Desalter Effluent Recycle Pilot

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Introduction

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Objective

"Treat Desalter effluent for its reuse"

SA Filed A Patent

"In line with Company Policy and commitment to conserve Kingdom's ground water resources (Policy Number INT-11)"

Background

JDA

- Saudi Aramco policy agreement
- P&CSD initiated idea, JDA for Aramco IP Protection
- Veolia & Swing engagement

Pre-commissioning

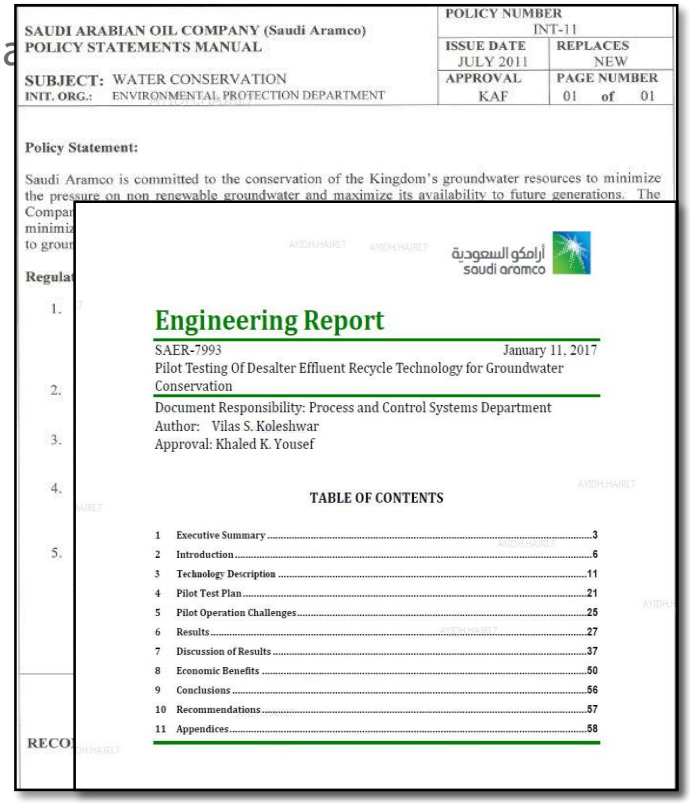
- Khurais selection for pilot tria
- Risk assessment and HAZOP

Pilot Test

- Install:July- August 2016
- Pre-commisiong:Sept
- Trial:Oct-Dec, 2016

Analysis

- Pilot trial results analyzed
- Final report issued



SAUDI ARABIAN OIL COMPANY (Saudi Aramco)
POLICY STATEMENTS MANUAL

POLICY NUMBER INT-11
ISSUE DATE JULY 2011 | REPLACES NEW
APPROVAL KAF | PAGE NUMBER 01 of 01

SUBJECT: WATER CONSERVATION
INIT. ORG.: ENVIRONMENTAL PROTECTION DEPARTMENT

Policy Statement:

Saudi Aramco is committed to the conservation of the Kingdom's groundwater resources to minimize the pressure on non renewable groundwater and maximize its availability to future generations. The

أرامكو السعودية
saudi aramco

Engineering Report

SAER-7993 January 11, 2017

Pilot Testing Of Desalter Effluent Recycle Technology for Groundwater Conservation

