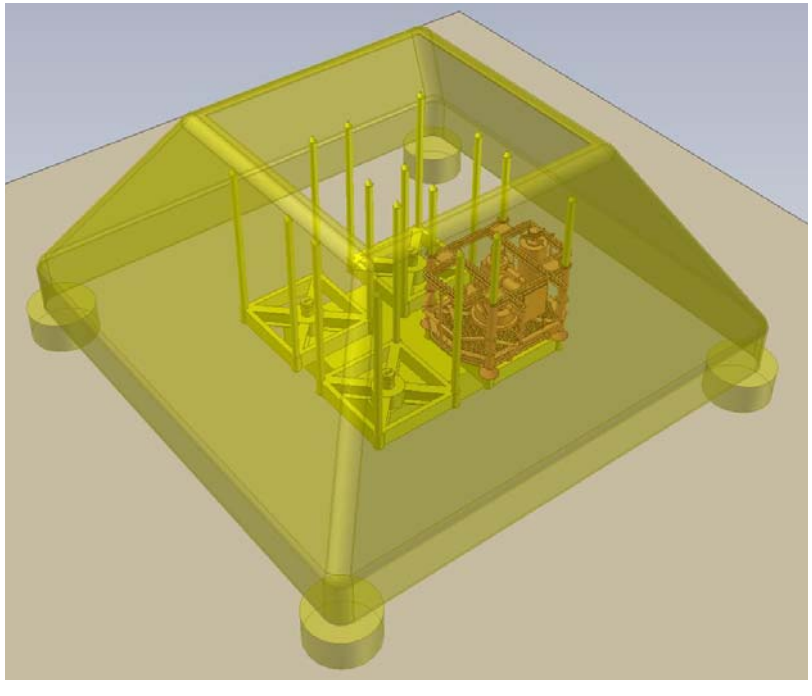
SWIT - Subsea Water Injection & Treatment
(patented)



Jan Olav Hallset
R&D manager
Poseidon Group AS

FFU seminar - February 2nd 2006, Stavanger

Well Processing

Poseidon Group AS

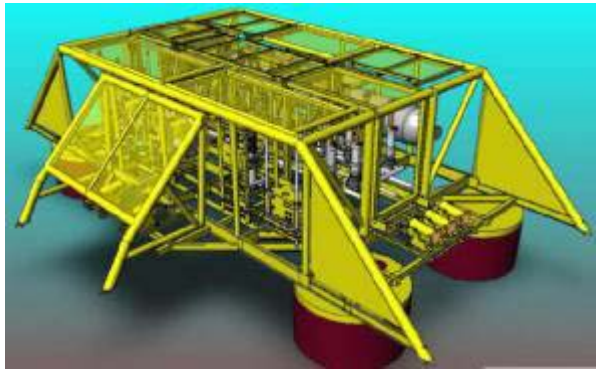
- Emerged from former Saga Petroleum's subsea operation department

- Established: 2000
- Staff: 70
- Offices: Stavanger, Bergen, Trondheim, Oslo, Aberdeen

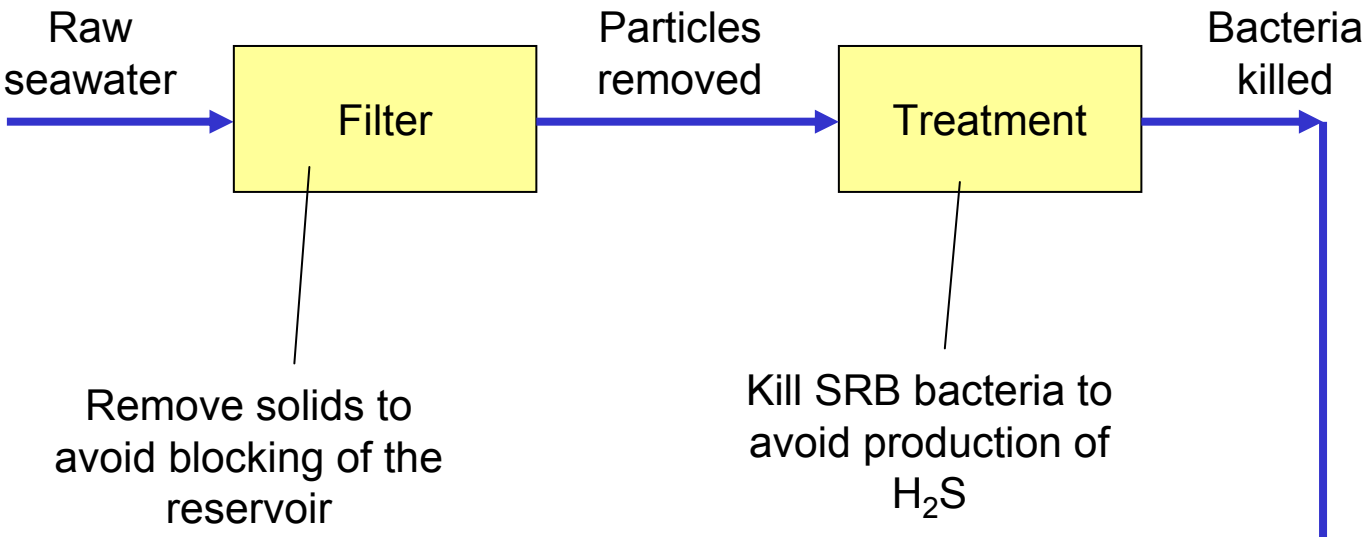
- We are specialists in subsea systems
  - We have focus on fields in operation (IOR)
  - We provide engineering services and solutions
  - We provide technology

