

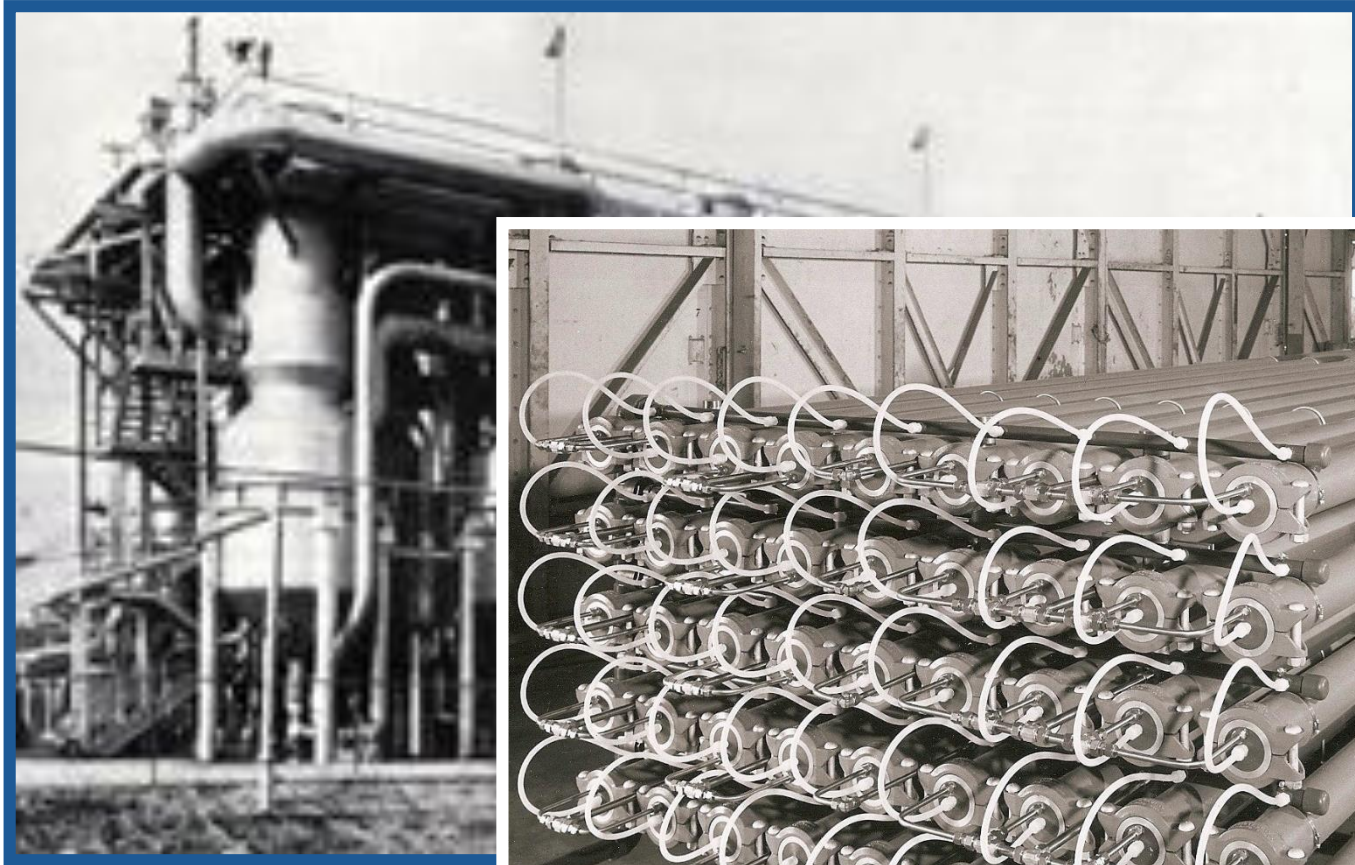
Emerging Technologies: Introduction & Overview