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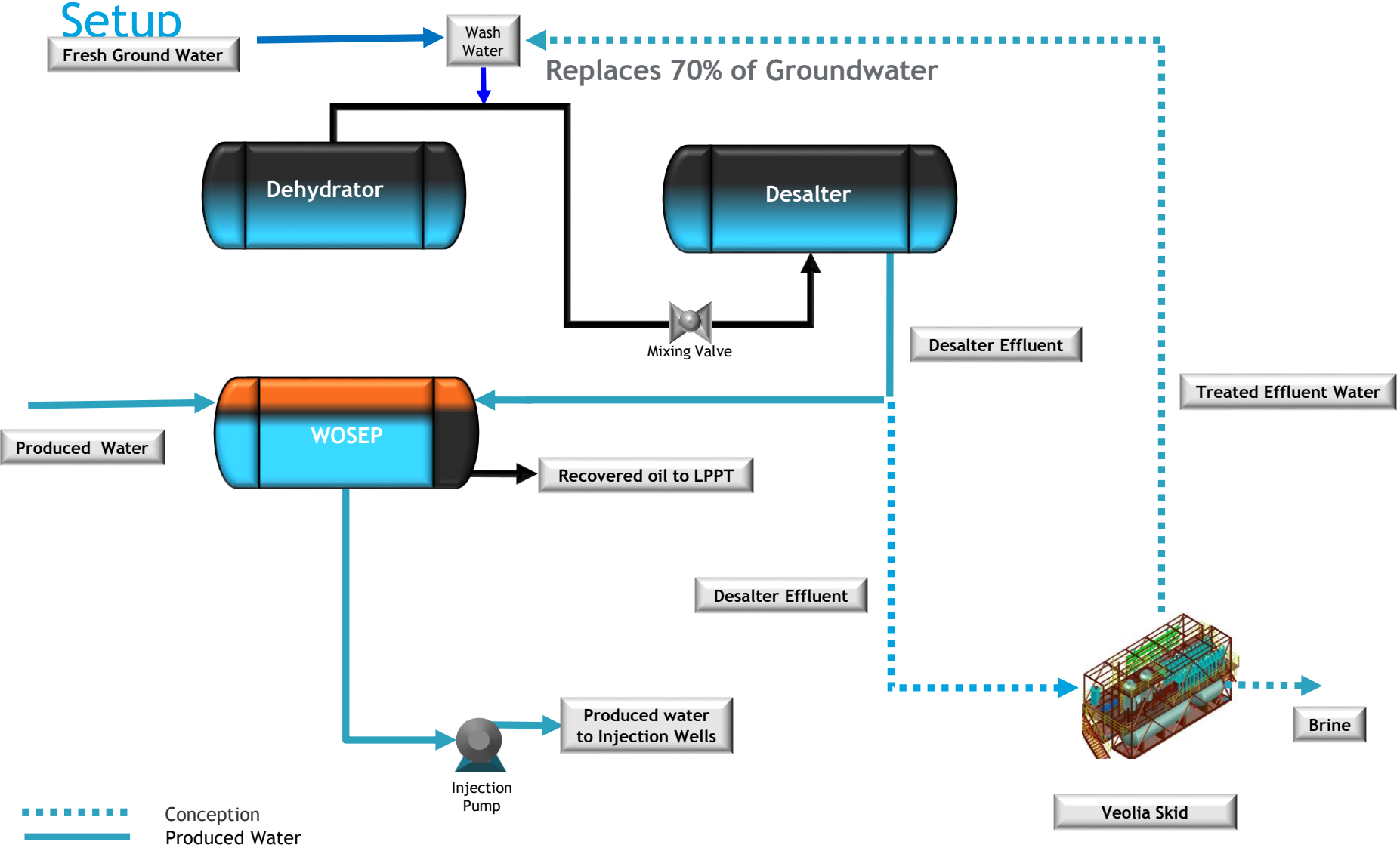
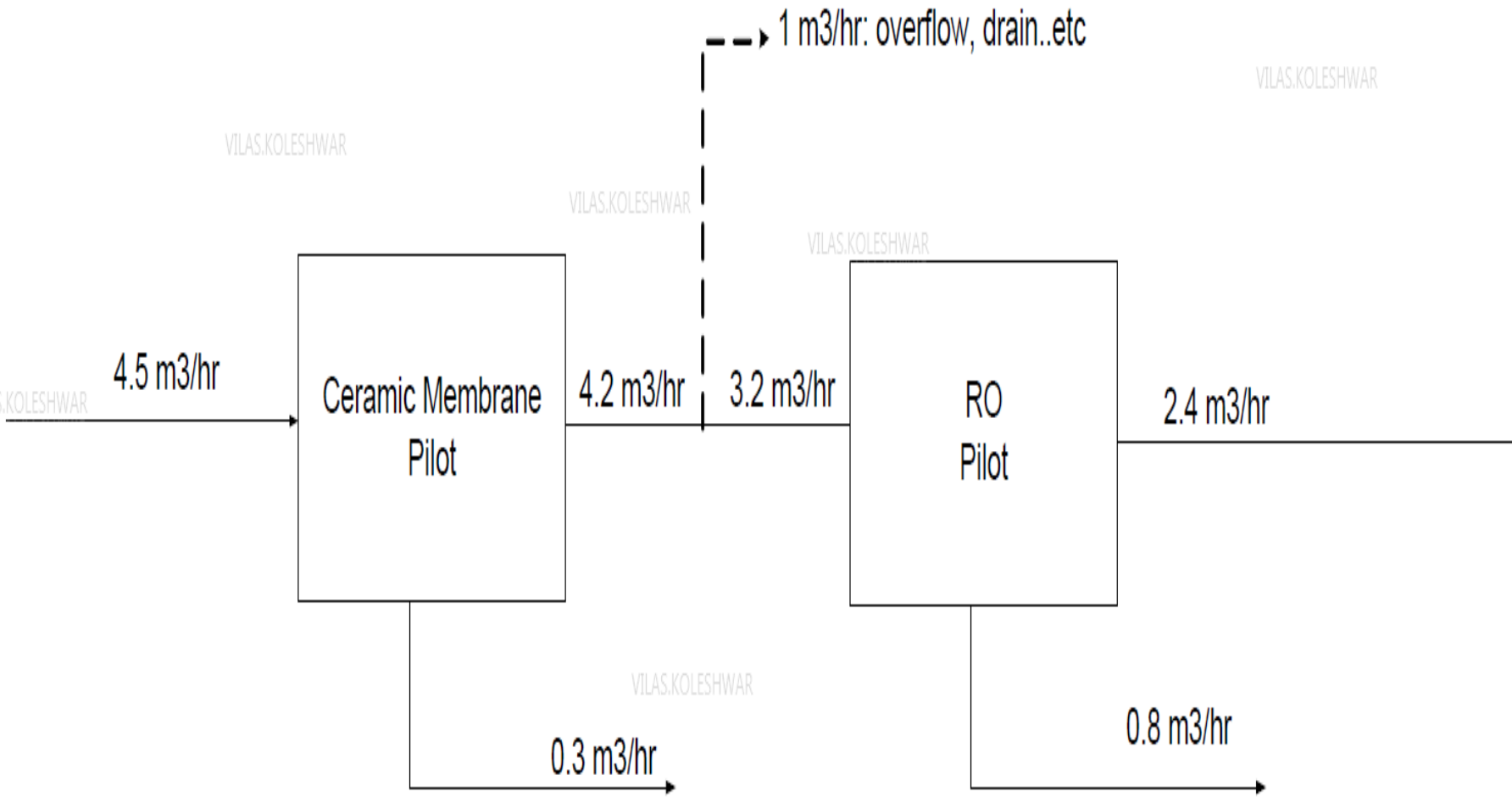
