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Managing Water in the West

Strategies for Treating Variable Source Waters

Michelle Chapman
Frank Leitz

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Bureau of Reclamation

The most common process of desalination used today is reverse osmosis (RO).

Yuma Desalting Plant in Yuma, Arizona

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The typical desalting plant is designed for constant operation optimized for average water condition.

However, when the amount of water to be treated, or the composition changes widely, one needs to consider global optimization.

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Examples of Variable Source Waters

- Irrigation return flows
- Estuarial Rivers with tidal influx
- Coastal regions with seasonal storm water and surface water that rely on seawater during the dry season.
- Groundwater aquifers that become more saline over time.

Factors Limiting Flexibility

- Materials
- Membrane element design
- Number of stages, elements per stage
- Degree of separation
- Energy conservation
- Water conservation

RO Operating Constraints

- Maximum feed flow and maximum feed pressure
- Minimum concentrate flow
- Maximum product flow

Configuration	Elements per Vessel	Number of Vessels in Stage 1	Number of Vessels in Stage 2	Number of Vessels in Stage 3
I	6	26	14	–
II	5	32	16	–
III	4	26	20	14

ESPA I membrane, 240 elements, 3800 m^3/day

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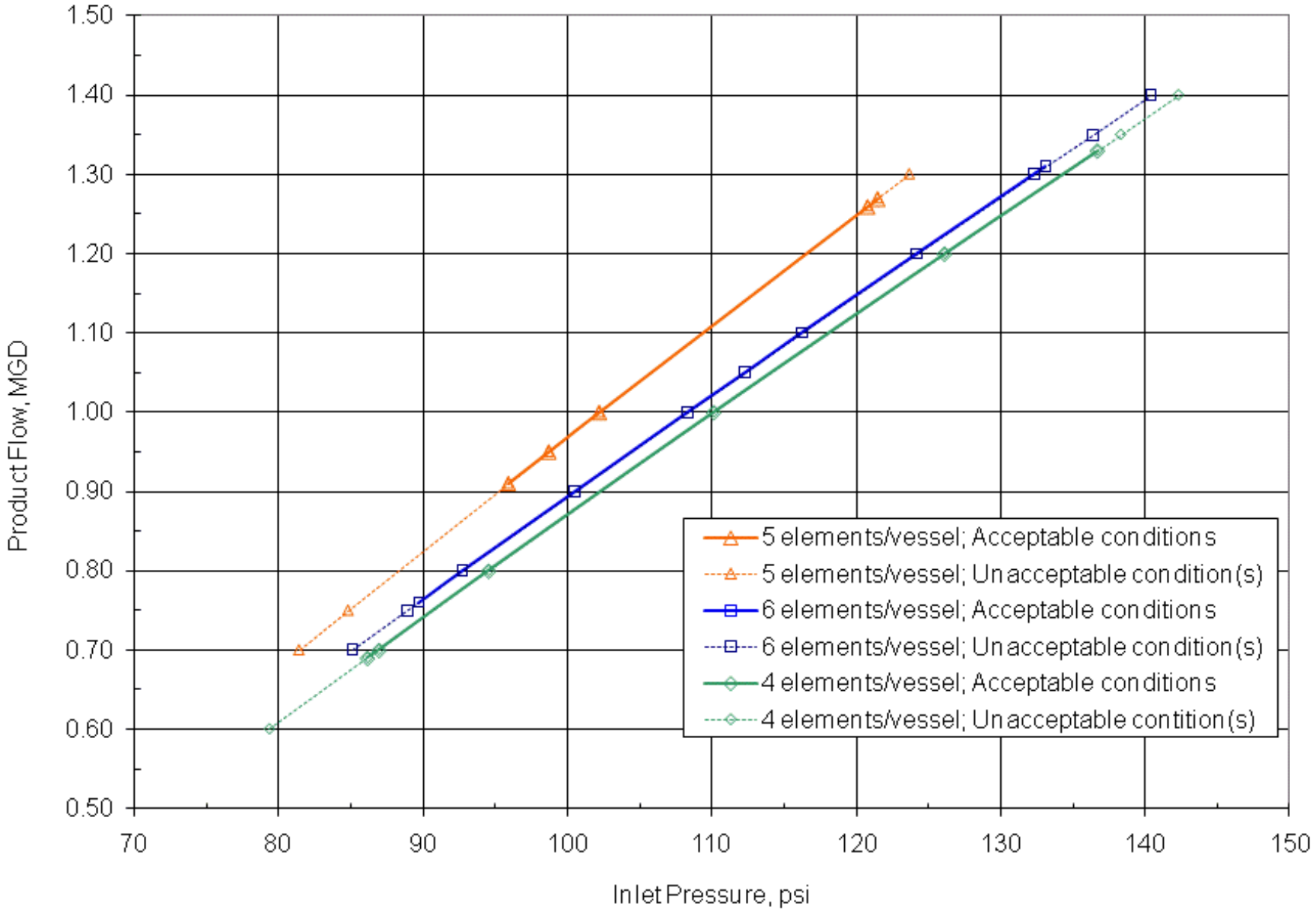
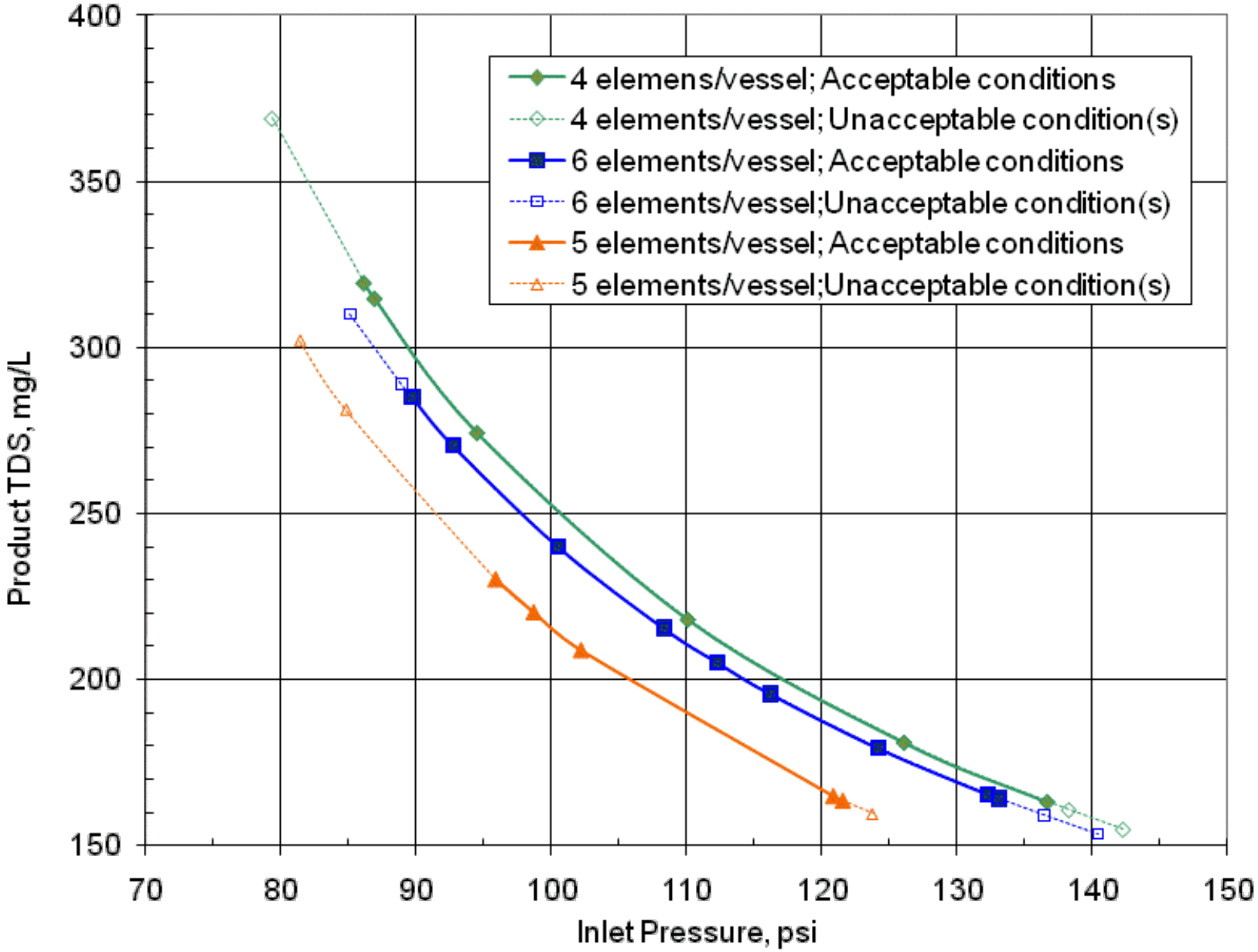
Variation in Capacity