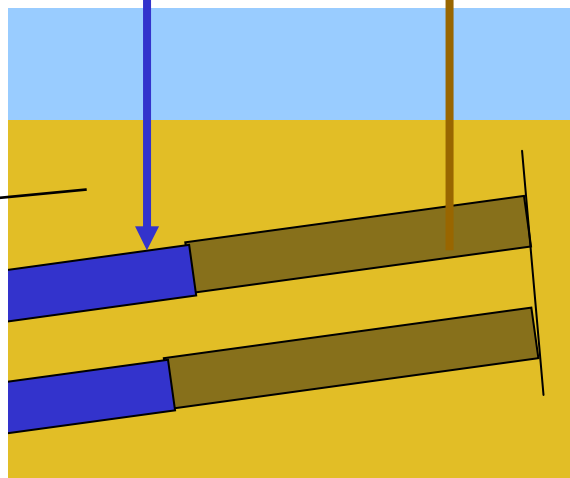
Subsea processing - overview

- Subsea processing includes
  - Pumping (boosting)
  - Separation
  - Produced water re-injection
  - Compression
  - Well intervention
  - **Raw water injection & treatment**
- Projects
  - Lufeng (1998)
  - Troll pilot (2001)
  - Tordis (2007)
  - Tyrihans (2009)
  - Ormen Lange (2014?)



Water injection?





Inject water to recover oil :

