

DORIS Engineering

Subsea Processing Technology

Society of Underwater Technology

Perth, October 2019



Agenda

- **Multiphase Pumping**
 - Case Study: TOTAL Moho-Bilondo Project, Congo
- **Subsea Separation**
 - Case Study: TOTAL PAZFLOOR Project, Angola
- **Subsea Storage & Chemical Injection Station**
 - Enabler of very long subsea tiebacks

A large offshore oil platform is shown in the foreground, featuring a complex network of pipes, walkways, and a crane. A long subsea pipeline extends from the platform across the ocean. In the background, another offshore vessel is visible on the horizon under a blue sky with scattered clouds.

Subsea Multiphase Pumping

Multiphase Pumping

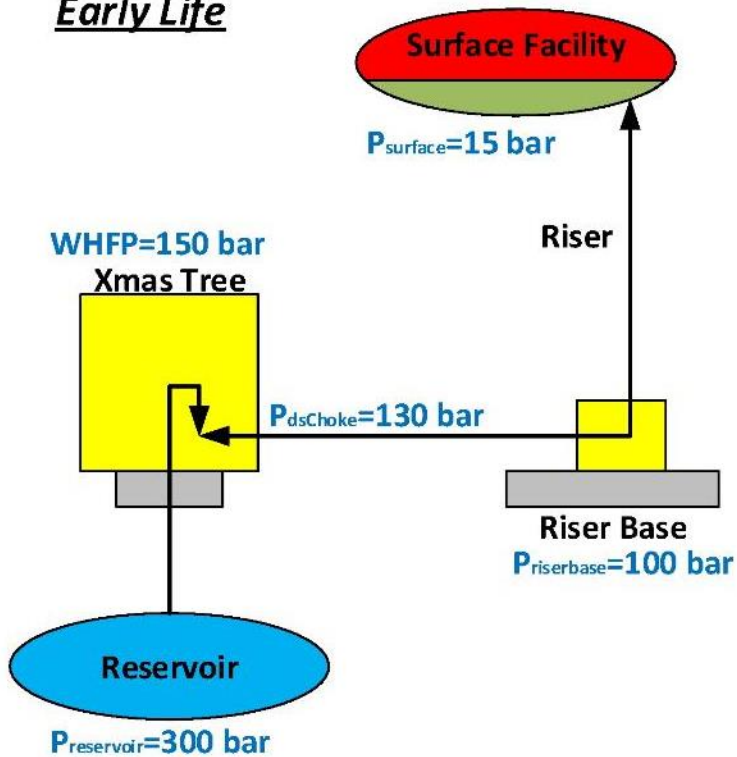
- Field proven technology
- Facilitates:
 - Increased initial production rates when installed at start of field life
 - Enhanced recovery when MPPs are installed at end of field life
 - Production of heavy oil reservoirs
 - Production of low-pressure reservoirs
- Avoids bottom hole gas lift
- Increased field life due to longer production plateaus

BUT!

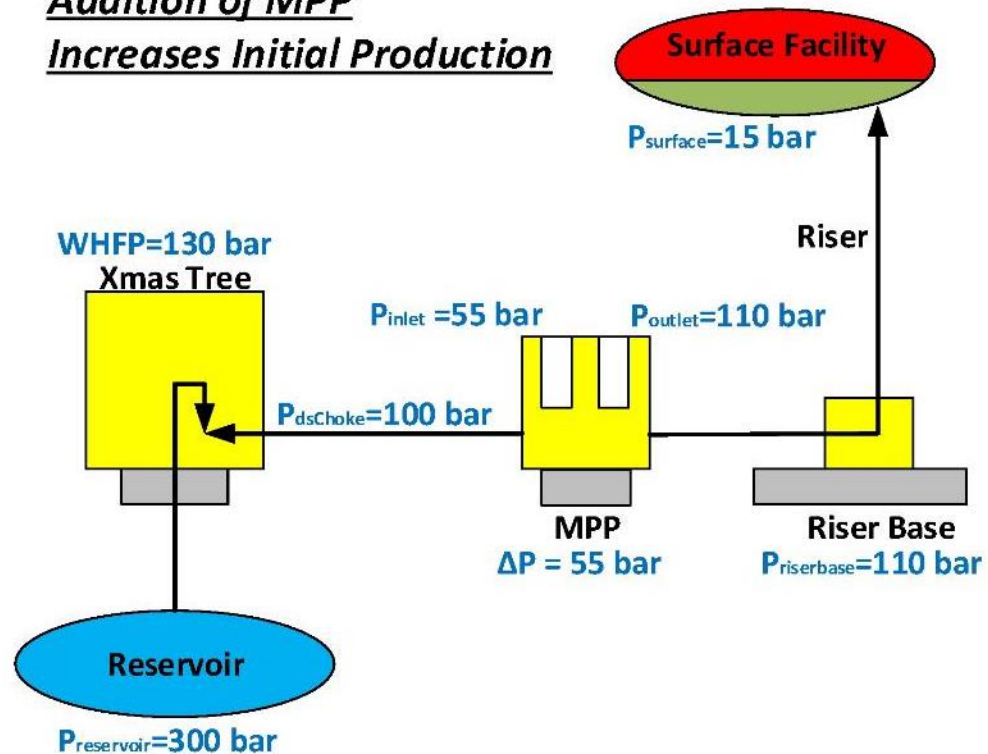
- Positioning the MPP is important!

