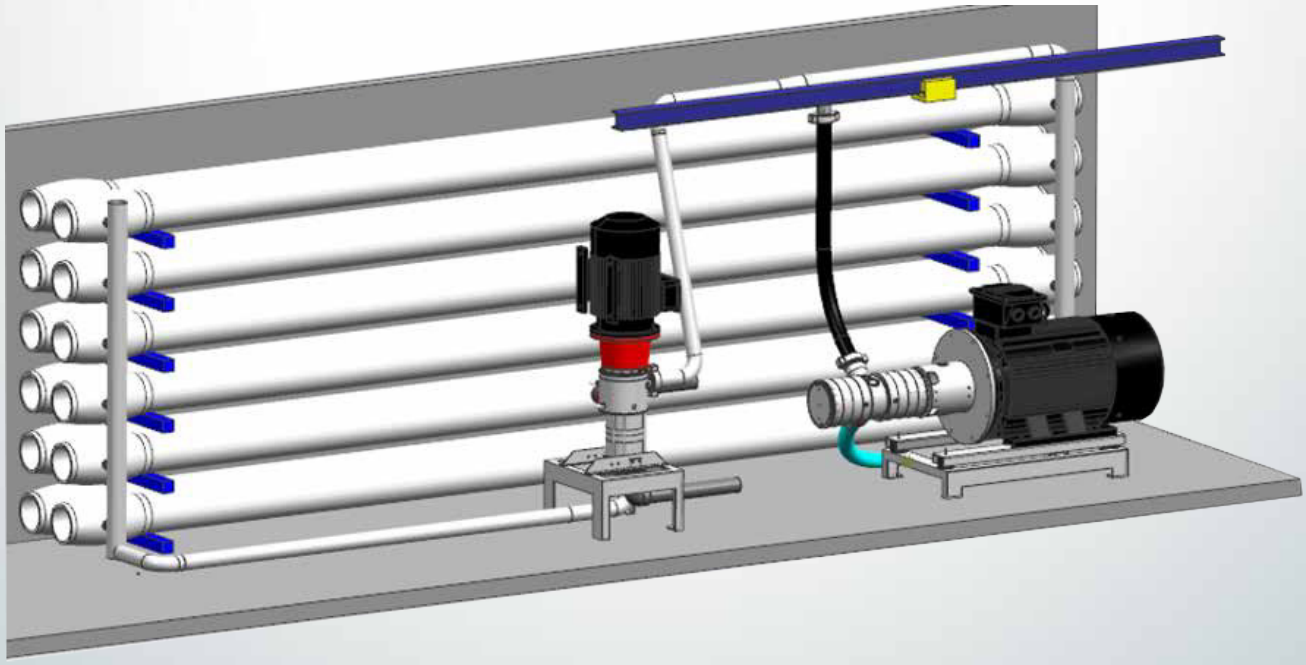
ENGINEERING
TOMORROW

Service Guide

SWRO plants working with APP pumps and iSave ERDs

Trouble shooting guide



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1. Introduction

This document gives a good understanding how the SWRO plant works together with APP pump and iSave energy recovery device.

- Explain the function of each main product.
- Explain how the SWRO plant reacts when main products get adjusted.
- Trouble shooting guide with possible causes and actions.

Information specific on the individual APP and iSave must be found in the Data sheets or Operating guides (IOM).

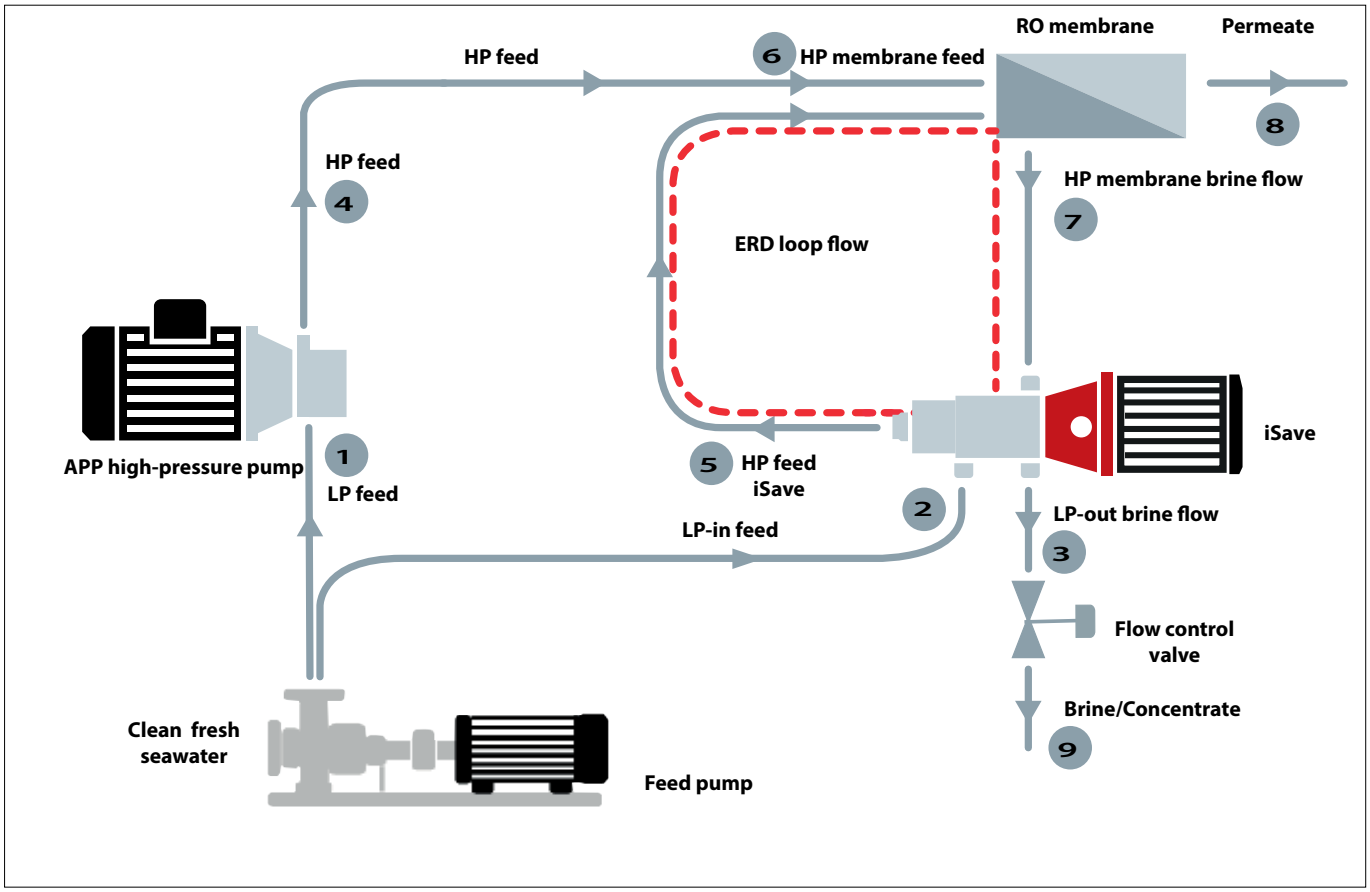
APP pumps

Danfoss APP pumps are positive displacement pumps with axial pistons that move a fixed amount of water in each cycle. Flow is proportional to the number of input shaft revolutions (rpm). Unlike centrifugal pumps, they produce the same flow at a given speed no matter what the discharge pressure is.
The design of the APP pump ensures lubrication of the moving parts by the fluid itself.

iSave energy recovery device

The iSave consists of an isobaric pressure exchanger, a high-pressure positive displacement booster pump and an electric motor.
The isobaric pressure exchangers are based on the technology used in the Danfoss APP pumps, and the high-pressure booster pumps are based on the vane pump principle enabling a very light and compact design.
The design of the iSave ensures lubrication of the moving parts by the fluid itself.