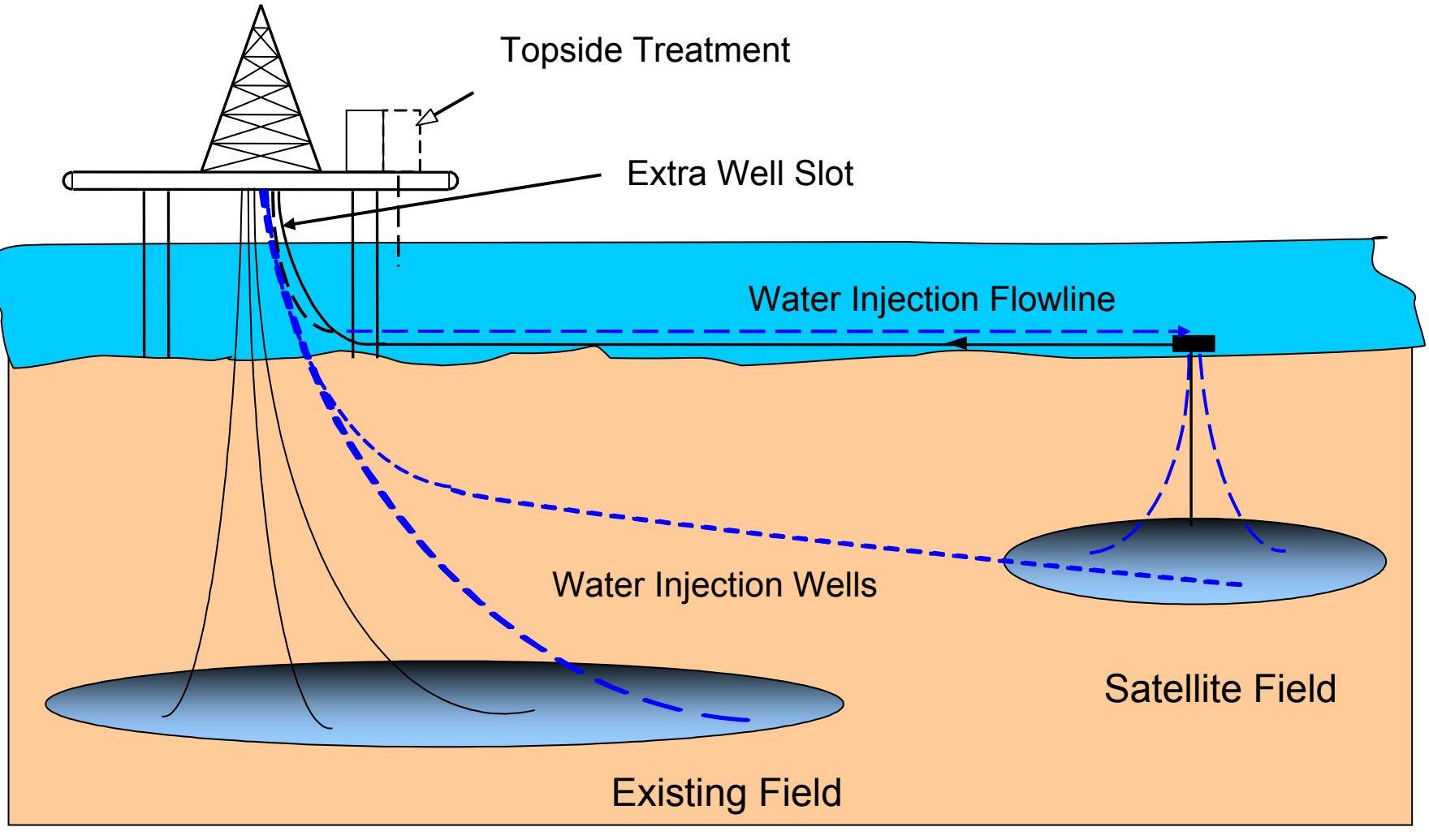
- Maintains pressure

- Drives oil to production well(s)

Bacterial Control Prevents Reservoir Souring

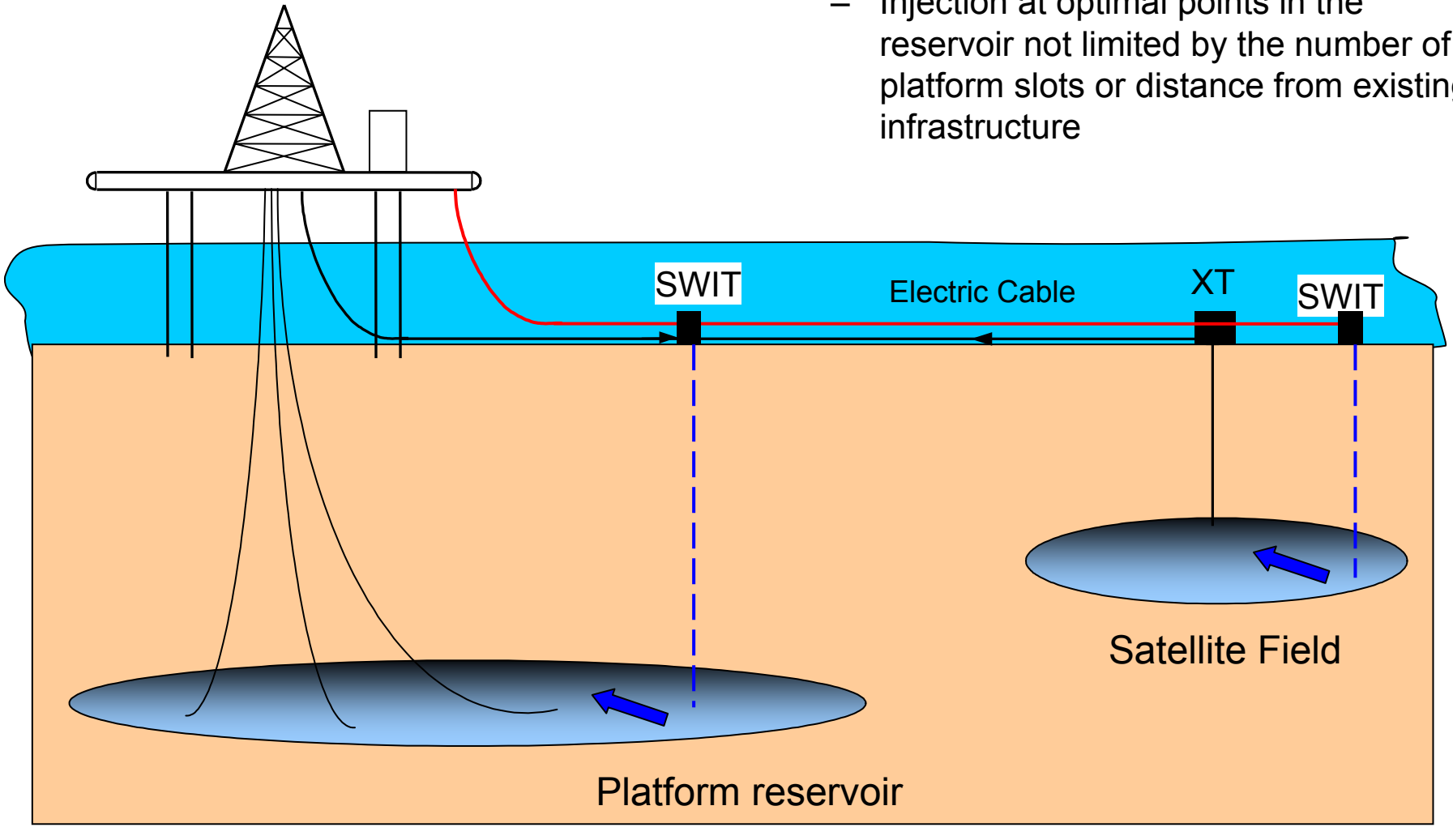
- Bacterial control prevents reservoir souring and generation of hydrogen sulphide
  - H2S is extremely toxic, flammable and it rapidly corrodes steel.
  - It has severe safety implications and reduces the value of gas and oil considerably
- A significant H2S content limits oil and gas export opportunities via existing pipelines
  - Processing will be required to remove it.
  - This significantly adds to processing costs.