Tom Pankratz, Houston, Texas

Dow Chemical, Freeport – 1961



Texas Instruments, Dallas – 1969



Animal-powered RO



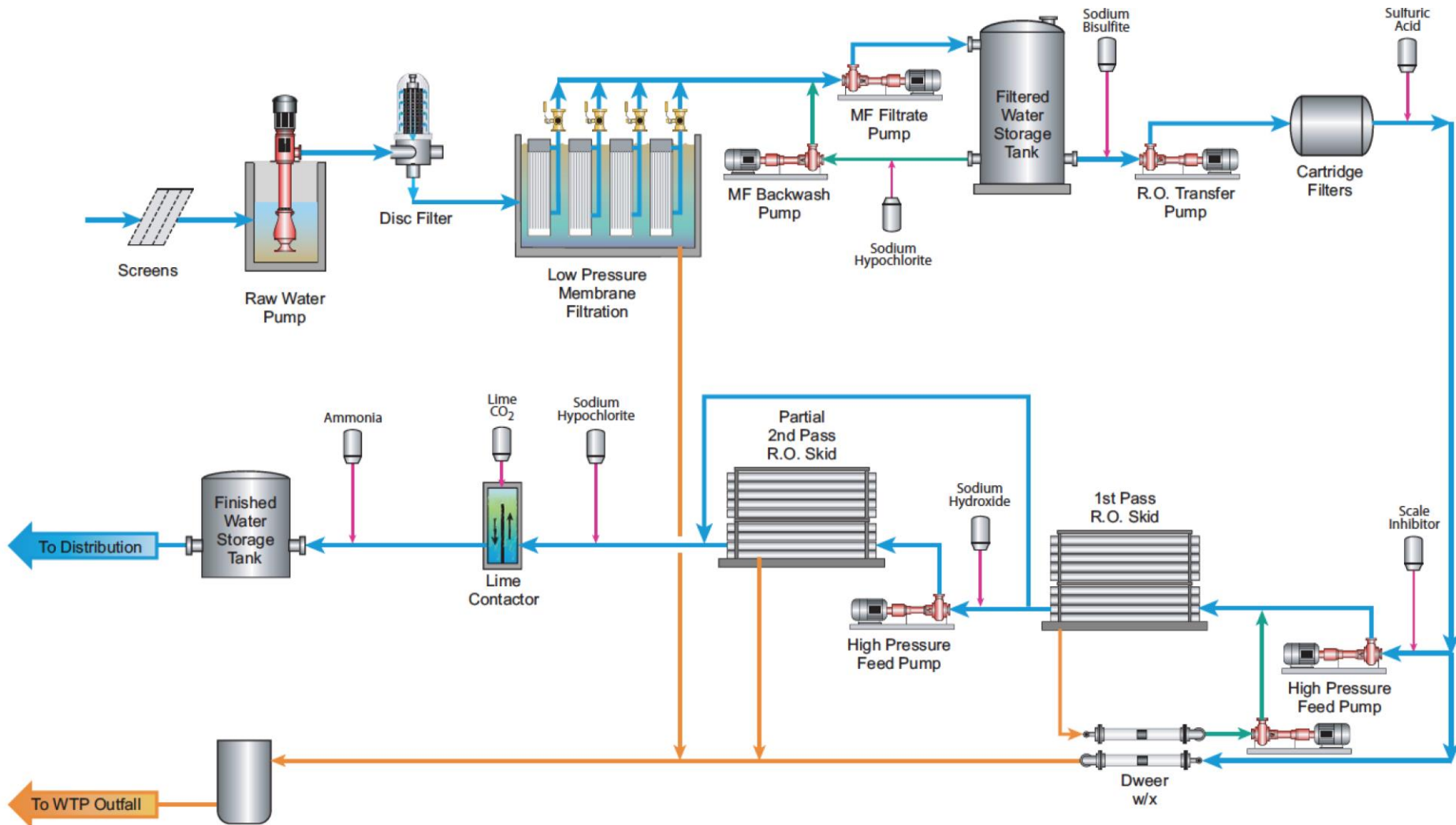
source: India's CSMCRI

Animal-powered RO

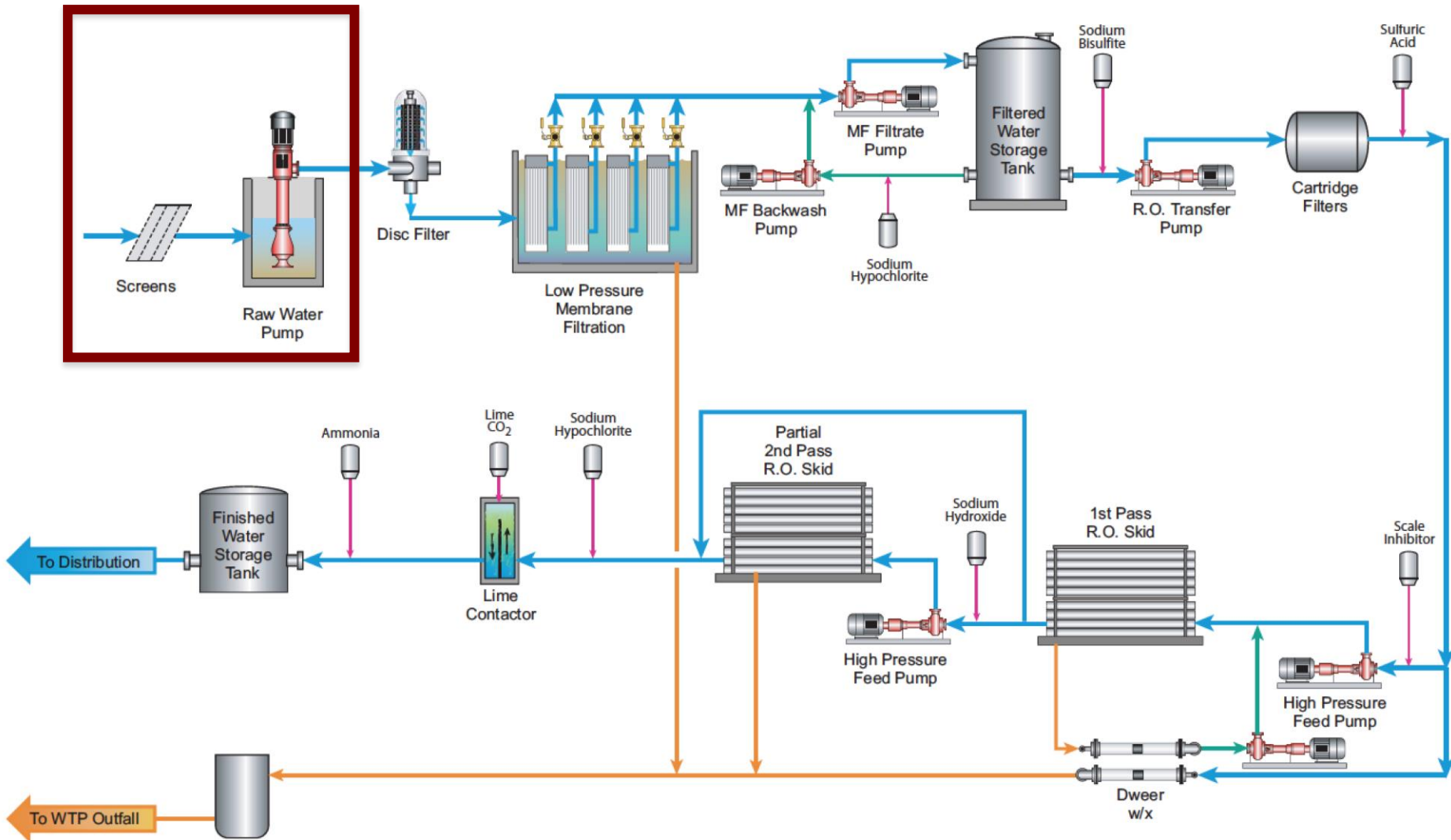


source: India's CSMCRI

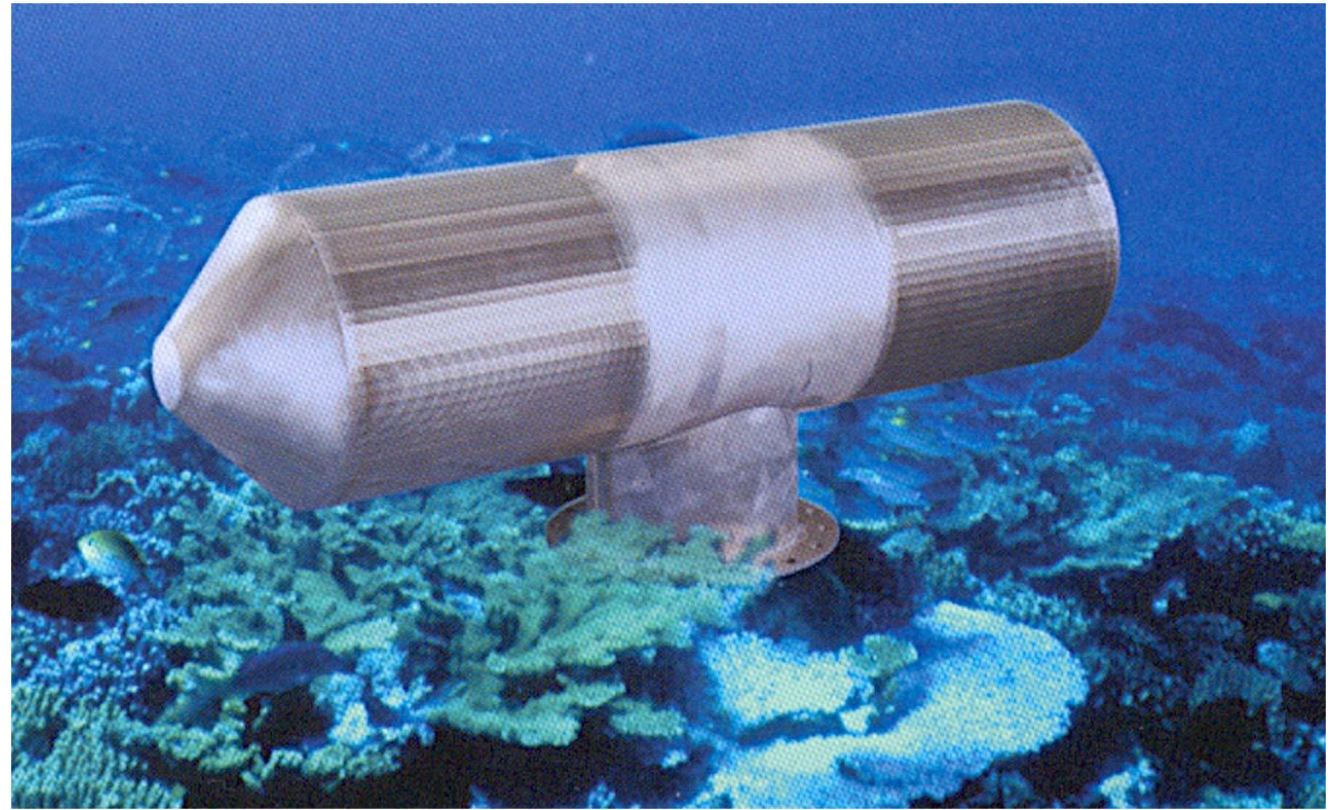
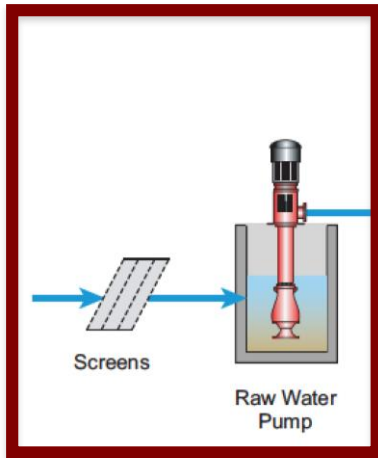
Reverse Osmosis (RO) Desalination



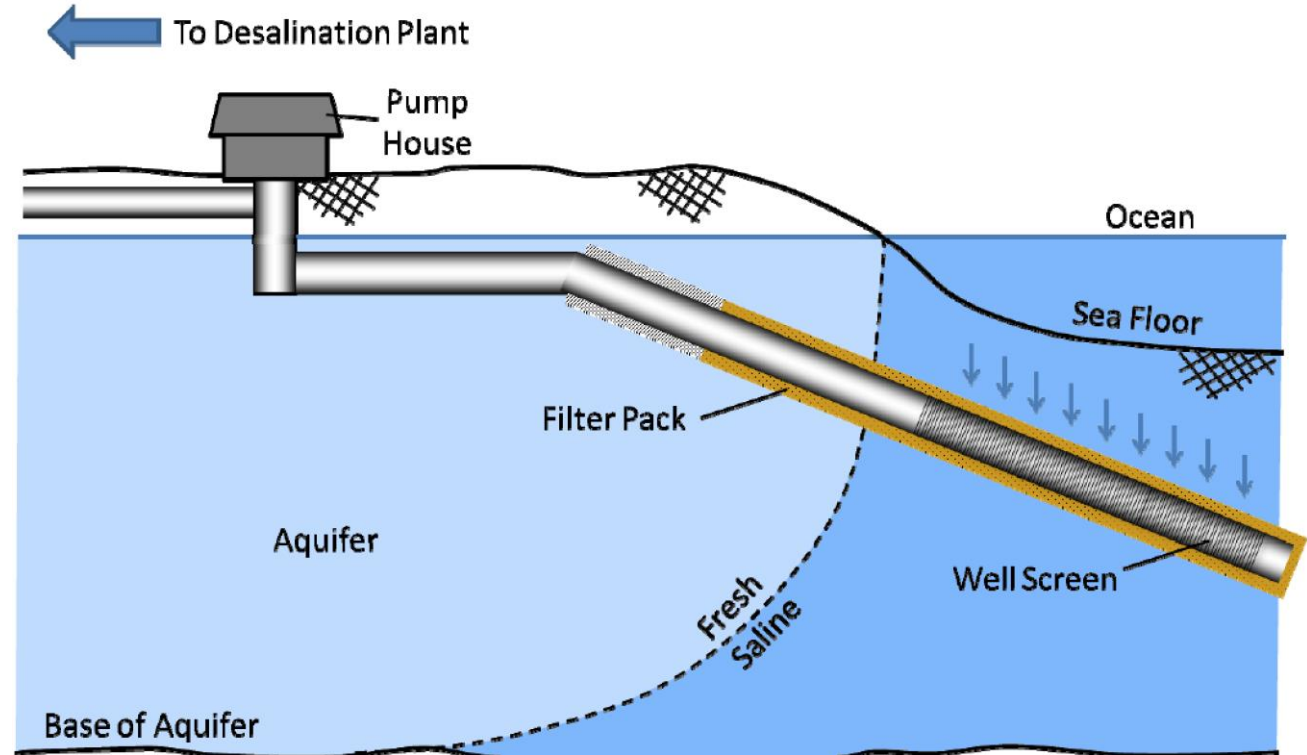
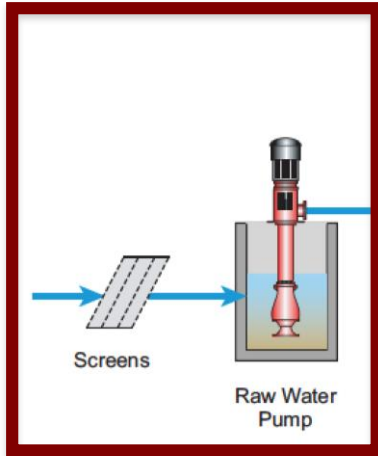
Raw Water Intake