2. Seawater desalination system - terms of understanding

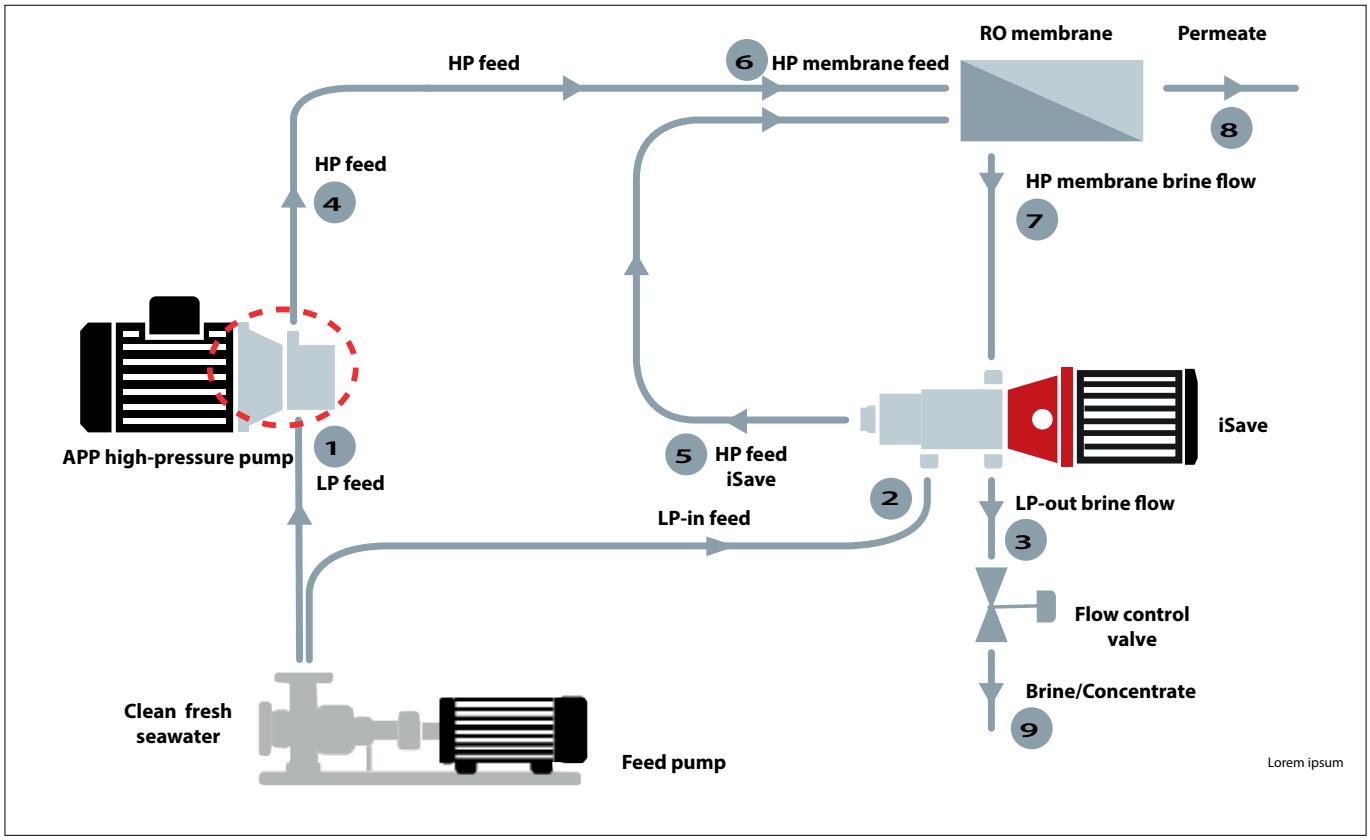


① Low Pressure seawater feed flow to high-pressure pump
② Low Pressure seawater feed flow to iSave ERD (LP-in)
③ Low Pressure brine flow from iSave ERD (LP-out)
④ High Pressure flow from pump to membrane
⑤ High Pressure flow from iSave ERD to membrane (HP-out)
⑥ High Pressure total flow to membrane (④+⑤)
⑦ High Pressure brine flow from membrane (HP-in)
⑧ Permeate flow from membrane
⑨ Brine/concentrate flow

Items	Description
⑤ High Pressure flow from iSave ERD to membrane (HP-out) ⑥ High Pressure total flow to membrane (④+⑤) ⑦ High Pressure brine flow from membrane (HP-in)	ERD loop flow (membrane cross flow)
⑥ High Pressure total flow to membrane ⑧ Permeate flow from membrane	**Membrane recovery rate -** the % **recovery** is defined as the ratio of permeate flow **rate (8)** divided by the membrane feed flow **rate (6).** Example: (100 m^3/250 m^3) x 100 = 40%

