

## Water Arabia 2013 Conference & Exhibition

*Innovative Water and Wastewater Technologies for a Sustainable Environment*

4 to 6 February, 2013

Le Meridien | Khobar, Saudi Arabia

# Addressing increasing wastewater volumes in industrial and oil & gas operations using thermal systems

## Ali Ben Haj Hamida

Global Leader

Enhanced Oil Recovery

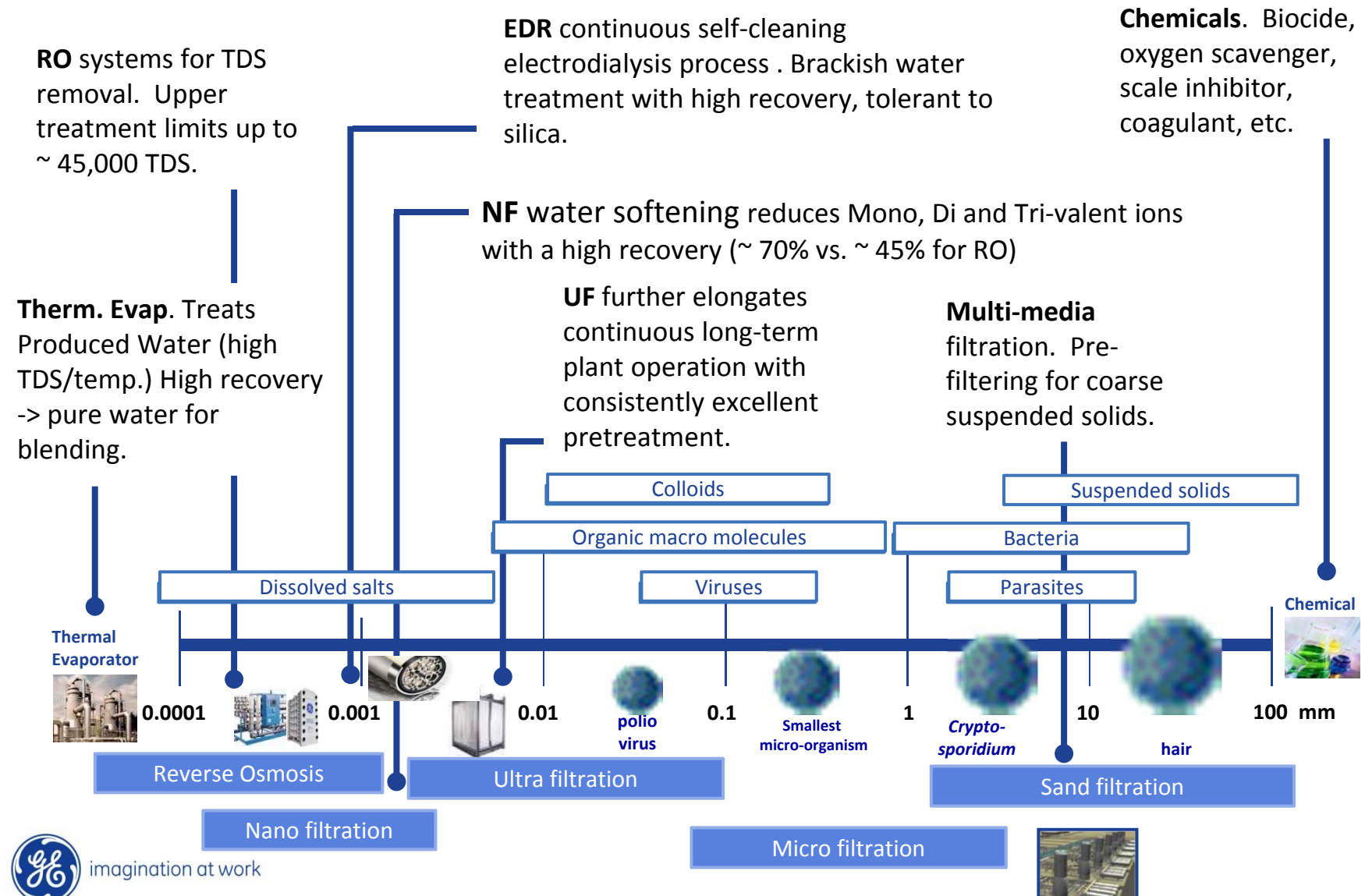
GE Power & Water, Water & Process Technologies