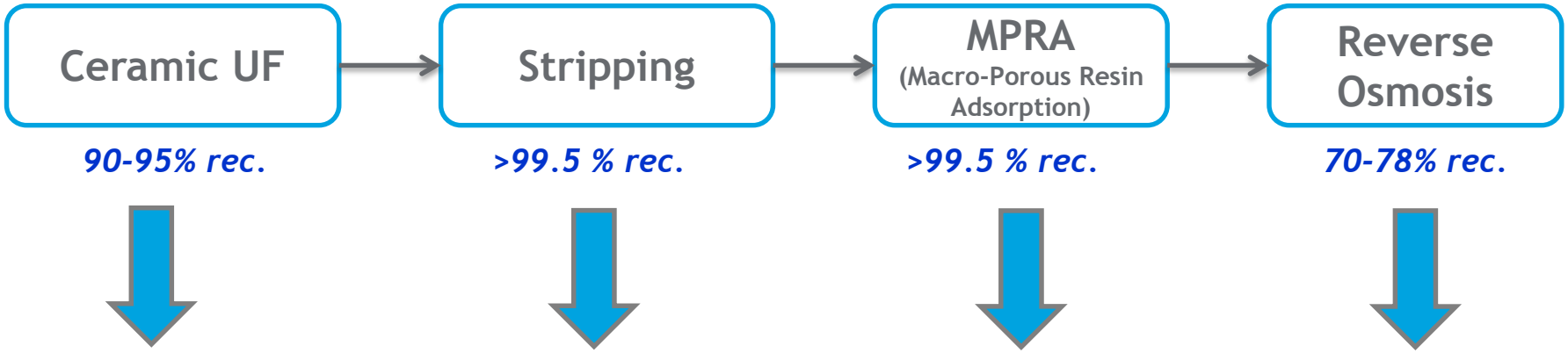
Process Overview with the Desalter Effluent Recycle Pilot Setup