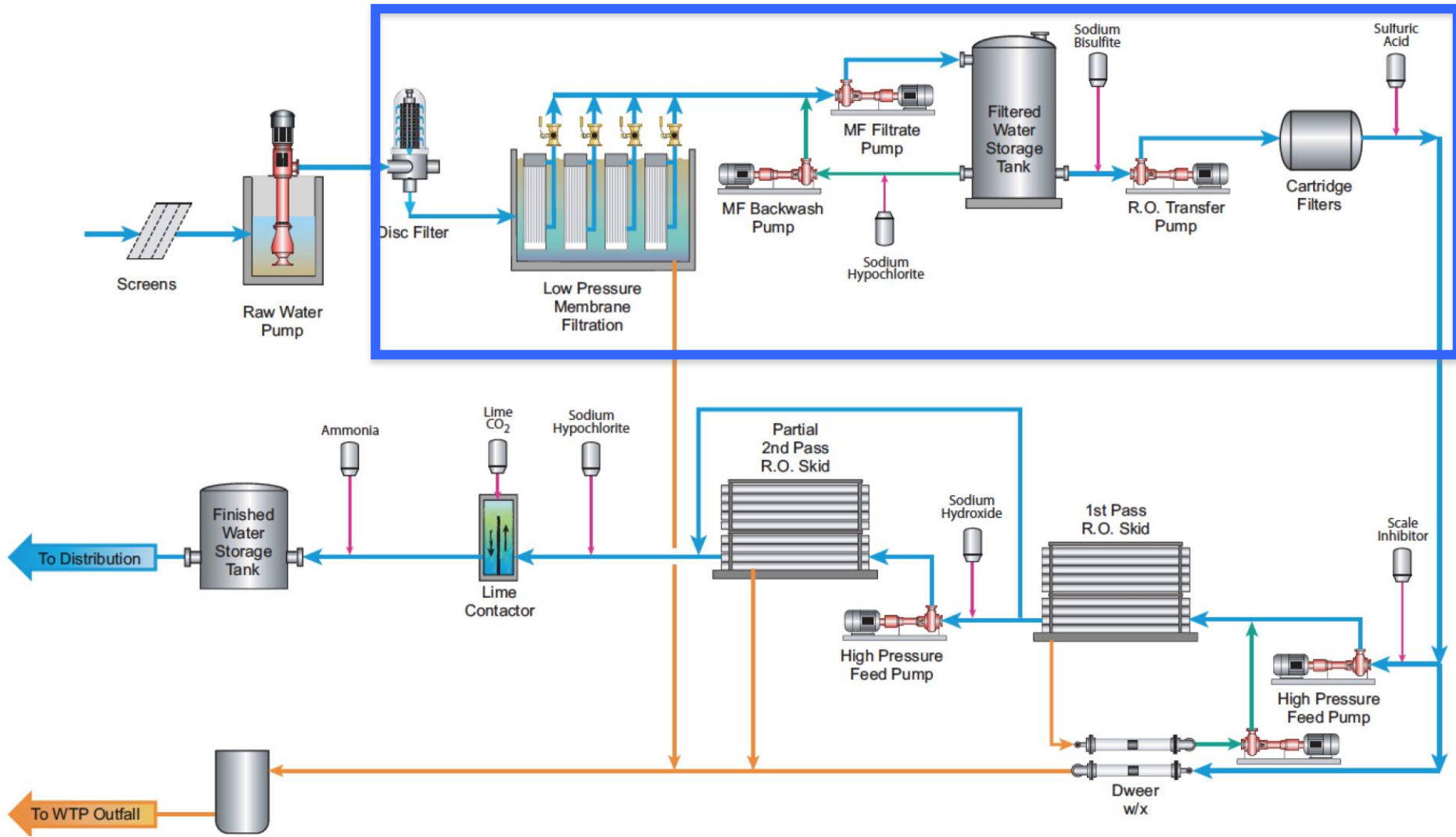
Passive Screens mitigate I&E



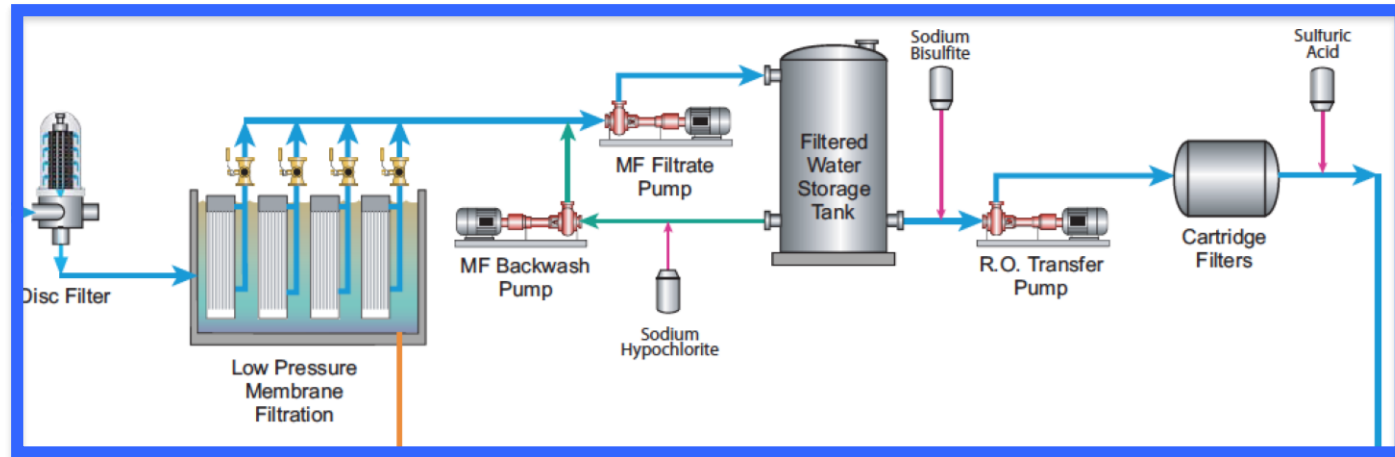
Sub-seabed Intakes eliminate I&E



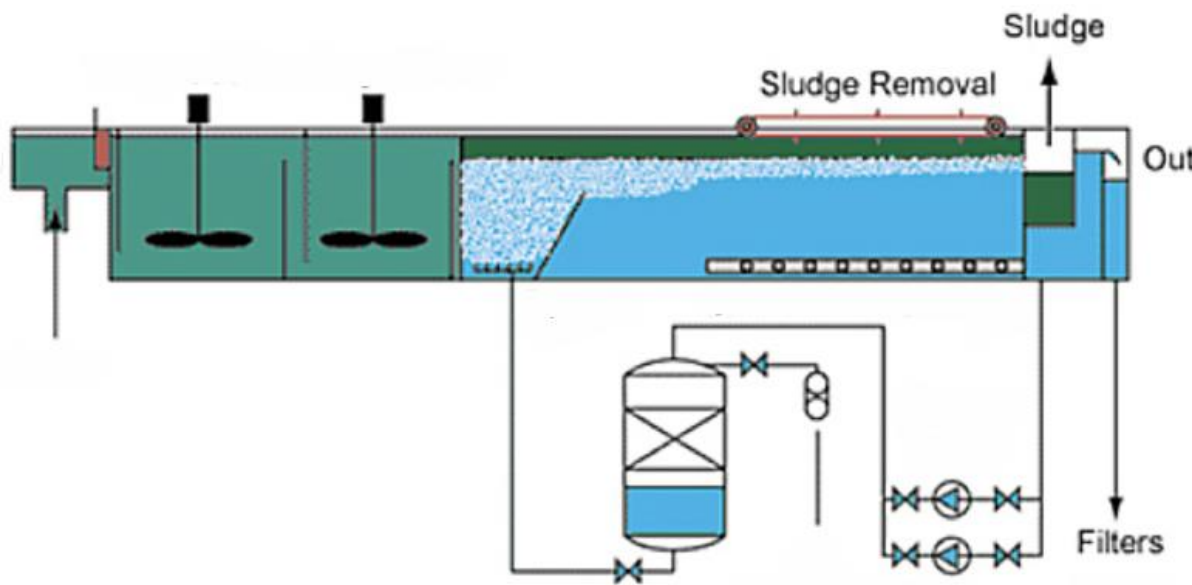
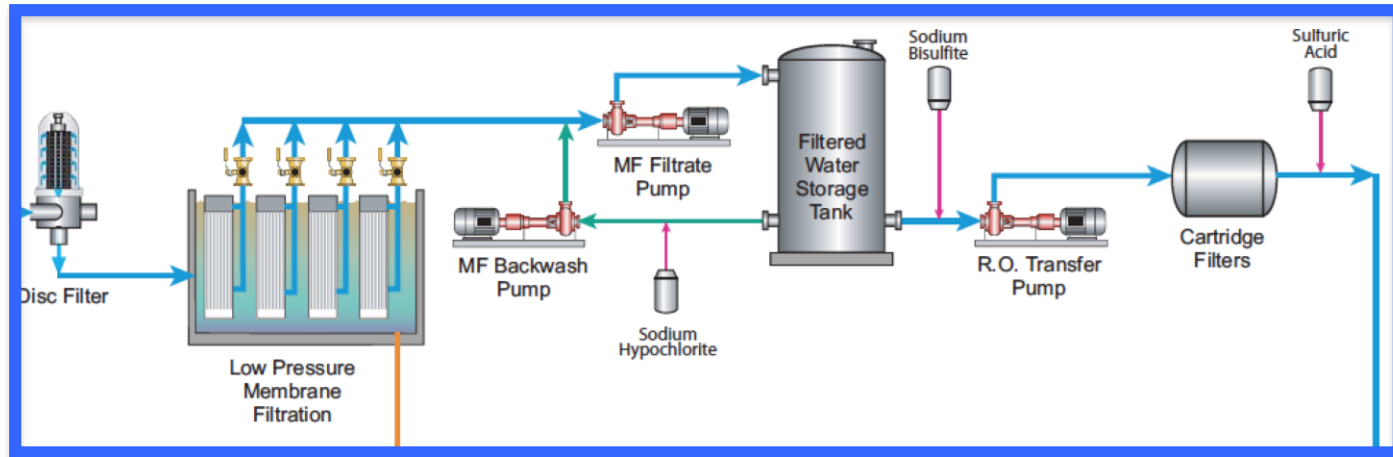
RO Pretreatment