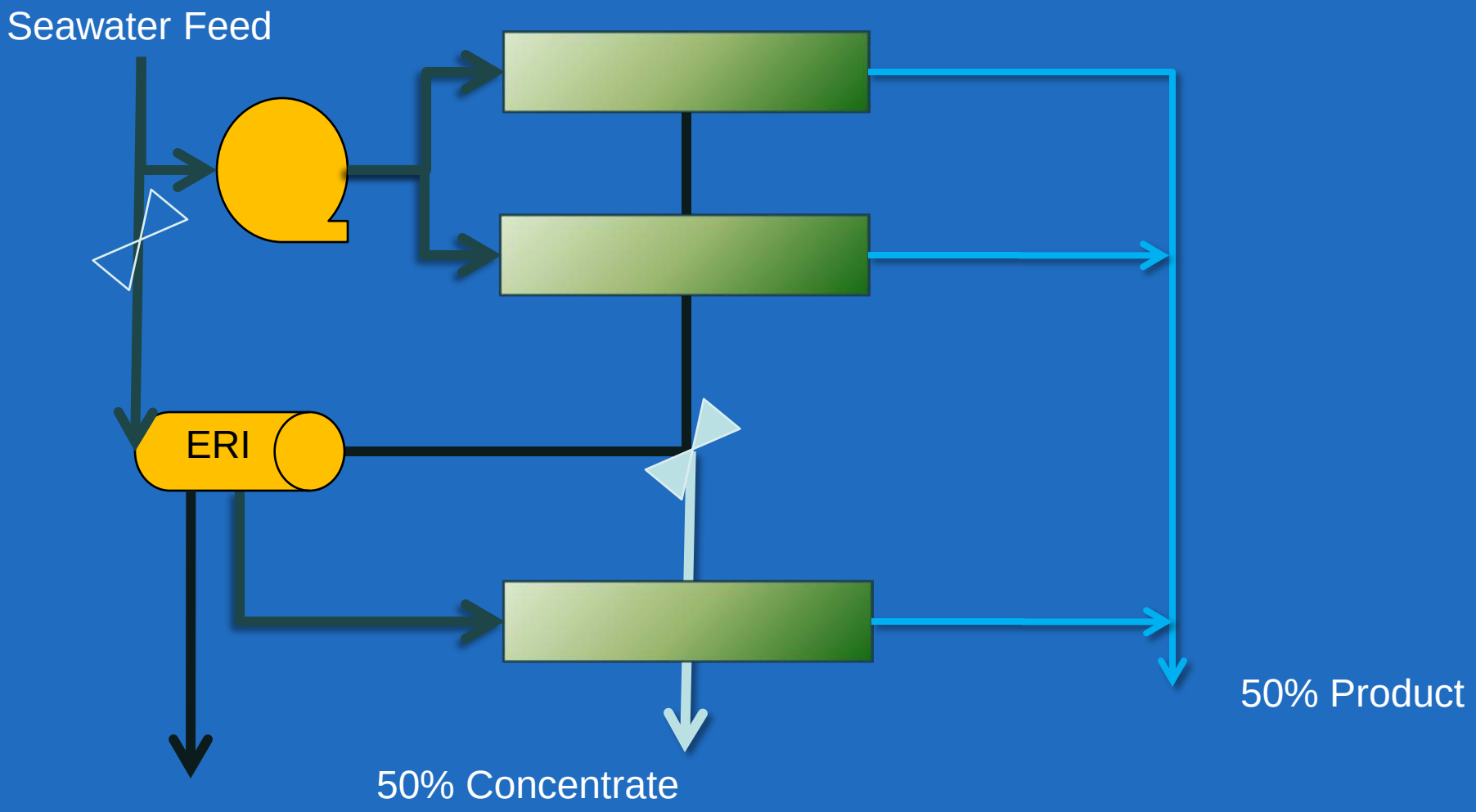
Configuration and Quality



Expeditionary Unit Water Purifier

~375 m^3/day
UF-RO
50% Recovery