Pilot Description: Block Flow Diagram

- 4.5 m3/h (0.68 MBOD), 70% recovery
- 24 hours / day, 7 days / week since mid October



- TiO2 & SiC ,
- Oil & Solids removal

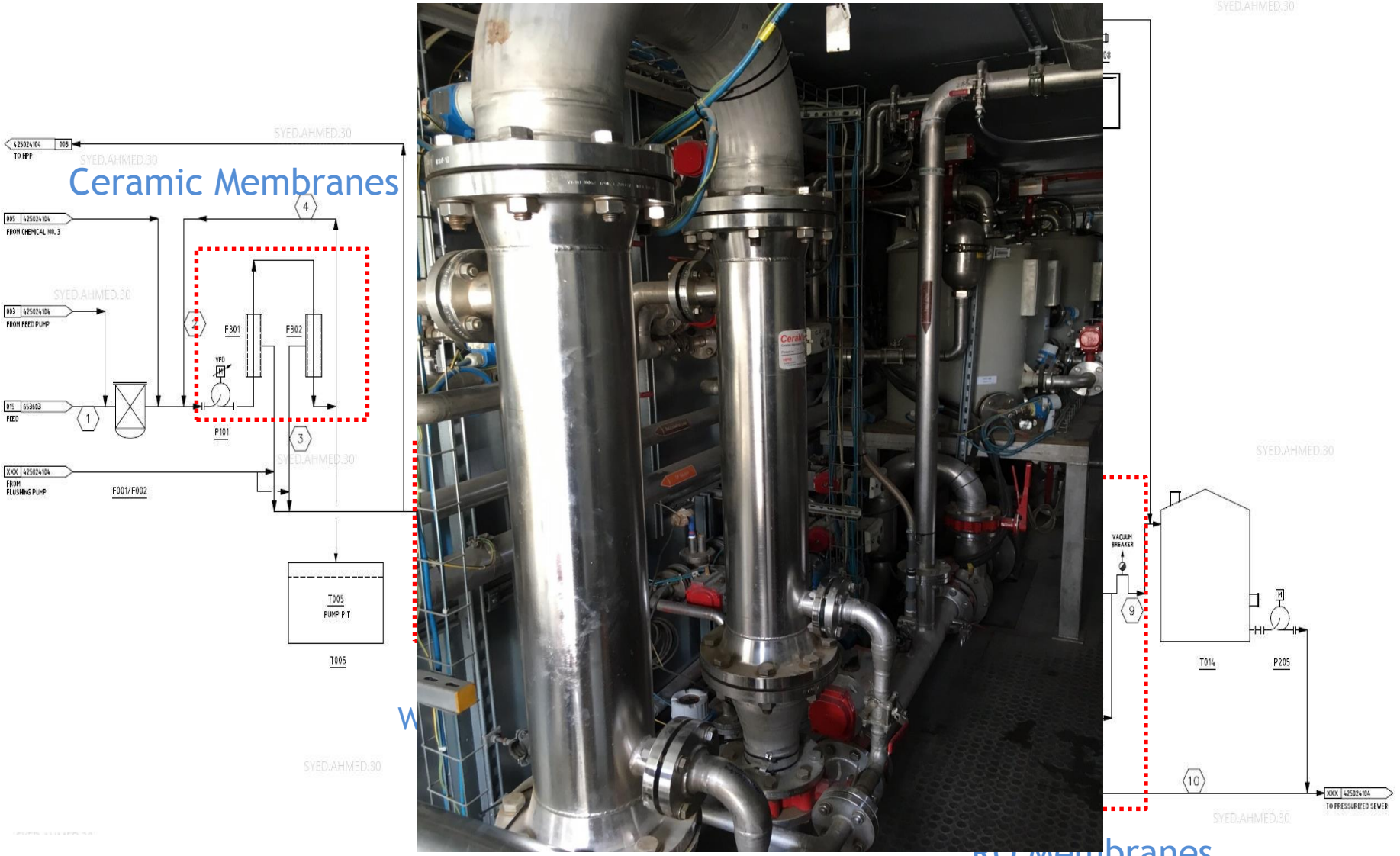
