ENGINEERING
TOMORROW

Design guide

iSave Energy Recovery Device

Start and stop of the SWRO with iSave

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Below procedures are general guidelines for the start-up and shut-down functions of SWRO-systems with the Danfoss iSave Energy Recovery Device.
Procedure details may differ depending on the system design.
The numbers marked in () refer to the diagram on page 5.

iSave can be both a single iSave and multiple iSaves in parallel.

General SWRO system understanding with ISave

- Basically the permeate flow is the same as the flow from the high-pressure pump.
- The HP concentrate flow into iSave HP-in and HP seawater-out is determined by the rpm of the iSave.
- The iSave (s) HP flow determines the recovery rate (higher rpm on the iSave gives lower recovery rate and vice versa).
- Flow on the low-pressure side of the iSave is determined by feed pump and the pressure control valve LP-out (15) (not by the rpm of the iSave).
- The flow on the low-pressure side must be at least the same as on the high-pressure side of the iSave (LP in flow = HP in flow; this is called balanced flow).
- Continuously operation:
- To minimize mixing, the flow on the low-pressure side can be adjusted up to 10% higher than the high-pressure flow with the limitation that the flow rate at LP inlet may not exceed 70 m^3/h.

Prior to start-up

High quality water extends the service life of the whole system.
Both the APP pump and iSave are sensitive to hard particles.
Before connecting any APP pump or iSave to a piping system **ALL** pipes must be thorough flushed with high quality pre-filtered water or mechanical cleaned.

1. Install all filter cartridges in the system.
2. With the iSave(s) and APP pump(s) *disconnected* from the piping, the system must be flushed in order to remove possible impurities from the system (pipes, hoses, membranes etc.).
   Flushing must run until the system can be ensured clean.
3. Connect the iSave(s) and APP pump(s) to the pipework. The iSave(s) and APP pump(s) are now ready for start-up.

Starting up the system

1. Make sure that all valves are set in normal operating positions.
2. Start the seawater supply pump (A).
3. Make sure all pipework is flushed with water. Vent all air from the system through air valve (8) and iSave unit (11). After venting, close valve (8).
   At initial start-up also bleed the iSave(s) and APP pump(s).

4. Start the iSave(s).
In general: Only start the iSaves when the pressure "HP in" (10) is below 20 barg/290 psig. Always start the iSave unit before the high-pressure pump is started.

   There are in principle two ways to start multi ple iSaves:
   - Slowly ramp up all the iSaves at the same time.
   - Slowly ramp up one by one.

   Starting sequence - one by one:
   a) Start iSave #1.
   b) After 5 sec. start iSave #2.
   c) In a sequence of 5 sec. start the remaining iSaves.
   Comments:
   - Ramp up time on iSaves is set between 10 –15 sec.

   Starting sequence - Start all iSaves at the same time.
   Comments:
   - Ramp up time on iSaves is set between 10 –15 sec.

   If the pressure (10) at "HP in" drops below 3 barg/43.5 psig, the sound will change of the iSave. This is due to cavitation. "HP in" pressure at 3 barg/43.5 psig is acceptable for less than 10 min. within a period of 6 hours. Run the iSave at its min allowable speed during this period to reduce cavitation.

5. With a pressure control valve (15), adjust the back pressure of the "LP-out" to fulfill the minimum presure requested in the Data sheet. (May only be necessary at initial start up).

6. An "over flush" of the iSave can be done to bleed any remaining air from the system. Flush over a period of minimum 2 minutes.

7. Adjust the speed of the iSave unit to desired flow (rpm). The speed is controlled by a VFD.

8. Start the high-pressure pump(s) (4), and the system pressure (5) will rise until the permeate flow (17) almost equals the flow (2) from the high-pressure pump.

9. **For iSave 21 and iSave 40:**
   Check the low pressure flow rates (12), and if required, adjust flow with valve (15) to achieve balanced flow to the iSave(s).

   1. If the "LP-in" flow (12) is too low and the "LP-out" pressure (14) is higher than 1 barg/14.5 psig, increase flow and decrease pressure by opening the pressure control valve (15).
   2. If the "LP-in" flow (12) is too low and the "LP-out" pressure (14) is below 1 barg/ 14.5 psig, adjust the flow by raising the flow from the seawater supply pump (A).
   3. If the "LP-in" flow (12) is too high, reduce flow by closing the pressure control valve (15) or the flow from the seawater supply pump (A).

10. **For iSave 50 and iSave 70:**
    Check the low pressure flow rates (12), and if required, adjust flow with valve (15) to achieve balanced flow to the iSave(s).

    1. If the "LP-in" flow (12) is too low and the "LP-in" pressure (21) is higher than 2 barg/29 psig, increase flow and decrease pressure by opening the pressure control valve (15).
    2. If the "LP-in" flow (12) is too low and the "LP-in" pressure (21) is below 2 barg/ 29 psig, adjust the flow by raising the flow from the seawater supply pump (A).
    3. If the "LP-in" flow (12) is too high, reduce flow by closing the pressure control valve (15) or the flow from the seawater supply pump (A).

