Integrated Solution Provider

NALCO Water
An Ecolab Company

Aquatech

Leading End-to-End Water Management Platform

Leaders in Water Technology

- Established: 1981 - Headquarters: Canonsburg, PA
- Diverse portfolio of technology & services for the industrial and infrastructure markets
- Pioneer in Zero Liquid Discharge ("ZLD") and Brine Management
- Specializes in Industrial Process Water, Desalination, Reuse & ZLD and Wastewater Treatment
- Global footprint with over 1,500 completed facilities across 60 countries
- Diversified blue chip customer base

Suite of Water Management Solutions

Technology Solutions

Integrated Water Solutions

Energy Services

QUA

AQUIOS

Blue Chip Customer Base

Global Footprint

Note: Please see pages 77-78 of the Confidential Information Memorandum ("CIM") for a detailed reconciliation and definition of pro forma financials.

NALCO Water
An Ecolab Company

Aquatech

Overview

Aquatech is a leader
in water purification and wastewater treatment

NALCO Water
An Ecolab Company

Division Detail: Technology Solutions Toolbox

Aquatech uses a variety of **value-added**, **differentiated technology** to meet their customer's needs and distinguish themselves from other market participants

Solution Offering		Applications		Key Differentiators
Industrial Process Water		▪ Clarification ▪ Filtration ▪ Membranes	▪ Demineralization ▪ Condensate Polishing ▪ Ultrapure	▪ High Rate Clarification , DAF ▪ QUA™ Polymeric and ceramic membranes ▪ HERO™ (High Efficiency Reverse Osmosis) ▪ UPCORE™ Packed Bed Technology ▪ QUA FEDI™ Fractional Electrodeionization Technology ▪ EXPOL™ Externally Regenerated Condensate Polishing
Wastewater Treatment		▪ Primary Treatment ▪ Secondary Treatment ▪ Tertiary Treatment (Nutrient Removal)	▪ Sludge Handling ▪ Disinfection ▪ Resource Recovery	▪ BioCORE™ Fluidized Bed Bioreactor process ▪ QUA ENVIQ™ Membrane Bioreactor Process ▪ CERA Q Ceramic UF Membrane ▪ Microbial fuel cell based products in development for Waste to Energy
Desalination		▪ Intake Systems ▪ Sea Water Conditioning ▪ Filtration	▪ Membranes / Thermal ▪ Post Conditioning ▪ Energy Recovery Devices	▪ Qua™ QSEP Membranes for SWRO Pretreatment ▪ BioQ™ Nutrient Removal for SWRO Pretreatment ▪ LoWatt™ Desalination Process ▪ Horizontal Sprayfilm™ MED-based Evaporation

NALCO Water
An Ecolab Company

Aquatech

Division Detail: Technology Solutions Toolbox (cont'd)

Solution Offering	Applications	Key Differentiators
Recycle, Reuse & ZLD 	▪ Wastewater Conditioning ▪ Brine Conditioning ▪ Filtration and Membrane Recycling ▪ Brine Minimization ▪ Crystallization ▪ Resource Recovery	▪ QUA BioCore™ and EnviQ™ ▪ High Rate Clarification ▪ HERO™ (High Efficiency Reverse Osmosis) ▪ QUA™ Polymeric and Ceramic Membranes ▪ AquaR2RO™ ▪ AquaChem™ VTFF Brine Concentrators ▪ Membrane Distillation Brine Concentrators ▪ AquaChem™ Forced Circulation Crystalizers ▪ Ceramic Membrane Based Crystallizers ▪ MDMC ZLD Process ▪ AquaEZ™ Integrated ZLD Process ▪ HERO-BC-FCC HYBRID Process
Produced Water 	▪ Produced Water Conditioning ▪ Oil Removal ▪ Membranes ▪ Brine Minimization ▪ Crystallization ▪ Salt Solutions	▪ EM-ZLD Process ▪ EDE – Electrodemulsification ▪ MoTreat™ and MoPress™ Mobile Conditioning Units MoVap™ Mobile Evaporator ▪ QUA CeraQ™ Ceramic Filtration ▪ PureMist™ Process ▪ High Silica Brine Conditioning ▪ AquaChem™ VTFF Brine Concentrators ▪ SmartMOD™ ▪ HeVap™ Process ▪ AquaChem™ Forced Circulation Crystallizers