- H2S & BTEX removal
- 2 stage unit

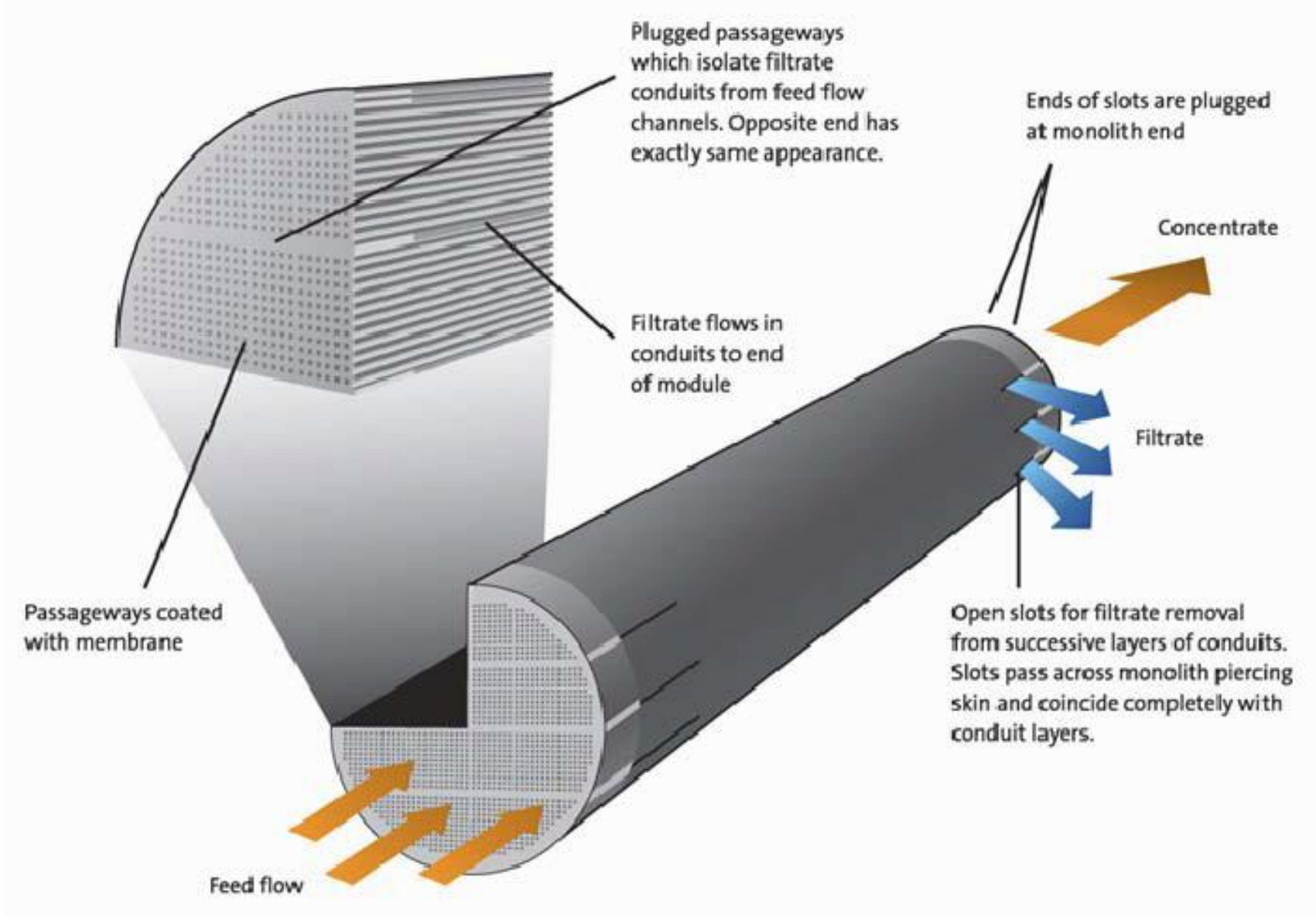
- TOC reduction
- RO protection

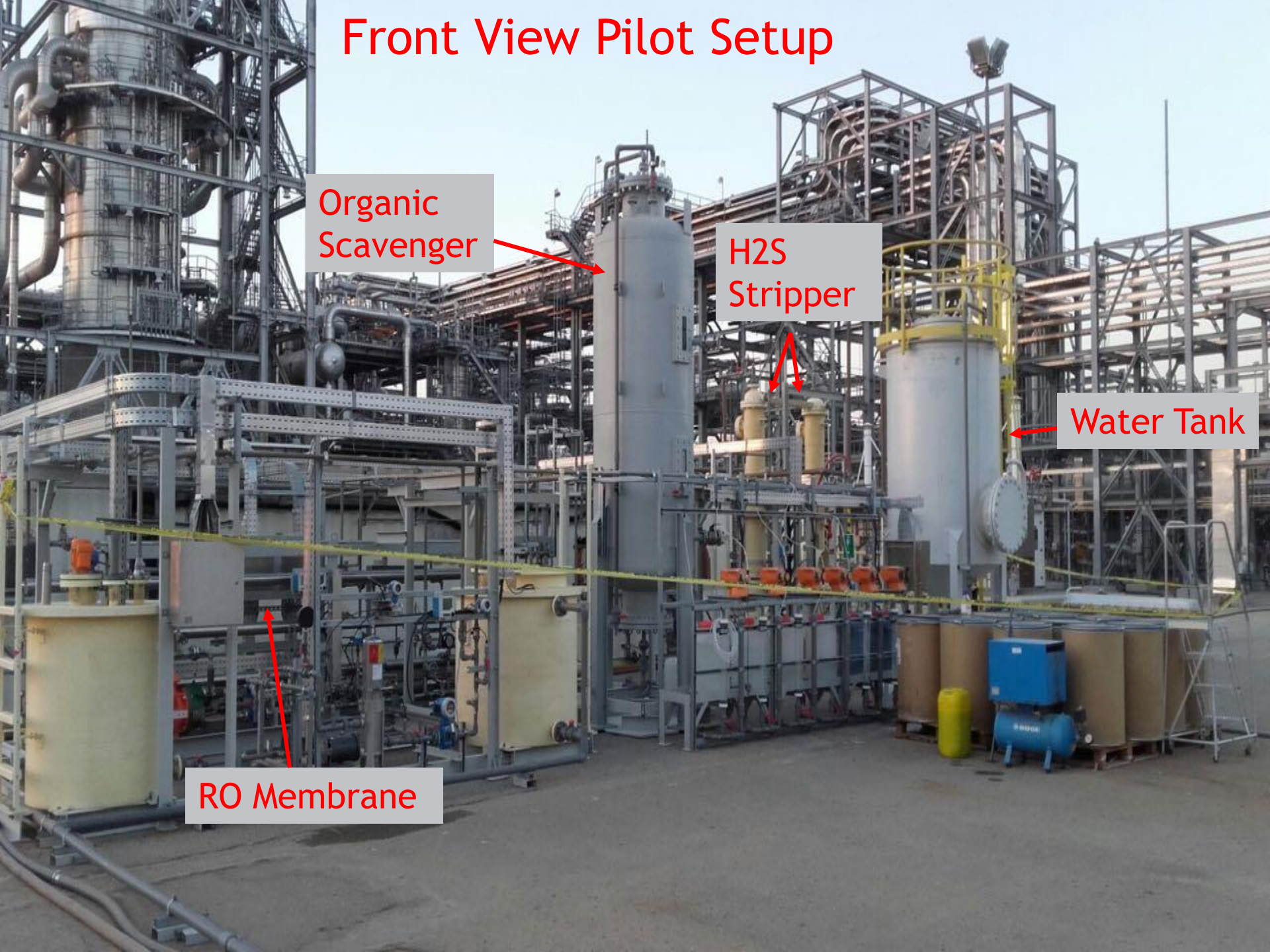
- Dissolved Salts removal @ high temperature

