GLOBAL INDUSTRIAL WATER
SEAWATER TREATMENT SYSTEMS

Water Injectivity Test

Project Value <US$3,000,000
GLOBAL INDUSTRIAL WATER

Design Basis:
Location: Jacked up Barge
Duration of Pilot Test: 3-6 months
Plant Capacity: 4000 BWPD of Treated Water
Mode of Operation: Continuous
Max Allowable Downtime: 6 days in 180 days of Operation
GLOBAL INDUSTRIAL WATER

Feed Water Specifications:

<table>
<thead>
<tr>
<th>Ion</th>
<th>mg/l</th>
<th>ppm CaCO₃</th>
<th>meq/l</th>
<th>Total Conc. (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium (NH₄⁺ + NH₃)</td>
<td>0</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>0</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>13800</td>
<td>30230.540</td>
<td>604.611</td>
<td>13800.00</td>
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<tr>
<td>Magnesium (Mg)</td>
<td>1615</td>
<td>6642.810</td>
<td>132.856</td>
<td>1615.00</td>
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<td>Calcium (Ca)</td>
<td>520</td>
<td>1297.405</td>
<td>25.948</td>
<td>520.00</td>
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<tr>
<td>Strontium (Sr)</td>
<td>0</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Barium (Ba)</td>
<td>0</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Carbonate (CO₃⁻)</td>
<td>76.817</td>
<td>128.009</td>
<td>2.560</td>
<td>76.82</td>
</tr>
<tr>
<td>Bicarbonate (HCO₃⁻)</td>
<td>164</td>
<td>134.415</td>
<td>2.588</td>
<td>164.00</td>
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<tr>
<td>Nitrate (NO₃⁻)</td>
<td>0</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Chloride (Cl⁻)</td>
<td>24400</td>
<td>34411.760</td>
<td>688.236</td>
<td>24400.00</td>
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<td>Fluoride (F⁻)</td>
<td>0</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Sulfate (SO₄²⁻)</td>
<td>3348</td>
<td>3484.375</td>
<td>68.608</td>
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<td>Silica (SiO₂)</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
<td>0.000</td>
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<tr>
<td>Boron (B)</td>
<td>0</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
</tbody>
</table>

System Temp: 25.0 °C, System pH: 8.50

Note: Any changes in raw feedwater composition will affect scaling calculations. Please review scaling calculations.
GLOBAL INDUSTRIAL WATER

Product Water Specifications

Particle Size: 0.5 microns(<250 particles per ml > 0.5 microns in diameter)

Oxygen Content: < 10 ppb (GIW Deoxygenation System)

Injection Pressure: 2500 psig
Process Flow Diagram
SEAWATER PRETREATMENT

STEP 1: COARSE FILTRATION > 250 MICRON stage 1
       COARSE FILTRATION > 150 MICRON stage 2
       COARSE FILTRATION > 50 MICRON stage 3
       DECHLORINATION PROCESS UPSTREAM

STEP 2: ULTRAFILTRATION MODULES

PROCESS REQUIREMENTS:

TURBIDITY (NTU):    < 10
TSS (mg/L):         < 20
Gross Flux (L/M^2/hr):  80
UF System Recovery (%):  96-97
pH Range            2-11
NaOCl, Cleaning Maximum 2,000 ppm
STEP 2: ULTRAFILTRATION MODULES: 40 Modules Required

The Ultrafiltration (UF) modules are made from high strength, hollow fiber membranes that have excellent features and benefits:

- Estimated Weight Water Filled 100 kg
- Membrane Area: 77 m²
- Overall Length 2360 mm
- Diameter: 225 mm
- Expected SDI ≤ 2.5
- Expected Turbidity ≤ 0.1 NTU
- MAXIMUM OPERATING TEMPERATURE: 40 °C

- 0.03 μm nominal pore diameter for removal of bacteria, viruses, and particulates including colloids to protect downstream processes such as RO