NALCO Water
An Ecolab Company

Aquatech

Thermal Desalination

- Multiple Effect Distillation (MED)
  - Advantages
  - Drawbacks

Membrane Desalination

- SWRO
  - Advantages
  - Drawbacks

NALCO Water
An Ecolab Company

Aquatech

Aquatech Major Desalination Experiences

- Rabigh Refinery – MED 10,000 m3/day on BOOT basis
- Ras Tanura Refinery – MED 12,000 m3/Day
- Abu Qir Power Project – MED 10,000 m3/Day
- WEB Aruba – MSF 48,000 m3/Day
- KJO – MSF 6,000 m3/Day
- Ras Al Khaimah FEWA – SWRO 68,200 m3/day
- KAIA, Jeddah – SWRO 40,000 m3/Day on BOOT basis
- CGPL – SWRO 24,000 m3/Day
- Petroleum Co of Trinidad & Tobago – SWRO 12,000 m3/Day

NALCO Water
An Ecolab Company

Aquatech

MED Desalination

Advantages

- Very flexible in operation
- Smaller footprint
- Is fairly insensitive to salinity fluctuations.
- Requires less electrical power if steam driven

NALCO Water
An Ecolab Company

Aquatech

MED Desalination

Advantages

- Produces high purity water in a single process unit <10 ppm TDS

- Can accept some suspended solids and turbidity, minimal pretreatment on open intake

- Can work during upsets like red tide algal bloom

NALCO Water
An Ecolab Company

Aquatech

MED Desalination

Drawbacks

- Requires steam, higher on lifecycle costs compared to RO.
- Higher Capex when compared with RO.
- System recovery not more than 30%, larger feed flow required
- Systems utilizing mechanical vapor compression require power of 8 – 15 kwh/m3.