Temperature 60-65 °C

Desalter Effluent Treatment Process Overview






Front View Pilot Setup
Organic Scavenger
H2S Stripper
Water Tank
RO Membrane

H2S Stripper

Chemical Injection

Sulphuric Acid
Caustic Soda
AntiScale: Biocides

Mixer Tanks for Backwash flushing

3 Train RO Membranes

Pilot Trial Test Results

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Pilot Plant Objectives

1. Validate the design criteria (Recovery, Flux, BP duration, CEB interval and procedure, CIP interval and procedure, H2S removal efficiency, TOC removal efficiency,…etc).
2. Validate the permeate quality requirements are met.
3. Prove that the membrane is cleanable in an economical way.
4. Generate enough data in order to be used as a basis for membrane guarantee.
5. Generate enough date in order to design the full-scale system

Design Basis for Veolia Pilot Skid

Parameter	Unit	Design Basis	KhPD Desalter Outlet	Performance Target
TDS	ppm	3,500- 12,000	6,000 – 12,000	<1,650
Oil in Water	ppm	500 - 1000	50 - 200	<1
TSS	ppm	2 – 200	50 - 200	<1
Temperature	°F	150	140-149	-
pH	-	7	6.5 – 7	6 - 7.4

Ceramic Membrane and H2S Stripper Performance

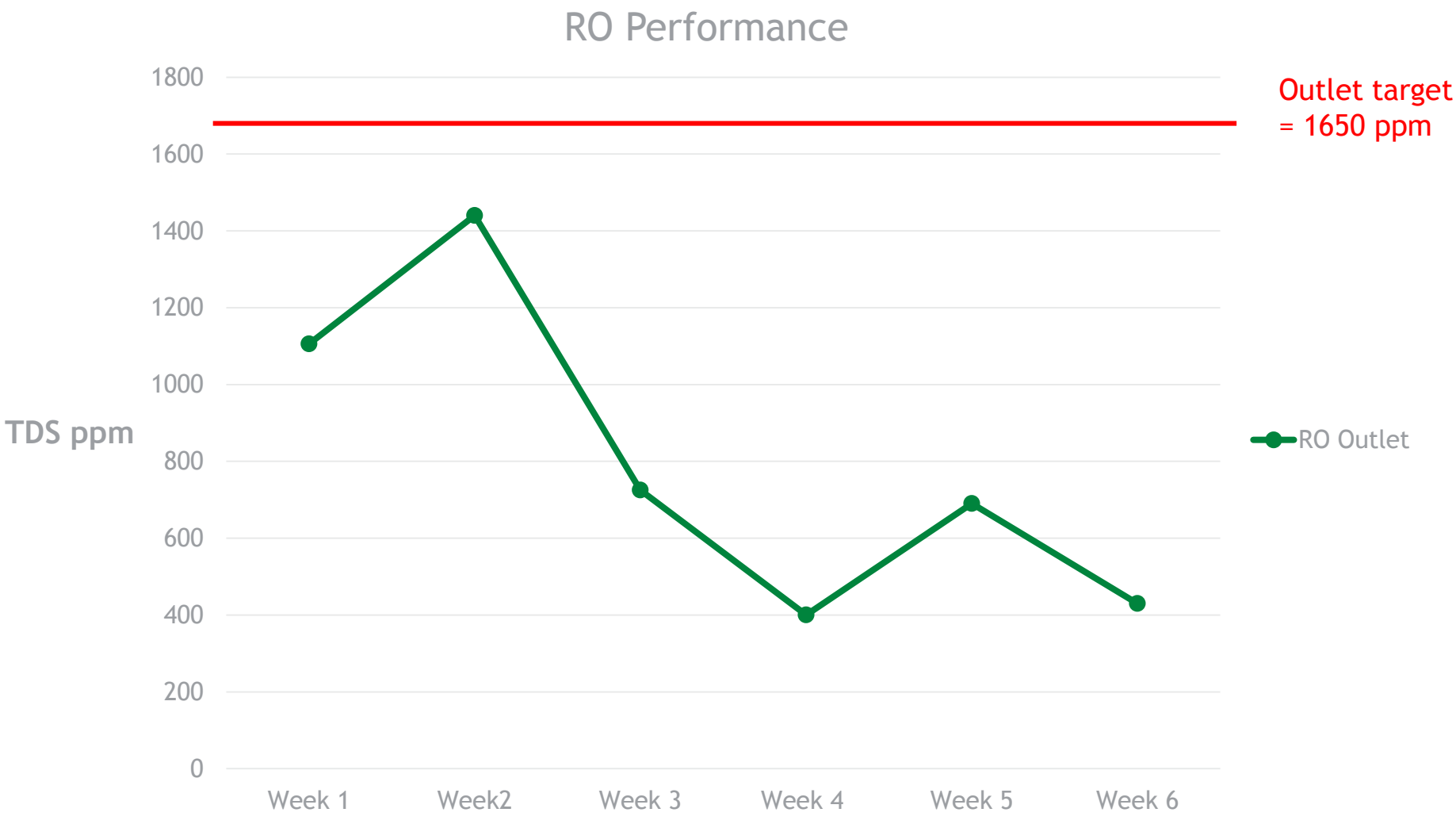
- Ceramic membrane

Parameter (ppm)	Outlet, ppm (Actual)	Outlet, ppm (Target)
Desalter Effluent, OIW	5	<1
Desalter Effluent, TSS	3.8	<1

- H2S Stripper Performance

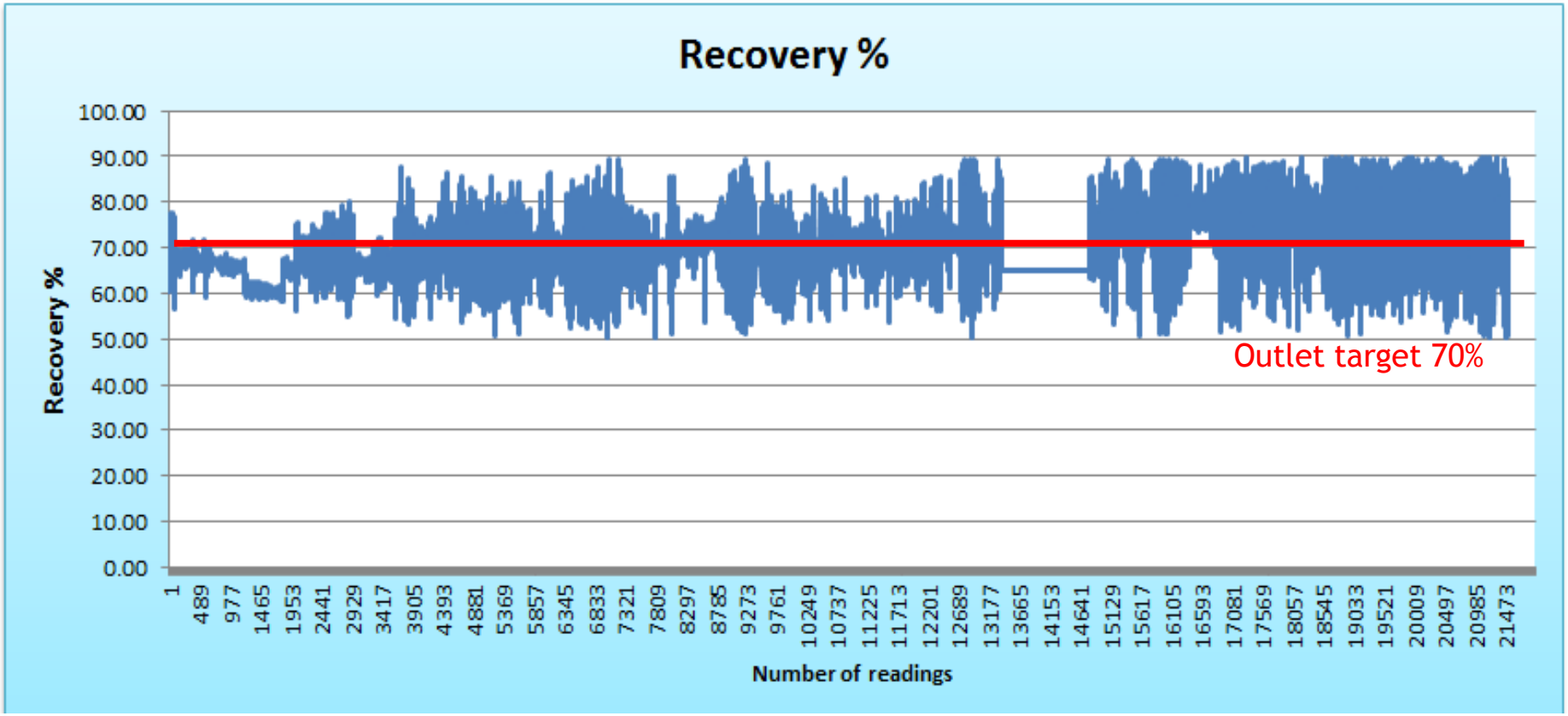
Parameter (ppm)	Outlet H2S, ppm (Actual)	Outlet H2S, ppm (Target)
Desalter Effluent,H2S	6.8	0.2

