

SAWEA 2007 Workshop

Breakthrough in Energy Savings in SWRO Plants: The Pressure Exchanger

Presented by:

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Making Desalination Affordable



Confidential-2006



AGENDA

ERI & PX Pressure Exchanger

Background: SWRO & Energy Consumption

How the PX Works

Implications for Design & Operations

Conclusions



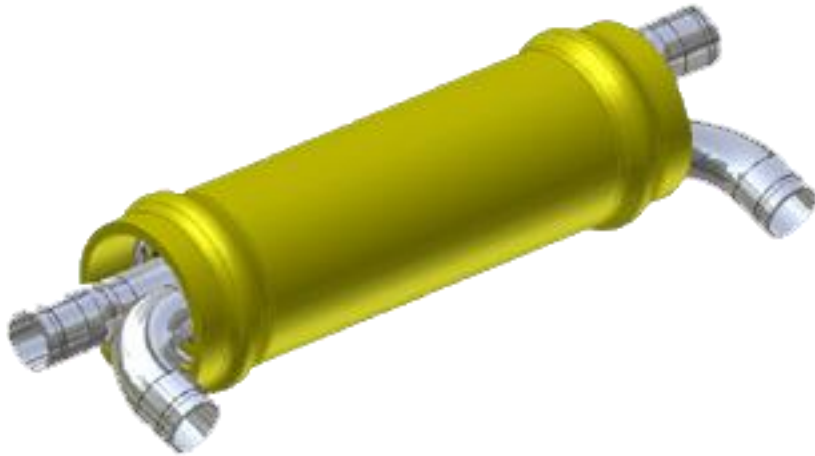


HQ Office in San Leandro (San Francisco), California USA
Regional Offices: Spain, China, Florida, UAE

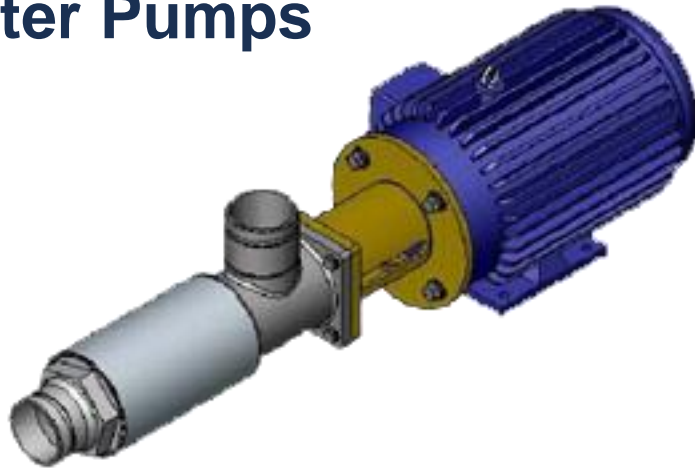


PX Pressure Exchanger

Pressure Exchanger (“PX”) energy recovery devices



PX Booster Pumps



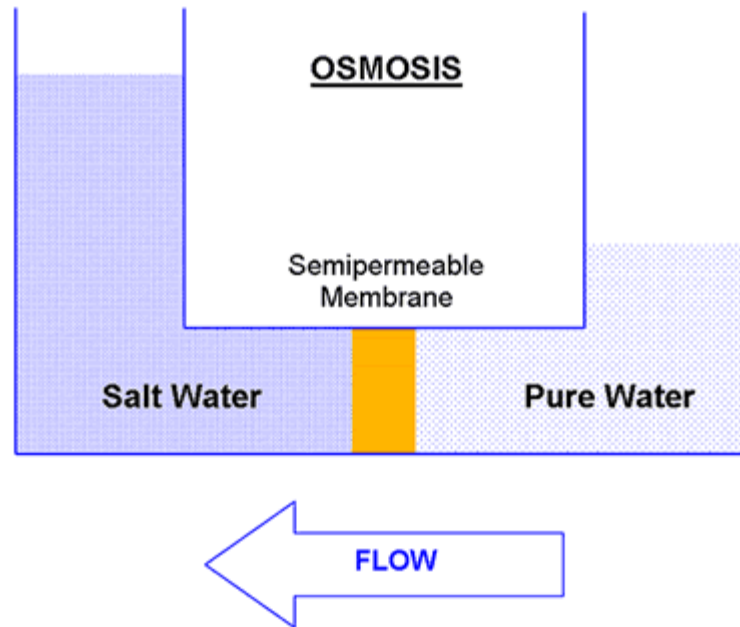
References

Country	Project/City	Size (m3/d)	Contractor
Cyprus	Dhekelia	40,000	Caramondani
Egypt	Sinai Peninsula	10,000	Intech
	Sharm El Sheikh	Multi. <1,000	Metito
UAE	Sharjah	22,700	CH2M Hill
	Zawrah	27,300	Aqua Engineering
	Qidfa	13,650	Aqua Engineering
	Ghalilah	13,650	Fisia Italimpianti
Oman	Sur	9,200	Aqua Engineering
	Sur	4,600	Aqua Engineering
Algeria	Hamma	200,000	GE Water
	Beni Saf	200,000	Geida
	Skikda	100,000	Ecoaqua Ingenieros
Saudi Arabia	Saudia / Jeddah	9,000	GE Water
	Shuaibah	150,000	Doosan