Early Field Life - Impact on Network Pressures

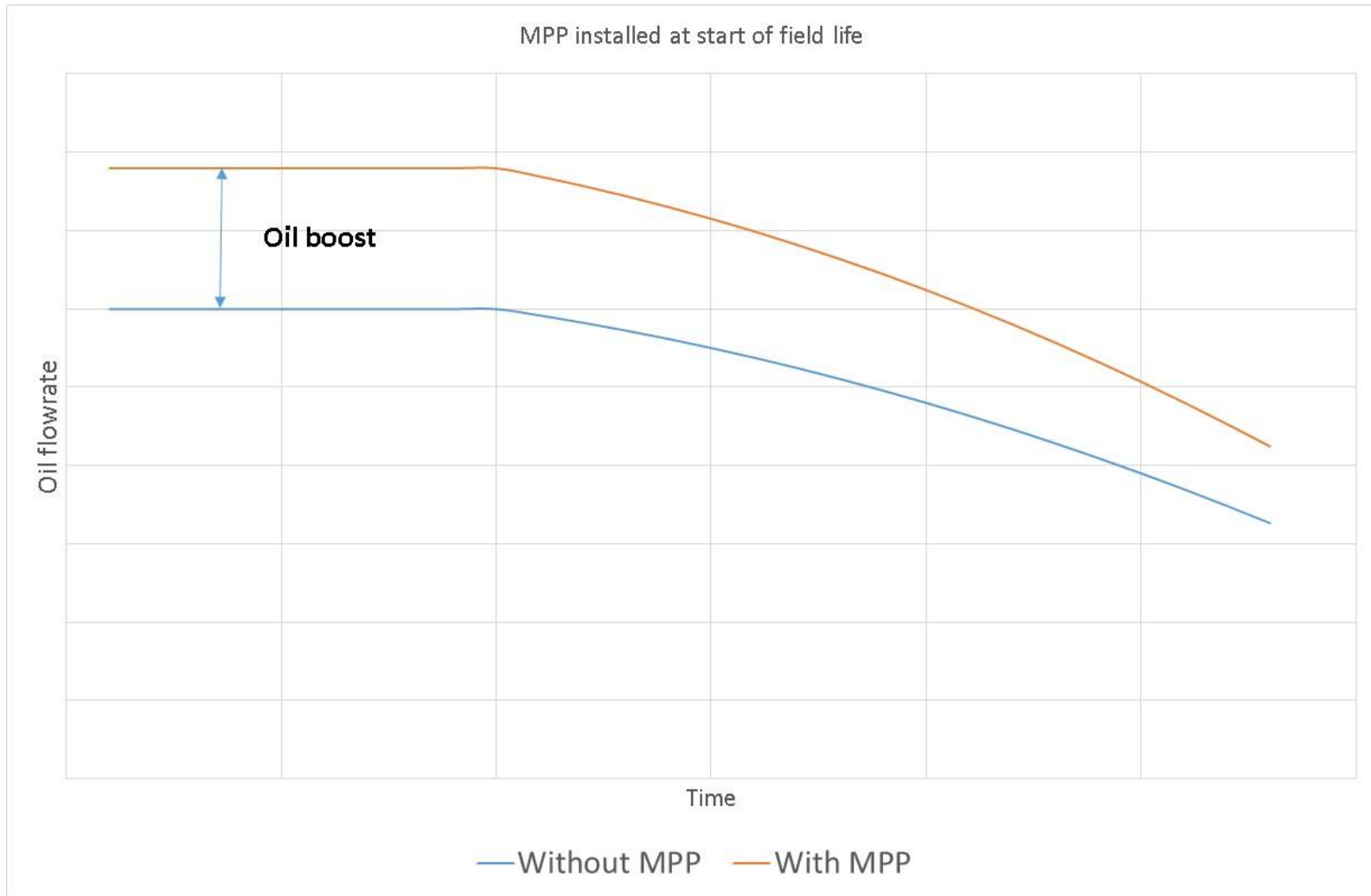
Early Life



Addition of MPP Increases Initial Production

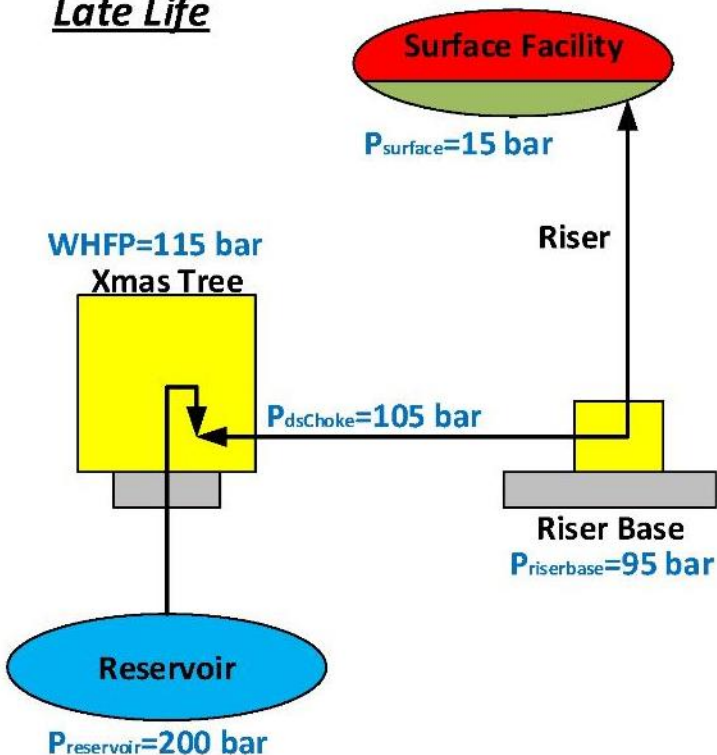


Early Field Life - Boost Oil Recovery

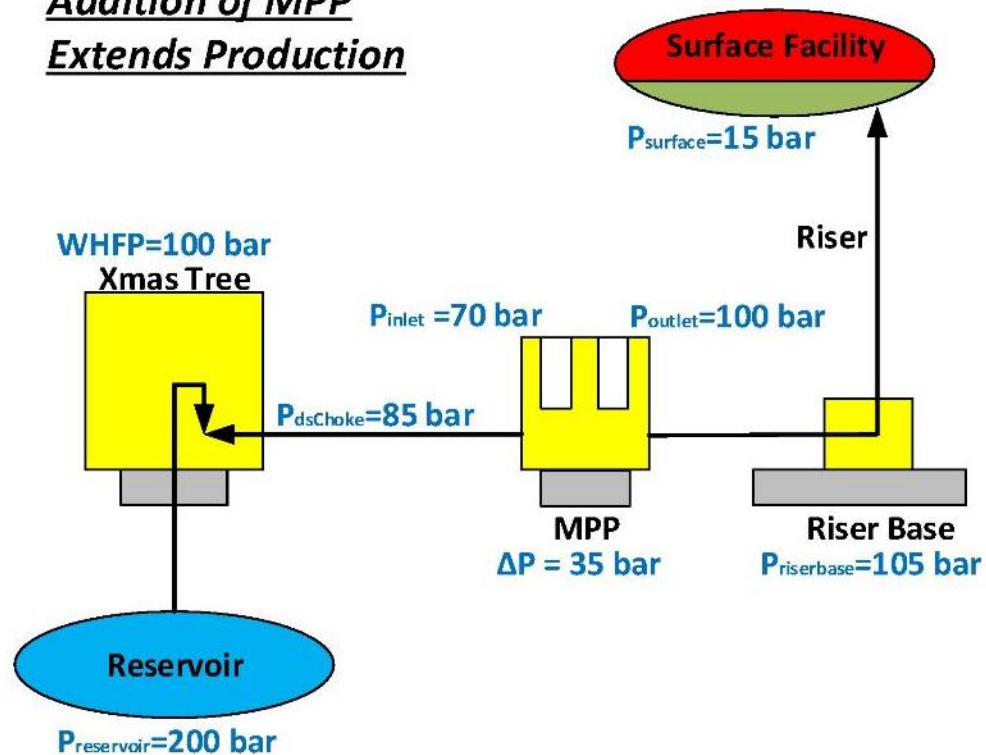


Late Field Life - Impact on Network Pressures

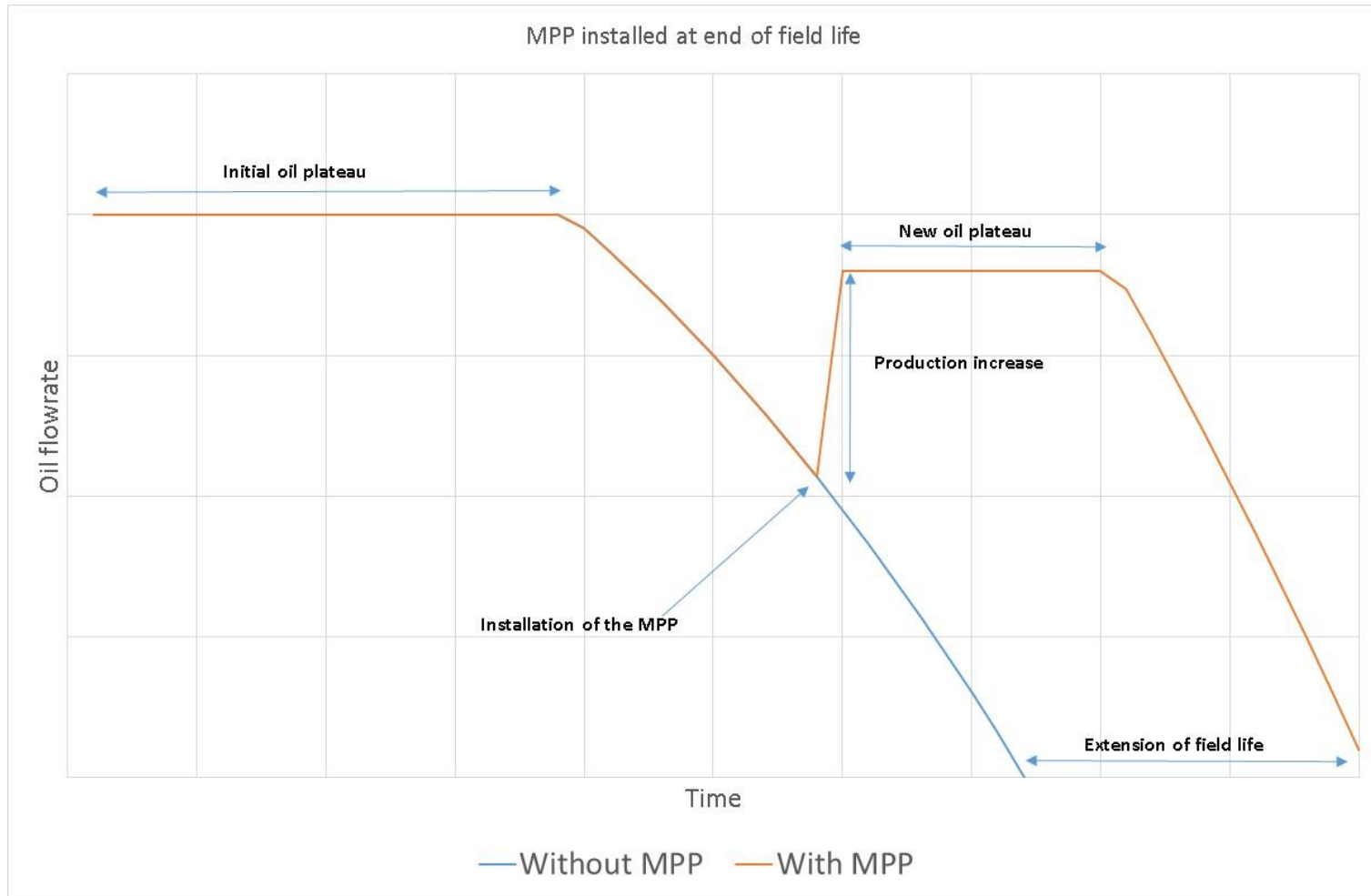
Late Life



Addition of MPP Extends Production



End of Life - Enhanced Oil Recovery



Case Study:

TOTAL Moho-Bilondo

Moho Phase 1 (Congo) | FEED 2013

- **FEED phase covering**
 - Subsea tie-back on Moho Bilondo
 - Hybrid loop architecture, jumpers and XTs
 - MPP integration onto new hybrid loop
- **Main activities**
 - Flow Assurance
 - MPP system design
 - Flowline design
 - SPS Equipment functional specification
 - Contracts & Interfaces Packages preparation
- **Main highlights**
 - Fast track project