RO Membrane Performance



Overall Unit Recovery

- The average recovery has remained around 70% with variation in the range of 50-90%.



Conclusion

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Conclusion

- The pilot trial proved the concept through achieving:
  - the TDS specification requirement.
  - the overall wash water recovery of 70%.

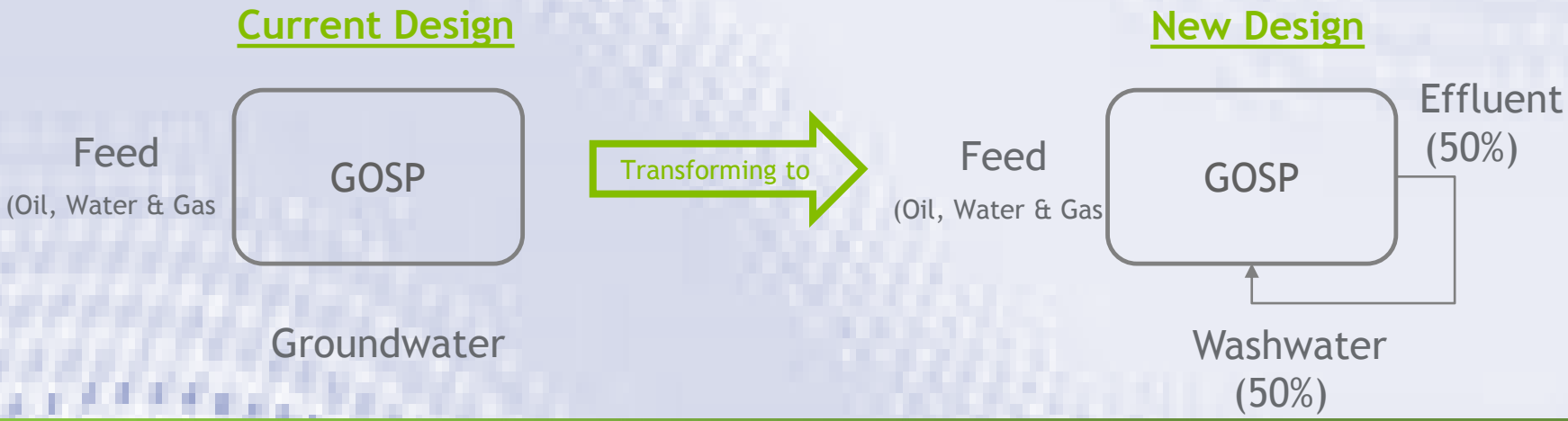
- P&CSD recommends the technology with the following enhancements:
  - Ceramic membranes.
  - H2S Stripper.

- Full case depolyment:
  - NPV for 1 GOSP of 300 MBOD is $0.9MM
  - KhCPF Savings of 9.2 MMBBL/YR with NPV of $3.6MM
  - 34.5 MMBBL/YR for all SAOO facilities

Potential Groundwater Conservation at Full Scale

580 Million liters/yr

Plan Forward



Questions?