NALCO Water
An Ecolab Company

Aquatech

Rabigh Refinery
MED-TVC (10,000 m3/d)
Saudi Arabia BOOT

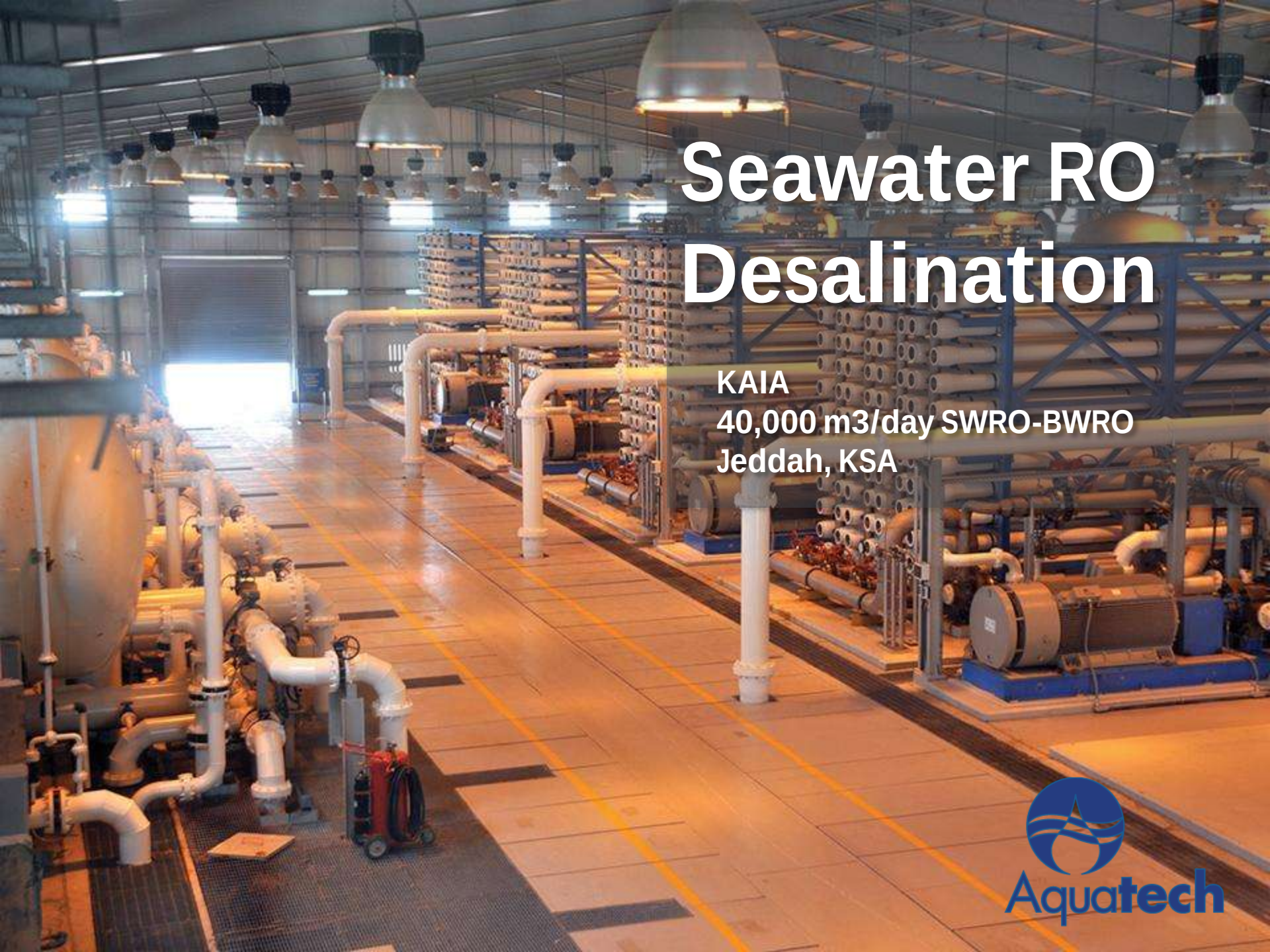
Aquatech

Ras Tanura Refinery MED-TVC (12,000 m3/d) – Saudi Arabia

NALCO Water
An Ecolab Company

Aquatech

Abu Qir MED-MVC (10,000 m3/d)



Seawater RO Desalination

KAIA
40,000 m3/day SWRO-BWRO
Jeddah, KSA

Aquatech

SWRO Desalination

Advantages

- Lower Capex compared to a thermal system
- Lower Opex
- Can be operated independent of power plant full load operations unlike steam driven MED.
- Operates at a higher recovery of about 40-50% depending on the water quality.
- No need for Steam

NALCO Water
An Ecolab Company

Aquatech

SWRO Desalination

Drawbacks

- Is sensitive to feed water temperature variations.
- Requires regular membrane replacement to maintain consistent quantity and quality.
- Adequate pre-treatment is required to minimize fouling and scaling.
- Boiler feed water requires additional second pass RO before the MB units.

NALCO Water
An Ecolab Company

Aquatech

Tata Power SWRO Desalination

- **Project:**
  Tata Power Ultra Mega Power Project

- **Client:**
  Coastal Gujarat Power Limited

- **Location:**
  Gujarat, India

- **Type of Plant:**
  4000 MW Power

- **Equipment Supplied:**
  Lamella Clarifier
  Dual Media Filters
  Seawater Reverse Osmosis
  Brackish Water Reverse Osmosis

- **Capacity:**
  SWRO- 4 x 262 m^3/hr (18,864/day)
  BWRO- 2 x 75 m^3/hr (3,600/day)

NALCO Water
An Ecolab Company

Aquatech

FEWA SWRO Desalination

- **Project:**
  Galilah, RAK
- **Client:**
  FEWA
- **Location:**
  UAE
- **Type of Plant:**
  Seawater UF/RO
- **Capacity:**
  15 MGD (68,200 m3/day)