Traditional Water Injection



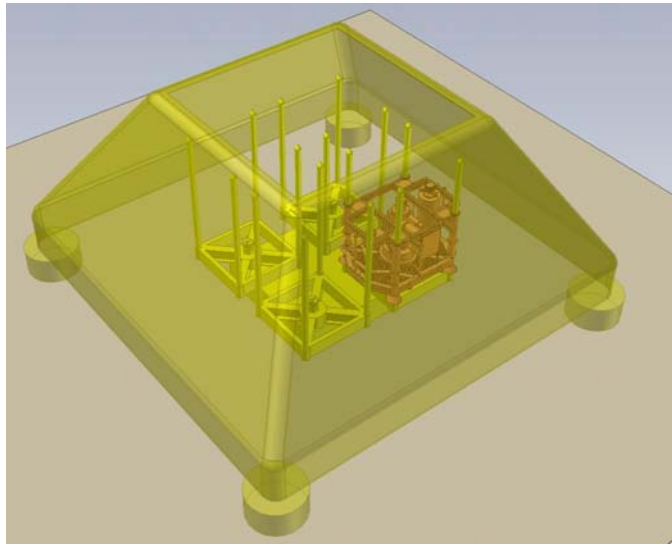
Typical Layout with SWIT

- Enables more effective field drainage
  - Injection at optimal points in the reservoir not limited by the number of platform slots or distance from existing infrastructure



SWIT is a cost effective solution for IOR

- Relocation of water treatment to the seabed
  - Simplified platform interface and reduced weight
- Eliminates injection flow lines
  - Reduces cost and energy consumption
- Reduced drilling and installation cost
  - Vertical wells
- All electrical, control and power through a high voltage cable
  - High cost umbilical is not needed

