUSTIC DOSING PUMP

- *PID TAG : P-302*
- *MODEL : BT4A1601PPE200UD110000*
- *ELECTRICITY : 120 V, 1 phase, 60 Hz*
- *I/O : 1 DI, 1 DO*
- *TANK MODEL : CT-15*
- *MANUFACTURER :*
    - *Dosing Pump : Prominent*
    - *Tank : Filtraqua*



Reverse osmosistends to reduce the PH of the treated water. The iInjection of Sodium hydroxide solution on the raises the PH of the treated water to an acceptable point of 6.5.

➥ **Maintenance :** Every day, check if the pump is primed and make sure it still have enough solution in the dilution tank.

3.3.5 – DOSAGE RATING AND DILUTION SOLUTION

PRODUCT	PID TAG	DOSING PUMP MODEL FREQUENCY / STROKE	INJECTION NEEDED	DILUTION RATIO	VOLUME OF WATER FOR SOLUTION	VOLUME OF PRODUCT FOR SOLUTION
Sodium Hypochlorite	P-300	Pump Model : BT4A1005NPB960UD11000 • Frequency : -- % • Stroke : -- %	Need to have at least 0.5 ppm of free chlorine on the outlet of green sand filter	**1 : 2**	5 usGal of water	5 usGal ofSodium Hypochlorite
Sodium Metabisulfite	P-301	Pump Model : *BT4A1601PPE200UD110000* • Frequency : -- % • Stroke : -- %	Need to have an oxidation reduction potential between 0 and 200.	**250 g / L**	90 Litres	22.5 KG (1 bag)
Spectraguard	P-302	Pump Model : *BT4A1601PPE200UD110000* • Frequency : 30 % • Stroke :50 %	3.0 mg / L	**1 : 5**	20 UsGal	5 UsGal
Sodium Hydroxide 25%	P-303	Pump Model : *BT4A1601PPE200UD110000* • Frequency : -- % • Stroke : -- %	Need to have a PH higher than 6.5 on permeate	1:1	0 UsGal	5 UsGal

3.4 – INSTRUMENTS

3.4.1 – ORP ANALYZER

- *PID TAG : AIT001, AE001*
- *MODEL :*
  - *AX260/51001 (Transmitter)*
  - *AP303/5001000 (Sensor)*
- *ELECTRICITY : 120 V, 1 phase, 60 Hz*
- *OUTPUT : 4-20 Ma*
- *MANUFACTURER : ABB*

The oxidation reduction potentiel is a good and easy way to know if the water still has sodium hypochlorine or sodium metabisulfite in excess. Presence of Sodium hypochlorite will increase the oxidation reduction potential of the water. Presence of sodium metabisulfite will decrease the oxidation reduction potential of the water.

ORP value	***CONCLUSION***	***SOLUTION***
ORP < 0	*Sodium metabisulfite in excess*	*Decrease the sodium metabisulfite dosing rate. Decrease frequency or stroke of the dosing pump*
0 < ORP < 200	*All the sodium hypochlorite is eliminated by sodium metabusulfate. No excess.*	*Good result, no modificationis needed.*
ORP > 200	*Sodium hypochlorite in excess*	*Increase Decrease the sodium metabisulfite dosing rate. Increase frequency or stroke of the dosing pump*

➥ **Maintenance :** Calibration and cleaning of the sensor is recommended every 3 months. Refer to the O&M Manual from the manufacturer for more informations.

3.4.2 –CONDUCTIVITY ANALYZER

- *PID TAG : CI207A, CE207A*
- *MODEL :*
    - *00426937 (series 8225 conductivity transmitter)*
    - *00428674 (S020 PVC True union fitting)*
- *PROCESS CONENCTION : True union Socket*
- *DIAMETER : 1½"*
- *K SENSOR : 1.0*
- *FITTINGS MATERIAL : PVC*
- *ELECTRICITY : 120 V*
- *OUTPUT : 4-20 mA*
- *MANUFACTURER : Burkert*

The conductivity is determined by the quantity of minerals in the water. The minerals increase the conductivity. The reverse osmosis membranes remove most part of minerals.

On a reverse osmosis system, a conductivity higher than 250 µS on the permeate could indicate a problem with the membranes. In that case, contact H2O Innovation support.

TYPE OF WATER	CONDUCTIVITY
ULTRA PURE WATER	0 to 0.1 µS
PURE WATER	0.1 to 1.0 µS
REVERSE OSMOSIS TREATED WATER	1.0 to 200 µS
SEAWATER	More than 50 000 µS

➥ **Maintenance :** Calibration and cleaning of the sensor is recommended every year. Refer to the O&M Manual from the manufacturer for more informations.