3. What does the APP high-pressure pump do

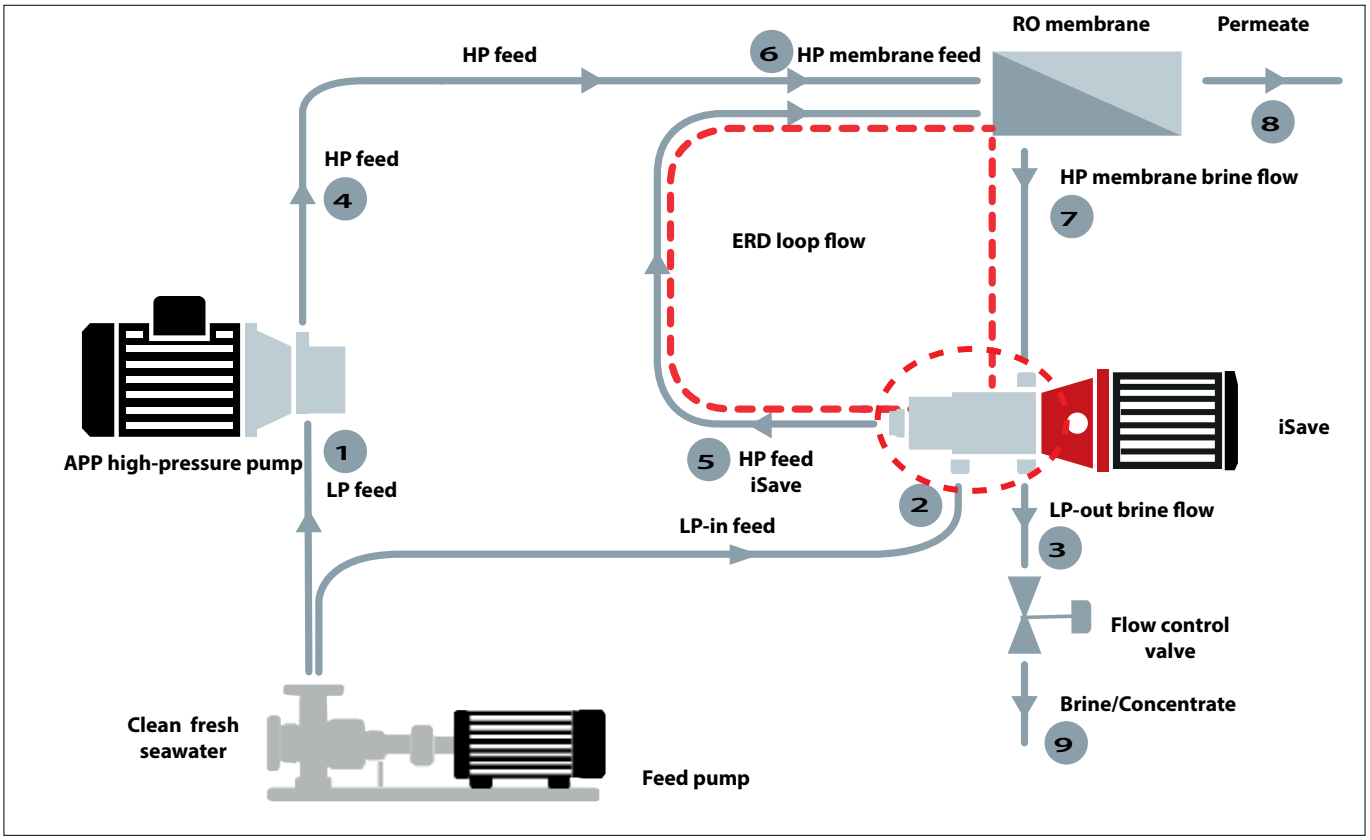
Flow from the high-pressure pump makes the permeate production.



Action	Result
Increase HP pump speed	Raise system pressure (6) and permeate flow (8)
Decrease HP pump speed	Lower system pressure (6) and permeate flow (8)
Changing the HP pump speed	**Does not** change the ERD loop flow (5 and 7)

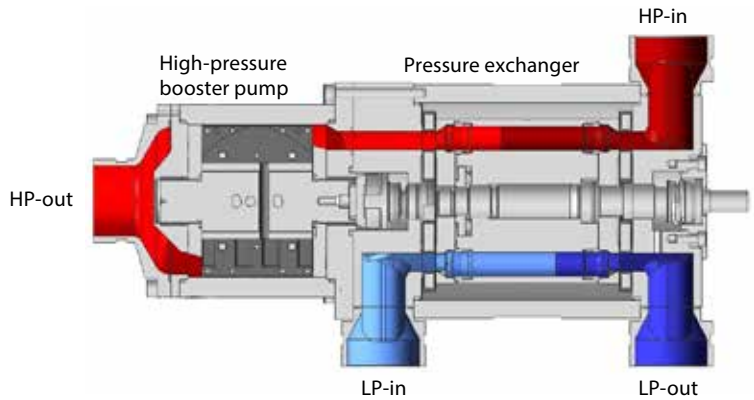
4. What does the iSave ERD do

The iSave controls the ERD loop flow (5, 6 and 7). The iSave exchanges brine flow with new seawater, transfers the brine pressure into booster pump and sends new seawater into membrane feed.



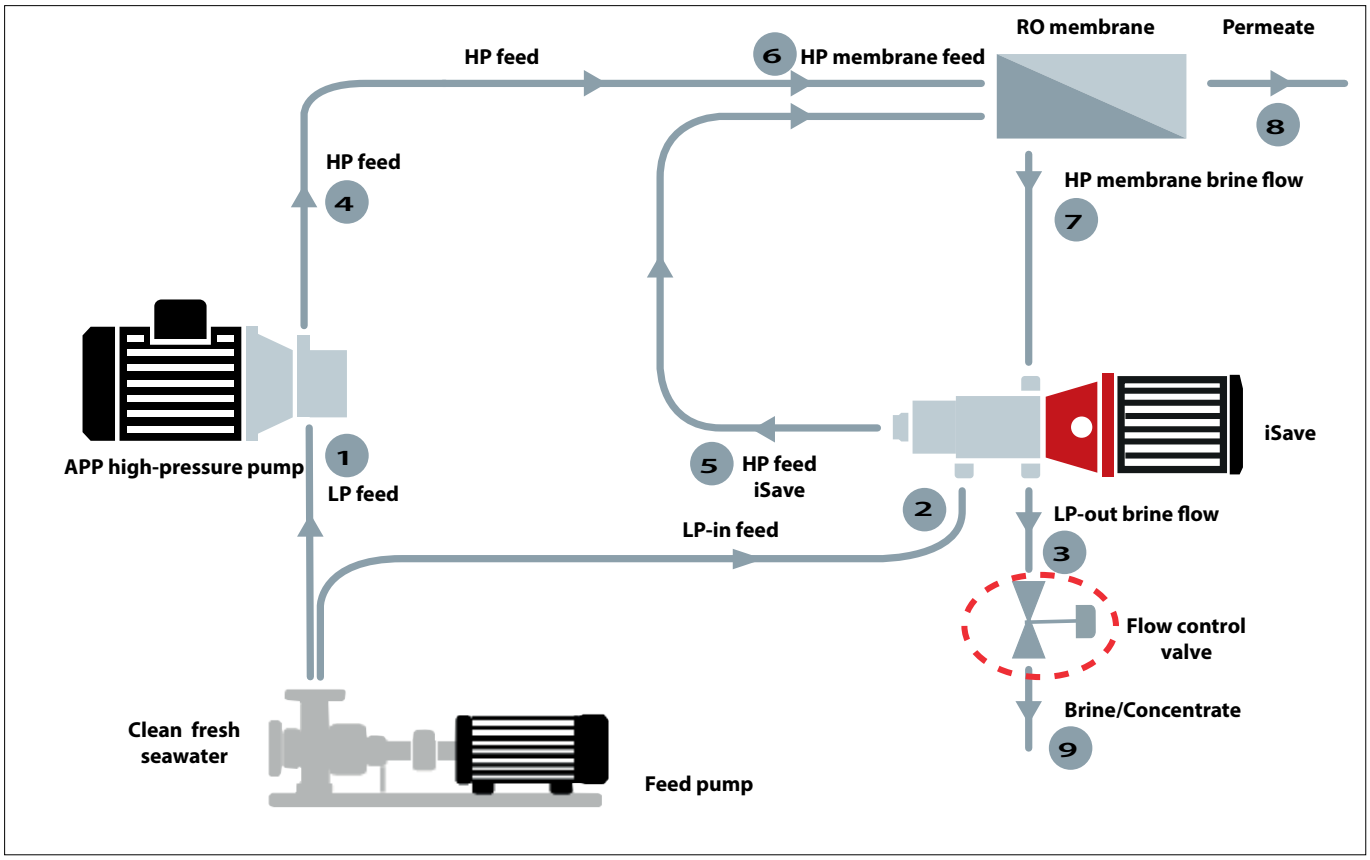
Action	Result
Increase iSave speed	Higher membrane loop flow (5 and 7) - lowers membrane recovery rate
Decrease iSave speed	Lower membrane loop flow (5 and 7) - raises membrane recovery rate
Changing the iSave speed	**Does not** effect the LP feed flow (2 and 3) and the permeate flow (8)