6<sup>th</sup> February, 2013



imagination at work

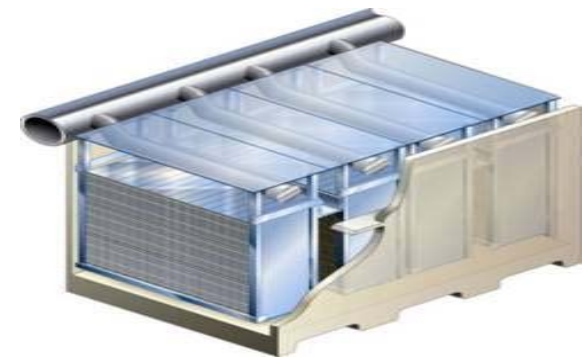
# The Water Treatment Spectrum



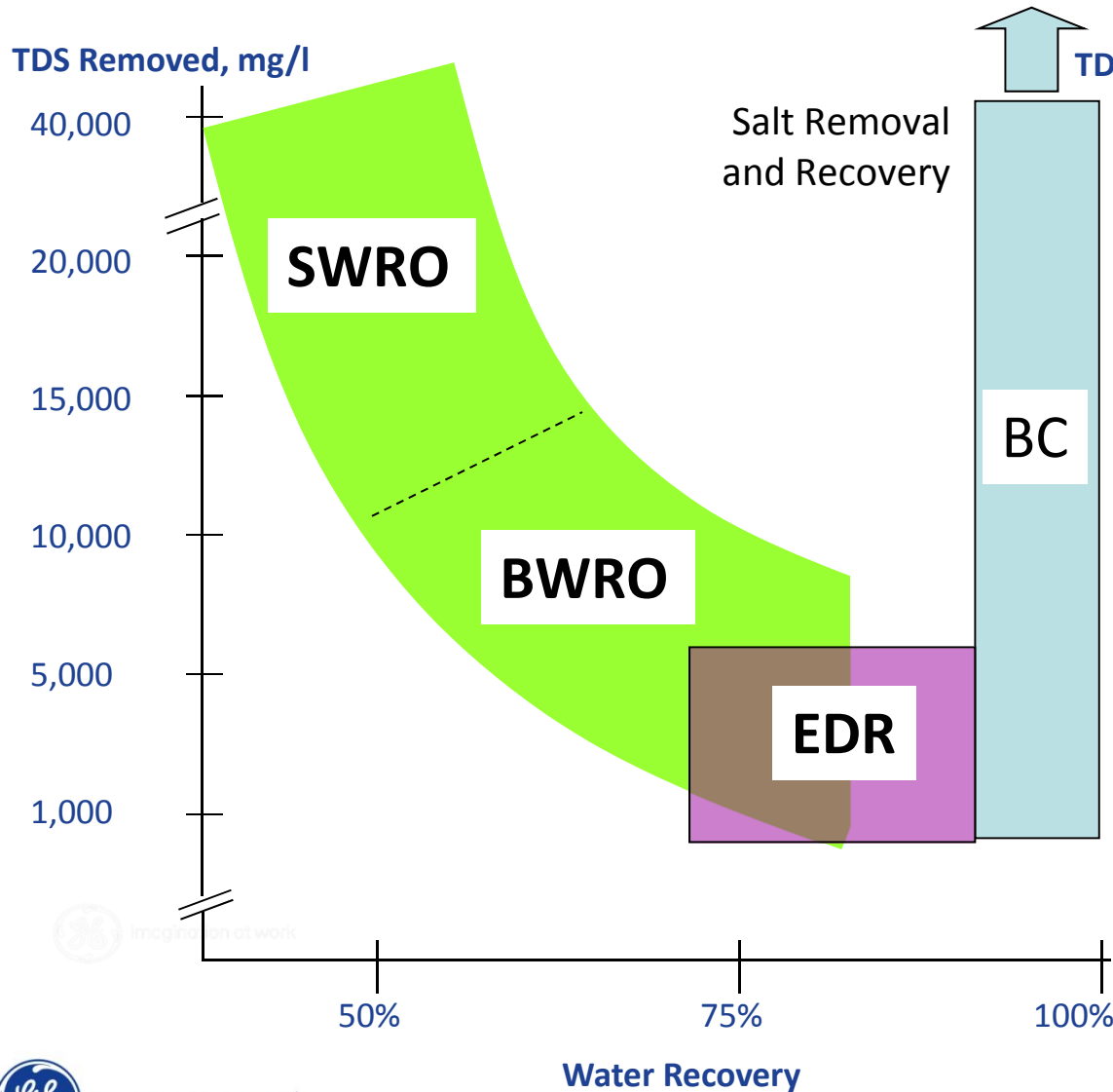
# Case Study

## IOR Water Injection Project – West Qurna

Project Name:	West Qurna IOR
State, region, country:	West Qurna, Basra, Iraq
Industry:	O&G, Upstream
Client:	SCOP, Ministry of Oil
EPC:	“EP”: GEW - “C” by : SCOP
Prime Technology:	UF & Deoxygenation
Capacity:	~4000 m <sup>3</sup> /h



# Application of Desal Technology



BC is uniquely suited to remove high salt levels AND achieve the highest water recovery for water scarce areas.

## Use Membranes if...

- technically feasible, given the cost advantage