NALCO Water
An Ecolab Company

Aquatech

LoWatt™ Technology

- Improves Reliability
- Consistent Performance throughout life of plant
- Lowers power usage by 20%
- Improves membrane life
- Reduces chemical cleaning
- Less operator labor for cleanings

NALCO Water
An Ecolab Company

Aquatech

LoWatt™ Technology

Step 1	**Membrane (UF) based Pretreatment**
Step 2	**System design for optimal energy consumption**
Step 3	**Prevention of Biofouling through an innovative technology**
Step 4	**Unique online cleaning technique to control and minimize fouling**
Result	**Reduced energy by design, reduce chemicals and cleaning cycles in order to maintain energy performance on a Sustainable Basis**

NALCO Water
An Ecolab Company

Aquatech

Desalination Design Variables

- Energy is the biggest life cycle factor, steam and/or power
- Intake should minimize pretreatment requirements, wells
- Outfall must minimize environmental impact, mixing zone
- Intake and outfall can be 30% of overall install costs
- Domestic distribution can be 30% of overall install costs
- Water quality in and out can affect overall cost
- DBOOM models have proven cost effective

A step in the right direction – co-locate at a Power Station

NALCO Water
An Ecolab Company

Aquatech

SWRO Project Details

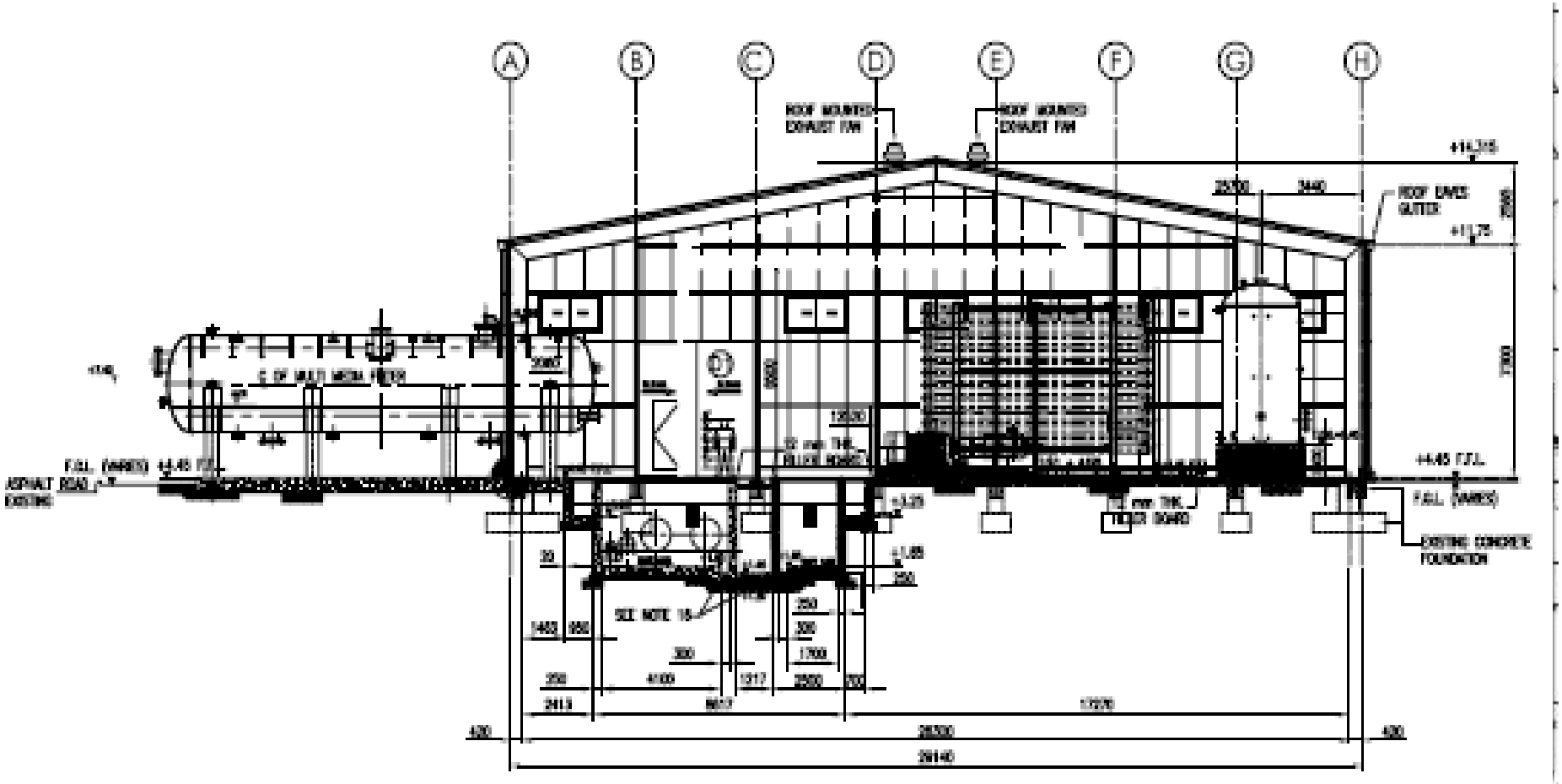
NALCO Water
An Ecolab Company

Aquatech

Plant Layout

An Ecolab Company

SWRO Building