Section view of iSave

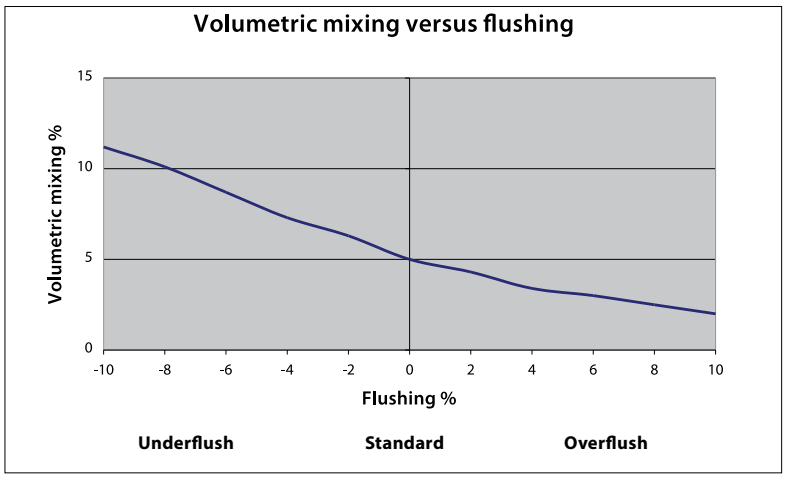


5. What does the LP-out flow control valve do

Flow control valve at LP-out (3) controls brine concentrate exchange flow at iSave and salinity mixing. LP-in seawater (2) is flushing the LP brine concentrate at iSave to LP-out (3).

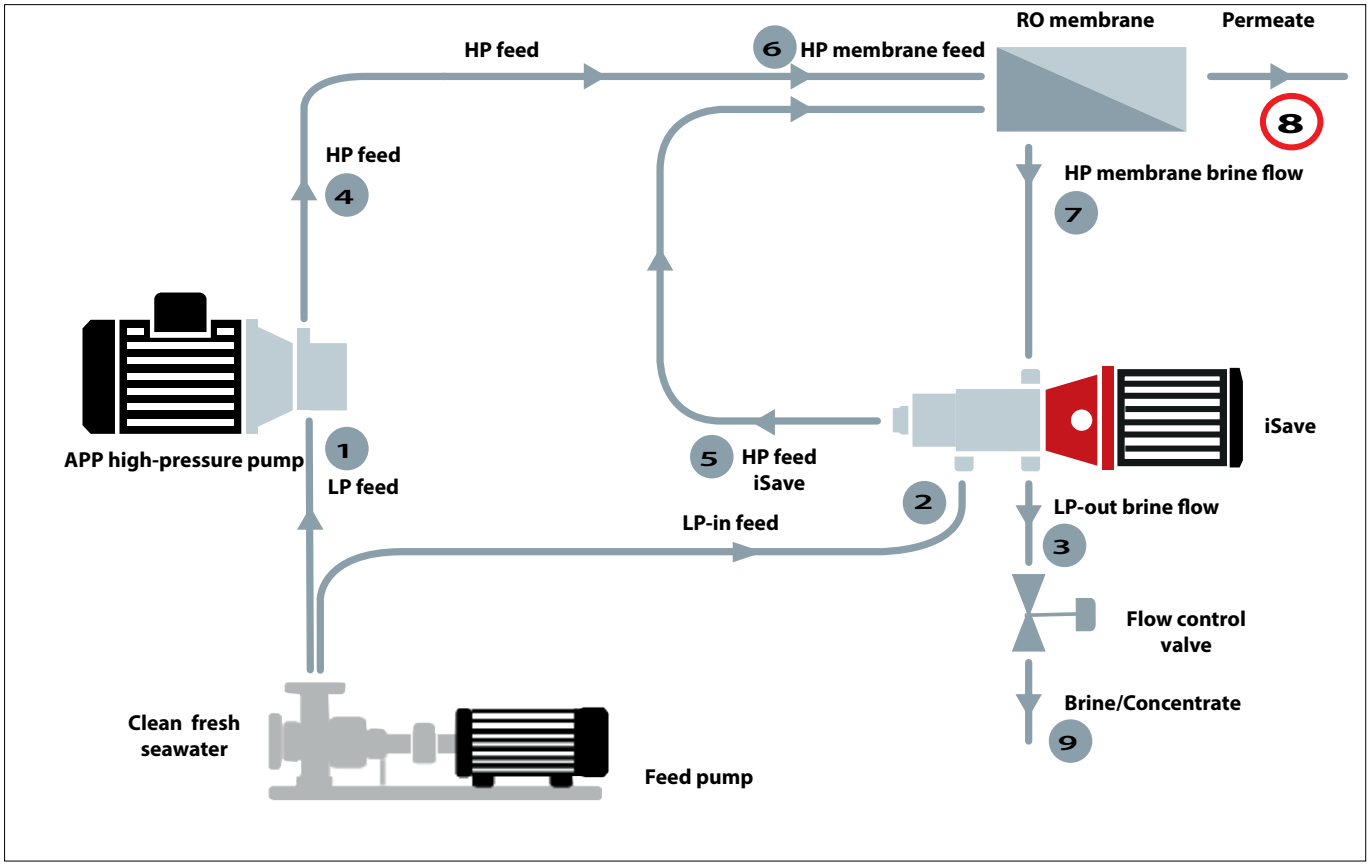


	Action	Result
Standard	LP-in seawater flow (2) is the same as HP flow (5)	Standard flow, standard mixing, small increase of salinity at membrane feed (6)
Overflush	LP-in seawater flow (2) is higher than HP flow (5)	Overflush flow, lower mixing, lower increase of salinity, membrane pressure decrease (6)
Underflush	LP-in seawater flow (2) lower than HP flow (5)	Underflush flow, higher mixing, higher increase of salinity, membrane pressure increase (6)
	Adjusting of flow control valve	**Does not** effect the HP flow at (5 ,6 and 7) or permeate (8)