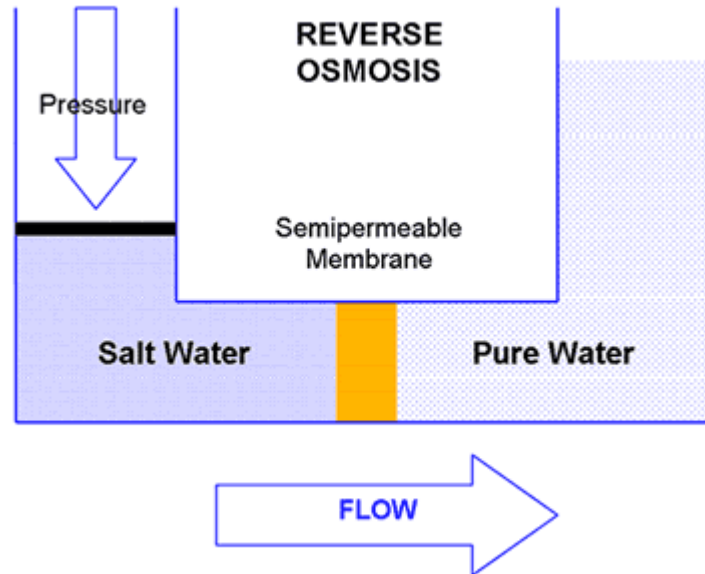
Brief Background

Osmosis



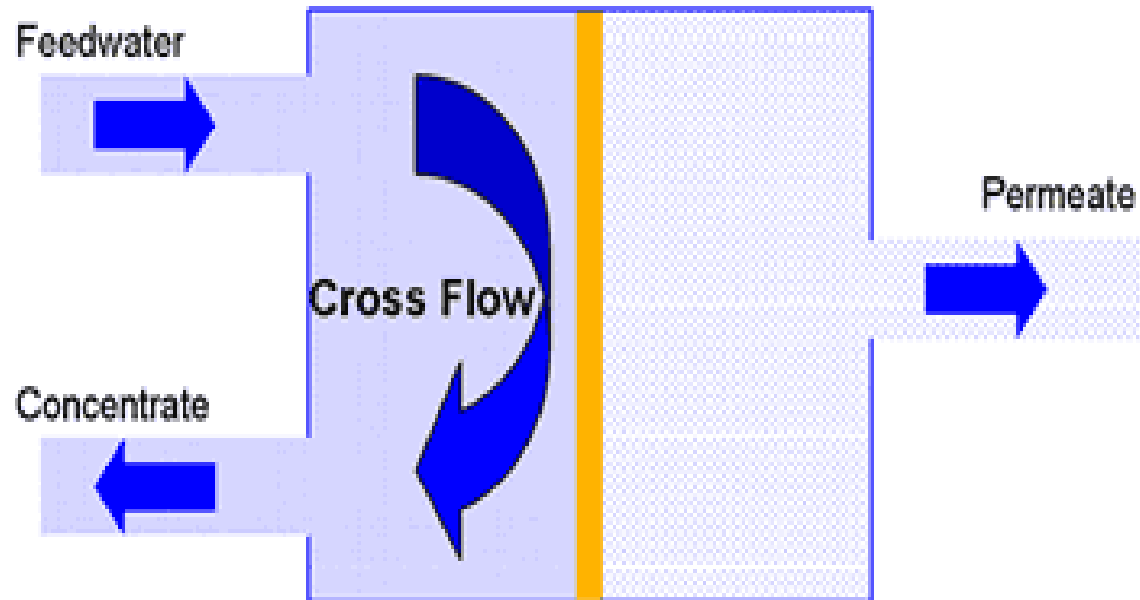
Brief Background

Reverse Osmosis



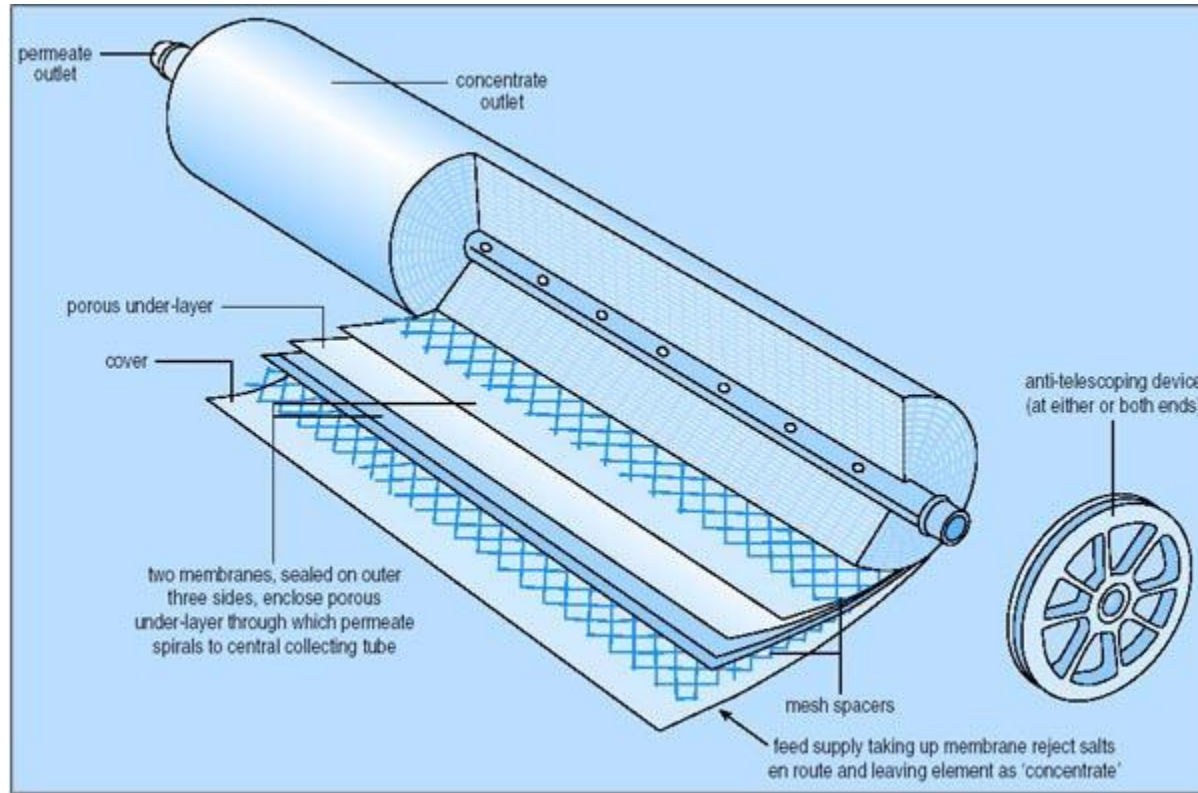
Brief Background

Reverse Osmosis with Cross Flow