- PVDF polymeric hollow fibers for high strength and chemical resistance allows long membrane life

- Hydrophilic PVDF fibers for easy cleaning and wettability that help maintain long term performance

- Outside-in flow configuration for high tolerance to feed solids that help reduce the need for pretreatment processes

- U-PVC housing, helping to eliminate the need for costly pressure vessels

This module is an ideal choice for systems with capacities greater than 50 m³/hr (220 gpm).
GLOBAL INDUSTRIAL WATER REVERSE OSMOSIS SYSTEM

STEP 3: RO SYSTEM

DESIGN FEATURES

• Enables systems to be designed and operated to optimize operating cost through lower energy consumption or to optimize capital cost through higher productivity at lower operating fluxes.

• High NaCl and boron rejection to help meet World Health Organization (WHO) and other drinking water standards.

• Effective use in permeate staged seawater desalination systems without impairing the performance of the downstream stage.

• High performance over the operating lifetime without the use of oxidative post-treatments. This is one reason DOW FILMTEC elements are more durable and may be cleaned more effectively over a wider pH range (1-13) than other RO elements.

• Automated, precision fabrication with a greater number of shorter membrane leaves reducing the effect of overall fouling and maximizing element efficiency, helping to lower your cost of operation.
GLOBAL INDUSTRIAL WATER REVERSE OSMOSIS SYSTEM

STAGE 3: RO SYSTEM DESIGN FEATURES

MEMBRANE SPECIFICATIONS

- ACTIVE AREA: 37 m² (400 ft²)
- MAXIMUM OPERATING PRESSURE: 83 BAR (1,200 psig)
- PERMEATE FLOW: 28 m³/day (7,500 gpd)
- MINIMUM SALT REJECTION: 88%
- DIAMETER: 201 mm (7.9 in.)
- Length: 1,016 mm (40 in.)
- Maximum Operating Temperature: 45 C (113 F)
- Maximum Element Pressure Drop: 1 bar (15 psig)
- Maximum Feed Silt Density Index (SDI): SDI 5

Note: All values based on 32,000 ppm NaCl, 5 ppm boron, 800 psi, 77 F (25 C), 8% Recovery
GLOBAL INDUSTRIAL WATER REVERSE OSMOSIS SYSTEM

STAGE 3: RO SYSTEM DESIGN FEATURES
Recovery: 33%
60 Elements Required
MAXIMUM DOWNSTREAM PARTICLE SIZE: 0.50 MICRONS
GLOBAL INDUSTRIAL WATER REVERSE OSMOSIS SYSTEM

STAGE 3: RO SYSTEM DESIGN FEATURES
MAXIMUM OPERATING TEMPERATURE: 45 C

<table>
<thead>
<tr>
<th>System Details</th>
<th>Value</th>
<th>Feed</th>
<th>Temperature</th>
<th>Recovery</th>
<th>Pressure</th>
<th>Permeate Flow</th>
<th>Feed</th>
<th>Concentrate</th>
<th>Power</th>
<th>Specific Energy</th>
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<tbody>
<tr>
<td>Feed Flow to Stage 3</td>
<td>2680.76 gpm</td>
<td>825.83 gpm</td>
<td>55.0 C</td>
<td>39.64 %</td>
<td>9000 psi</td>
<td>84 GPM</td>
<td>3900 psi</td>
<td>4.0 kW</td>
<td>20.16 kWh/lpg</td>
<td></td>
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<tr>
<td>Raw Water Flow to System</td>
<td>3980.76 gpm</td>
<td>850.83 gpm</td>
<td>55.0 C</td>
<td>39.64 %</td>
<td>9000 psi</td>
<td>84 GPM</td>
<td>3900 psi</td>
<td>4.0 kW</td>
<td>20.16 kWh/lpg</td>
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<tr>
<td>Feed Pressure</td>
<td>5.8 g</td>
<td>5.8 g</td>
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<tr>
<td>Flow Factor</td>
<td>0.8 g</td>
<td>0.8 g</td>
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<tr>
<td>Close Down</td>
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<tr>
<td>Total Active Area</td>
<td>2400,000 ft²</td>
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<tr>
<td>Water classification: seawater with conventional pretreatment, tcm &lt; 3</td>
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</tbody>
</table>
GLOBAL INDUSTRIAL WATER DEOXYGENATION SYSTEM