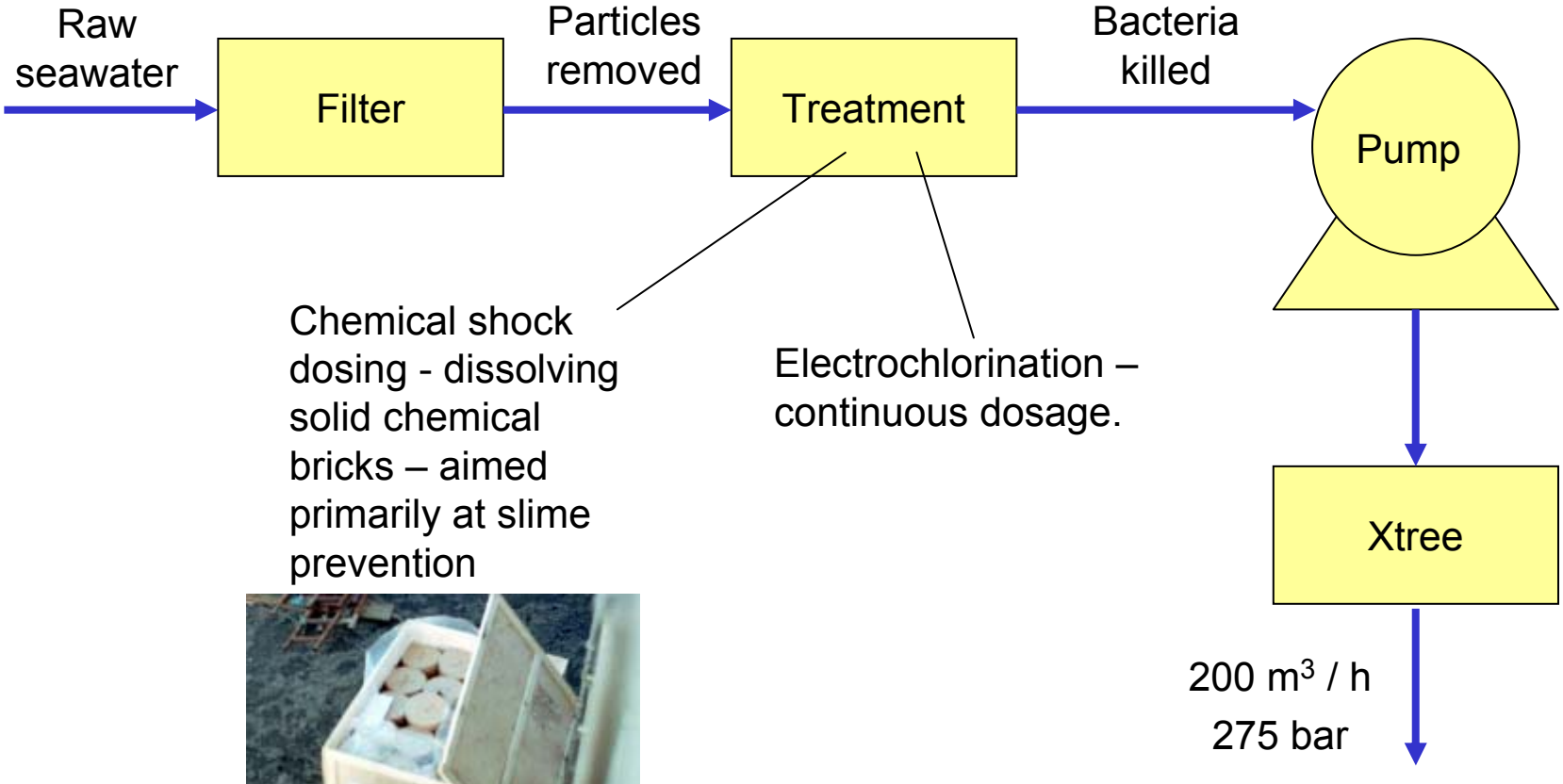


Ekofisk Feasibility Study - Design Basis

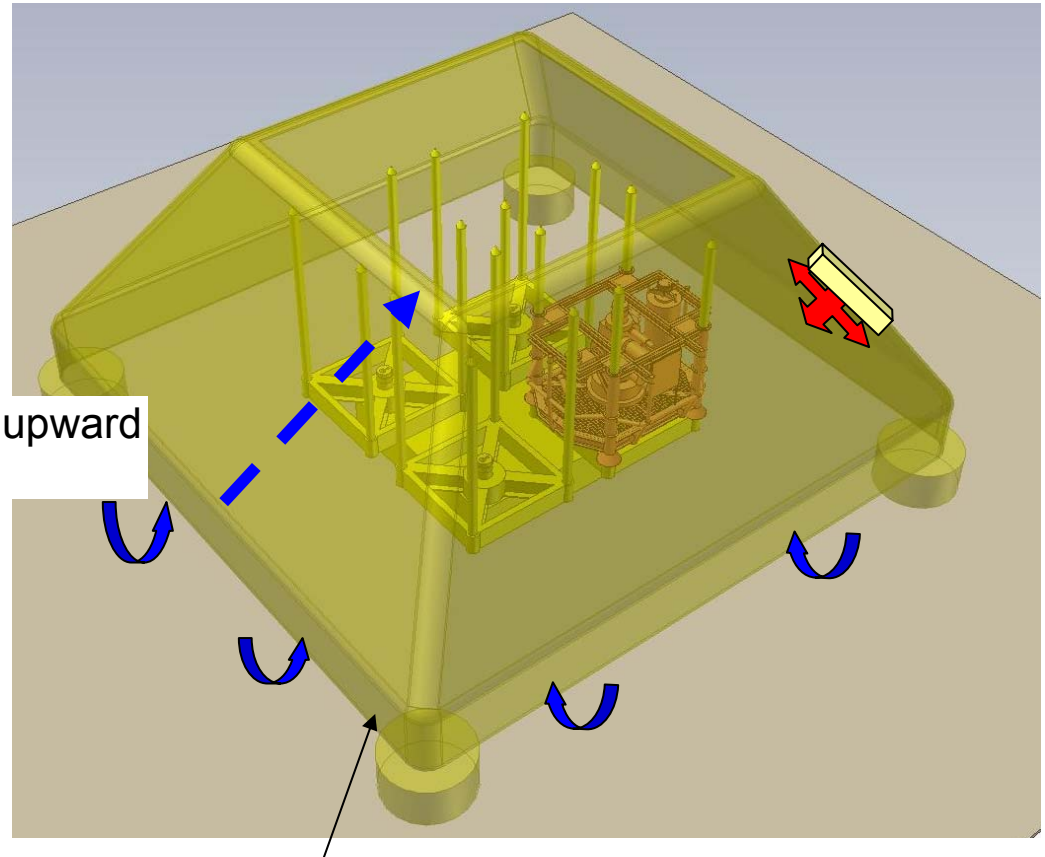
- Water treatment: Comparable with topsides
- Injection rate capacity: 67- 200 m^3/hr
- Differential pressure: 265 bar
- Power consumption: 2.5MW at 6600 volt
- Operational Philosophy: Condition monitoring required.
- Depth: 90 meters
- Design Life: 15 years
- Production regularity: 92%
- Intervention interval : Pump – 5 year
  Chemical refill – 1 year