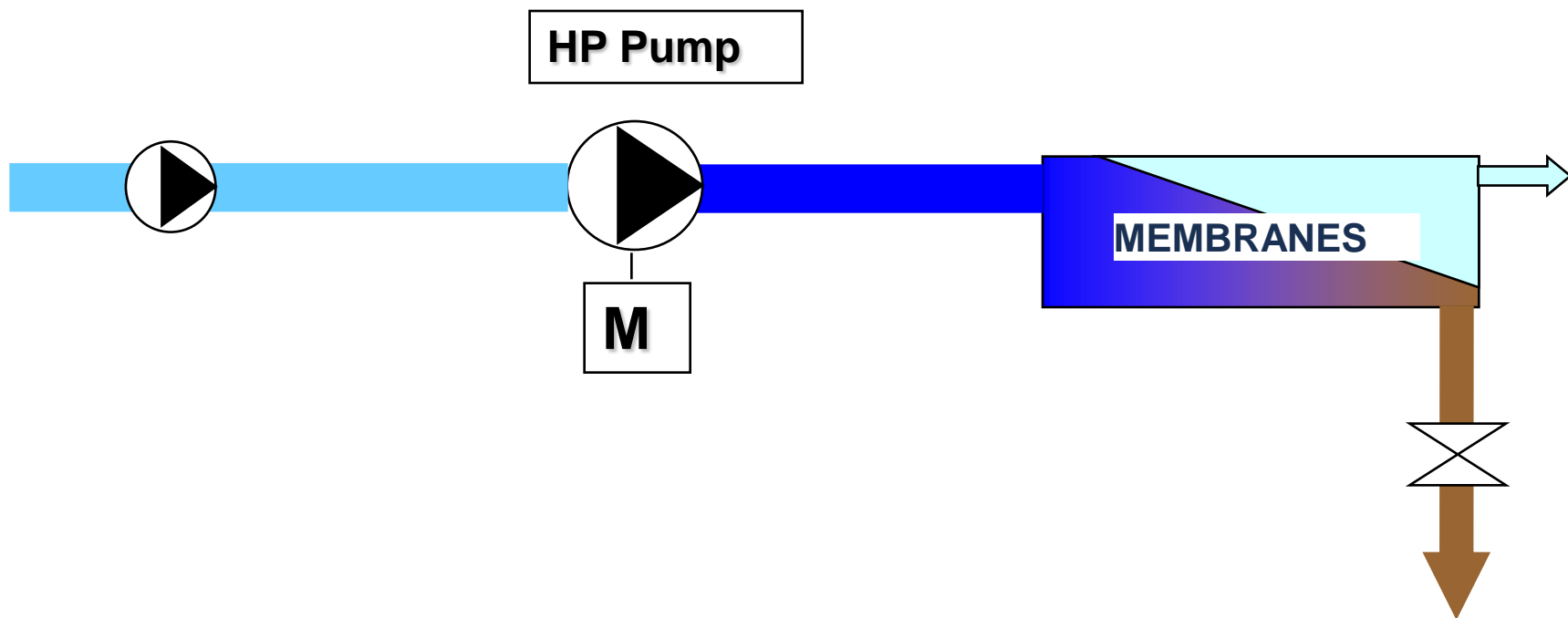


Brief Background

Spiral Wound Membrane Element



Brief Background: Not ERD



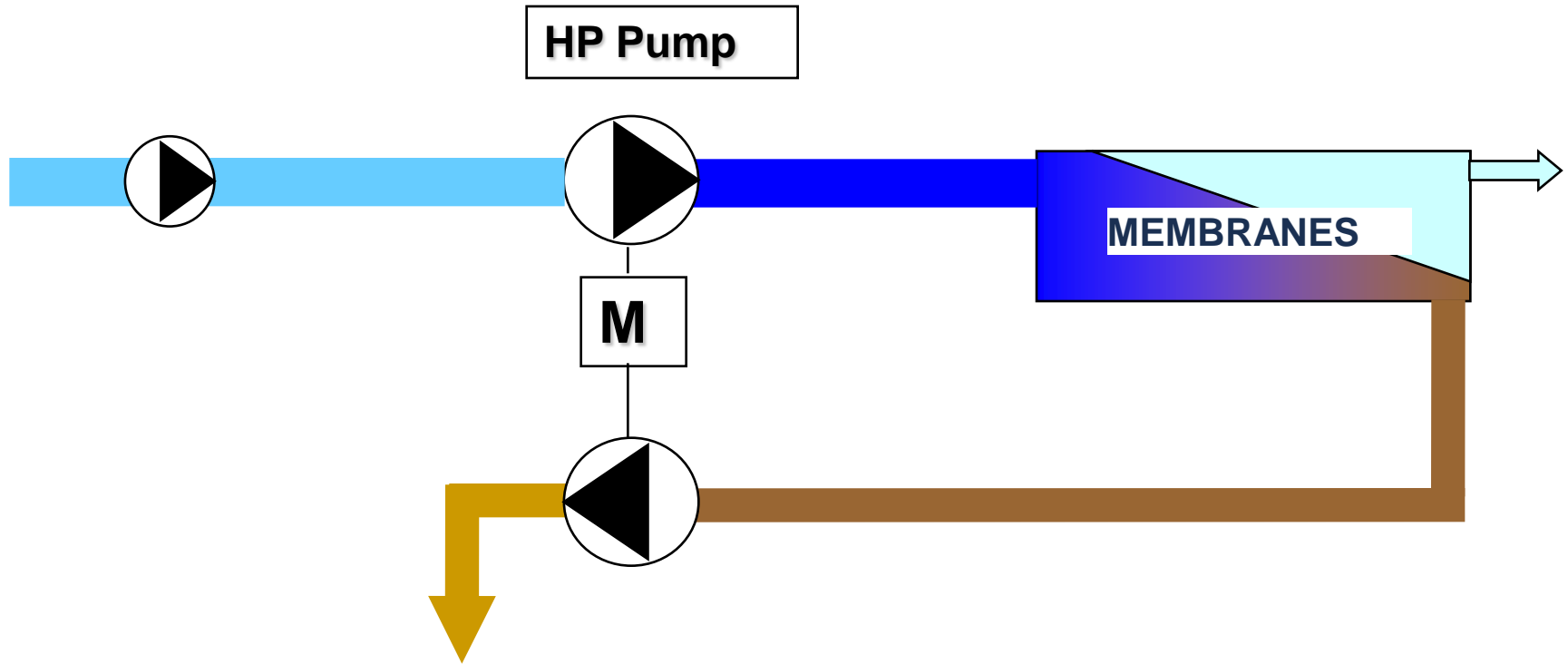
High Pressure Pump with Brine Control Valve (8 kWh/m³)