NALCO Water
An Ecolab Company

Aquatech

Salient Design features …

- **Design Capacity : 45,000 m^3/d**
- **RO train size : 7500 m^3/d (net)**
- The modular design , capable to accommodate expansion, over & above the current contracted capacity up to Design capacity of 45000 m^3/d at a minimum additional cost.
- Layout of the plant is designed to allow the addition of new trains within the existing facilities.
- Interconnecting piping & Electrical-Mechanical equipments are designed to accommodate expansion of plant up to 45000 m^3/d.

Intake Facility

Open seawater intake located at a depth of 10 m and directed through an open channel running through 400 m inland to a seawater intake basin

At the inlet of basin there are two stages of screens. First stage removes debris in the seawater down up to 20 mm size and it is followed by a second stage travelling band screen with 4 mm opening.

NALCO Water
An Ecolab Company

Pretreatment

Intake channel is chlorinated and it is envisaged to dose coagulant, coagulant aid, sulfuric acid to condition the feed water.

Media Filtration

- In line coagulation and flocculation is provided before Multimedia filters (MMFs).
- 14 nos. of Filter units of 8700 m3/day of capacity.
- It consists of three types of filtration media namely, Anthracite, Sand and Garnet.
- The filters are 3 m in diameter and 13 m long single compartment horizontal vessels.