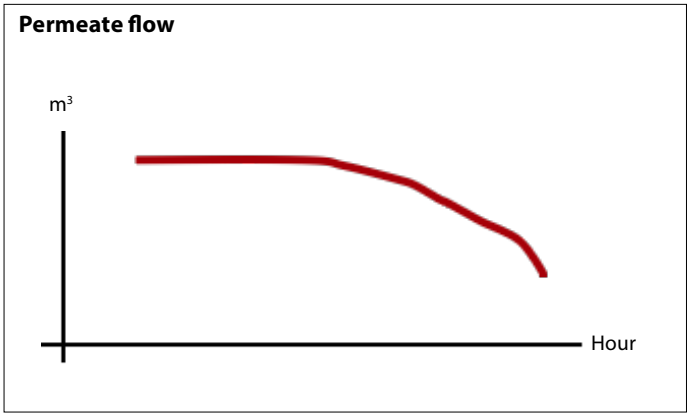


6. Trouble shooting

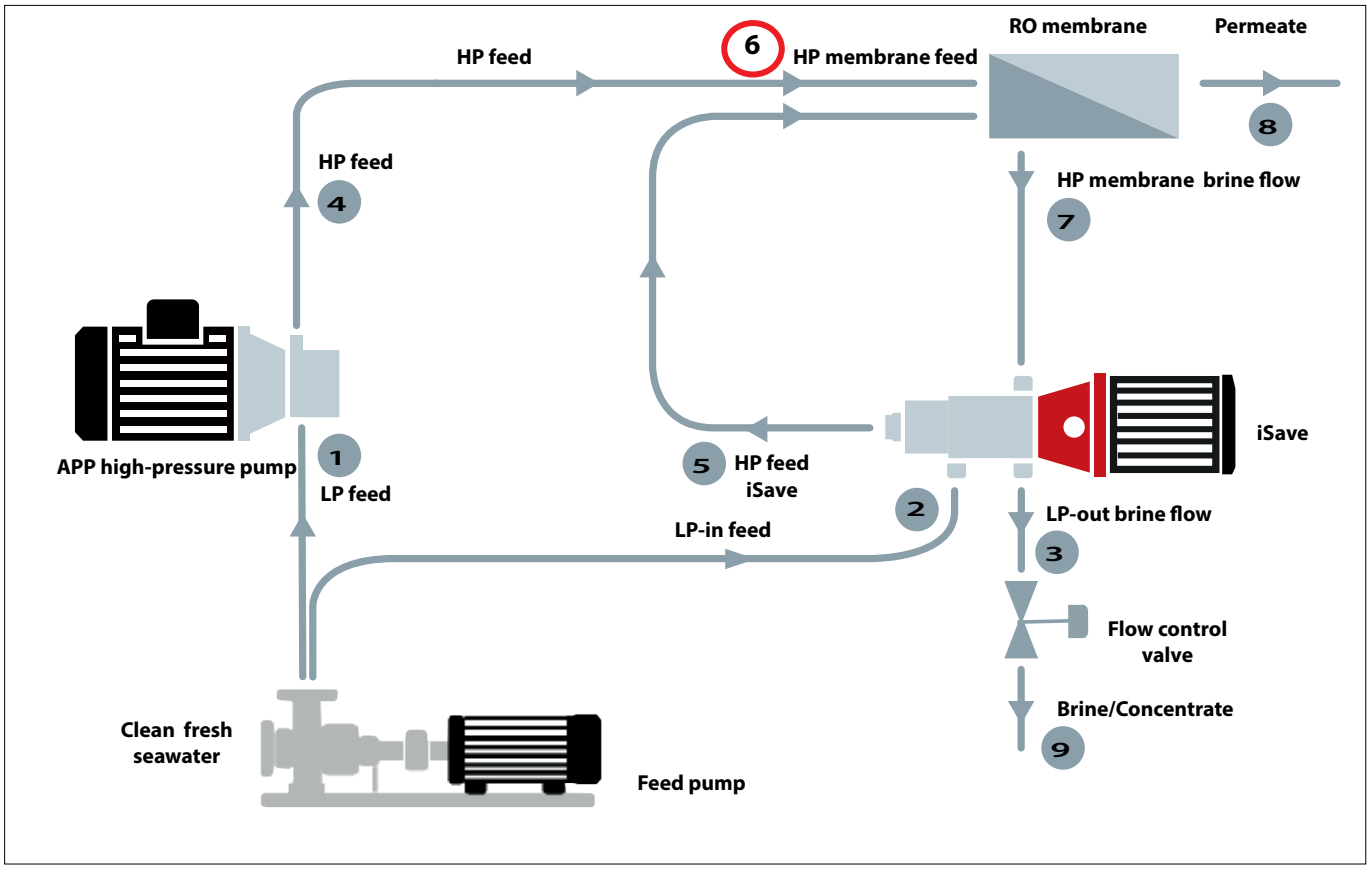
6.1 Permeate production decrease



Problem	Possible cause	Action
Permeate production decrease (8)	Valves at HP pipe's (4, 5 ,6 and 7) have internal or external leak	Repair or change valve(s)
	HP pump flow is too small (1 and 4)	Check speed on the HP pump
	HP pump speed correct, flow to low (1 and 4)	Repair the HP pump
	Internal leak at iSave increased	Repair iSave exchanger part