100% of energy into Membranes

60% wasted through control valve



Energy Recovery Turbine



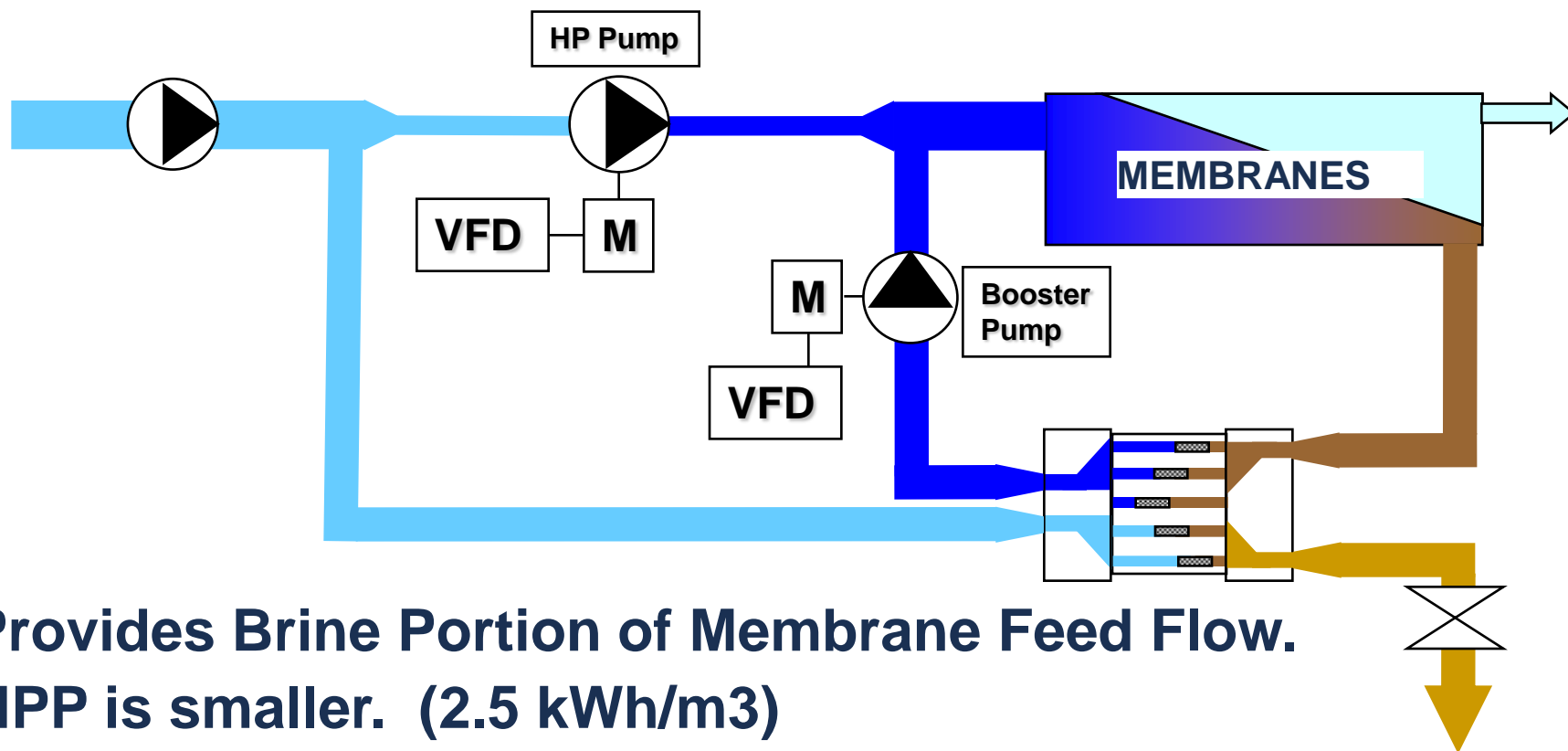
High Pressure Pump with Pelton Wheel (ERT)

ERT recovers energy and helps HPP spin (4 kWh/m³)