NALCO Water
An Ecolab Company

Overview of RO Plant

NALCO Water
An Ecolab Company

Aquatech

SWRO TRAINS A,B,C,D

NALCO Water
An Ecolab Company

Aquatech

Client

Costal Energen

CEPL

Location

South India, Indian Ocean

NALCO Water
An Ecolab Company

Aquatech

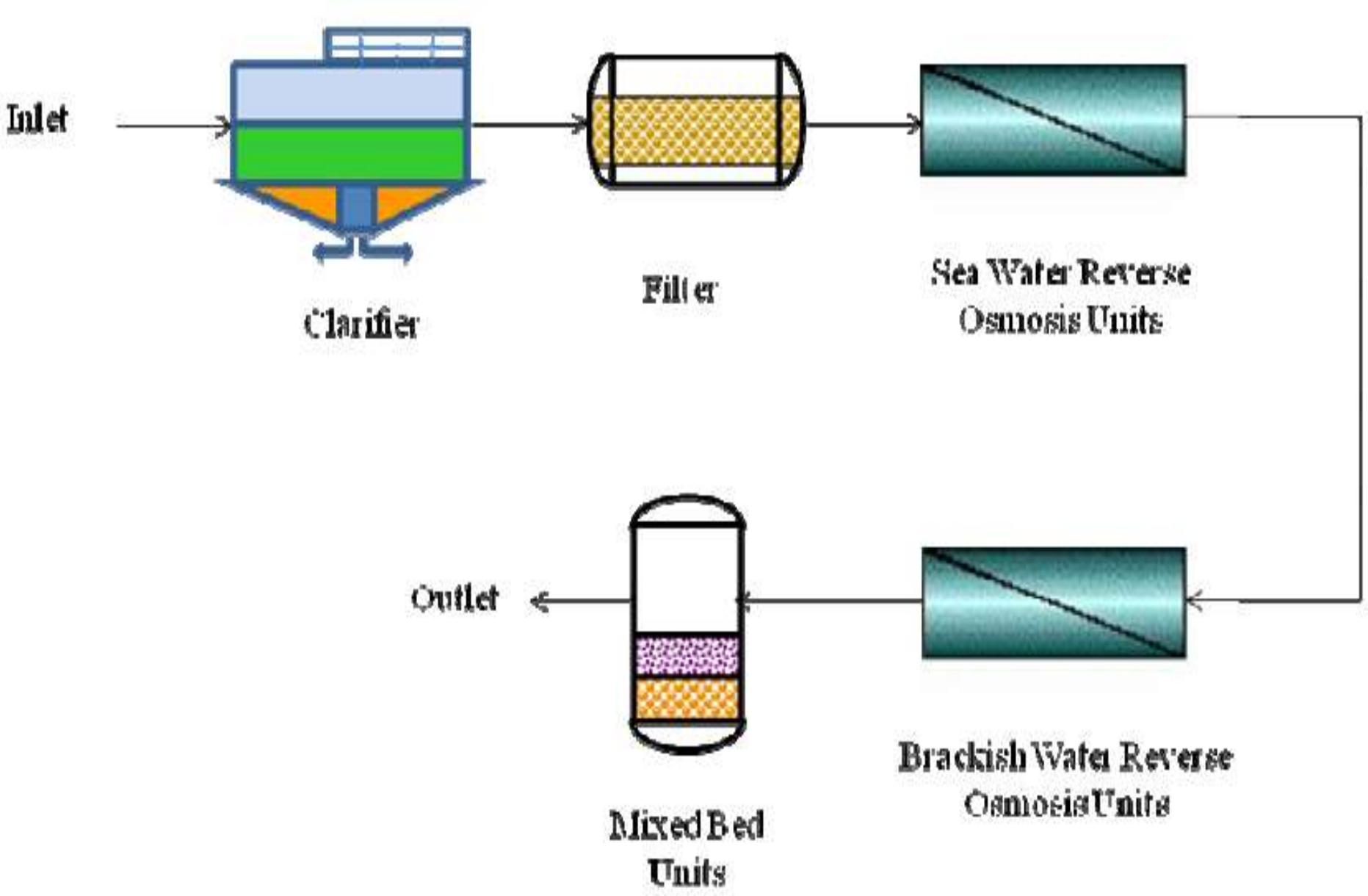
Sea water Characteristic

- Temperature varies from 25 to 29 deg C.
- Average salinity is 38000 mg/l
- pH is between 7.8 to 8.2
- Turbidity is around 25 NTU
- TSS 500 ppm