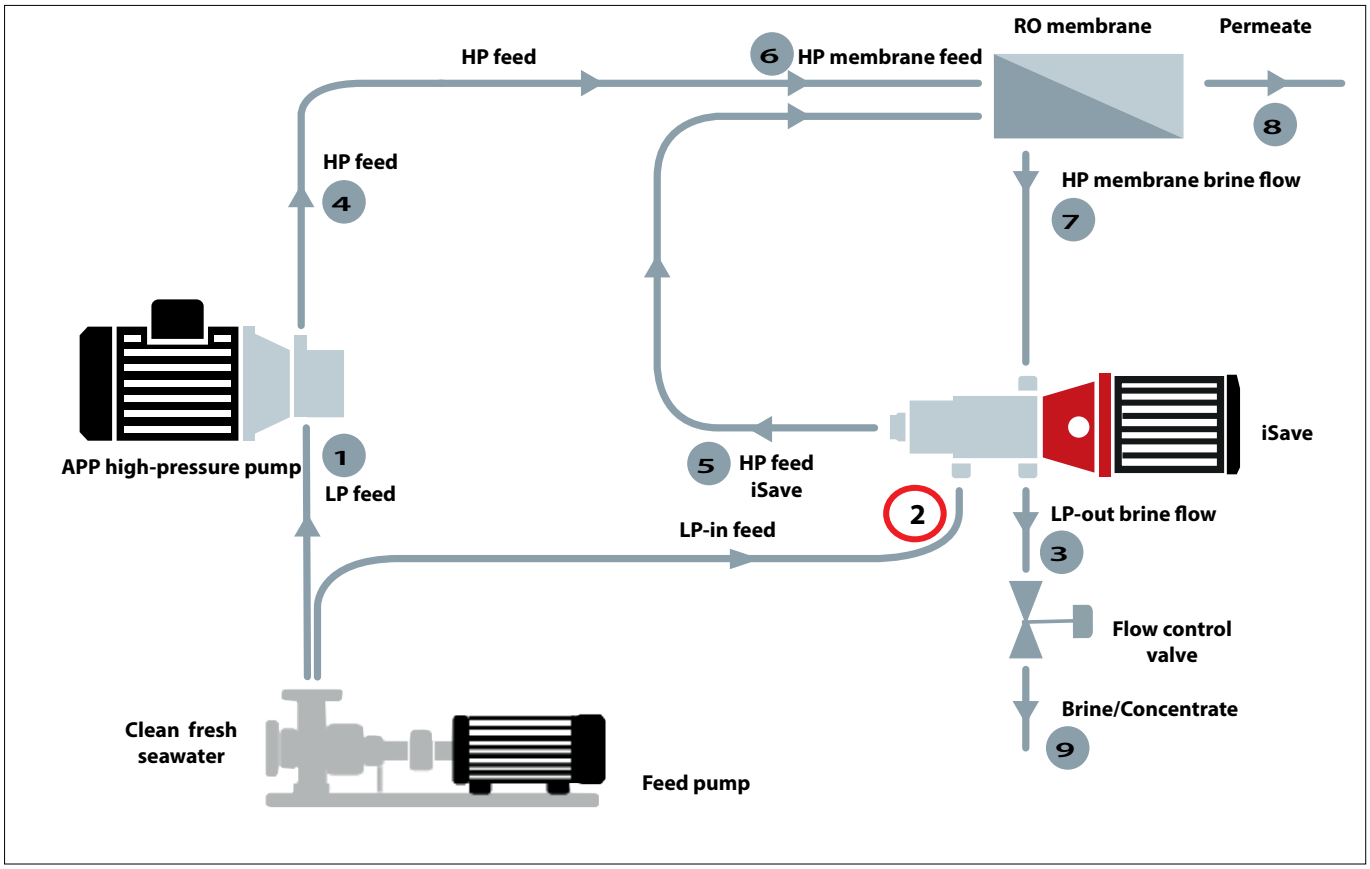


6.2 Membrane feed pressure decreases / increases



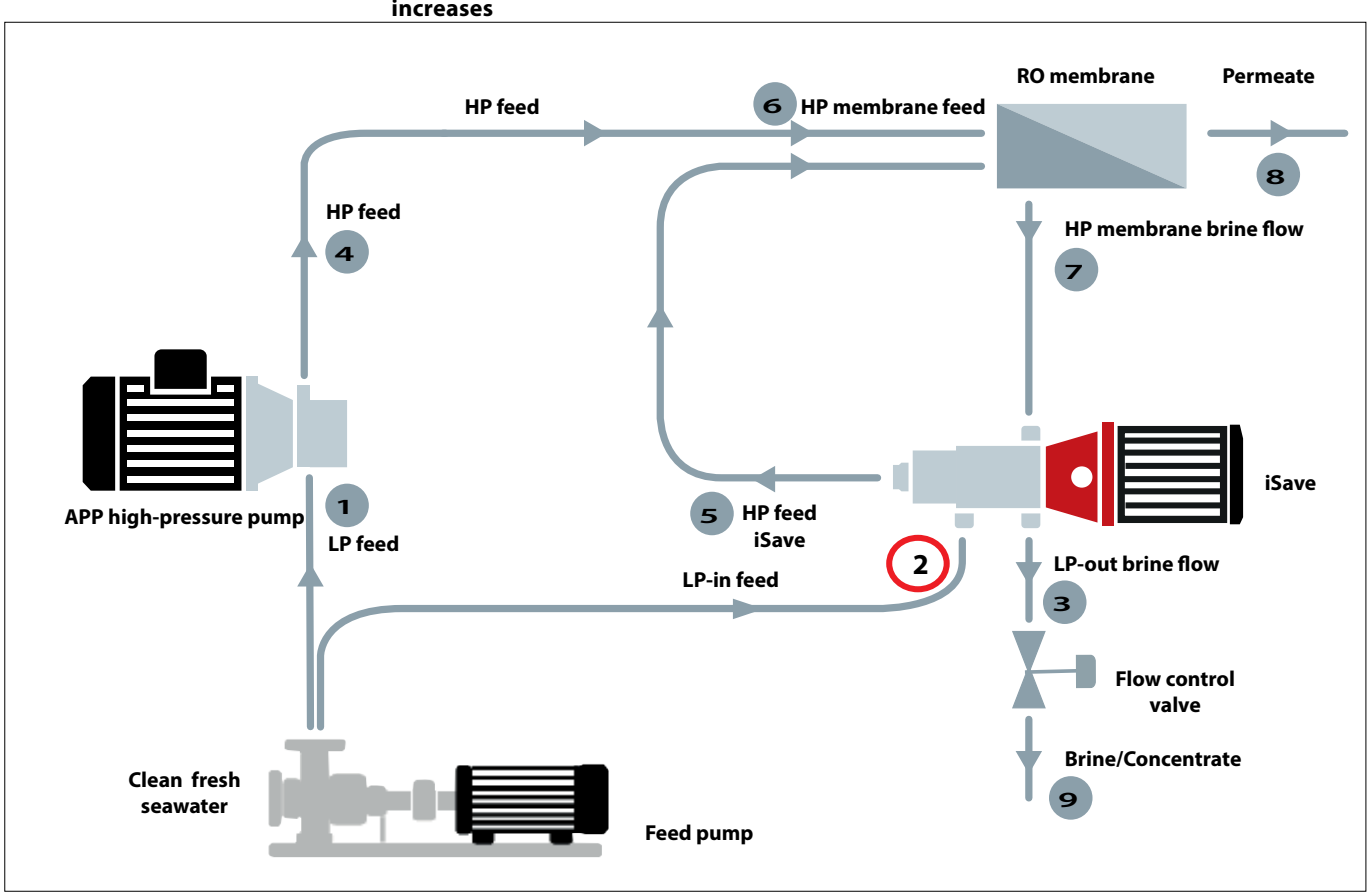
Problem	Possible cause	Action
Membrane feed pressure decrease (6)	Valves at HP pipe (4, 5, 6 and 7) are leaking	Repair or change valve(s)
	Feed water temperature increased or salinity decreased	None
	HP pump flow is too small (1 and 4)	Check speed on the HP pump
	HP pump speed correct, flow too low	Check the HP pump and repair
	Internal leak in iSave increased	Repair iSave exchanger part
Membrane feed pressure increase (6)	Salinity increased at membrane -Flow too low at LP-in (2). Mixing high	Increase flow at LP-in (2) by opening Flow control valve (3)
	Fouling at membranes	Clean the membranes
	HP flow (5 and 7) is too low, causes an increase of the recovery rate	Check speed at iSave and increase if necessary
	Feed water salinity increase or temperature decreased	None
	HP pump flow (4) is too high	Decrease speed at HP pump