80% eff. ERT, 80% eff. HPP, 64% Net Energy Transfer



PX Pressure Exchanger



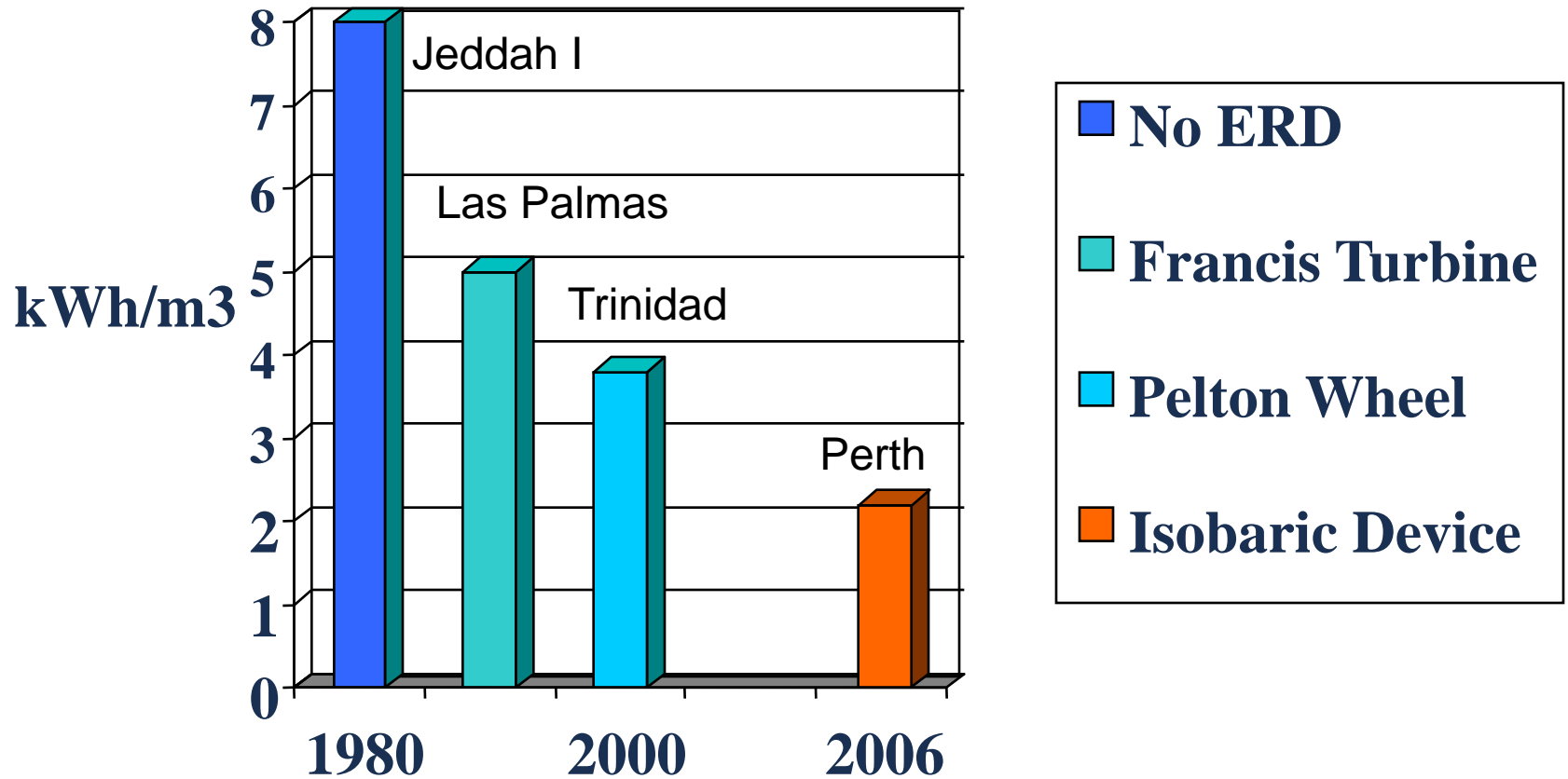
**Provides Brine Portion of Membrane Feed Flow.
HPP is smaller. (2.5 kWh/m³)**

97% Net Energy Transfer



Consumption & Costs

Energy Recovery Devices *Driving down the cost of Desalination*



PX Animation



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ERI SIM SWRO Process Simulator



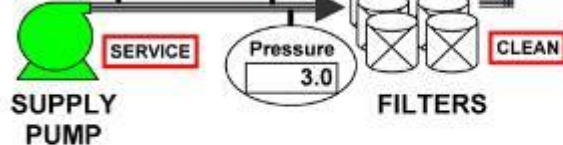
ERI Sim™
Revision 1
Copyright 2007
Energy Recovery, Inc.

Production Rate 10,332 m³/day
Total Power 1,058 kW
Specific Energy 2.46 kWh/m³
Operating Cost 4,384 \$/month