## Use Thermal if...

- Zero Liquid Discharge is required
- TDS of the feed is high and scaling tendencies of the membranes are likely

## Use Membranes upstream of an Evaporator if ...

- The flow is large (> 100 GPM) and pre-concentration can be done, saving OPEX

# Difficult to Treat Water and Zero Liquid Discharge

# Thermal and ZLD

## Waste streams

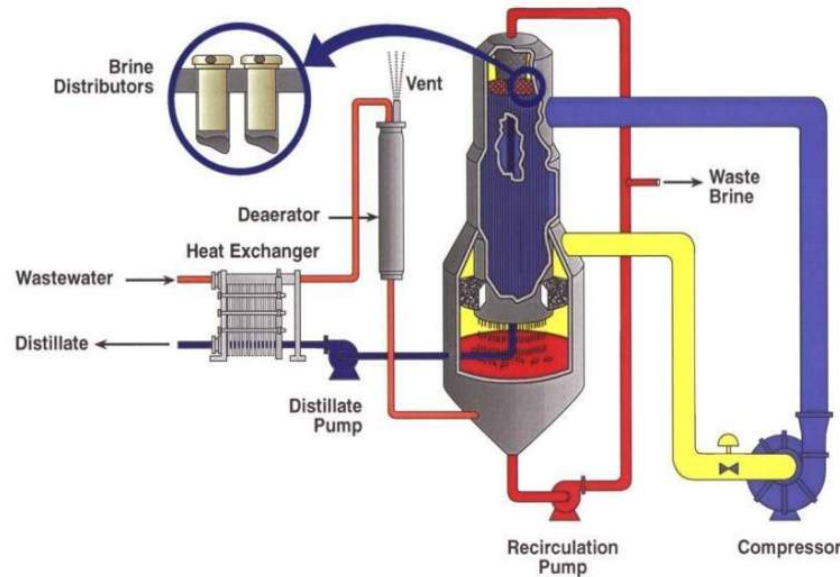
- Cooling tower blowdown
- Demineralizer waste
- Process wastewater
- Ash pond blowdown
- Scrubber blowdown
- Plant drains
- Produced water
- Oil Sands, SAGD
- Boiler blowdown
- Reverse osmosis reject
- Electrodialysis reject
- Mine drainage
- Salty effluents
- Landfill leachate
- Unconventional Gas, Frac Water/Shale Gas