6.3 LP-in seawater flow decreases / increases



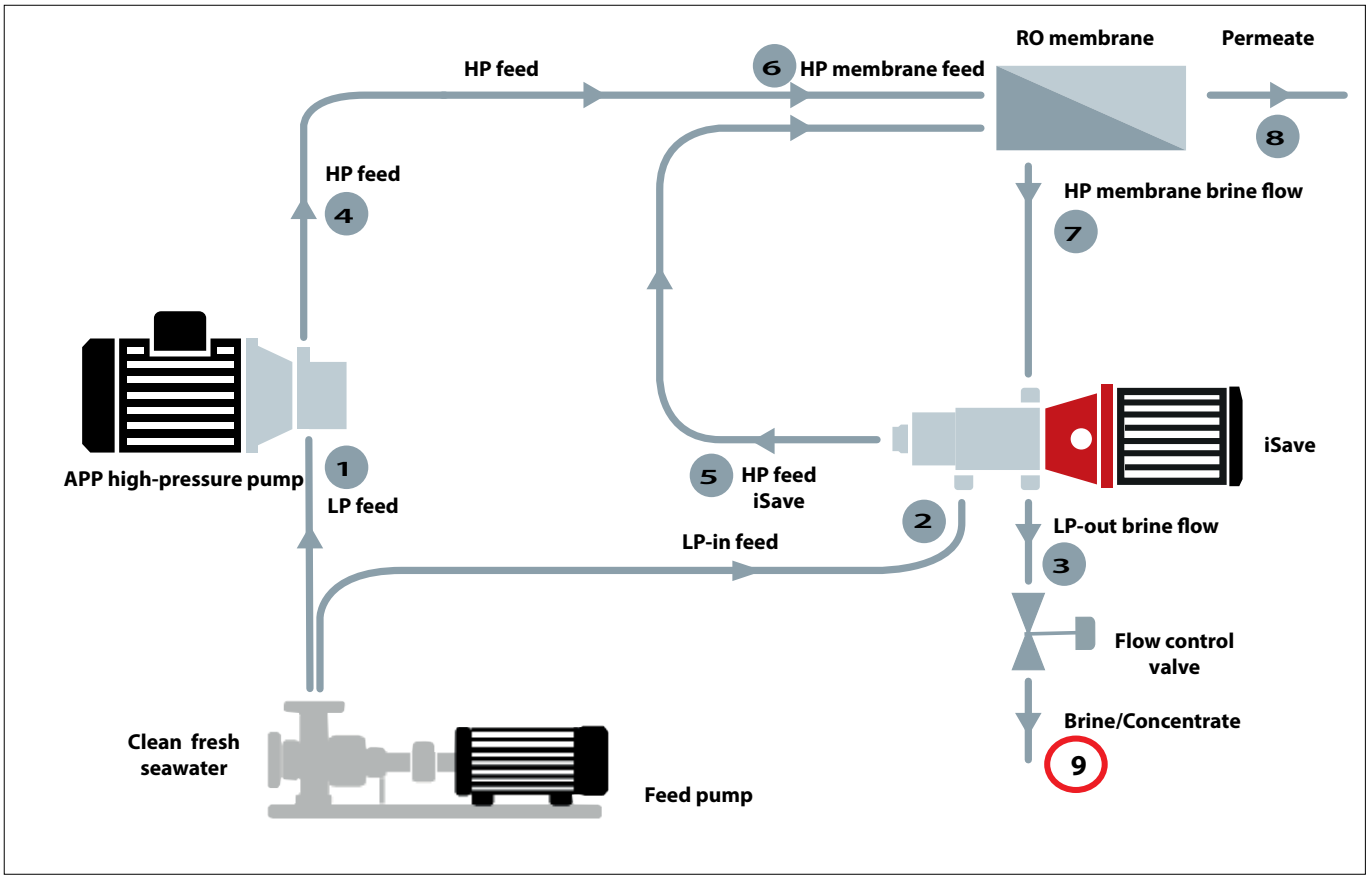
Problem	Possible cause	Action
LP-in seawater flow decrease (2)	LP-in pressure is decreased (1 and 2)	Check filtration and feed pump(s)
	Flowmeter indicates wrong flow (2)	Calibrate flowmeter or repair
	Flow control valve (3) has changed setting.	Increase flow at flow control valve (3)
	LP-out flow (3) has increased compare to LP-in flow (2)	Increased internal leak in iSave. Repair exchanger part
LP-in seawater flow increase (2)	LP-in pressure is increased (1 and 2)	Check feed pump(s)
	Flowmeter indicates wrong flow (2)	Calibrate flowmeter or repair
	Flow control valve (3) has change setting.	Decrease flow at flow control valve (3)

6.4 LP-in seawater pressure decreases / increases



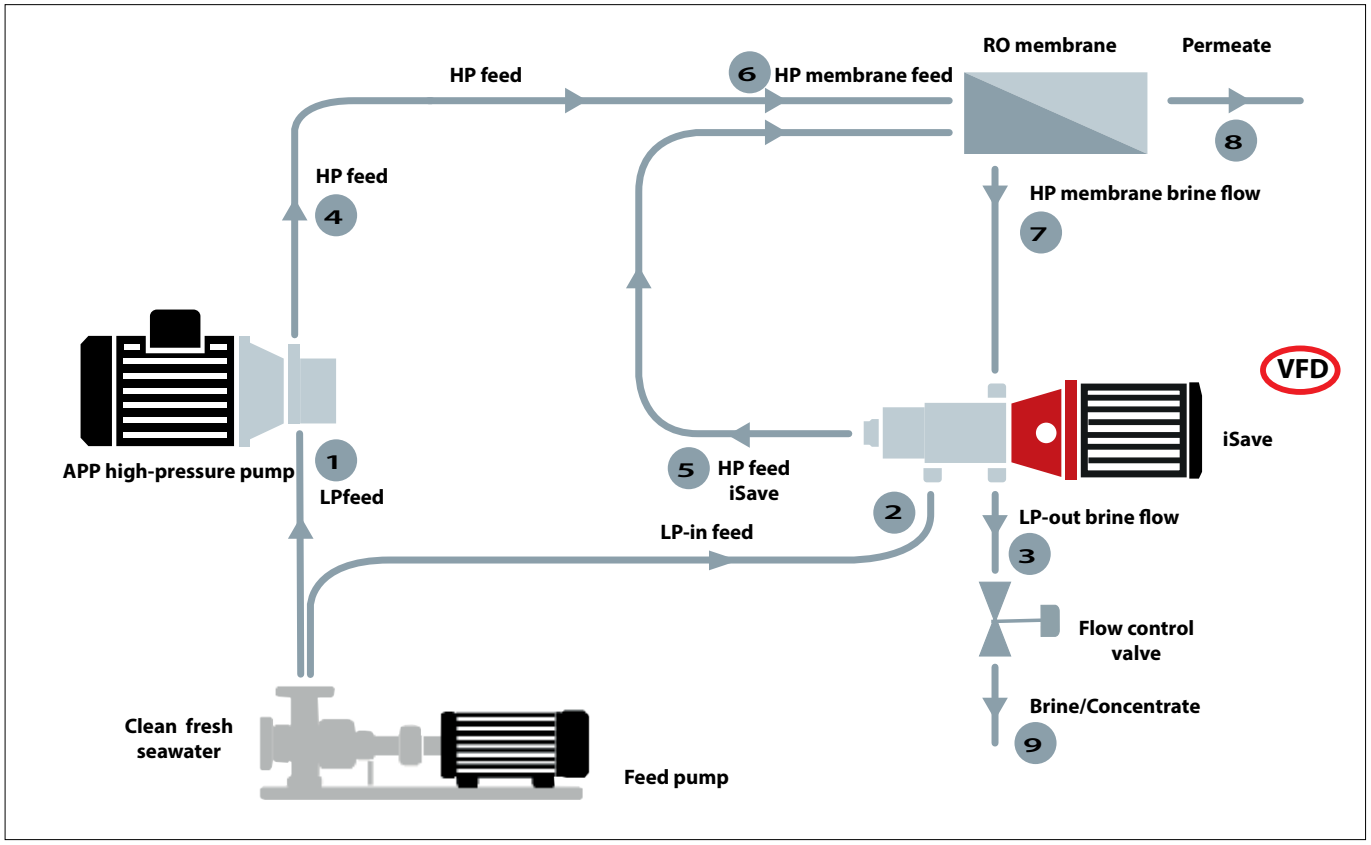
Problem	Possible cause	Action
LP-in seawater pressure decrease (9)	LP-in pressure is decreased (1 and 2)	Check filtration and feed pump(s)
	Pressure gauge/transmitter indicates wrong pressure (2)	Calibrate or repair. Check LP-in flow (2). Is it still correct?
	Flow control valve (3) has changed setting.	Adjust flow at flow control valve (3)
	LP-out flow (3) has increased compared to LP-in flow (2)	Increased internal leak in iSave. Repair exchanger part
LP-in seawater pressure increase (2)	LP-in pressure is decreased (1 and 2)	Check feed pump(s)
	Pressure gauge/transmitter indicates wrong pressure (2)	Calibrate or repair. Check LP-in flow (2). Is it still correct?
	Flow control valve (3) has changed setting	Adjust flow at flow control valve (3)
	LP-out brine flow (3) has increased compared to LP-in flow (2)	Increased internal leak in iSave. Repair exchanger part