3.5 kWhr/m^3

Sea Water System



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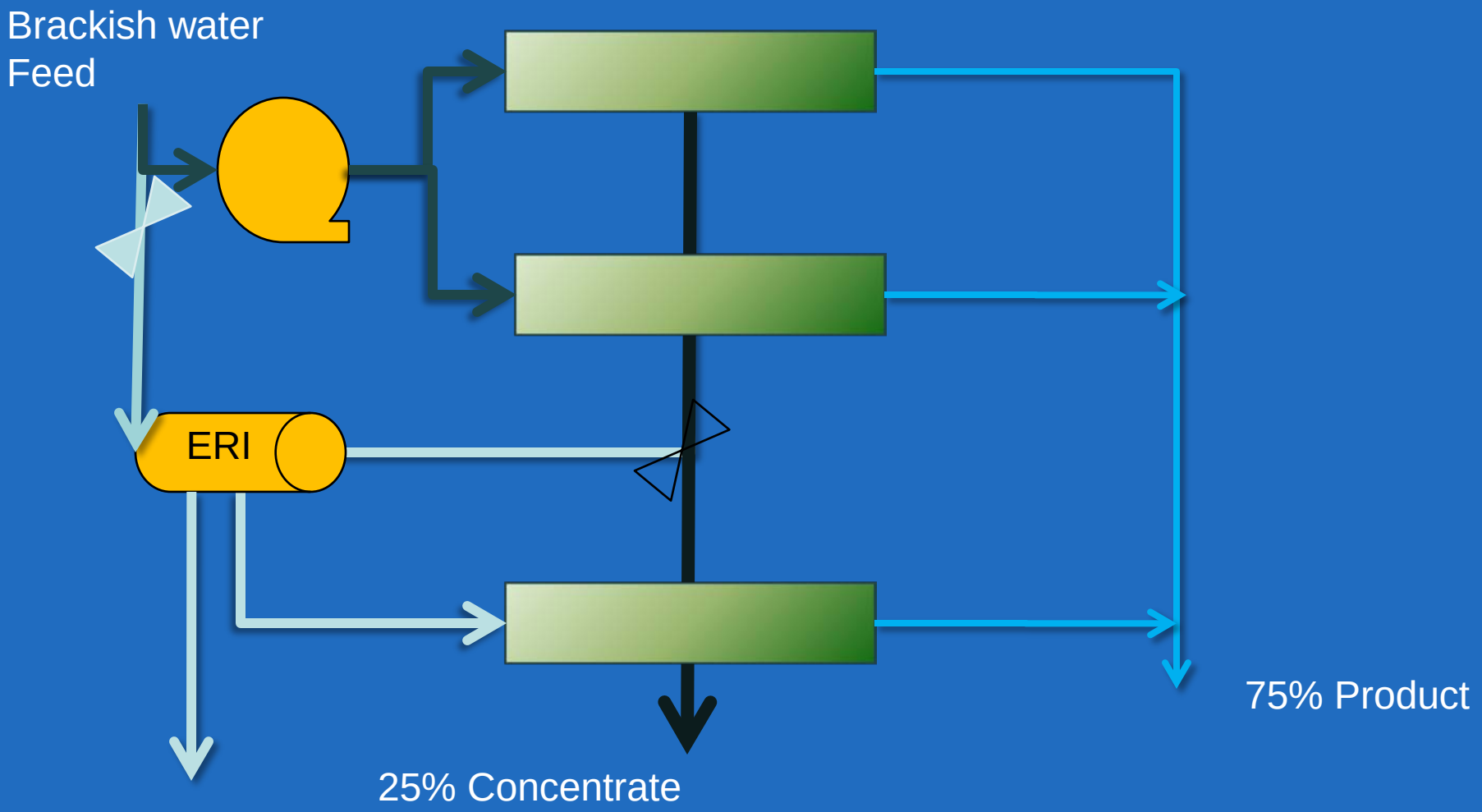
Sea Water System