## Drivers

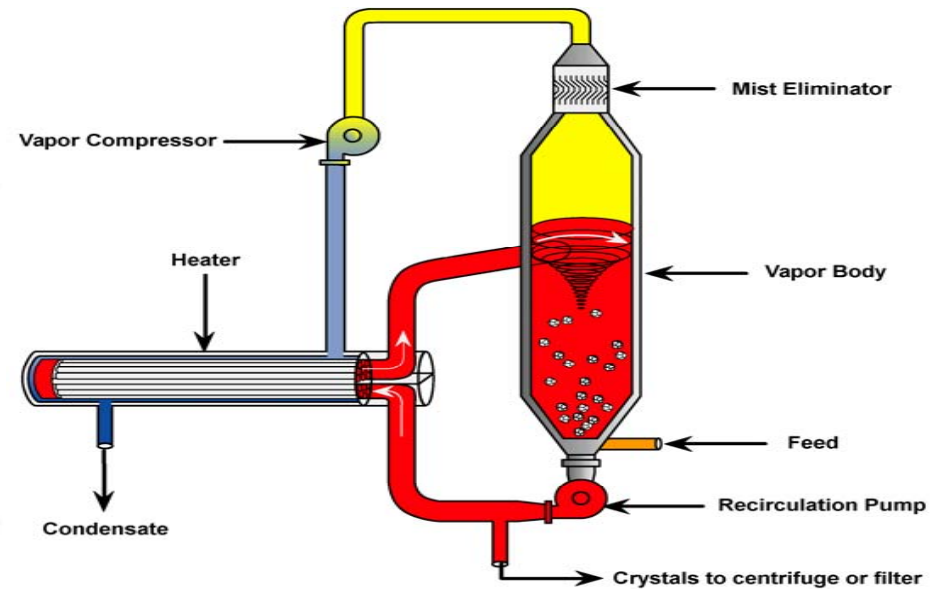
Environmental discharge regulations  
Water reuse quantity and quality  
Capital vs. energy costs  
Materials of construction  
Waste to value