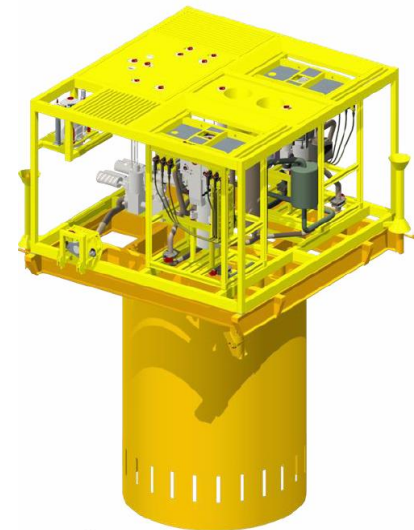
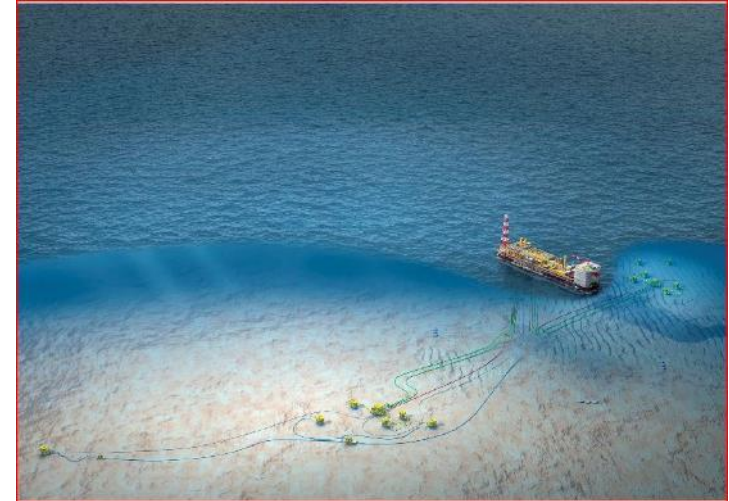
MPP
3,5 MW