Membrane Age 3 years
Cleaning Frequency 4 #/yr

ALARMS ALL STOP RESET

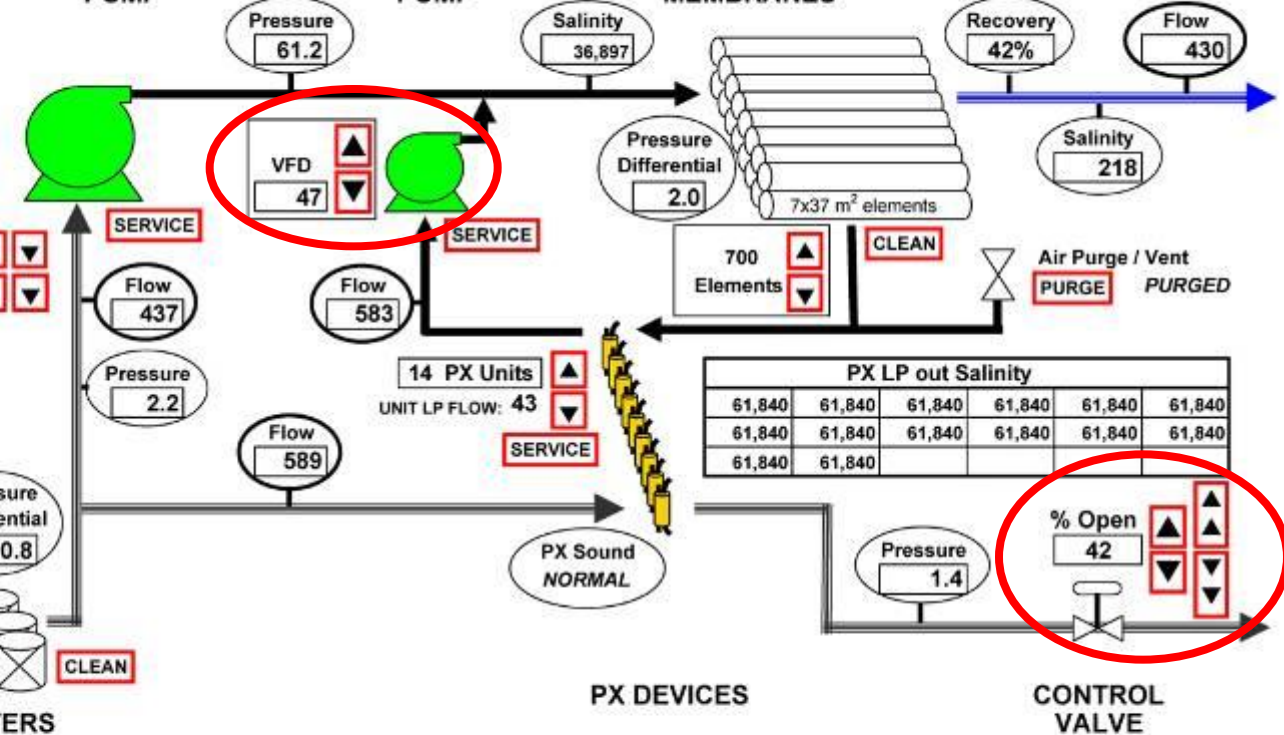
Temp 25
Salinity 36,000



HIGH PRESSURE PUMP

BOOSTER PUMP

SWRO MEMBRANES



PX LP out Salinity

61,840	61,840	61,840	61,840	61,840	61,840
61,840	61,840	61,840	61,840	61,840	61,840
61,840	61,840				