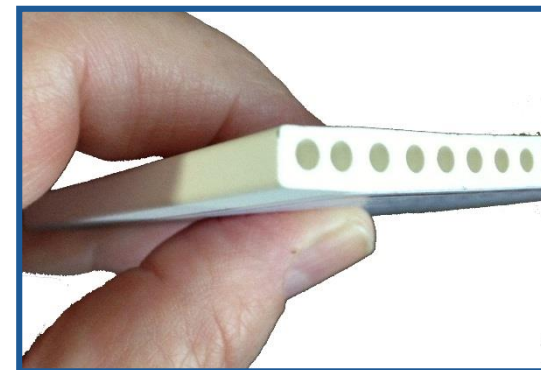
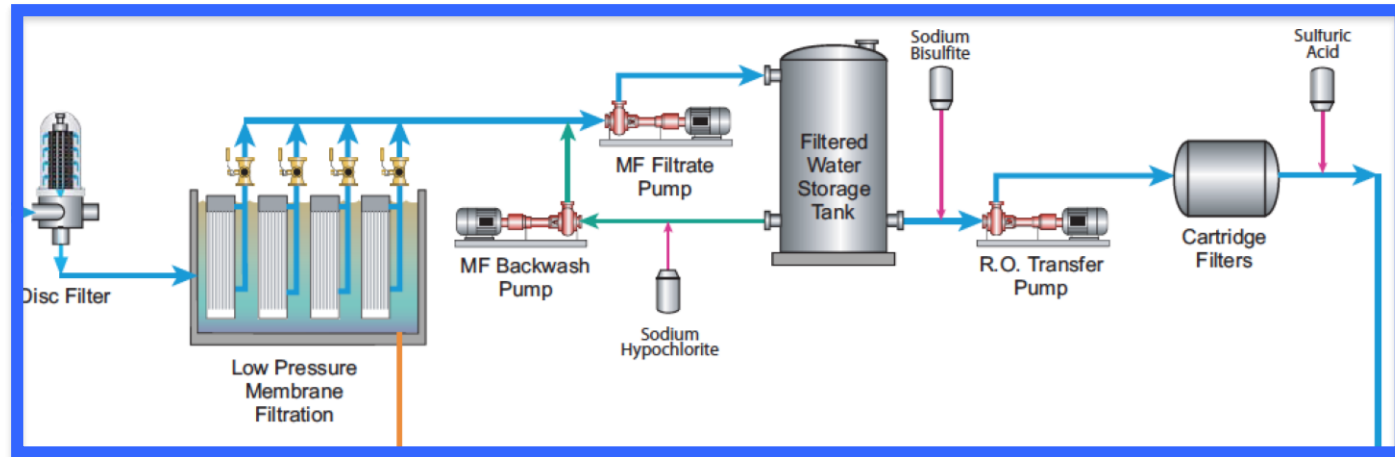
Pretreatment



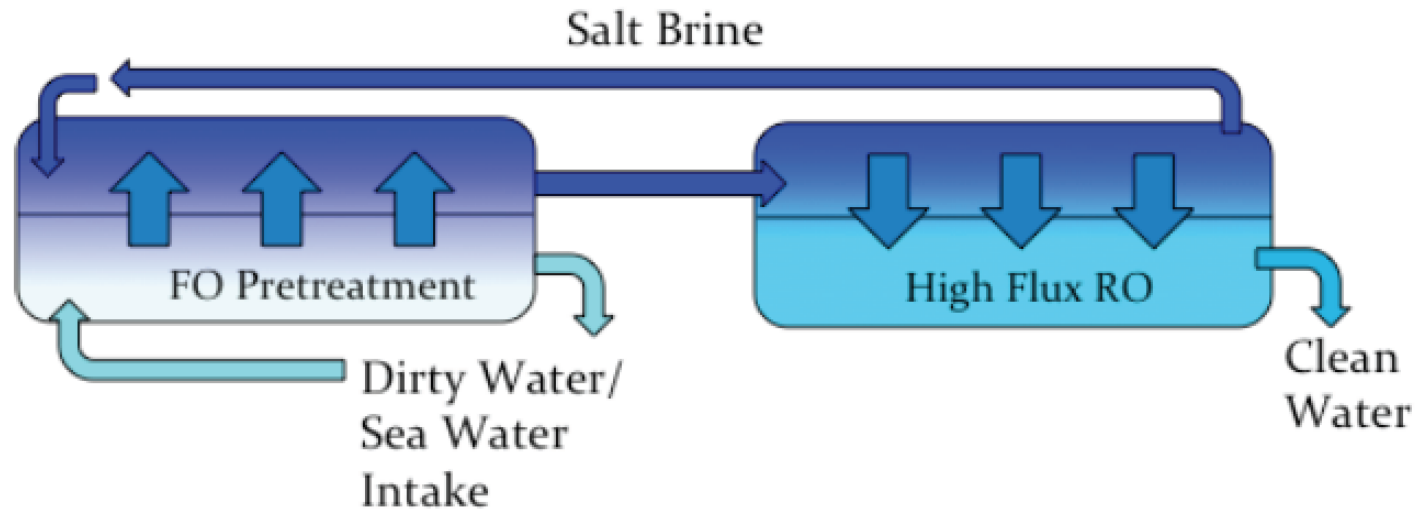
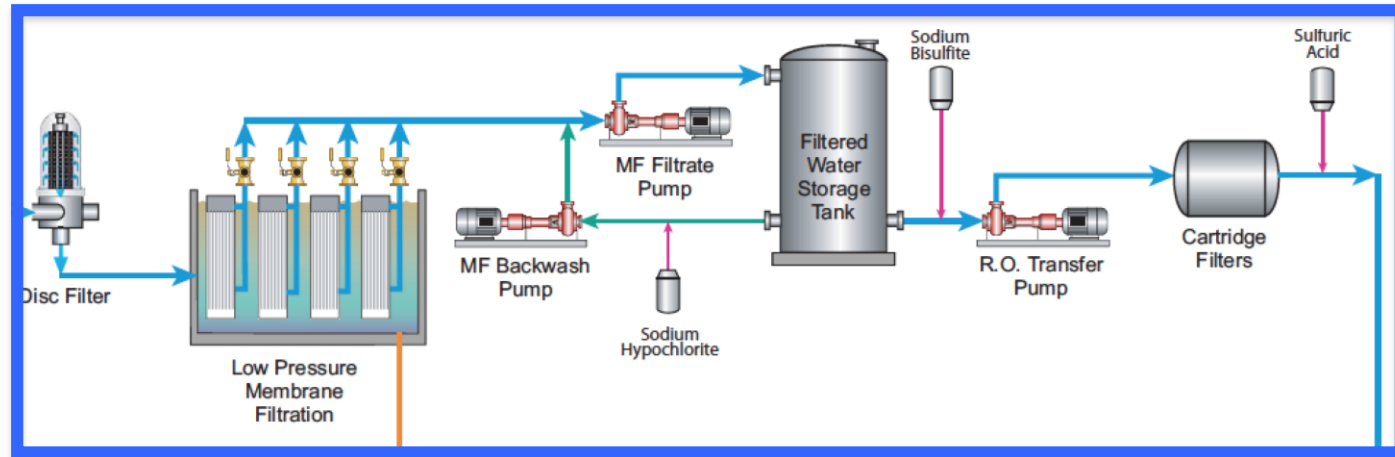
Dissolved Air Flotation (DAF) + UF