# Evaporator and Crystallizer Technology

## Evaporator

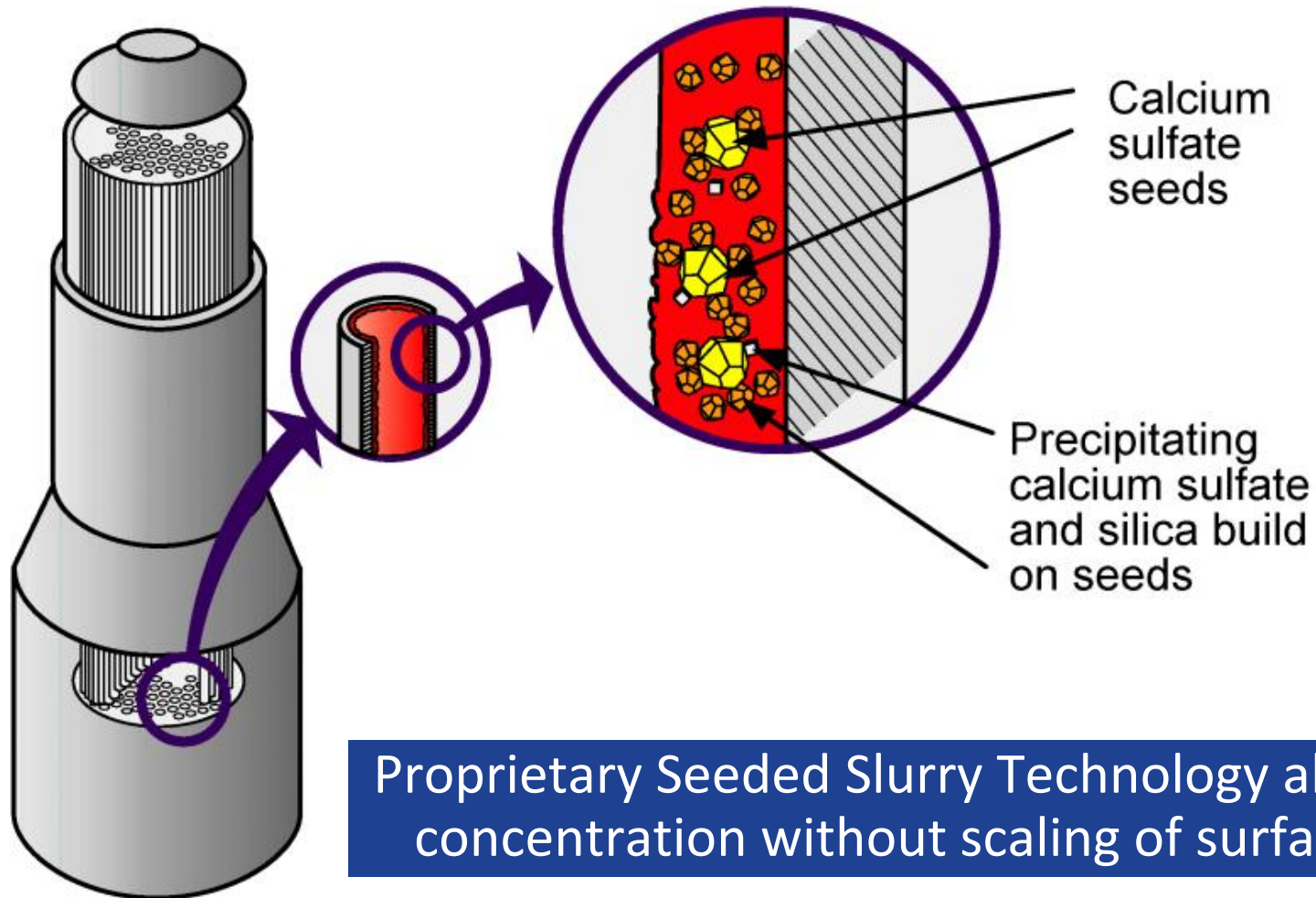


## Crystallizer



ZLD is achieved through the combination of