SWIT – Subsea Water Intake and Treatment

Subsea Water Injection for IOR

Deep Water Conference

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Content of presentation:
- Introduction to Seabox and SWIT
- SWIT – how does it work
- Benefits
- Wide range of water qualities
- Applications

SWIT is:
- *Superior quality clean water* generated subsea from surrounding seawater and ready for injection into subsea well
- SWIT is an *enabling technology* providing *game changing* possibilities for reservoir and asset management.
- Reliable and reducing total risk
Subsea WI - ‘De-coupling’ production and injection

- IOR / EOR, Reduced Risk, Cost and Emissions

Flexibility pays off:
- No long reach and complicated water injection wells
- No topside water treatment
- Reduced and optimized investments
- Reduced risk
- Decoupling production and injection well development, allowing for quicker ramp-up of production
Seabox is:

A Norwegian Subsea Technology Company founded around the patented SWIT (Subsea Water Intake and treatment) technology:

- Established 2004 by Apply Sørco and Poseidon.
- Successful laboratory testing in 2007 funded by ConocoPhillips and the Norwegian Research Council Petromax programme.
- 15 months successful SWIT pilot funded by major oil companies and NRC-Demo 2000. Concluded in 2010. Treatment results concluded to be superior to traditional technology.
- Newly completed Demo 2000 testing of SWIT combined with membranes for sulphate removal and low salinity water. Funded by oil majors and industry giant. Results have met or exceeded expectations.
What is SWIT?

*Subsea Water Intake & Treatment System for Water Injection*

- SWIT is full scale tested and qualified
  - 24 months operation

- From topside to subsea – no weight and space limitations:
  - *Superior quality* water due to a different concept
  - Large volume gives
    - Long residence time, 1-2 hours
    - Very accurate control of chlorine dosing
    - Low velocity – settling of particles by gravity
  - Hydroxyl Radical Generator kills remaining bacteria and mineralise organics at the outlet

- High reliability:
  - No rotating or moving parts
  - Redundancy installed
  - Very stable and favourable conditions at seabed

Example of 40 000 bpd unit

Easy replacement of cartridge every 4 years

PATENTED
Topside and Subsea Water Treatment Comparisons

**Topsides main equipment**

1. Lift pumps
2. Coarse Filters
3. EC package
4. Fine Filters
5. Chemical Injection Package(s) - up to 7 different chemicals
6. Deaeration tower(s)
7. Vacuum pumps
8. Booster pumps
9. Injection pumps

**Seabed main equipment**

1. EC cells
2. Stillroom
3. HRG cells
4. Injection Pump

**On the seabed there are no space and weight restrictions**

- This allows for a completely different approach for optimising effective disinfection, particle removal and reliability
- Large area electro-chlorinater grid for reliability, durability and minimised scaling issues
- Large treatment volume ensures long chlorine reaction time for very effective disinfection
Seabox - Control System

- Advanced Subsea Treatment Control
  - Robust and distributed control
  - Simple networked system maintenance

- Standard external device interfacing
  - SIIS, Modbus, OpenCAN, CiA, OPC
  - Easy system integration

- Smart Subsea Monitoring
  - Networked smart sensors
  - Redundant and scalable
  - Autonomous operation
Why SWIT?

- Reservoir management
  - IOR – optimised water injection – pressure support and sweep – full scale tested and qualified
  - EOR – SWIT combined with membranes will produce tailored water (i.e. low salinity). Full scale test completed.

- Significantly lower total cost
- Flexible – when and where you need water injection
  - Optimised reservoir and asset management
  - Increased production and recovery
- Higher regularity (as demonstrated in full scale test)
- Better energy efficiency – reduced cost and emissions

- Fully scalable technology
  - 15 k bpd to 500 k bpd units have been considered
- SWIT may be used in combination with injection of chemicals and surfactants
- The subsea approach enables easy storage of large volumes of chemicals, if required
What does SWIT look like?
Treatment capabilities SWIT combined with Membranes

Any required quality water including Low Salinity or Sulphate free water

Additional removal of particles down to < 0,1 my
Superior water quality for matrix flooding

SWIT:
- Disinfection
- Mineralization (HRG) of organics
- Removal of 99% of particles > 24 my
- Superior water for normal WI

Reverse osmosis
Hollow fiber MF
SWIT
SWIT - Main Product Families

**Product family 1: SWIT 40**
- SWIT 40 (40,000 bpd)
  - Superior disinfection and 99% removal of particles > 24my

**Product family 2: SWIT MF**
- SWIT MF
  - Micro filtration for “matrix flooding”. Superior disinfection and 100% removal of all particles >0.1 my

**Product family 3: The SWIT LSul**
- SWIT LSul
  - Sulphate removal or reduction for handling scaling issues and/or additional protection against reservoir souring

**Product family 4: The SWIT LSal**
- SWIT LSal
  - A 40,000 bpd low salinity unit including injection pump for furthermore enabling enhanced oil recovery
Applications, Summary

• **New developments** – taking full advantage of all knock-on effects
• **Optimising existing fields** in production – pin pointing infill locations for improved sweep
• **Tie-back of satellites** – SWIT allows in many cases a significant lower development cost making nearby potentials profitable
• **Gas Fields** – Enhanced Gas Recovery
• **Feed topside membrane plants** where sulphat removal is required, or low salinity water is used for EOR
• **Feed subsea membrane plants** (*
• **Test formation injectivity** for potential storage purposes
• **Dump water** in ‘almost depleted’ gas fields (no need for pump)
• **Other applications** where clean water is required (like gas compressor cooling etc)

*) Pilot successfully completed May 2013
Subsea Water Injection for IOR / EOR – SWIT

SWIT ready for use

- A complete integrated subsea water injection system can be deployed within 12 months!

- A range of water qualities can be produced subsea – from desinfection and solids removal, to matrix flooding water, and low sulphate and low salinity water for EOR.