6.5 LP-out brine water flow increase



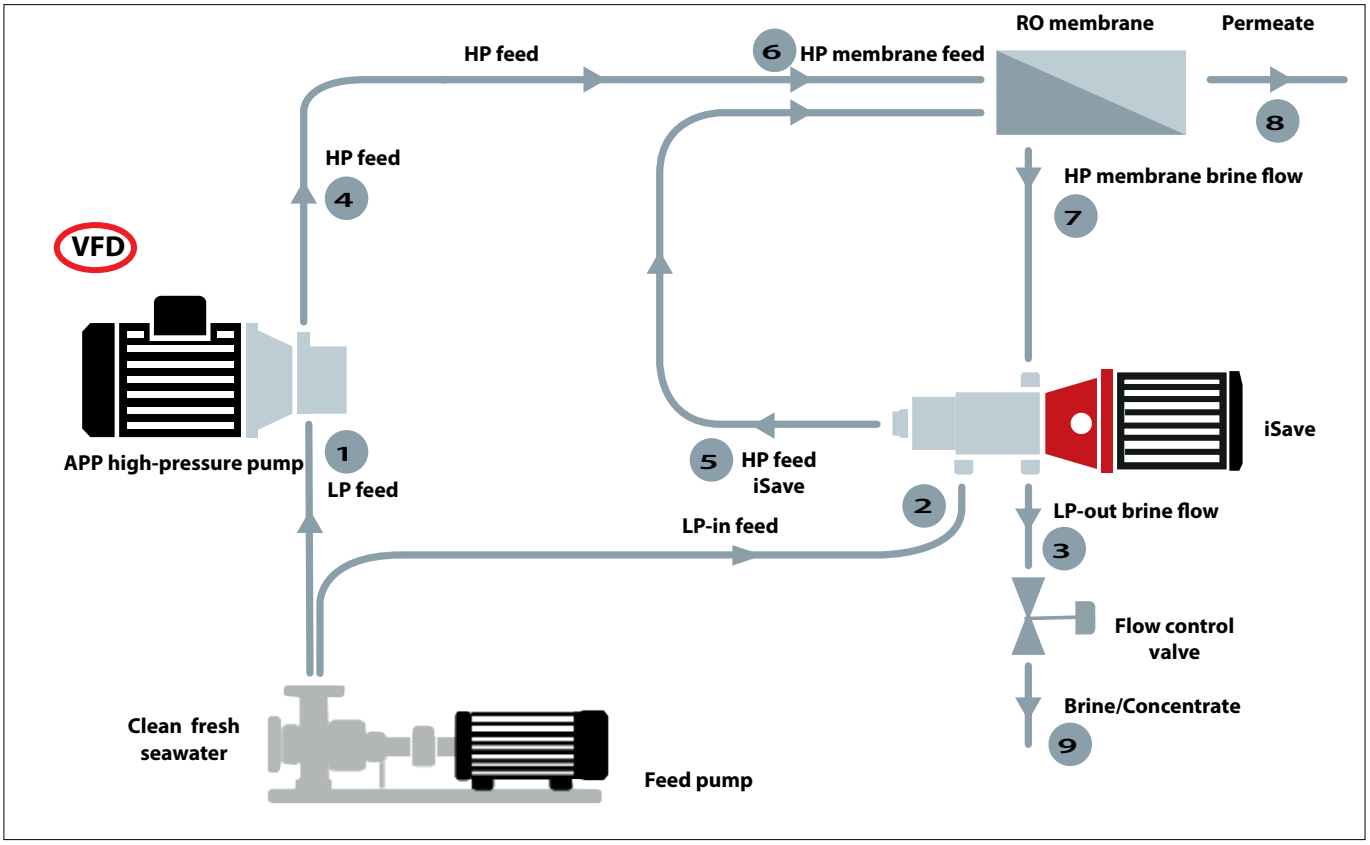
Problem	Possible cause	Action
LP-out brine water flow increase (9) (If flowmeter at LP-out (3))	LP-in pressure/flow is increased (2)	Check feed pump(s)
	Flowmeter indicates wrong flow (3)	Calibrate flowmeter or repair
	Flow control valve (3) has changed setting	Decrease flow at flow control valve (3)
	LP-out flow has increased compared to LP-in flow (2)	Increased internal leak in iSave. Repair exchanger part

6.6 High Amp / overload at iSave VFD



Problem	Possible cause	Action
High Amp / over-load at iSave VFD	High delta pressure at membrane. Above 5 bar	Clean membrane
	Increased stick/slip inside iSave. Need higher amp/torque to start rotation	Inspect, clean or repair iSave
	Impuries or damage inside iSave	Inspect, clean or repair iSave
	VFD settings wrong	Change settings, constant torque, increase overload value
	Electric motor	Check motor and cable

6.7 High Amp / overload at APP pump VFD



Problem	Possible cause	Action
High Amp / over-load at APP VFD	High pressure at membrane	See problem: high membrane feed pressure
	Damage inside APP	Inspect, clean and repair APP
	VFD settings wrong	Change settings, constant torque, increase overload value
	Electric motor	Check motor and cable

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