PROCESS UPSET RANDOM reveal

CLOGGED FILTERS BOOSTER MALFUNCTION PX INTERNAL LEAK FOULED MEMBRANES STOP ONE PX

UNITS Flow: cubic meters per hour
Pressure: bar
Salinity: parts per million

Temperature: deg C
VFD units: Hz



IMPLICATIONS

Two, independent and parallel feed flows to the membranes

PX Installation Design: Power Model, P&ID, Mounting Racks

Operations: ERI SIM, Training, Commissioning Assistance



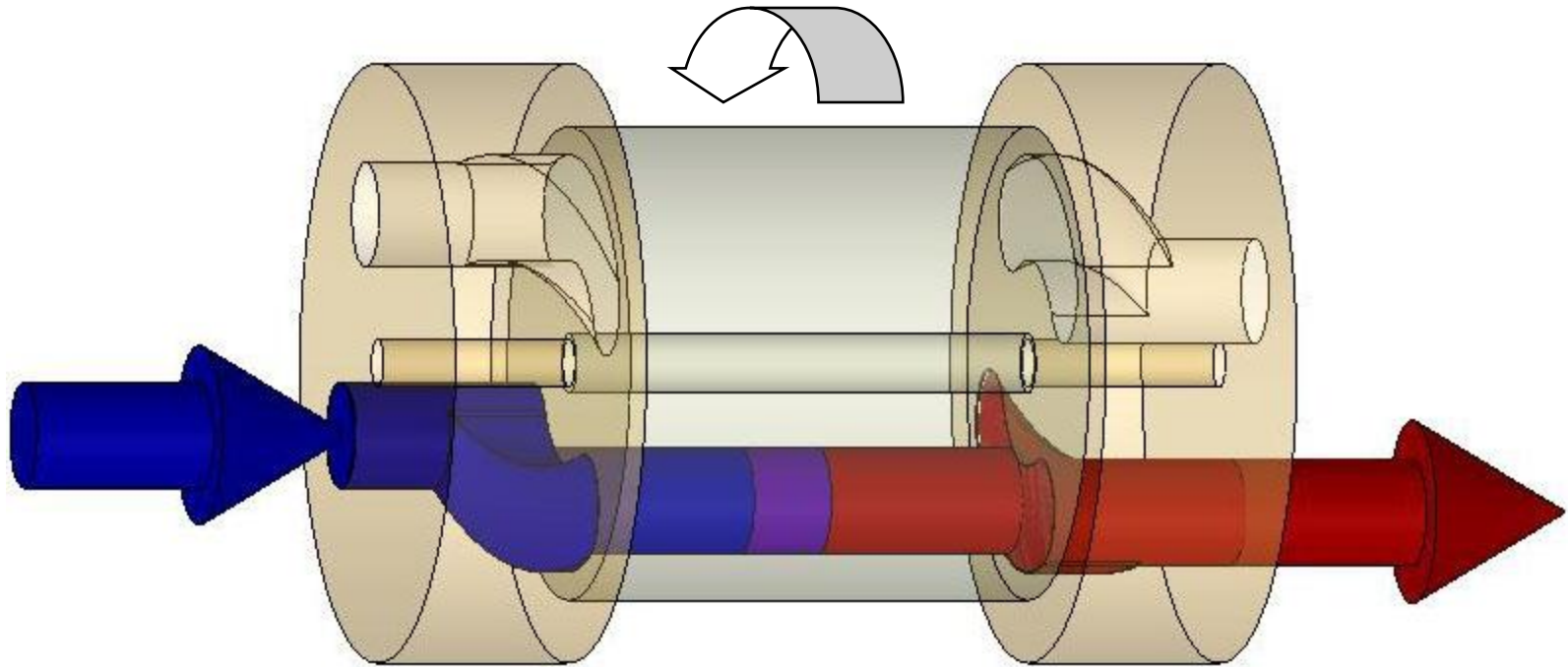


Making Desalination Affordable

Making Desalination Affordable™



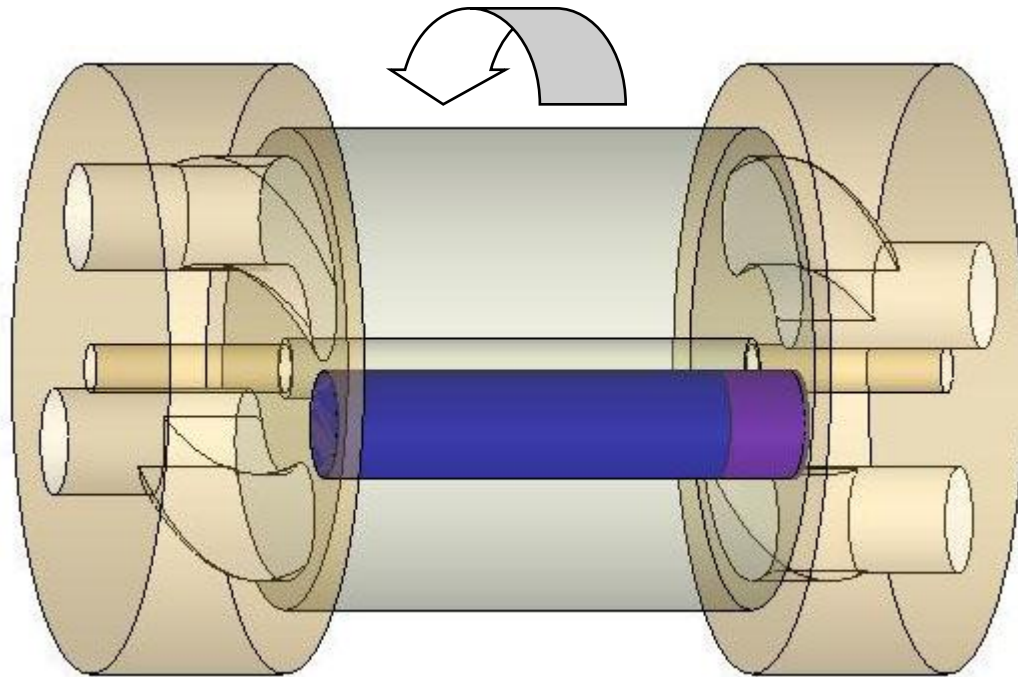