3.4.3 – TEMPERATURE TRANSMITTER

- *PID TAG : TT-201A, TT-200A*
- *MODEL : R18A-L-P-1-S3-4-S-12S-TN-006-00-2.5" (Sonde)*
    - *WA2 (Boitier)*
    - *TW03A12L2.5 (ThermoWell)*
    - *RT810/0/50 (Tranmitter)*
- *RANGED : 0-50 C*
- *PROCESS CONNECTION : ¾" NPT*
- *I/O : 4-20 mA*
- *MANUFACTURER : Intempco*

Water with a temperature higher than 40 °C could cause damage to the reverse osmosis membrane. To avoid this situation a temperature transmitter is installed in CIP tank and on the inlet of the membranes. The system will shut down if the temperature gets too high.

3.4.4 – LOW / HIGH PRESSURE SWITCHES

- *PID TAG : PSL, PSH*
- *MODEL :*
    - *Low : APARSDHS02-30PSI*
    - *High : APARSDHH02-1000PSI*
- *RANGE : 10-30 PSI*
    - *Low : 0-30 PSI*
    - *High : 0-1000 PSI*
- *PROCESS CONNECTION : ¼" MNPT*
- *MANUFACTURER : Ashcroft*

Low pressure switch protects pump from running dry. If the pressure at the pump suction gets too low, the pressure switch will stop the system.

High pressure switch protects pump from running without flow. If the pressure at the pump discharge gets too high, the pressure switch will stop the system.

4 – MEMBRANES FILTRATION

4.1 - RECOVERY RATE

To minimize membrane clogging, we have to be aware of the recovery rate. The recovery rate is the ratio between the permeate flow and the feed flow (raw water) of the membrane filtration system.

THE RECOVERY RATE MUST NOT EXCEED 75%.

Example: We measure a reject flow of 13 GPM and a total permeate flow of 37 GPM

Feed flow (raw water) = reject flow 13 gpm+ permeate flow 37 gpm = 50 GPM

Recovery rate = $\frac{\text{permeate flow } 37}{\text{Feed flow } 50} \times 100 = 74\%$

The recovery rate can be over 75% for a short period of time without causing irreversible damage. A recovery rate around 75% is the best way to operate the system.

4.2 – MEMBRANE PERMEABILITY TEST (MPT)

The MPT procedure will indicate when you have to perform a cleaning procedure. After 100 hours this membrane pressure at about 37 gpm of permeate will become the reference pressure. When the membrane pressure will increase by 15% to 20% at fixed permeate flow (37 gpm) it will be the time to schedule a cleaning procedure. With this method we can follow the membrane performance week after week. It is with this method that you will know when to clean the membranes. You will measure the MPT every week. The initial reference pressure MPT must be taken after 100 hours of running.

4.2.1 - EXAMPLE:

MPT initial (reference) after 100 hours:

- Membrane Pressure = 150 psi.
- Permeate flow = 37 gpm.

Your MPT (actuel) readings at 196hrs:

- Membrane pressure = 163 psi
- Permeate flow = 37 gpm

150 PSI x 1,15 = 173 PSI

In this case you have below 15% of loss. You can wait until you reach 173 PSI before the membranes. If the losses are lower then continue to operate. If the pressure is higher than 15%-20% start a cleaning procedure.

5 – OPERATIONS CYCLE

5.1 – OPERATION SUMMARY

Cycle	Description	Feed	Permeate	Concentrate
Treatment	Feed water is separated in two different flows. The treated water is call Permeate and the reject water containing all the minerals is called concentrate	From pretreatment	To treated water tank	To concentrate tank
Rinse	To mode is used to rinse the membranes with pretreated water. All the water used in this mode is going to concentrated tank.	From pretreatment	No permeate	To concentrate tank
Wash	Washing solution is circulating in a closed loop. Membranes are fed by IP tank trough CIP pump. After going through the membranes all the washing solution is going back to the CIP tank.	Fed by CIP tank	To CIP tank	To CIP tank

5.2 – HOW TO POSITION THE VALVES

	AUTOMATIC VALVES					HAND VALVES (moves by operators)	
Cycle	Feed Valve (HV200A)	CIP Pump Valve (HV208E)	Booster pump feed Valve (HV203A)	Booster pump bypass Valve (HV203B)	Flush Valve (HV204A)	CIP Feed Valve (HV208G)	Treated tank feed Valve (HV208H)
Treatment	Auto (Opened)	Auto (Closed)	Auto (Opened)	Auto (Closed)	Auto (Closed)	Closed	Opened
Rinse	Closed	Opened	Closed	Opened	Opened	Closed	Opened
Wash	Closed	Opened	Closed	Opened	Opened	Opened	Closed

5.3 – RINSE CYCLE

The rinse cycle should be done on the start-up of the system with new membranes and after each membrane washing Cycle.