Daily system shutdown

1. The system is running in normal operation and producing permeate flow.

2. Stop the high-pressure pump (4).

3. Keep the iSave(s) (11) running until the TDS in the high-pressure line is equal to the TDS in the low-pressure line.
   NB! If the pressure (10) at "HP in" drops below 3 barg/43.5 psig, the sound will change of the iSave. This is due to cavitation. "HP in" pressure at 3 barg/43.5 psig is acceptable for less than 10 minutes within a period of 6 hours. Run the iSave at its min allowable speed during this period to reduce cavitation.

4. Stop the iSave(s)(11).

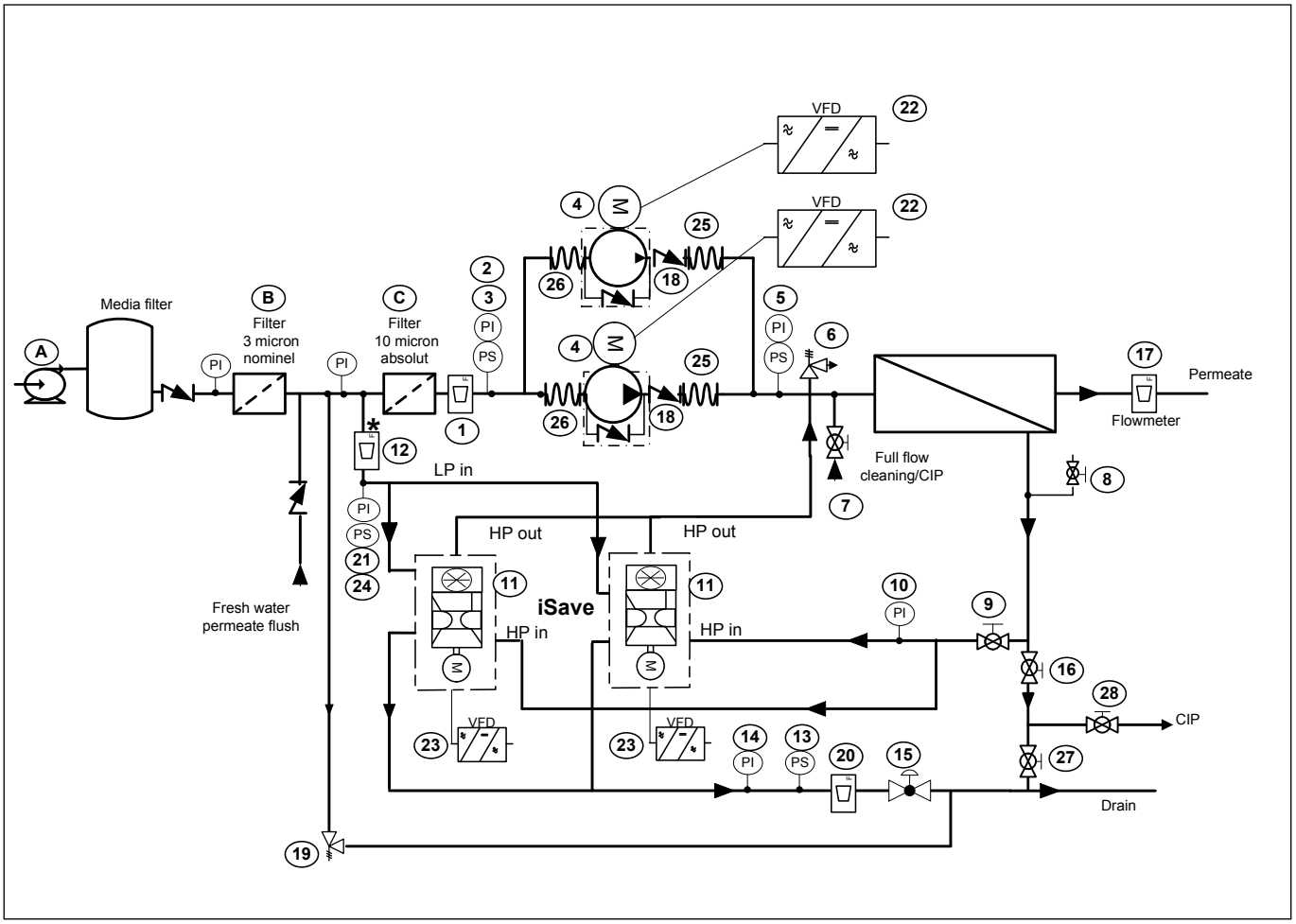
5. Stop the seawater supply pump (A).

More than one day system shutdown

1. Run the "daily system shutdown" procedure.
2. Supply permeate water to the SWRO system by using fresh water/permeate flush connection..
3. When the pressure "HP in" (10) is below 20 barg/ 290 psig start the iSave(s).

   NB! If the pressure (10) in "HP in" drops below 3 barg/43.5 psig, the sound will change of the iSave. This is due to cavitation. "HP in" pressure at 3 barg/43.5 psig is acceptable for less than 10 minutes within a period of 6 hours. Run the iSave at its minimum allowable speed during this period to reduce cavitation.

4. Start the APP pump(s) in a period of 5 sec. by using normal ramp-up settings.
5. Stop the APP pump(s) after 5 sec.
6. Run the iSave(s) until the TDS in the high-pressure line is equal to the TDS in the low-pressure line.
7. Stop iSave(s) and permeate water supply.



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