Hybrid
Loop

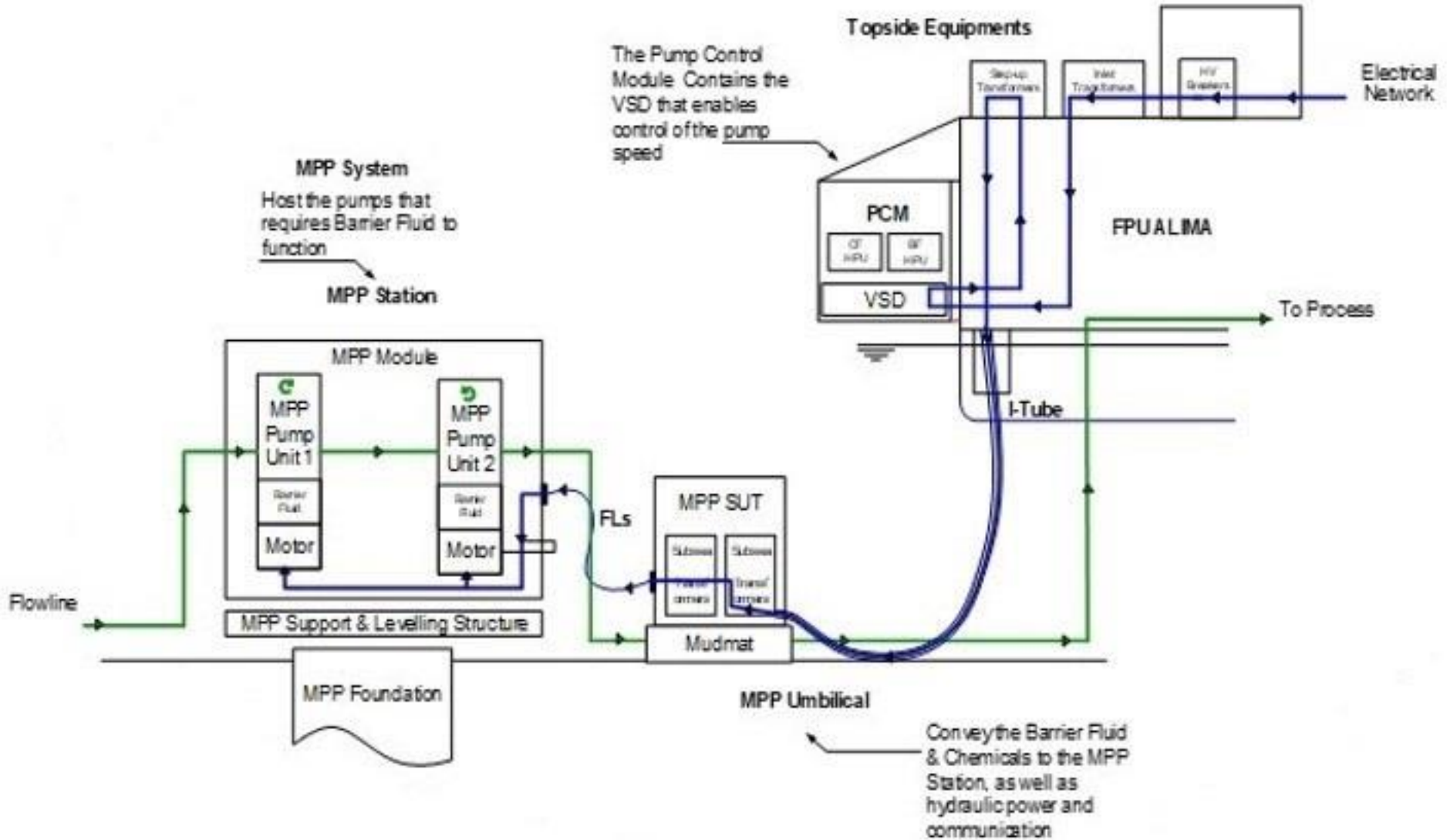
Flow
Assurance

Contracts
&
Interfaces
Packages

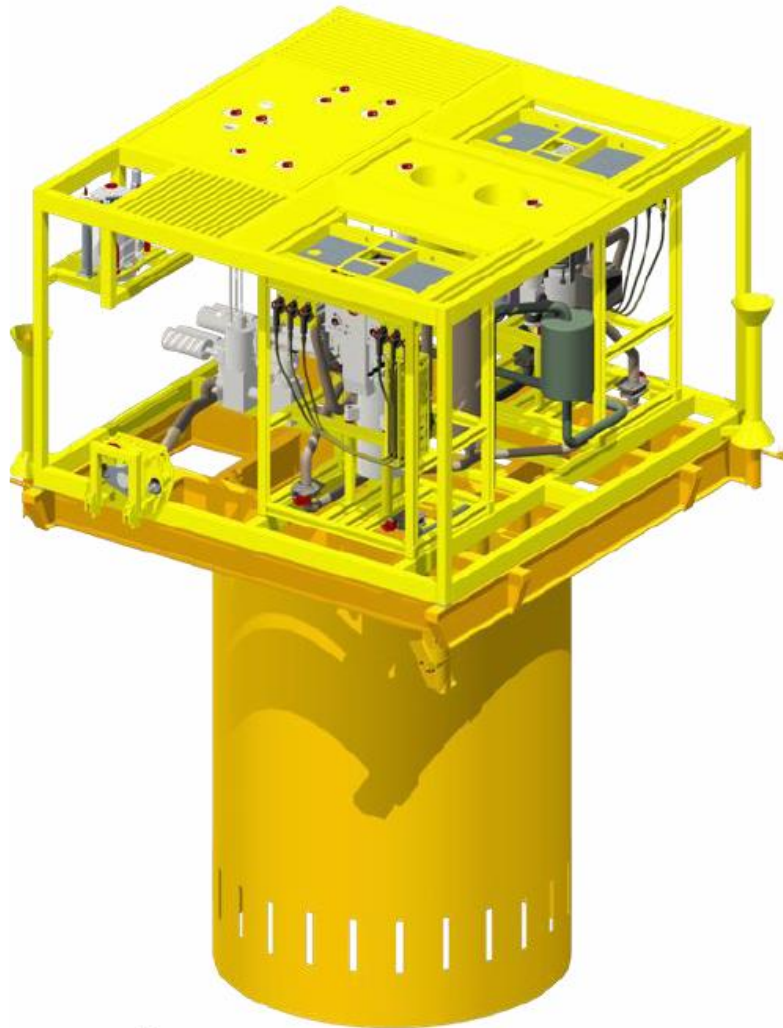
Fast Track



Moho-Bilondo MPP System Layout



MPP Station



Pump Units

Chokes

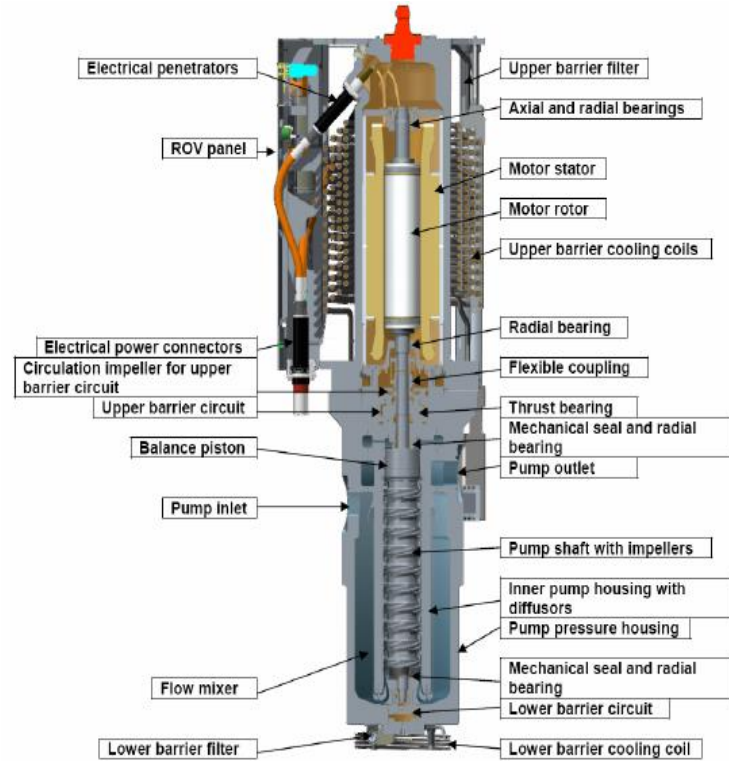
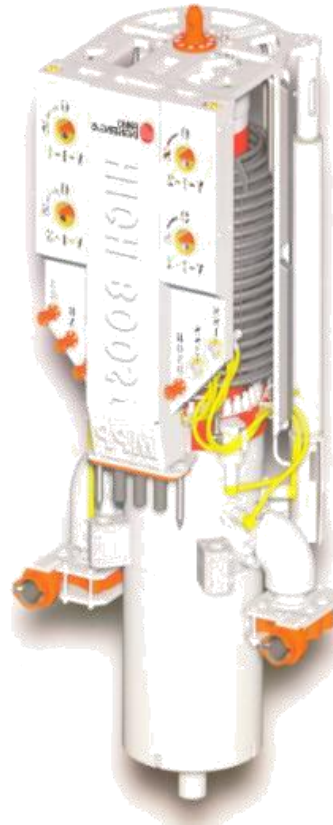
SCM

Pump Module

Intermediate
Frame

Suction Anchor

Pump Unit & MPP



A large offshore oil and gas platform is shown in the foreground, featuring a complex network of pipes, walkways, and a crane. In the background, a support vessel is visible on the ocean. The image is overlaid with a dark blue semi-transparent shape on the right side, which contains the title text.