1. Open and close the valves :

AUTOMATIC VALVES					HAND VALVES (moves by operators)	
Feed Valve (HV200A)	CIP Pump Valve (HV208E)	Booster pump feed Valve (HV203A)	Booster pump bypass Valve (HV203B)	Flush Valve (HV204A)	CIP Feed Valve (HV208G)	Treated tank feed Valve (HV208H)
Closed	Opened	Closed	Opened	Opened	Closed	Opened

2. Start Pump P-208A.

3. Wait 15 to 20 minutes. On a washing procedure rinse until you get a PH between 6 and 9 on concentrate

4. Stop pump P-208A.

5.4 – WASHING PROCEDURE

Washing Procedure is composed of 3 washing Cycles with three different solutions. Between each washing cycle we have to rinse the membranes :

1. Washing cycle with Lavasol 1
2. Rinse cycle
3. Washing cycle with Oxysan
4. Rinse cycle
5. Washing cycle with Lavasol 7
6. Rinse cycle

5.4.1 – WASHING SOLUTIONS AND TEMPERATURE

	Product volume (Litres)	Total Volume (Litres)	Maximum Temperature (°C)
Lavasol 1 Washing Solution (Acid Wash)	20 Litres or until you reach a pH of 2	2000	40
Oxysan Washing Solution (disinfection wash)	20	2000	23
Lavasol 7 Washing Solution (Caustic)	20 Litres or until you reach a pH of 13	2000	40

5.4.2 – WASHING CYCLE

1. For each washing cyle, be sure to prepare in the CIP tank the solution by following the recipe in section 6.4.1

2. Open and close the valves :

AUTOMATIC VALVES					HAND VALVES (moves by operators)	
Feed Valve (HV200A)	CIP Pump Valve (HV208E)	Booster pump feed Valve (HV203A)	Booster pump bypass Valve (HV203B)	Flush Valve (HV204A)	CIP Feed Valve (HV208G)	Treated tank feed Valve (HV208H)
Closed	Opened	Closed	Opened	Opened	Opened	Closed

3. Start CIP tank Heater H-500
   a. **IMPORTANT :** Do not start the heater when using OXYSAN.

4. Start Pump P-208A.

5. Wait 1 hour or until you reach the maximum temperature. If you reach the maximum temperature stop the heater, wait until the temperature goes down of some degrees and restart the pump.

6. Stop pump P-208A and Heater H-500.

7. Flush the solution to the drain by using P-208A.

8. Start a rinse cyle (refer to section 6.3)

6 - MAINTENANCE

6.1 – DAILY READINGS

We recommend to takes readings of the system every day and to ask questions when one of the readings seems abnormal. You will find in the annexes a form that suggests you which readings are interesting to follow daily. H2O Innovation will need this form filled to answer to your question.

Be sure when you take the readings that the system is in operation and in the treatment mode.

6.2 – PROLONGED SYSTEM SHUTDOWNS

If we plan to stop the system for more than 7 days, some actions need to be taken. To prevent biological growth during prolonged system shutdowns, it is recommended that membrane elements be immersed in a preservative solution.

1. In the CIP Tank prepare a 1 to 2% solution of Metabisulfite. Add one bag (22.5 Kg) of sodium metabisulfite in 1500 Litres of water.

2. Open and close the valves :

AUTOMATIC VALVES					HAND VALVES (moves by operators)	
Feed Valve (HV200A)	CIP Pump Valve (HV208E)	Booster pump feed Valve (HV203A)	Booster pump bypass Valve (HV203B)	Flush Valve (HV204A)	CIP Feed Valve (HV208G)	Treated tank feed Valve (HV208H)
Closed	Opened	Closed	Opened	Opened	Opened	Closed

3. Start the CIP pump P-208A

4. Wait 15 to 20 minutes.

5. Stop pump P-208A.

6. You can now drain all the system.

ANNEXES

DAILY READINGS

Date	Flow (Gpm)			Pressure (PSI)											Temp (°C)	Cond µS	Redox mV	PH
	Concentrate	1st stage permeate	Total Permeate	Feed	GSD Filter		Prefilter		1st st Membranes		2nd st Membranes		Permeate					
					Before	After	Before	After	Before	After	Before	After	1st st valve	2nd st valve				
	FI 205A	FI 206A	FI 207A	PG 100A	PG 100B	PG 104A	PG 200A	PG 200B	PG 201A	PG 202A	PG 203B	PG 204A			TT 201A	CIT 207A	AIT 100A	

MEMBRANE WASHING READINGS

Technician :

Pressure Before membranes	Flow permeate (gpm)	Temperature (C)	MEP = 100 – ((Initiale pressure /Actual pressure) x 100) = Lost %	Date
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		
psi	Q= 37	T =		