NALCO Water
An Ecolab Company

Aquatech

Process Flow Diagram



Overall Plant Photo-CEPL

Lamella Clarifier-CEPL

Horizontal Filter-CEPL

SWRO Skid with PX-CEPL

BWRO Skid-CEPL

MB Exchanger-CEPL

Client

Costal Gujarat Power Limited

CGPL

Location

West India, Arabian Sea

NALCO Water
An Ecolab Company

Aquatech

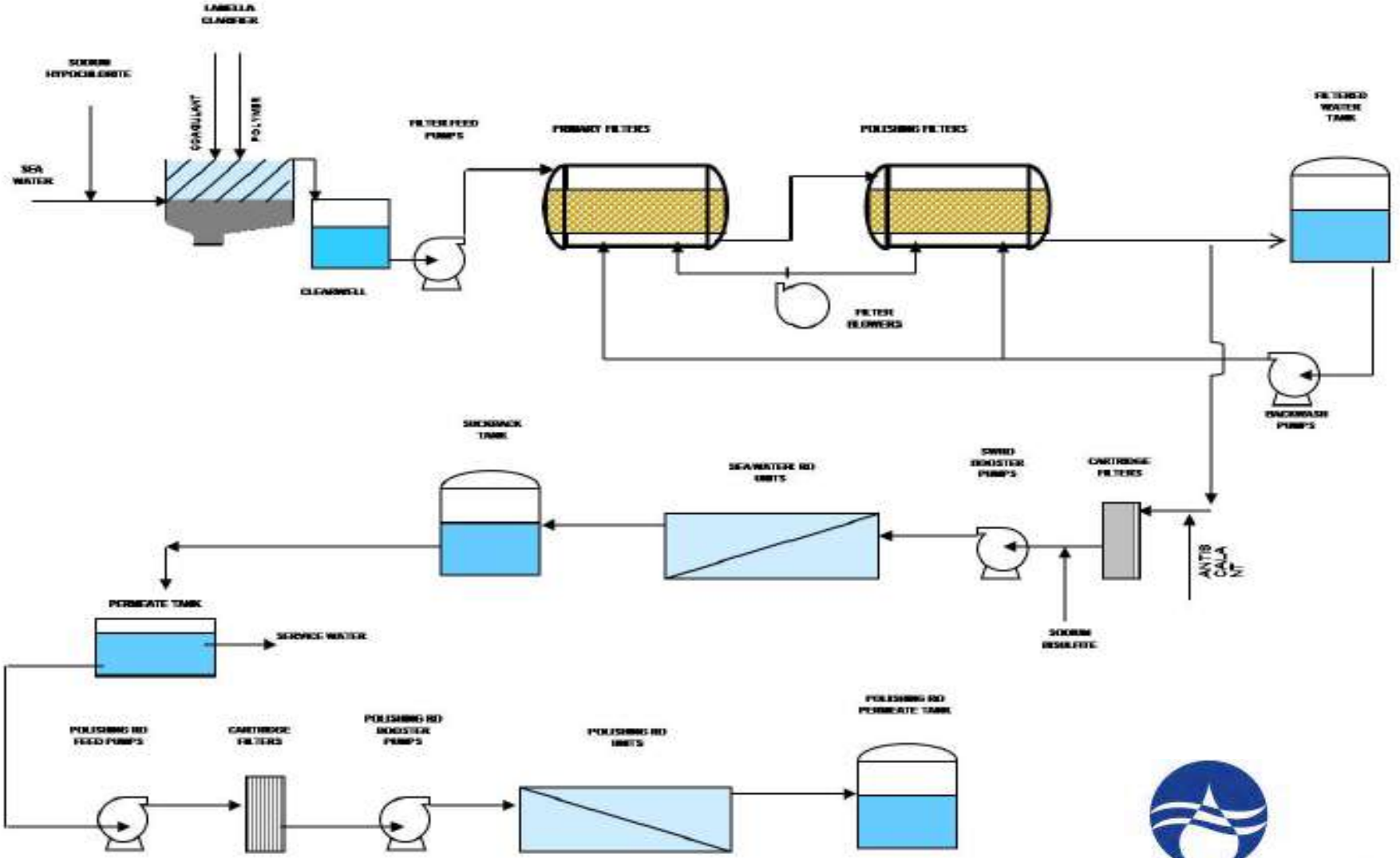
Sea water Characteristic

- Temperature varies from 25 to 34 deg C.
- Average salinity is 46000 mg/l
- pH is between 7.8 to 8.2
- Turbidity is around 100 NTU
- TSS 1000 ppm

NALCO Water
An Ecolab Company

Aquatech

Process Flow Diagram



Aquatech

Two Stage Filtration-CGPL

Cartridge Filter-CGPL

NALCO Water
An Ecolab Company

Aquatech

SWRO Skid-CGPL

BWRO Skid-CGPL

Thank you

Rolando Piaia

Patrick Randall

NALCO Water
An Ecolab Company

Aquatech