evaporation followed by crystallization

# Seeded Slurry Technology





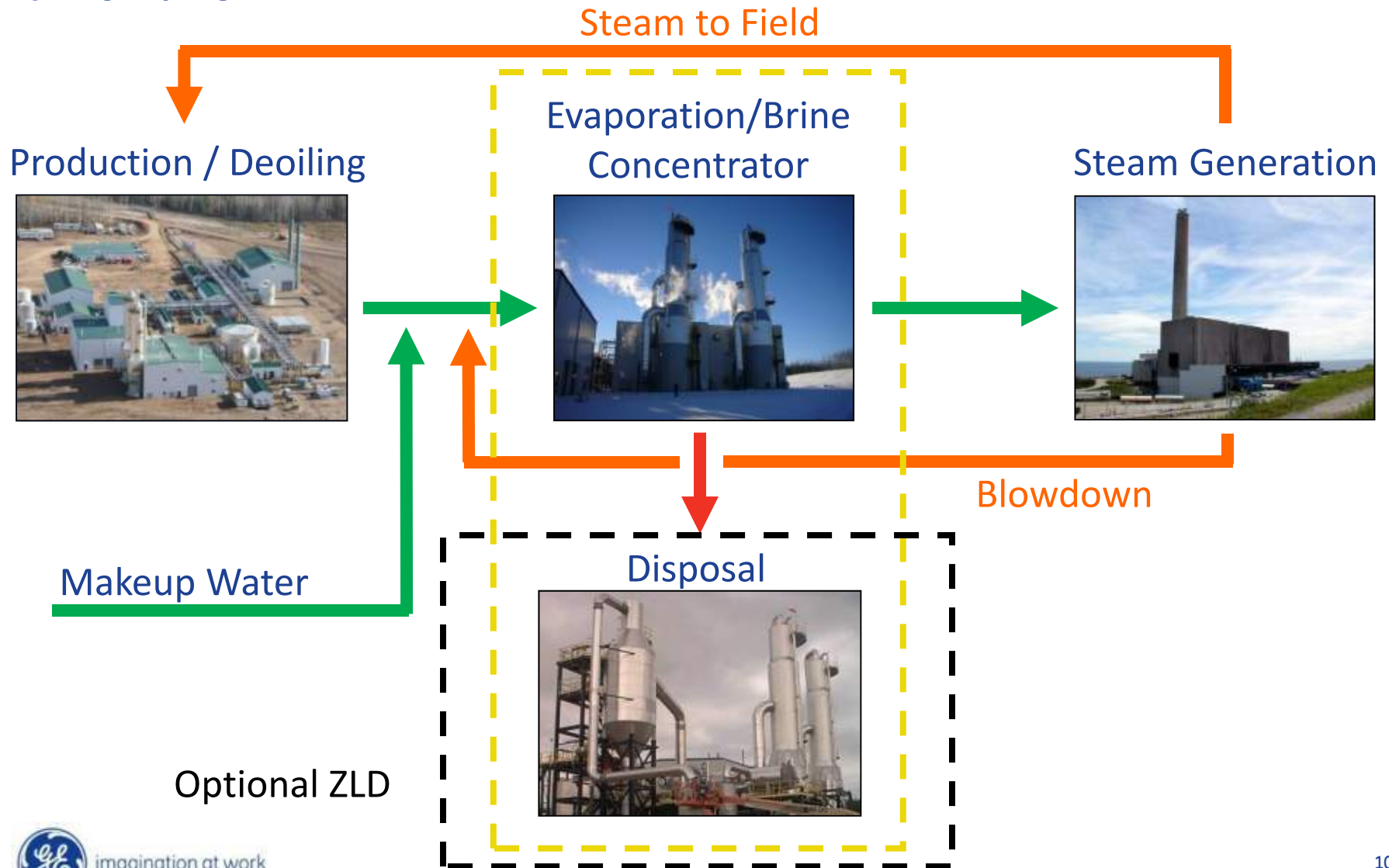
# Cedar Bay Brine Concentrator/Crystalizer