Subsea Separation

Subsea Separation

- The term refers to complete separation units installed on the seabed as fully integrated and remotely operated facilities.
- Operations benefits:
 - Stabilised flow regime in risers
 - Improved artificial lift
 - Possibility of disposal or re-injection of water subsea
- Cost savings:
 - Reduced thermal insulation and MEG / methanol requirements
 - Potential size reduction of downstream facilities
 - Reduced size of first stage separator

Case Study:

TOTAL Pazflor

PAZFLOR Field Layout

FPSO :

Oil storage : 1.9 million barrels
Oil production : up to 220,000 bpd
Water injection : 382,000 bwpd
Gas compression : 4.3 MSm³/d
Power generation : 120 MW

Offloading Terminal :

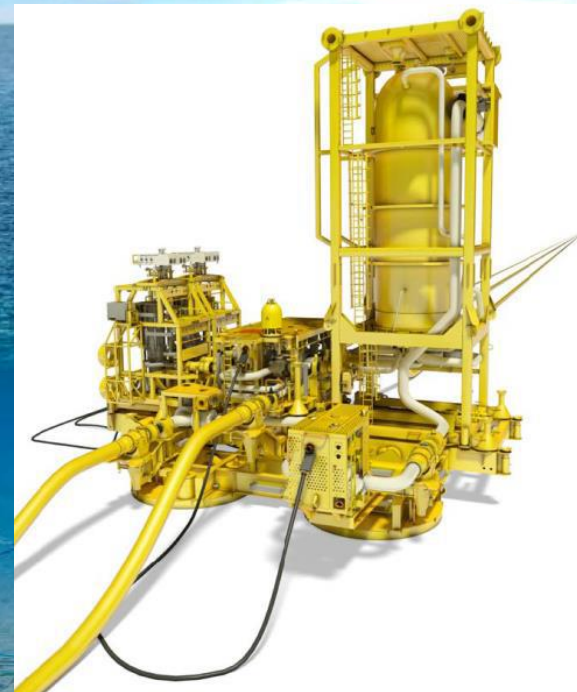
6,600 m³/hour with innovative Trelleborg solution

WELLS :

49 wells (23 at First Oil)
Oligocene : 7 producers, 5 water injectors and 2 gas inj.
Miocene : 18 producers, 17 water injectors

Drilling Campaign :

2 Dynamic positioning Rigs starting in 2009
Estimated duration campaign : 2700 days

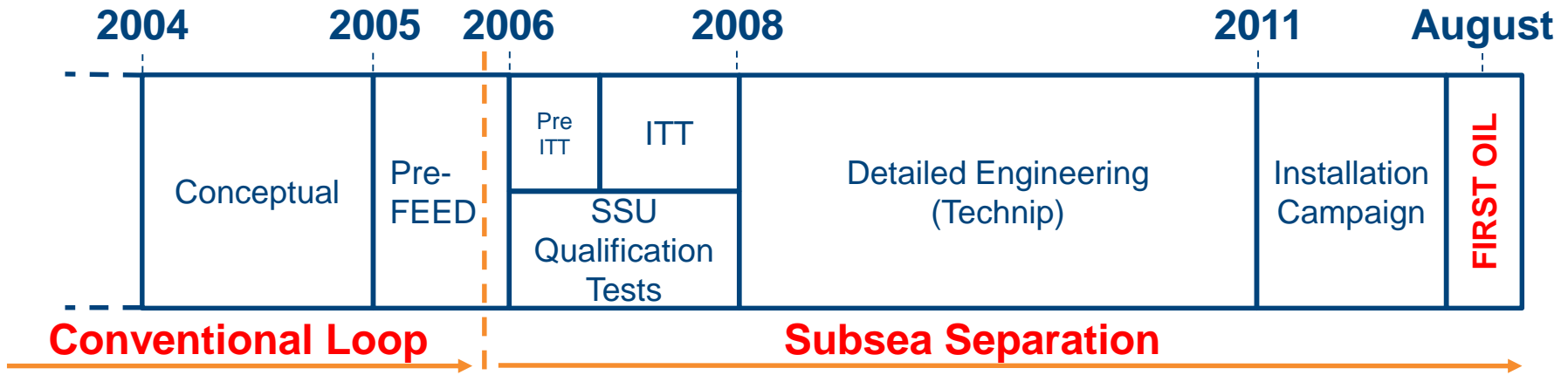


SSPS (Subsea Separation and Production System):

49 horizontal Christmas trees
3 SSU including related umbilicals and topside modules
3 four slot manifolds

Total length of pipelines : 175 km
Total length of umbilicals : 90 km

Timeline of Development



Qualification Tests

Test 1: Scale model with model oil (Cranfield University)

- Equipment: transparent unit to monitor flow pattern using model oil with viscosity from 40cP to 2500cP
- Outcome: Vertical separator selected for sand management purpose, and objective of 15% GVF for liquids being pumped in normal operation. Completed January 2007.

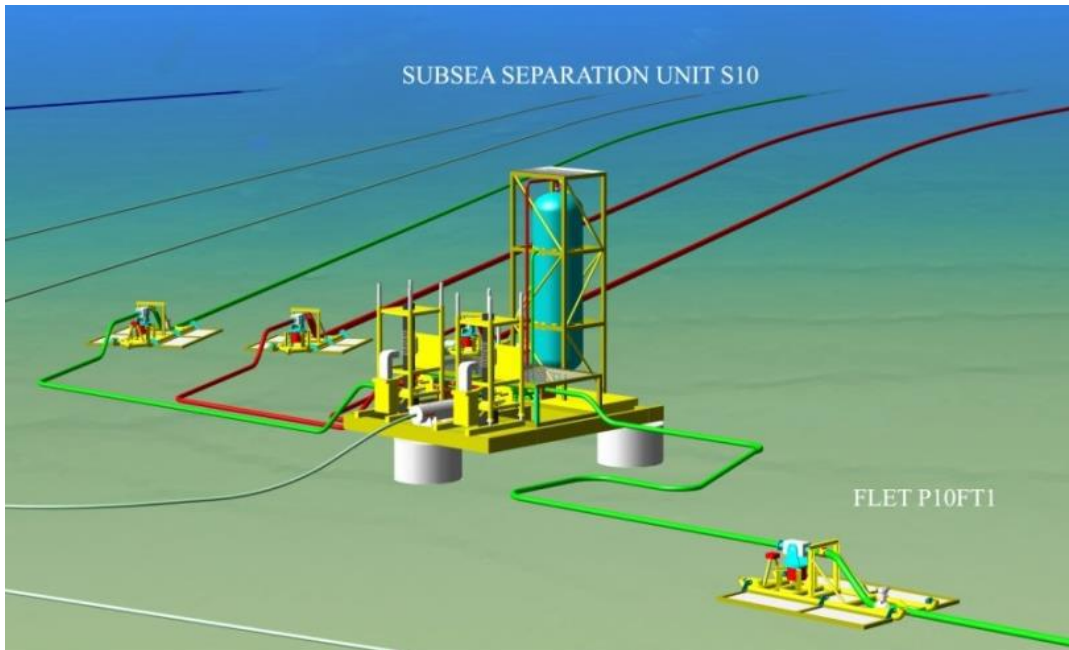
Test 2 : Scale model with real oil (Institut Français du Pétrole)