Energy Recovery Systems



1. Low-pressure feed water fills rotor chamber, displacing brine

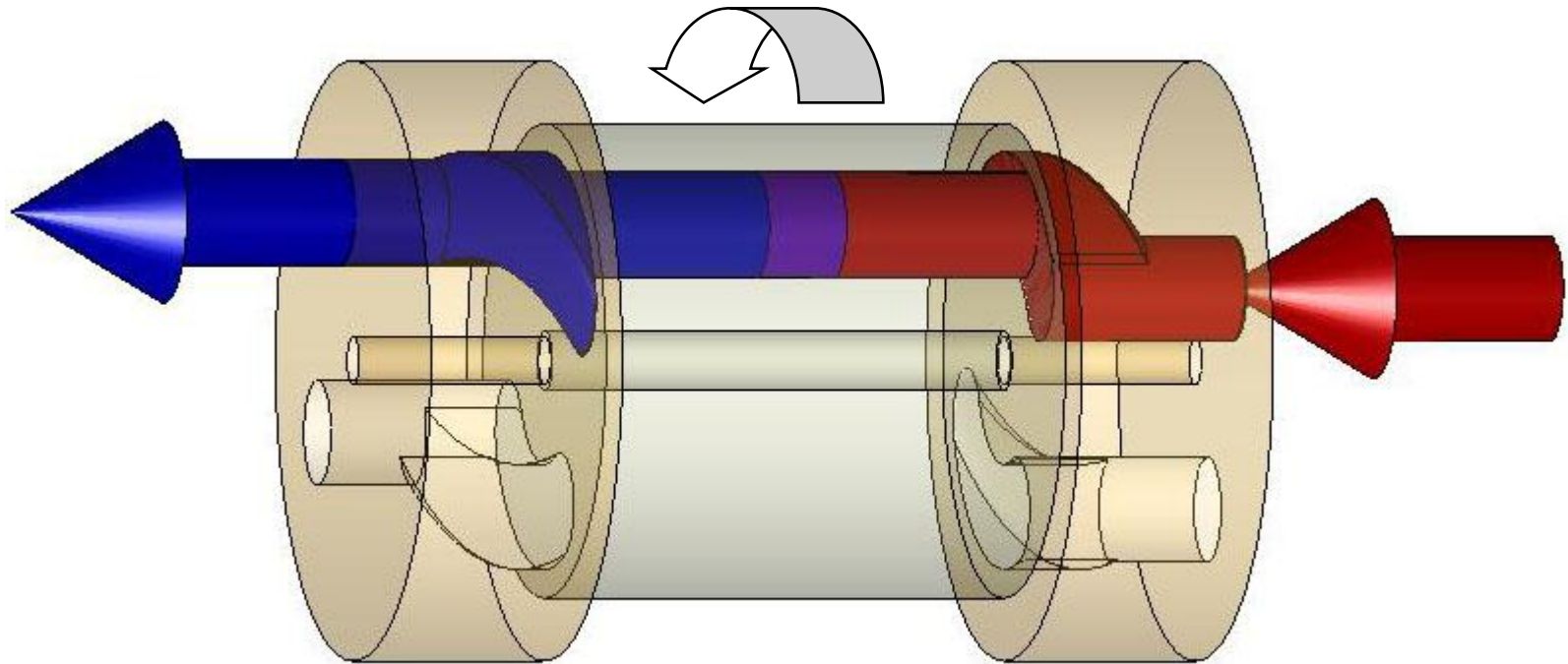


Energy Recovery Systems



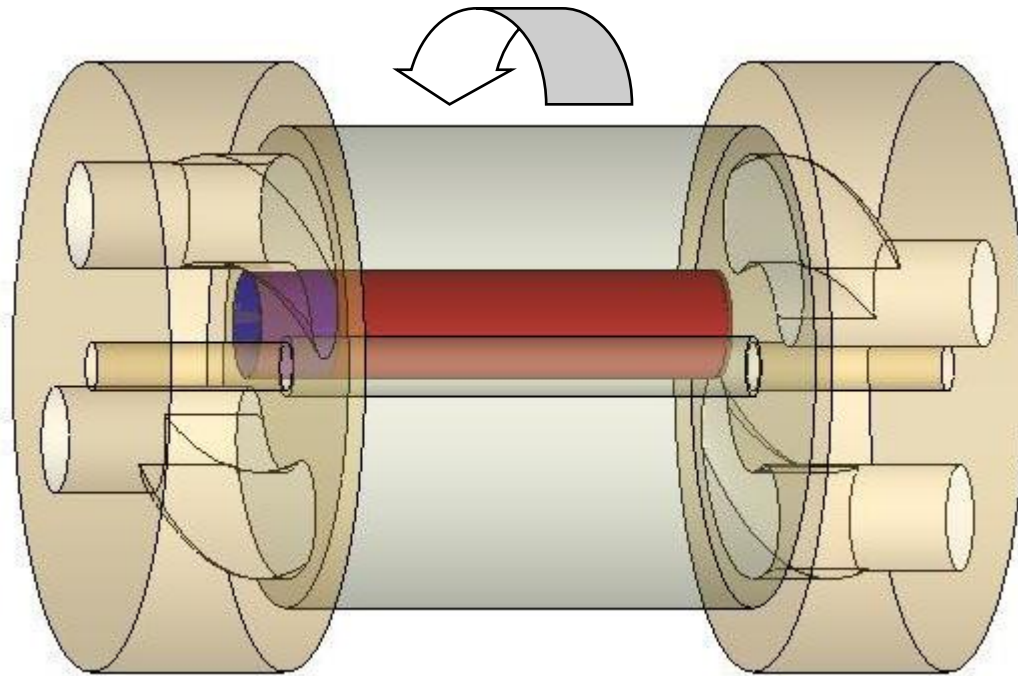
2. Rotor chamber seals, containing low-pressure feedwater

Energy Recovery Systems



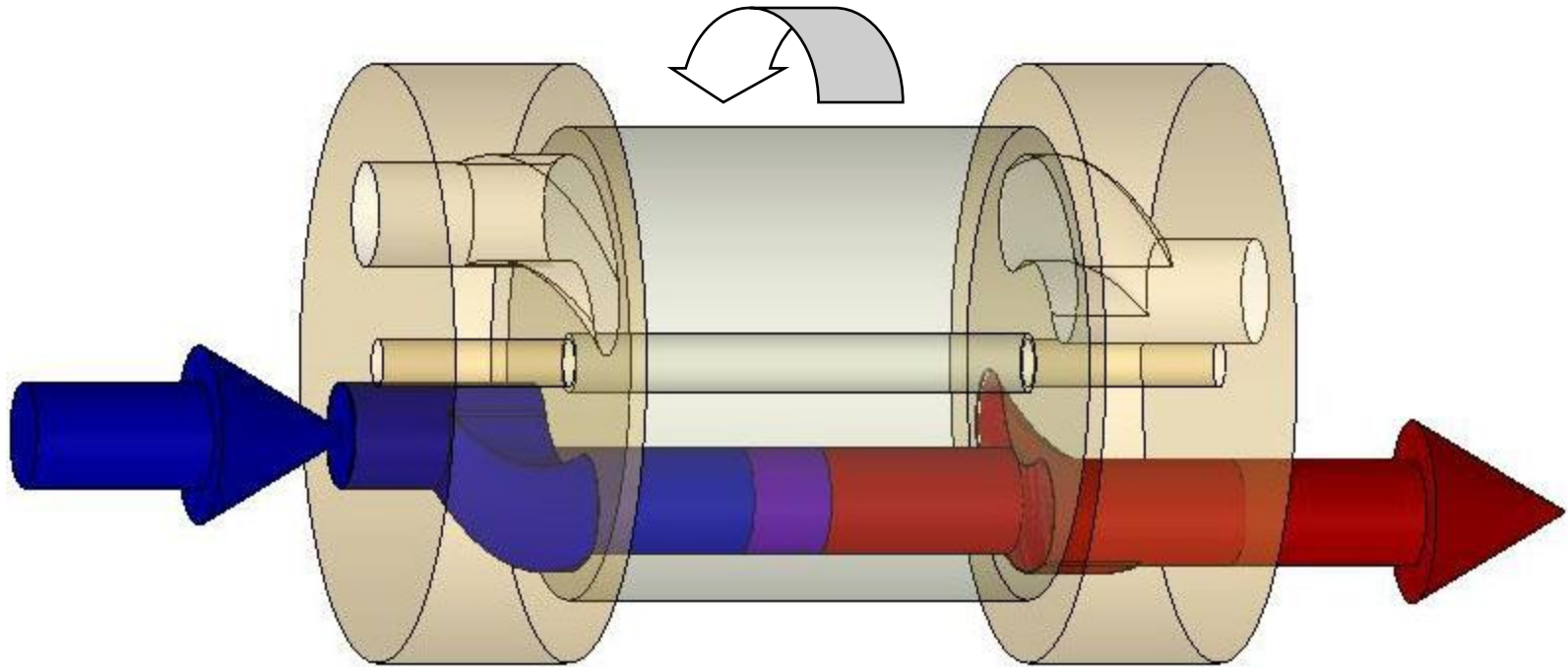
3. High-pressure brine pressurizes and displaces feedwater

Energy Recovery Systems



4. Rotor chamber seals, containing high pressure brine

Energy Recovery Systems



1. Low-pressure feed water fills rotor chamber, displacing brine