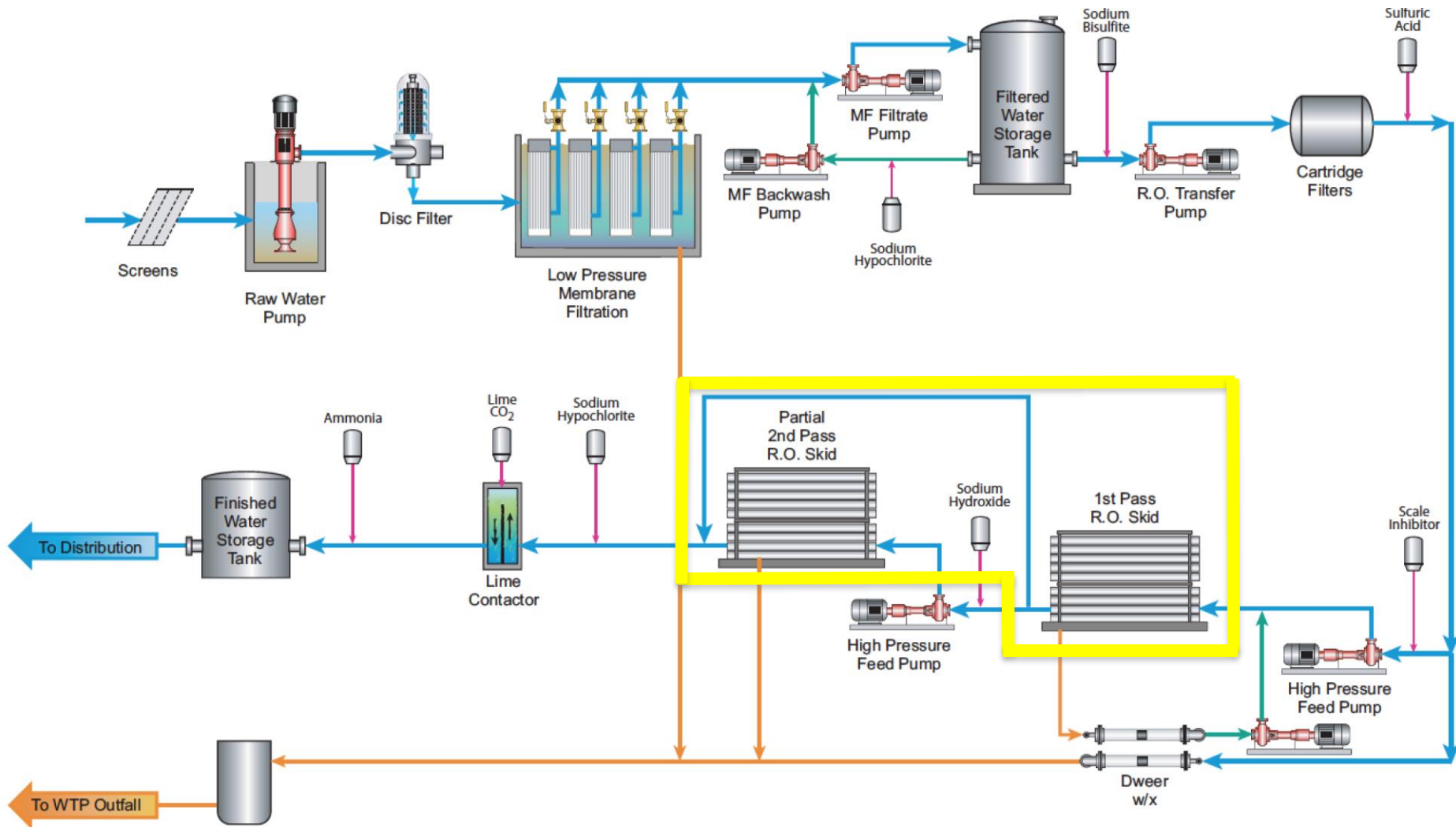
Ceramic UF Membranes



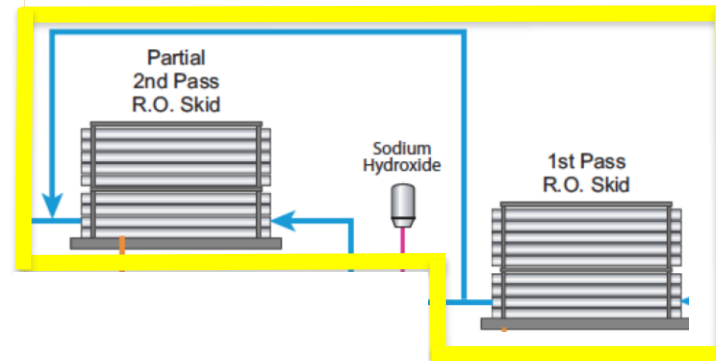
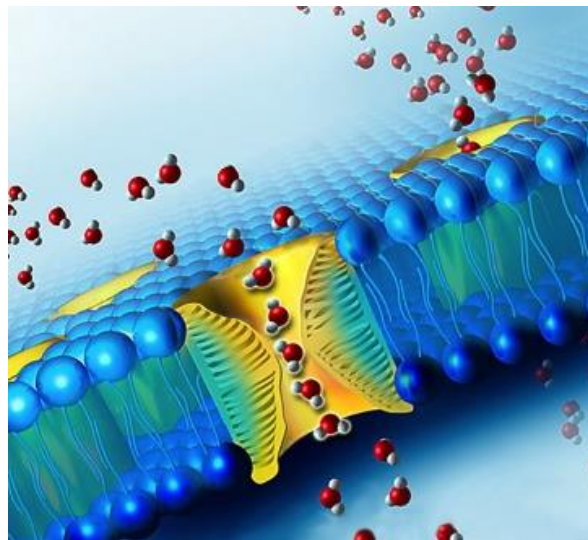
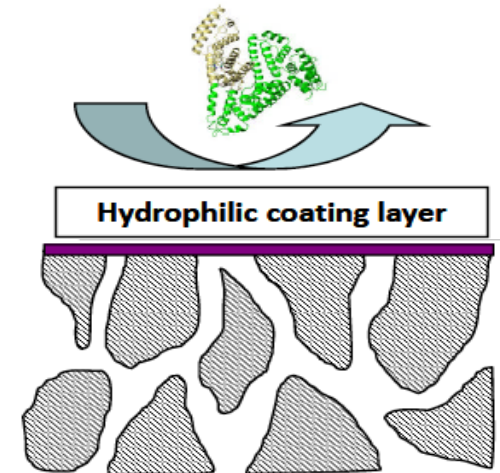
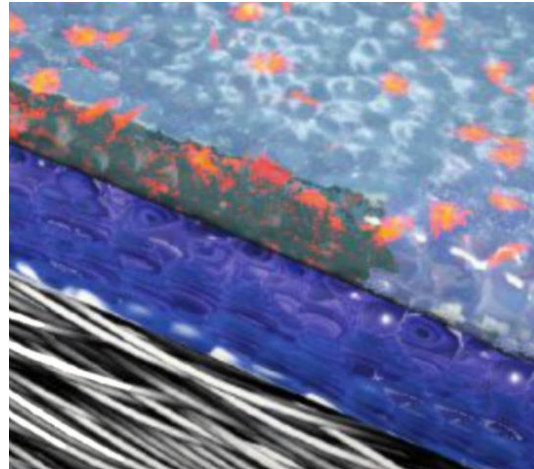
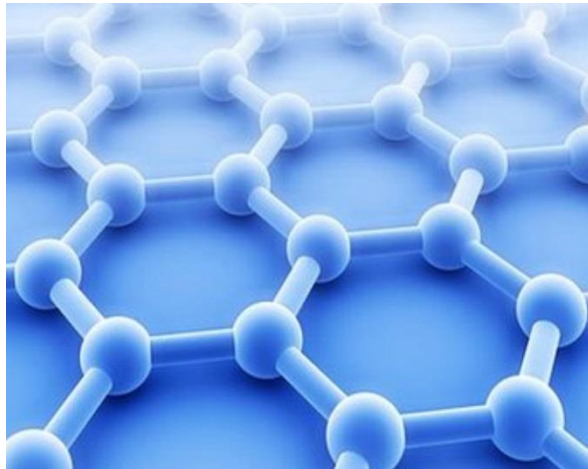
Forward Osmosis (FO) Pretreatment



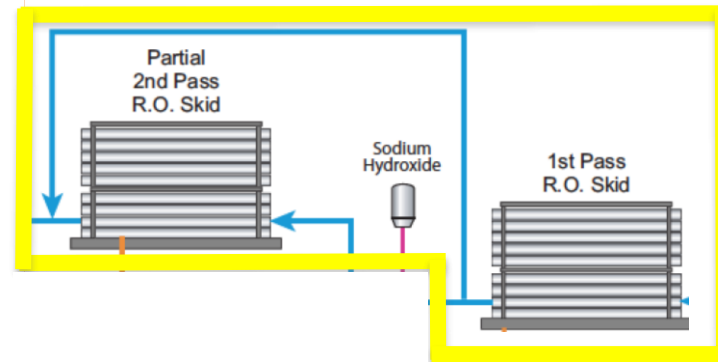
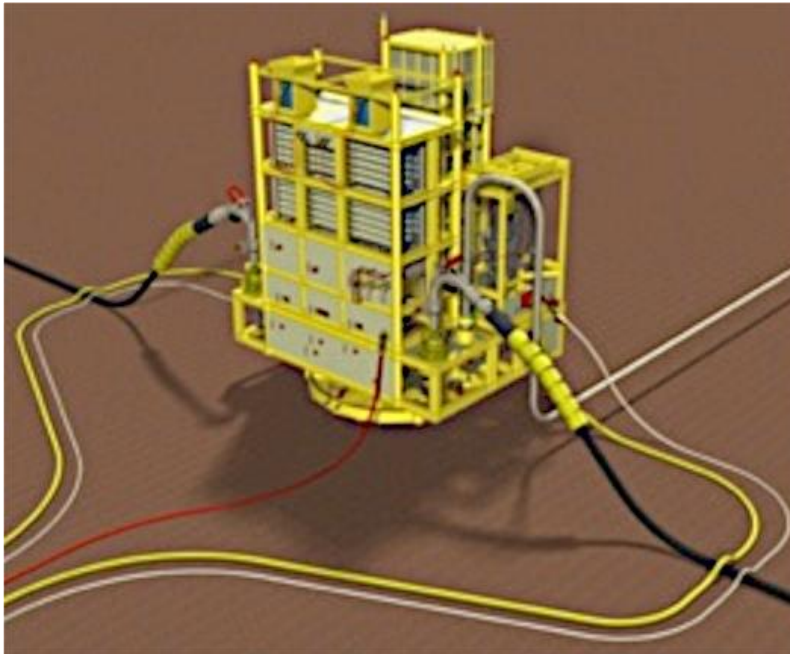
RO Membranes