STAGE 4: DEOXYGENATION SYSTEM

REQUIREMENT < 10 ppb

BENEFITS:

- Modular Design
- High Inlet Pressure and Low Pressure Drop
- Maximized Surface Area
- No Chemical Requirements
- Quick Start Ups
- Can operate under a variety of Flow Rates
GLOBAL INDUSTRIAL WATER HIGH PRESSURE INJECTION PUMP

STAGE 5: HIGH PRESSURE INJECTION

REQUIREMENT 2500 PSIG
GLOBAL INDUSTRIAL WATER HIGH PRESSURE INJECTION PUMP

STAGE 5: HIGH PRESSURE INJECTION

SPECIFICATIONS:

MFG.: NATIONAL OILWELL VARCO Quintuplex Plunger Pump
QTY : 1 IN OPERATION
RATED: 261 Kw (350 HP)
Maximum Discharge Pressure: 3483 psi
Weight PUMP only: 4082 kg (9000 lbs)
Engine: DIESEL DRIVEN
Oil Capacity: 25 gallons (94.63 L)
Discharge: 3 Inch ANSI 1500 FF
Suction: 6 inch ANSI 300 FF
GLOBAL INDUSTRIAL WATER PERFORMANCE TEST REPORTS

STAGE 6: CONTROLS SYSTEM  AUTOMATED SYSTEM FOR PRECISION PROCESS CONTROL

DATA CAN BE EMAILED OR DOWNLOADED ONSITE
Area Required: 304 m² Minimum
UltraFiltration Skid Modules

1. Qty 40 Modules
2. Feed Flow: 134000 BPD/391 GPM
3. Individual Membrane Area: 77m²
4. 0.03 micron nominal pore diameter
5. Estimated Weight: 12000 lb/5443 kg
6. PVDF Polymeric Hollow Fibers for High Strength and Chemical Resistance
7. Outside-in Flow Configuration
8. U-PVC Housing
9. Diameter: 8 inch  Length: 80 inch
10. Maximum Operating Temperature: 104°F (40°C)
RO Skid Modules

1. Qty 60 Modules
2. Feed Flow: 134000 BPD/ 391 GPM
3. Active Membrane Area: 37m²/400ft²
4. High NaCl and Boron rejection
5. Estimated Weight: 11000 lb/4989 kg
6. Polyamide Thin-Film Composite Membrane Type
7. Maximum Element Pressure Drop 15 psig (1.0 bar)
8. U-PVC Housing
9. Diameter: 8 inch    Length: 40 inch
10. Maximum Operating Temperature: 113°F (45°C)
11. 0.50 micron Particle Size in Product Stream
Deoxygenation Skid

1. Qty 9 Contactors Required at 8x80
2. Feed Flow: 134000 BPD/ 391 GPM
3. Oxygen Content < 10 ppb Product Stream
4. Nitrogen Composition 99.95%
5. Liquid Ring Vacuum Pump
6. Vacuum Level 75 mm Hg abs
7. Maximum Operating Temperature 34 C
High Pressure Injection Pump Skid

1. National Oilwell Varco Model Quintuplex Plunger Pump
2. Rated at 5000 BPD at 2500 PSI Discharge
3. Diesel Driven
4. 350 HP
5. Discharge: 3 inch ANSI 1500 FF
6. Suction: 6 Inch ANSI 300 FF
7. Oil Capacity: 25 gallons
8. Weight Pump/Engine: 14,000 lbs