- Equipment: steel unit, vertical separator, mixture of Dalia/Sincor oils
- Outcome: GVF objectives confirmed. Completed June 2007

Test 3: Scale model with Pazflor oil (Institut Français du Pétrole)

- Equipment: Same test rig as Step 2, Pazflor Miocene oil
- Outcome: GVF objectives confirmed. Completed January 2009

From Conceptual to As-built



SSU Concept (DORIS)



As-Built SSU (Technip)

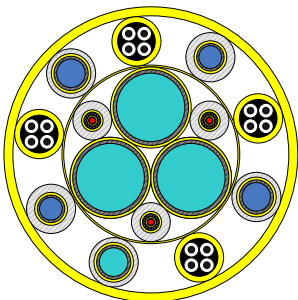


Subsea Storage & Chemical Injection Station

Limitations for Long Tiebacks

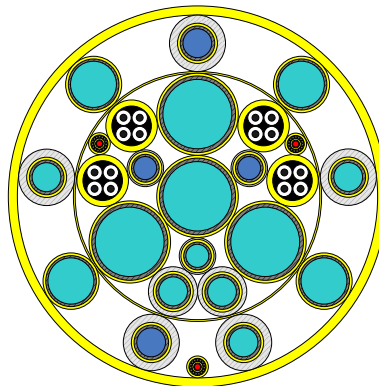
- Subsea tiebacks rely on umbilicals to convey flow assurance chemicals and hydraulic fluid services.
- Long subsea tieback means larger tubes or hoses and therefore larger cross-sections ...

15 km



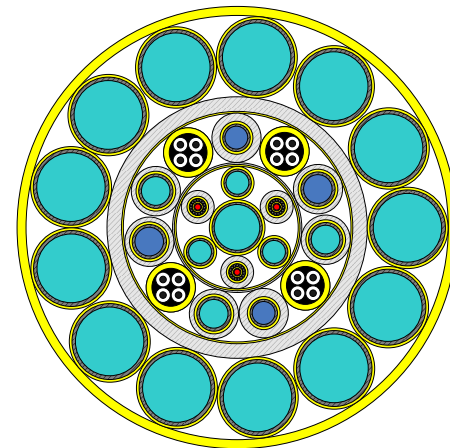
OD = 160mm / 6"

30km



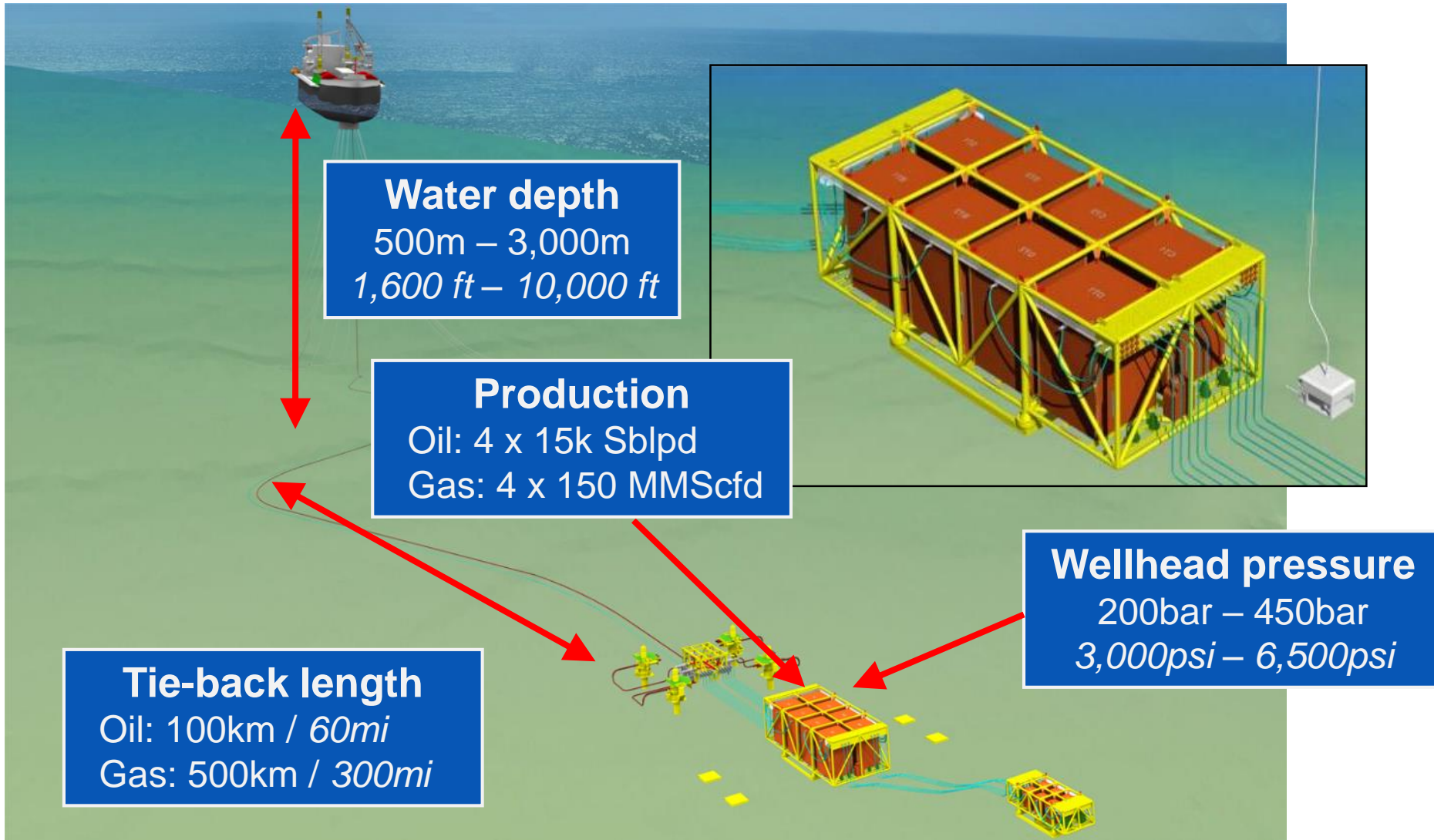
OD = 210mm / 8"