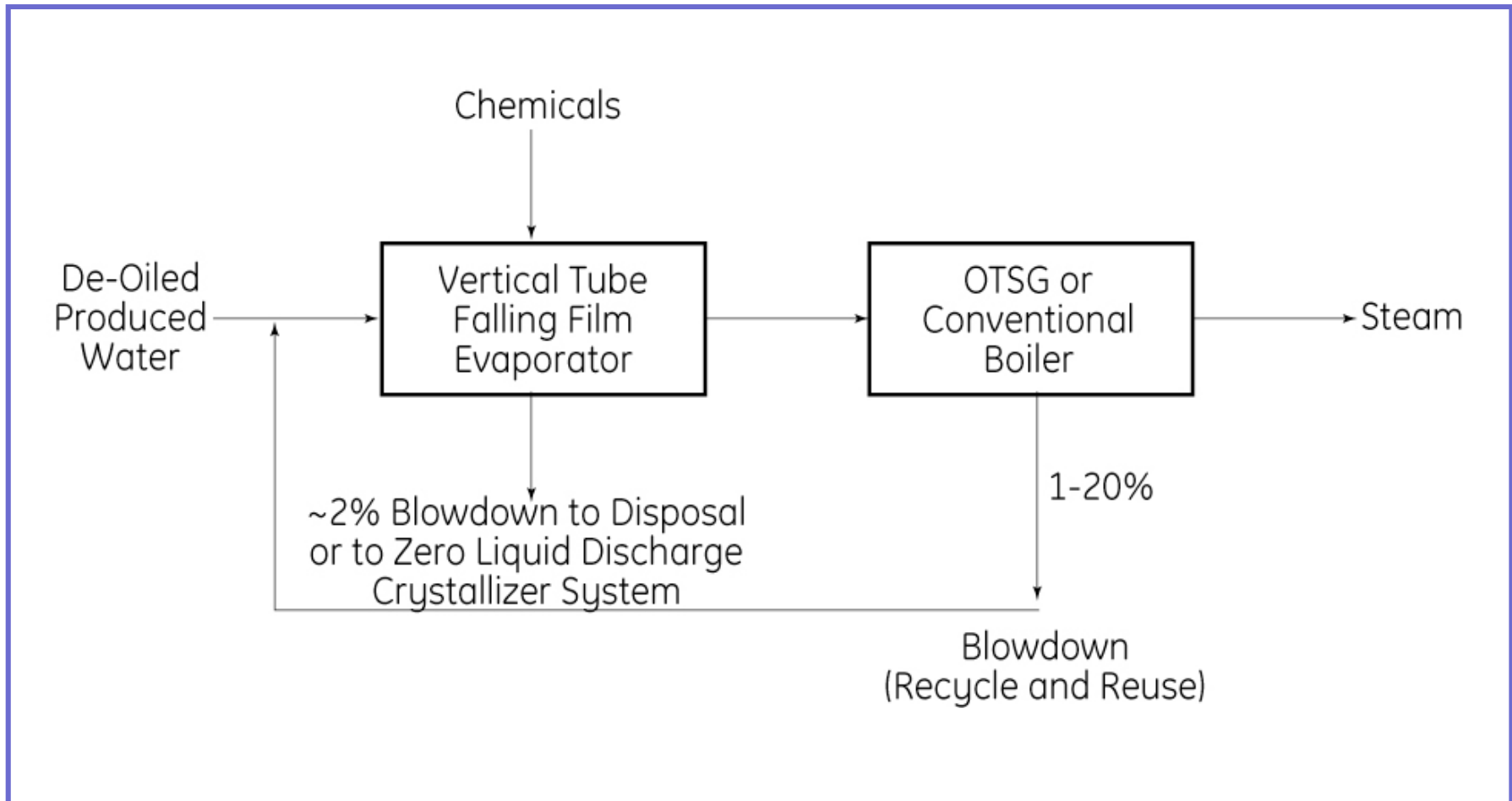
21,000 BBL/Day  
Fixed system

# Produced Water Evaporation Process

for Thermal EOR



# Produced Water Evaporation Process



# Evaporator and Crystallizer Benefits

## Brine Concentrator

- **Corrosion resistant titanium** —High grade construction means GE BCs will last for decades.
- **Scale control** —Proprietary seeded slurry tech. controls scale, limiting cleaning periods.
- **Patented brine distributors** —Individual tube distributors ensure a smooth flow of brine, avoiding scale formation.
- **Variable waste flows** — 10 gpm to 1,200 gpm for a single BC.
- **Energy-efficient** operation
- **Ability to run on electricity or steam**
- **Fully automated operation** —Maintain precise system control while minimizing operator interaction.

## Crystallizer benefits

- **Ease of use** —With simple color graphic controls and an automatic wash system, GE's crystallizers are easy to operate.
- **Ease of installation** —Skid-mounted, fully packaged systems with all auxiliary equipment and controls.
- **Valuable product recovery** —Systems can be designed to recover specific salts from a waste stream.
- **Expertise in zero liquid discharge** — GE has more than 35 years of experience developing and implementing thermal technologies to solve zero liquid discharge challenges for customers worldwide.

# ZLD – Creating Value



# Mobile Evaporator



imagination at work

# Tight (Shale) Gas -> Fracturing

- Tight gas reservoirs require fracturing to produce the gas
- Fracturing requires high volumes of water to prepare fracturing fluid.
- Fracturing results in even higher volumes of produced water and formation water flowback.
- Requirements are
  - Source water filtration, some options being
    - Mobile Ultrafiltration (UF)/Reverse Osmosis (RO)
    - Build-Own-Operate (BOO)
  - Produced water recycling, some options being
    - Thermal, membrane, filtration, chemistry



# Thermal Experience



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# GE Thermal Products & ZLD

- World leader in Zero Liquid Discharge (ZLD) technology
- 40 years of thermal waste water re-use experience
- Over 275 operating evaporator and crystallizer units at more than 150 installation sites.
- Supplied a majority of all ZLD systems

Canadian Oil sands projects recycle 80–95 per cent of water used.