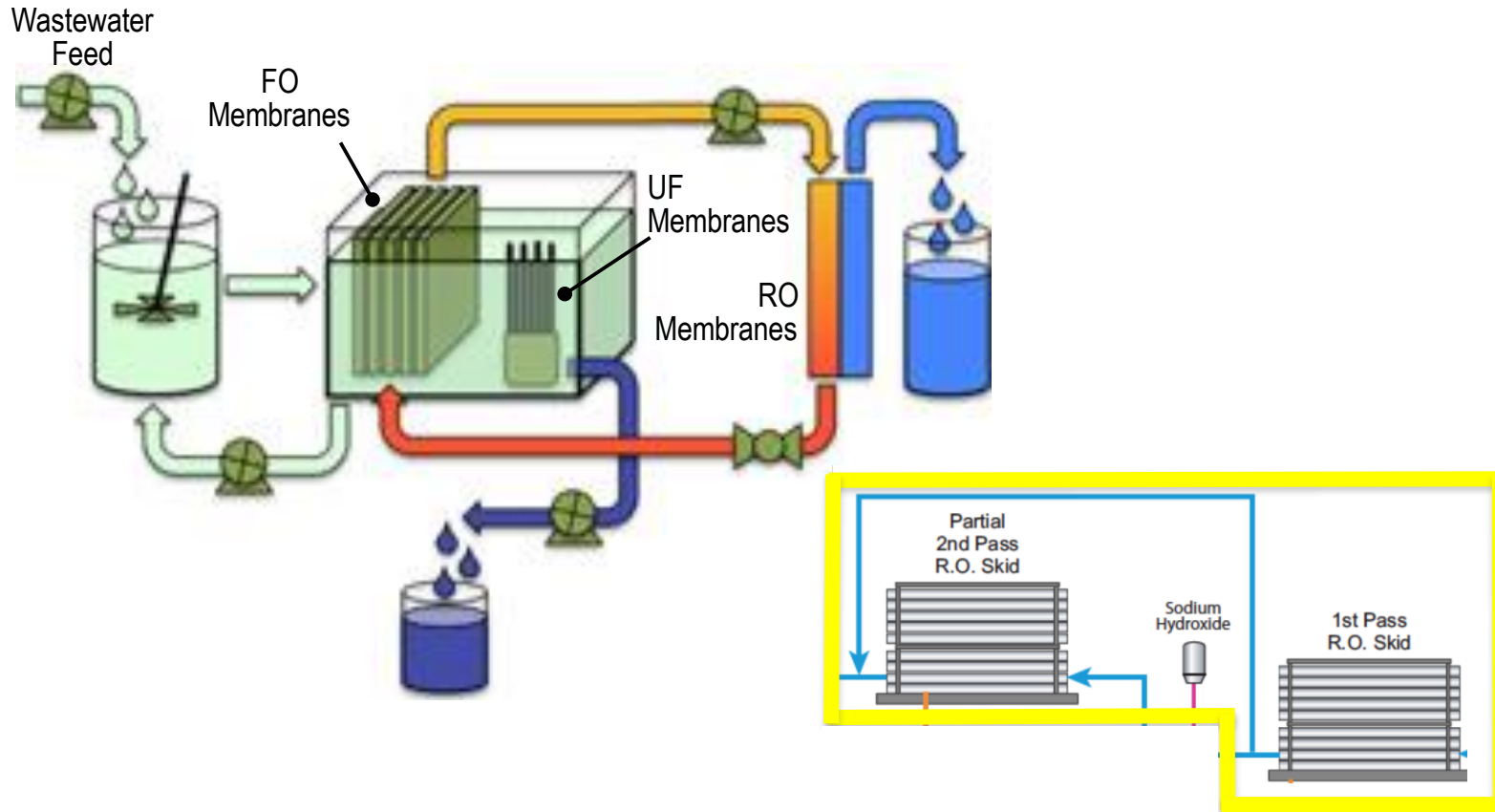
RO Membranes & Coatings



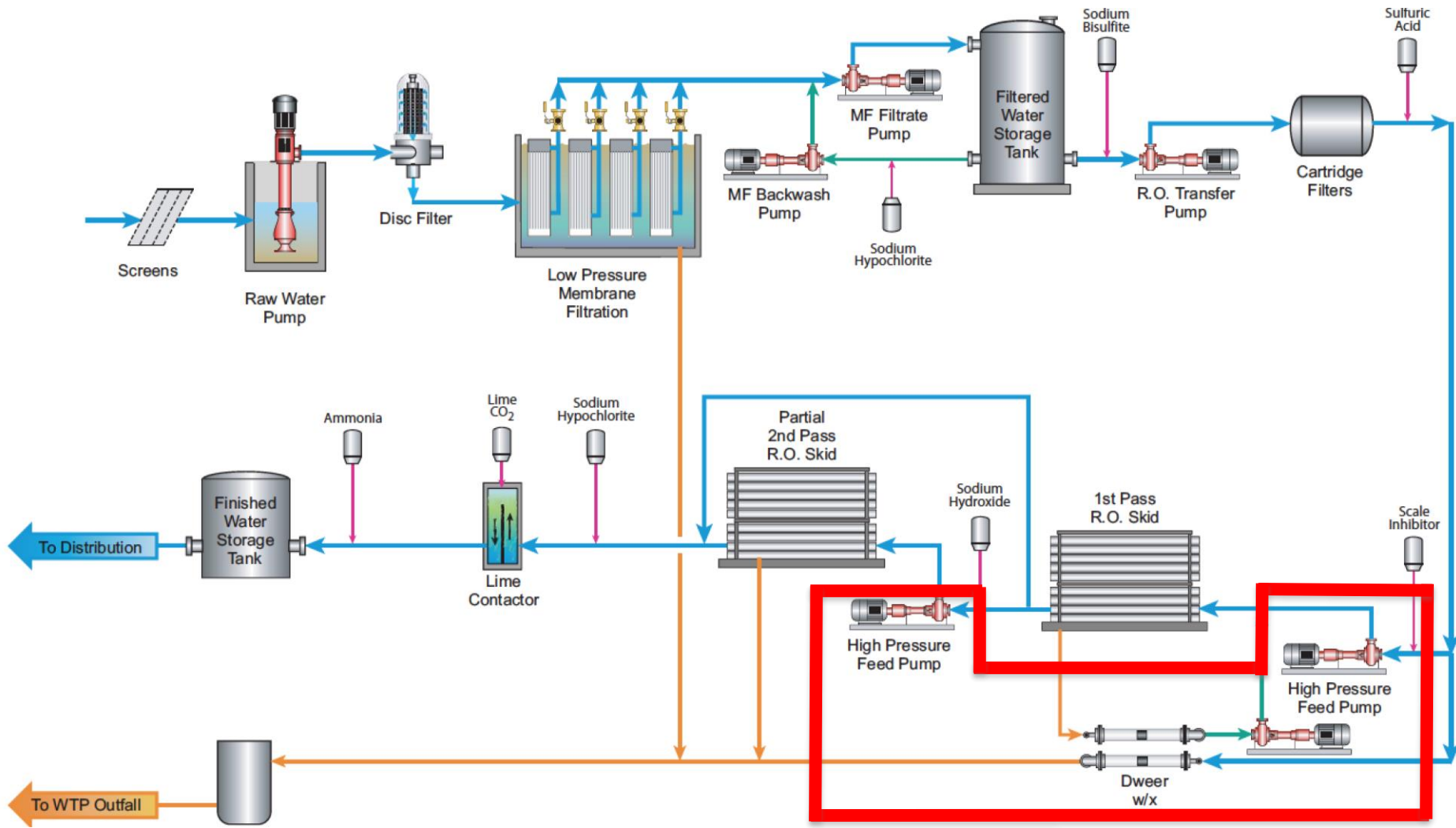
Subsea Desal System



MBR Hybrid with UF/FO/RO

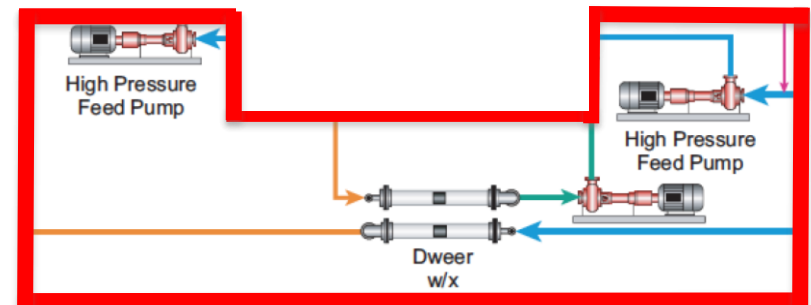
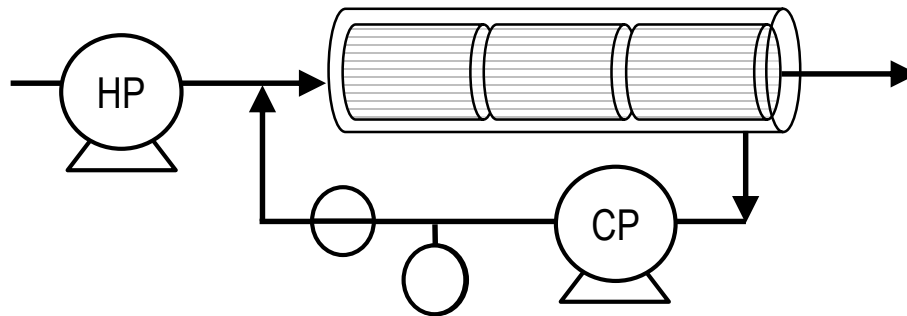


HP Pump & Energy Recovery

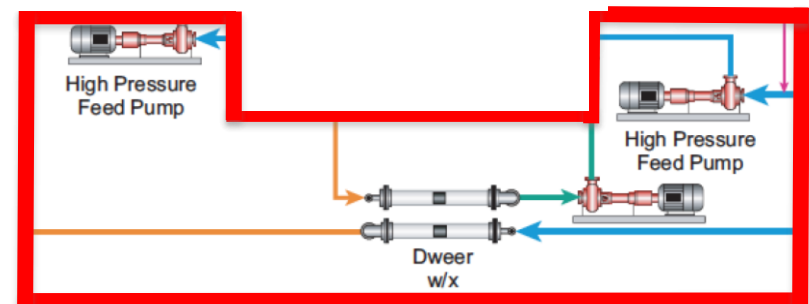
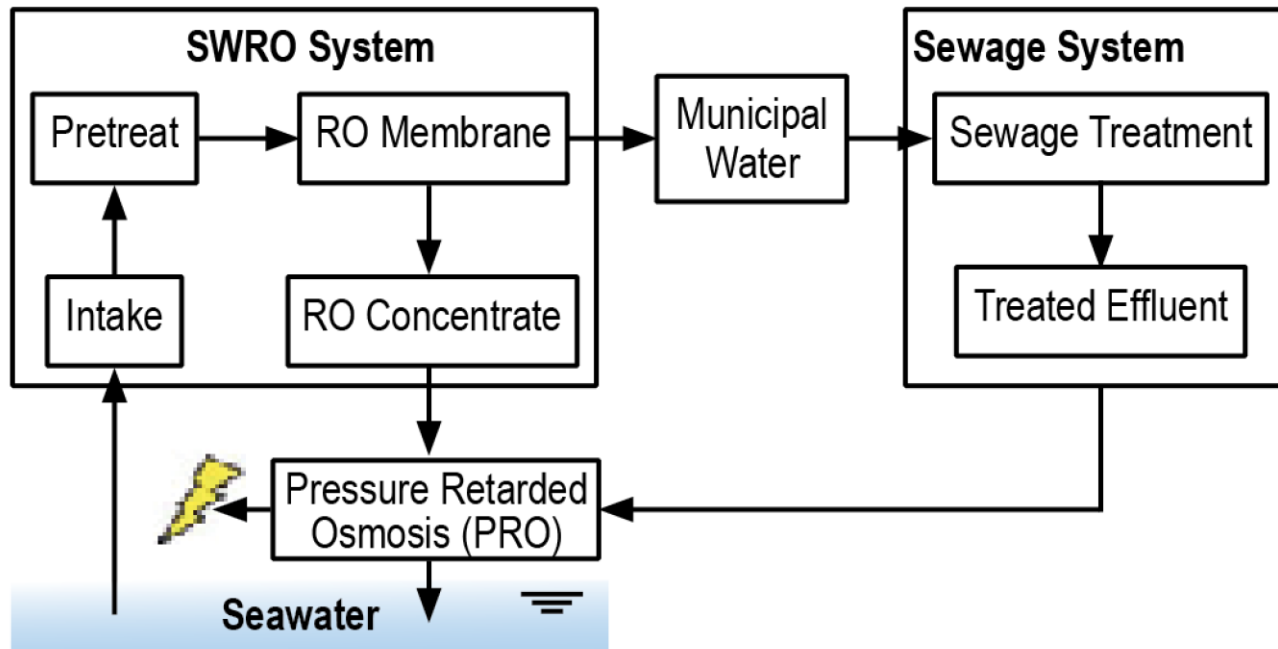