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Actual Performance w/ SW & BW

	Feed			Permeate			Concentrate		
	Flow (L/min)	TDS	Pres (Bar)	Flow (L/min)	TDS	Pres (Bar)	Flow (L/min)	TDS	Pres (Bar)
Seawater HP Array	430	32,627 mg/L	65	212	240 mg/L	1.4	218	N/A	62.8
Seawater PX Array	250		63	95		1.4	155		59
Brackish HP Array	408	1720 µS/cm	20	185	9 µS/cm	1.4	223	3640 µS/cm	14
Brackish PX Array	148		14	61		1.5	87		9.6

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Simulated Performance w/ 75% Recovery using 2 stages

	Feed			Permeate			Concentrate		
	Flow	TDS	Pres	Flow	TDS	Pres	Flow	TDS	Pres
Brackish HP Array	439	2928 mg/L	29.3	238	6.4 mg/L	1.5	200	6527 mg/L	25.9
Brackish 2nd Stage	200	6527 mg/L	25.5	89	16 mg/L	1.5	111	9108 mg/L	22

Options for Converting ERI to Flow Through Connection

- Replace on off valve with 3-way valve
- Remove 90° connections & install straight pipe.
- Or, re-plumb vessel inlets.

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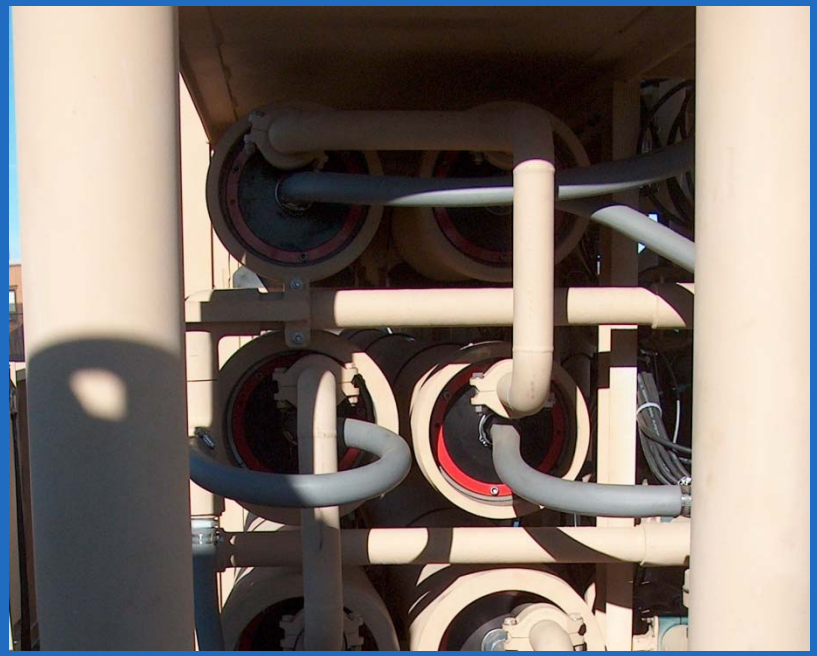
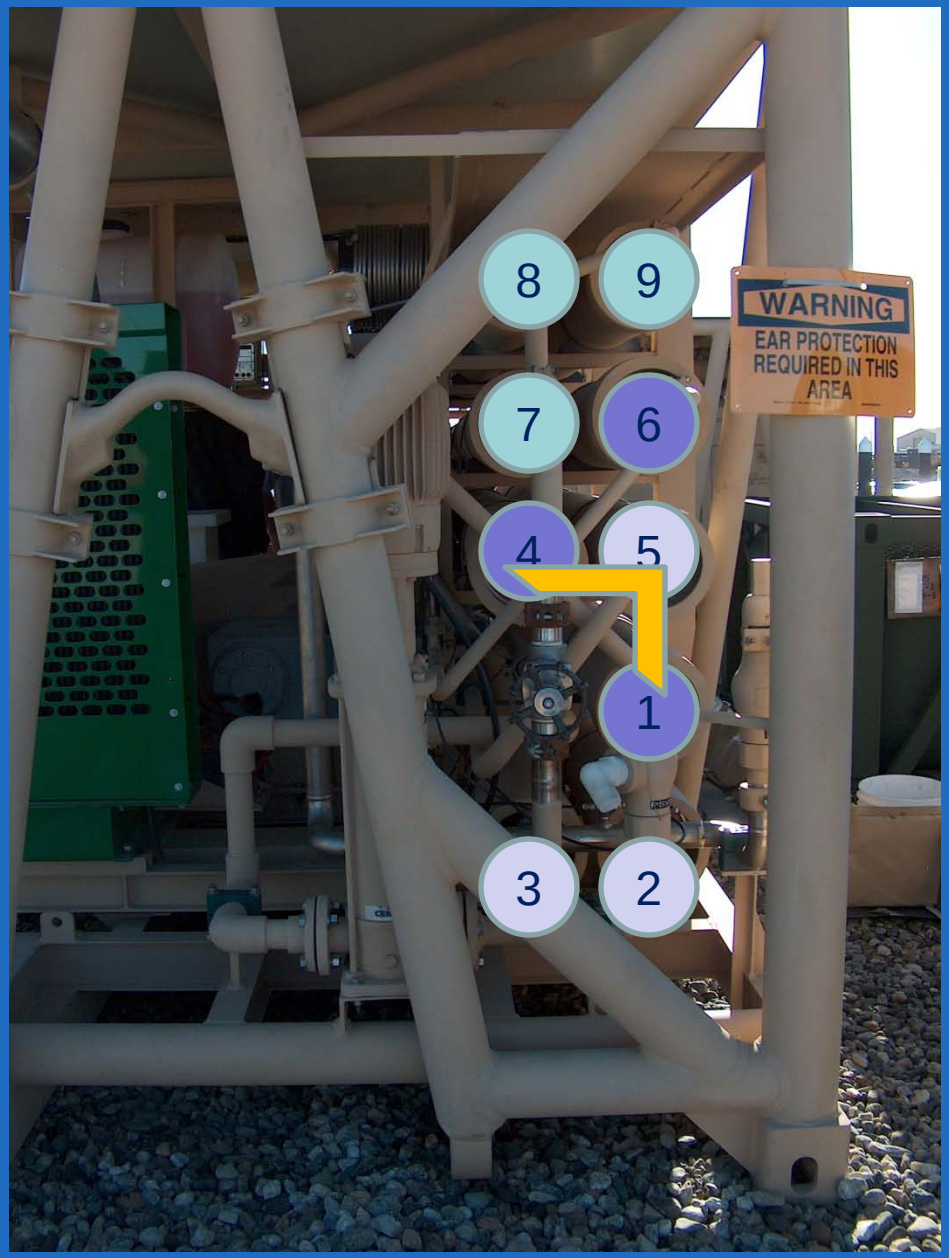
Vessel Inlet Manifolds



Use the Second Pass Manifold to connect vessels 1 and 4 to 5.



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The examples presented above refer to brackish water and seawater. Other combinations of waters could be treated using the same approach.

Acknowledgements

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