- Well Interface: Compatible with all XT's

The SWIT process



Trawler protection = Filter

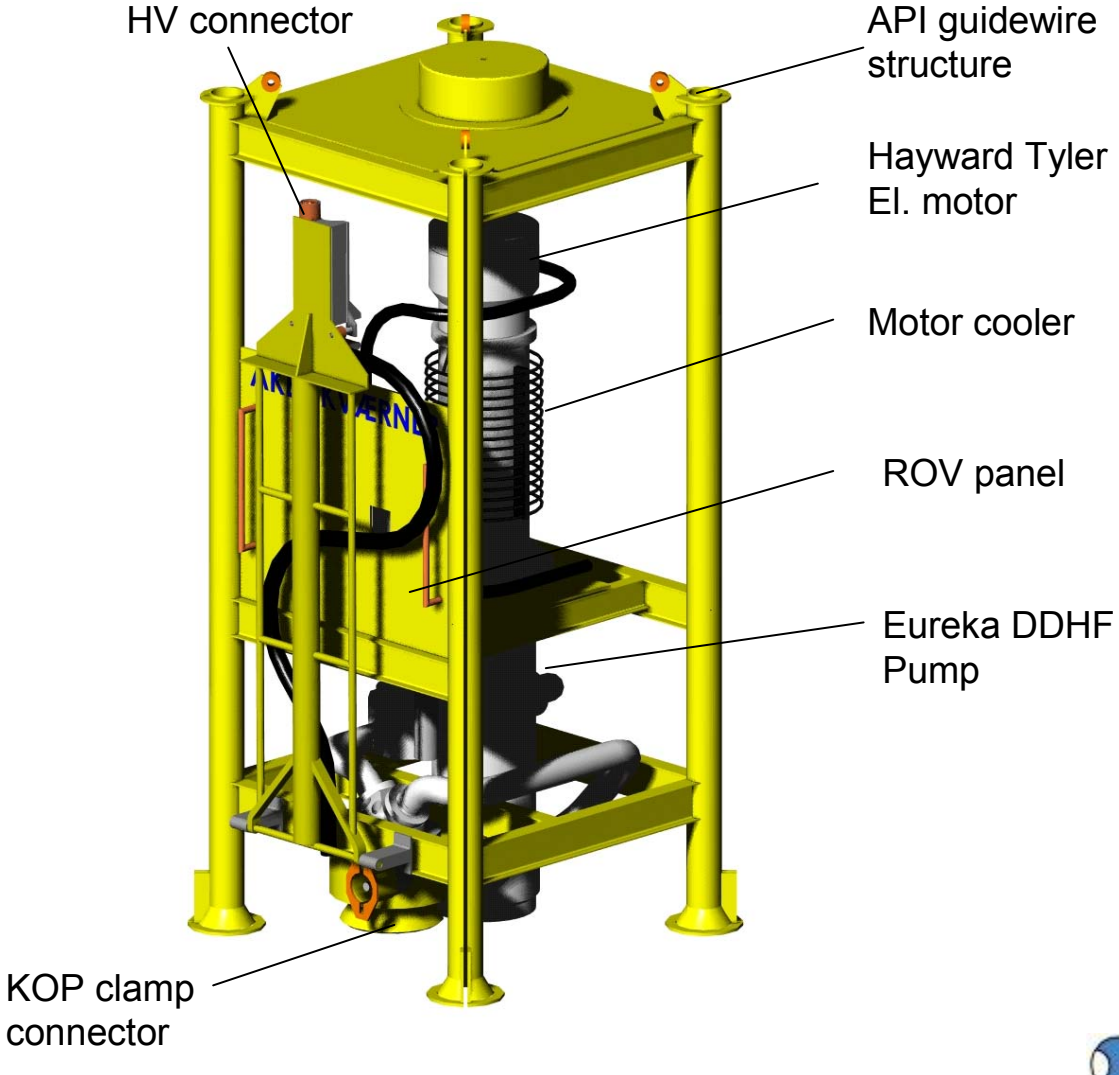


Ca. 3 hours upward flow time

Organic growth – copper ion release

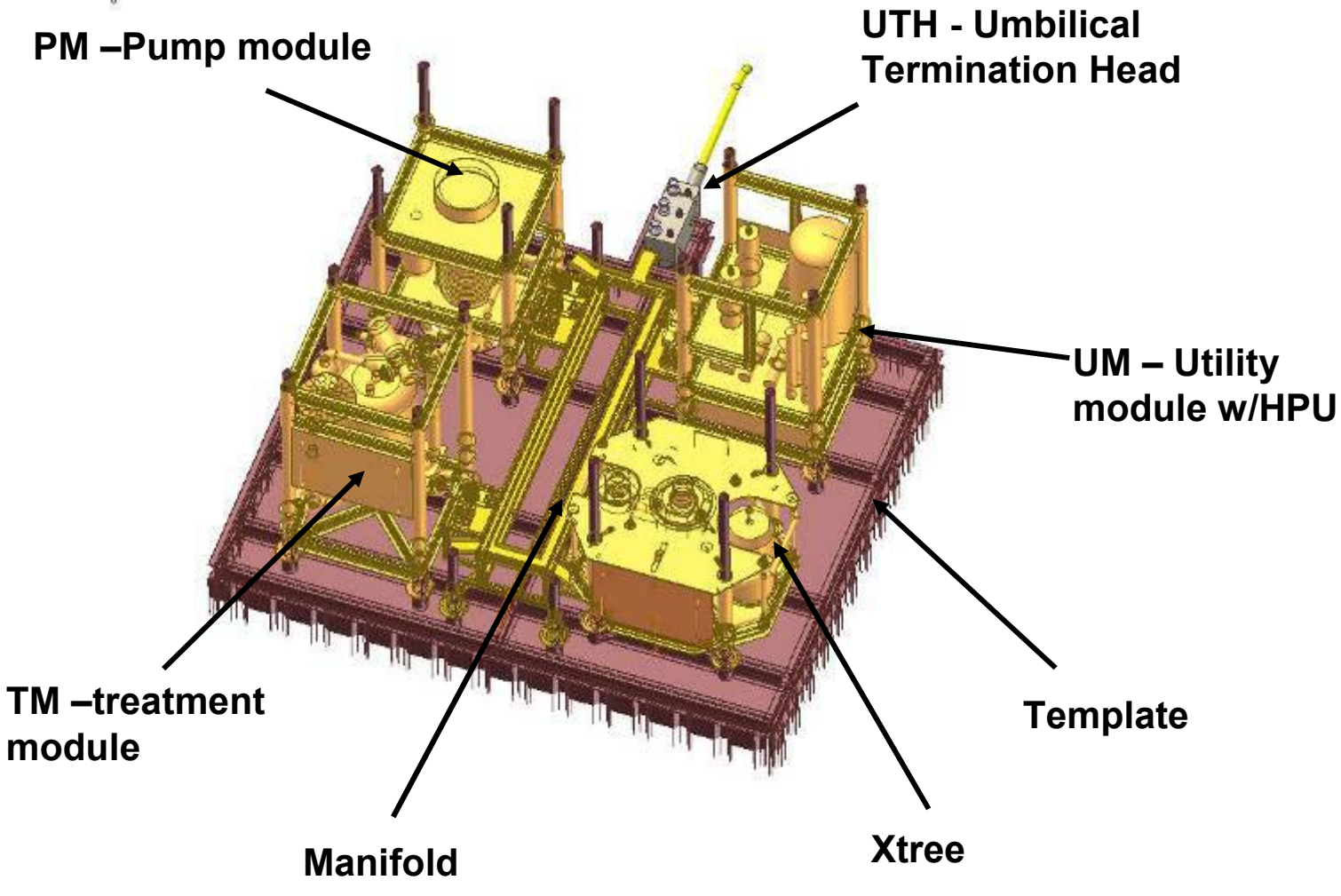
Strainer prevents entrapment of marine life – low water inlet velocity.