Semi-batch Process

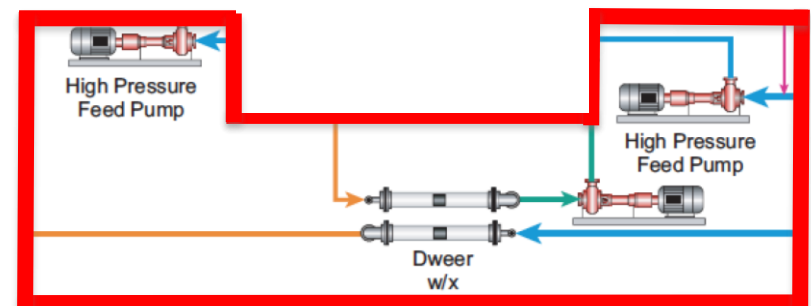
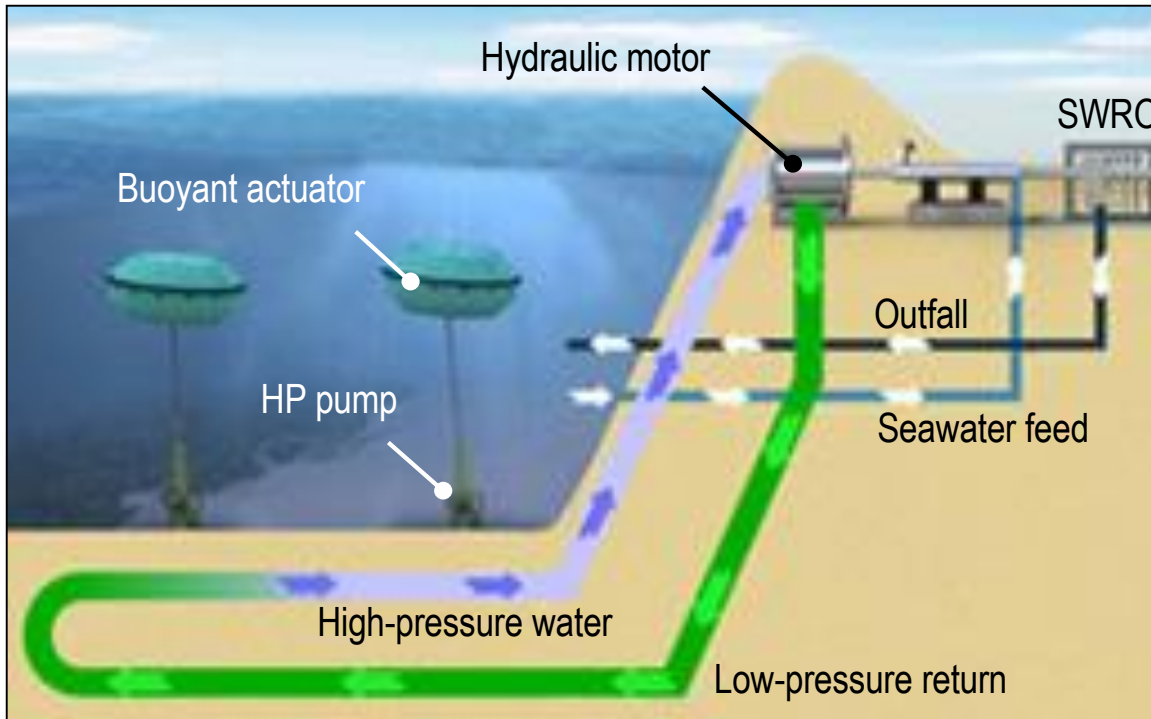
Closed Circuit Desalination



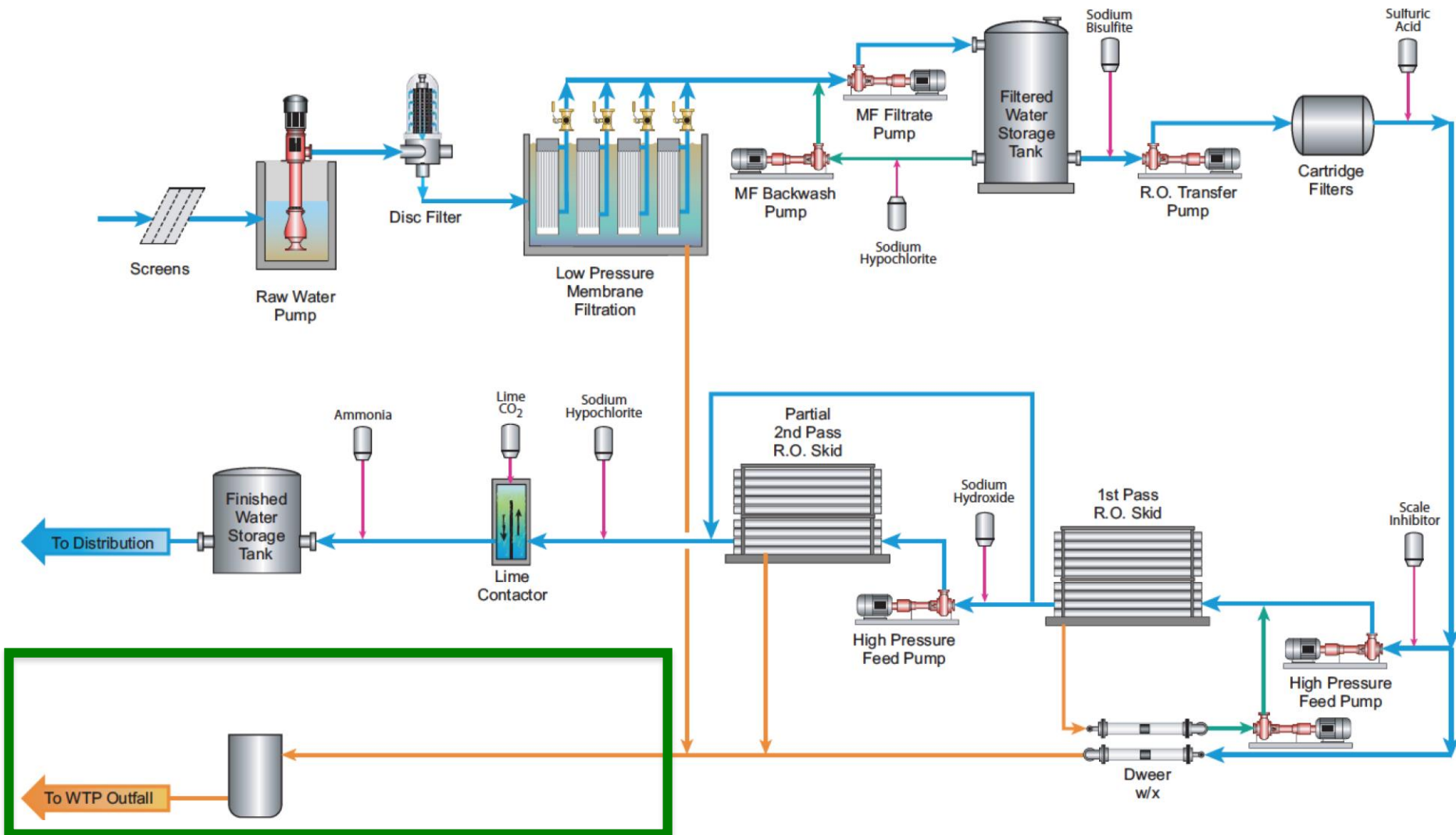
SWRO-Pressure Retarded Osmosis



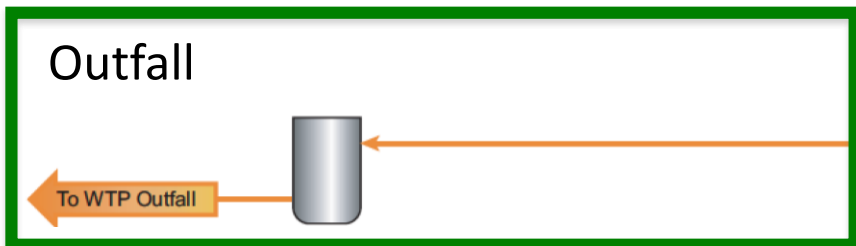
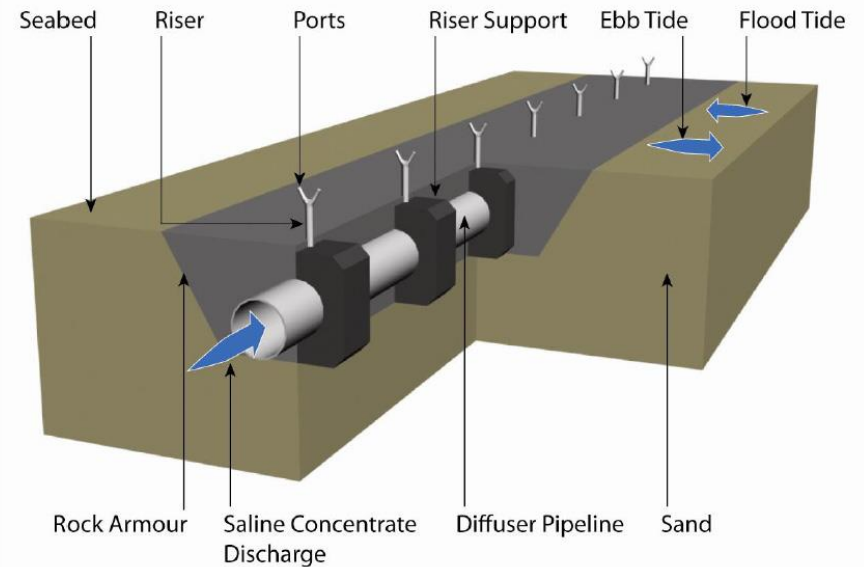
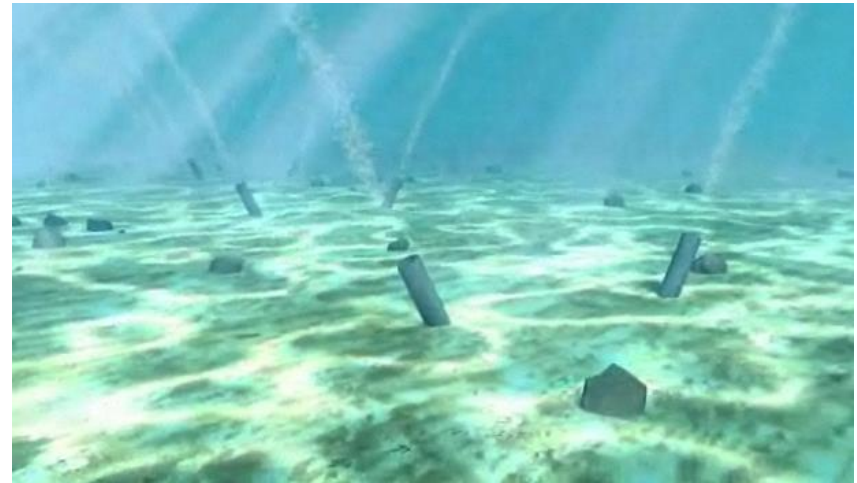
Renewable Energy



