Sustainable Desalination

The World’s 1st Solar Powered Zero Carbon Footprint Water Plant

Sep 2017
1. Changing the Game

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2. Sustainability Features
3. Al Khafji Project
4. Process Overview
5. Video
Changing the Game

Al Khafji Project

...the game-changer of the water industry

1. Savings and Protection
   - Saves on oil fuel resources and protects the environment by CO₂ emission reduction

2. Synergy
   - Surplus power during daylight hours is sent to the grid. In the evening hours, an equal amount of energy is pulled from the grid

3. Initiative
   - The world’s 1st full-scale, zero carbon footprint, solar powered water treatment installation, designed to produce 60,000 m³/day of drinking water

4. Projects
   - Under the King Abdullah initiative for Renewable Energy Desalination, Al Khafji is intended to be the first of a series of such projects in the Kingdom to transform the water sector
2. Sustainability Features

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Sustainability Features

1. RO/PV Pilot plants for Process Enhancement

2. Compact plant design that reduces environmental impact

3. Optimized power consumption that minimizes power demand

4. High-Pressure Pumps (HHP) equipped with Variable Frequency Drives (VFD)

5. Variable frequency drives installed for main pumps avoiding peak current and voltage drops
AWT has a broad mandate to explore bankable opportunities along the water value chain.

Upstream

- EPC Contractor
- Desalination
- Renewable Energy
- O&M
- Parts & Components
- Membranes

Downstream

- Smart Technology
- Equity Ownership
- Chemicals
- Supply Chain
- Distribution
- Water Management
- Treatment & Reuse
Line of business

• Design and Construction of Water Projects
  (desalination, treatment & reuse)

• Developer of Projects

• O&M of Water Plants

• Other Lines of Business
  • E.g. technology & equipment provider
Company Profile

At the heart of AWT lies the key to success. The ingredients include:

- World-class management team
- Strong engineering & project management capabilities
- Global industry-leading partners
- Stakeholder support and the ability to work with other stakeholders
- Core drivers of innovation and sustainability
- Financial backing
AWT’s Unique Features:

1. **Innovation** along the entire water value chain

2. **Sustainability** in solutions and practices

3. **Superior Performance** in engineering and project execution
3. Project Milestones

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Khafji Project (Key Technical Items)

Plant General Information

- Assured Electrical Efficiency of the plant: < 4.2 Kwh/m³
- Plant intake - 3 offshore towers and intake pipes which extend 2.1 km into the sea
- Seawater outfall - 2 pipes with diffusers at 3 km offshore

Plant Technical Data

<table>
<thead>
<tr>
<th>Pre-Treatment</th>
<th>RO Treatment</th>
<th>Post Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three inlet towers and pipelines with total intake capacity of 90,000 m³/day</td>
<td>Consists of first and second pass systems</td>
<td>Product water collected in 2,600 m³ concrete wet well</td>
</tr>
<tr>
<td>3 intake pumps</td>
<td>6 RO trains installed initially</td>
<td>3 Pumps convey product water to SWCC storage tank</td>
</tr>
<tr>
<td>12 +1 Dual Media Filters followed by 3 Self Cleaning Filters.</td>
<td>Additional 3 RO trains for 90 MLD for expansion</td>
<td>Chemical feed systems installed for capacity of 60,000 m³/day</td>
</tr>
<tr>
<td>12-train Ultrafiltration System</td>
<td>Each train with 144 pressure vessels in the 1st pass and 48 vessels in 2nd pass</td>
<td>Minimum Capex expected for capacity ramp-up of up to 90,000 m³/day</td>
</tr>
</tbody>
</table>

- Minimum Chemical Consumption
- High Quality Materials
- 40 % to 44 % Recovery

- Possibility of capacity ramp-up in phases depending on Off-take demand from SWCC
Khafji Project (Key Technical Items)

Pumps Manufacturing

Control System Cabinets

UF Units assembly

SWI

RO

Intake Pipes Installation
Project Milestones

Milestone 1: May 16 – Jan 17
(Arrival of long lead items: Main pumps, Screening System)

Milestone 2: Jun 16 – Dec 16
(Completion of main civil works)

Milestone 3: May 16 – April 17
(Completion of marine works)

Milestone 4: November, 2017
(Start of Commissioning)
4. Process Overview

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Process Overview

Water Balance Diagram
at 40% with all 6 SWRO+ 6BWRO Racks online

535 m³/hr @ 0.7 to 3 barg
8,390 m³/hr @ Line Losses 0.37 barg
#VALUE! 6.264 barg
Level Difference 0.36 barg

7,850 m³/hr @ 3.8 barg
8,390 m³/hr @ atm
490 m³/hr @ atm

8,900 m³/hr @ Line Losses 0.20 barg
Recovery 99.37%
65,836.80 m³/day @ atm

7,900 m³/hr @ 3 barg
4,515 m³/hr @ atm

7,050 m³/hr @ Line Losses 0.15 barg
Recovery 94.16%

7,850 m³/hr @ 2.9 barg
3,096 m³/hr @ atm

7,315 m³/hr @ 3 barg
2,743 m³/hr @ 1 barg

Intake Tower
Backwash Tank
Ultra Filtration
to Common Drain (survail)
Ultra Strainers
to Common Drain (survail)
Post Treatment Plant
Booster Pumps
Intake Pumps
Energy Recovery Units
Booster Pumps
Intake Tower
Process Overview

<table>
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<tr>
<th>Plant Operating scheme when all trains are in operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Total number of SWRO Trains @ 40% SWRO Recovery : 6</td>
</tr>
<tr>
<td>• Total number of BWRO Trains @ 40% SWRO Recovery : 6</td>
</tr>
<tr>
<td>• RO total gross water capacity @ 40% SWRO Recovery : 65,836 m³/day</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Plant Operating scheme during CIP or Maintenance of 1 train</th>
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<tbody>
<tr>
<td>• Total number of SWRO Trains @ 44% SWRO Recovery : 5</td>
</tr>
<tr>
<td>• Total number of BWRO Trains @ 44% SWRO Recovery : 5</td>
</tr>
<tr>
<td>• RO total gross water capacity @ 44% SWRO Recovery : 60,350 m³/day</td>
</tr>
</tbody>
</table>
Process Overview

Electrical System and Control System Scheme

- Two 30 MVA (34.5/4.16 KV) transformers are connected to 4.16KV switchgear
- 4.16KV switchgear (4.16KV, 2500A, 25KA / 3Sec) is feeding the MV drives of the Plant
- Siemens PCS 7 will be the control system for the project
1. Changing the Game
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Al Khafji SWRO
Thank you

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