Pump module – made for subsea installation



Well Processing

The SWIT subsea module



An idea – Maintenance by an AUV parked in a subsea garage

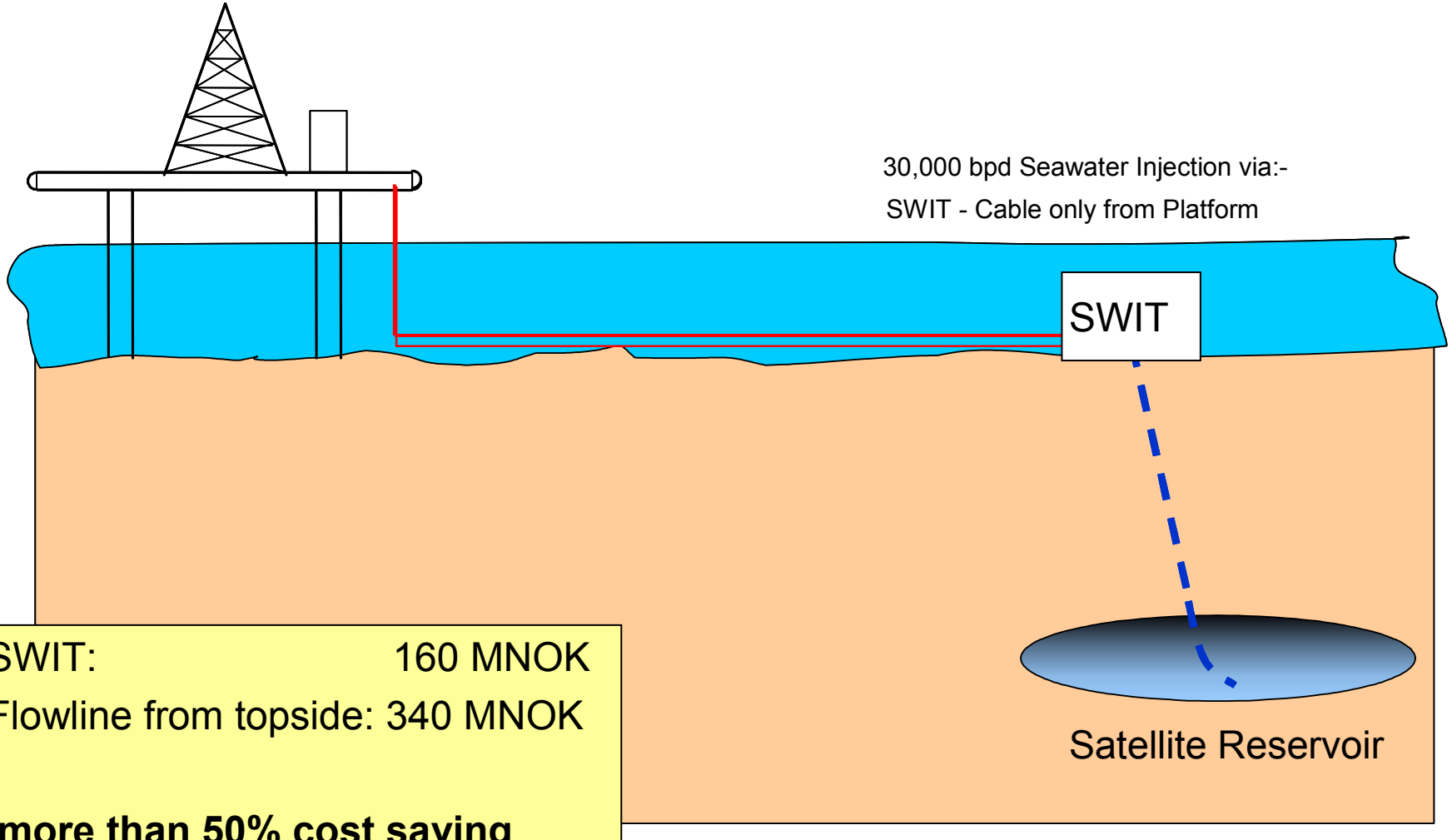
- Operated from a field centre or shore
- Always available, independent of weather and support ships.
- Capable of all types of inspection
- Capable of ‘light’ intervention

➔Fast detection and handling of incidents on subsea installations

➔ Reduced OPEX, as field personnel will operate the AUV

SWIT Cost comparison:

- Provision of 200m^3/h Treated Seawater to a Satellite Reservoir – 10Km



- SWIT: 160 MNOK
- Flowline from topside: 340 MNOK

- **more than 50% cost saving**

SWIT is a fast track development

June
2005

Phase 1 –
Conceptual Design
For Ekofisk

Jan
2006

Phase 2 –
Testing of key
components

Jan
2007

Phase 3 –
Detailed Design
of pilot

March
2007

Well Processing

- a provider of engineering services for subsea processing

- The company is jointly owned by:
  - Poseidon Group AS (www.poseidongroup.no)
  - Sørco AS (www.sorco.no).

- Our sponsors:
  - ConocoPhillips (www.conocophillips.com)
  - The Research Council of Norway (www.petromaks.no).