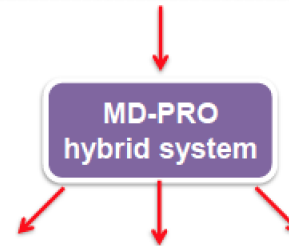
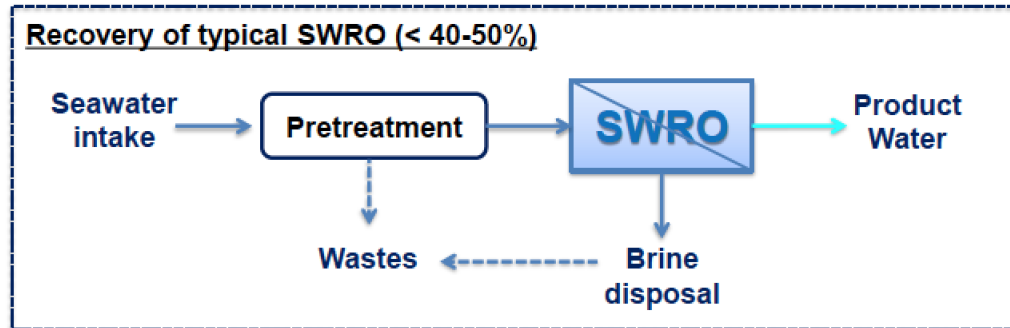
Concentrate Discharge



Diffused Discharge



Materials Recovery



30% increase
of product
water

5.0 W/m²
of membrane

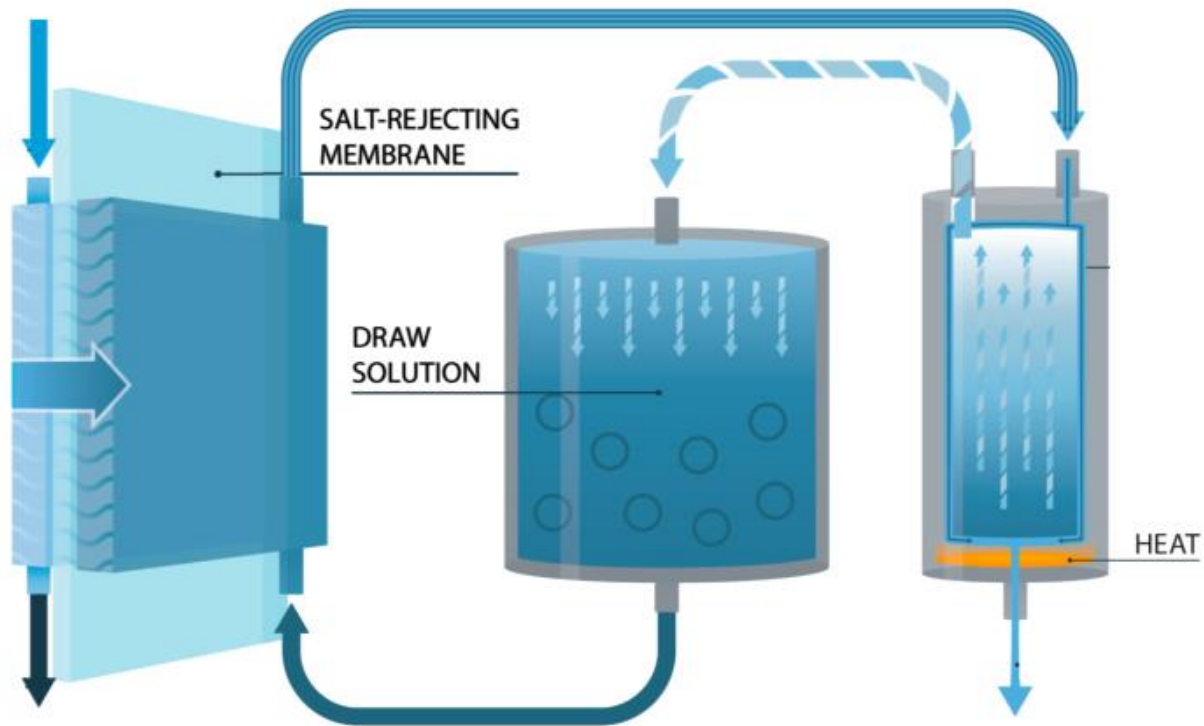
0.3 USD/ton
of wastes

Outfall

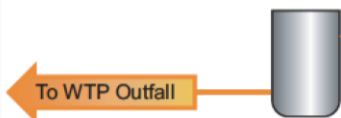


To WTP Outfall

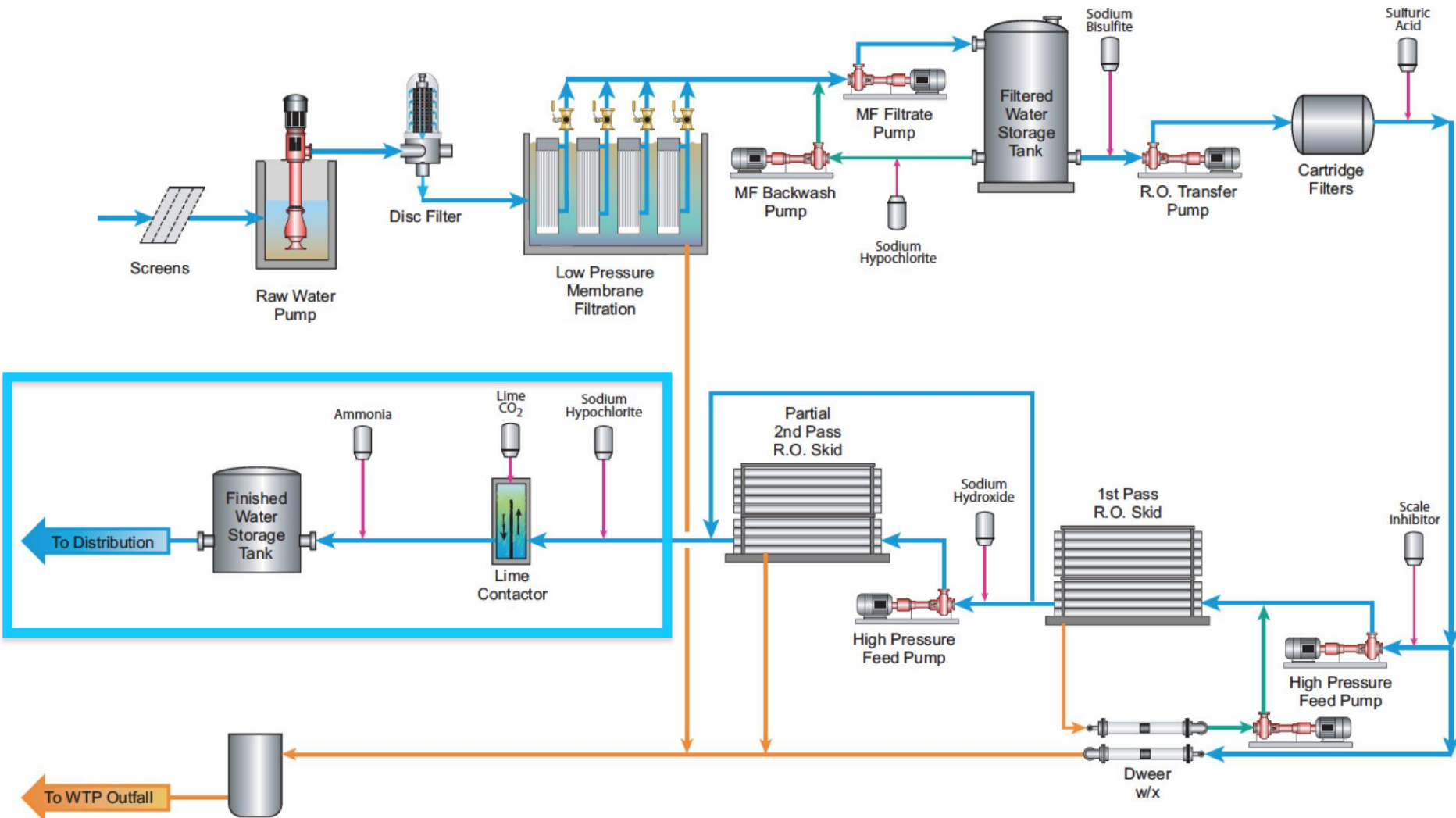
FO Brine Concentration



Outfall



Post-treatment & Distribution



54 years later, there's still work to do