50km



OD = 245mm / 10"

Subsea Station for Chemical Storage and Injection



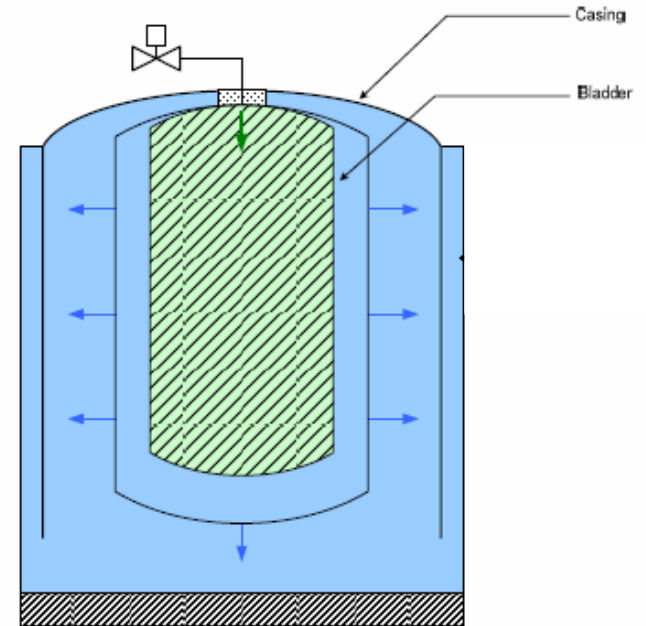
Pressure-balanced tank design

Protective Shell:

- Structural support, protection, level monitoring and leak detection

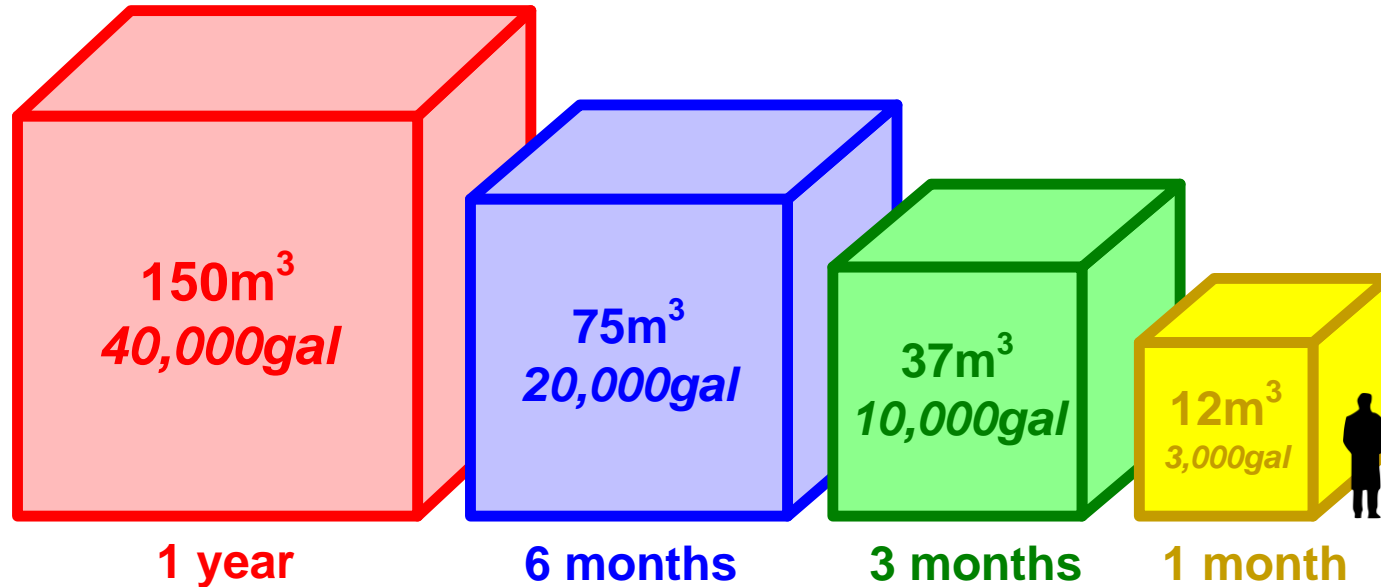
Bladders:

- designed for material compatibility
- shape is selected for constructability and design life

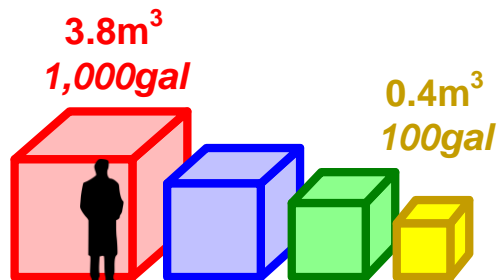


Chemical Storage and Refilling

Corrosion inhibitor – Oil field:



Biocide – Gas field:



Economic Benefit

CAPEX

- ↗ Cost of Station
- ↗ Refill hardware
- ↘ Umbilical
- ↘ Topside Chemical Skids

OPEX

- ↗ Refill operation
- ↗ Maintenance

- This is an innovative system that is cost effective for long SSTB
- The next step is a foundation case study and pre-qualification program to verify the feasibility
- Our goal is to support a fully autonomous "Subsea Plant"



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Pushing the boundaries of energy production
with integrated engineering.