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# 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 PAZFLOR Project, Angola
- **Subsea Storage & Chemical Injection Station**
  - Enabler of very long subsea tiebacks

# Subsea Multiphase Pumping

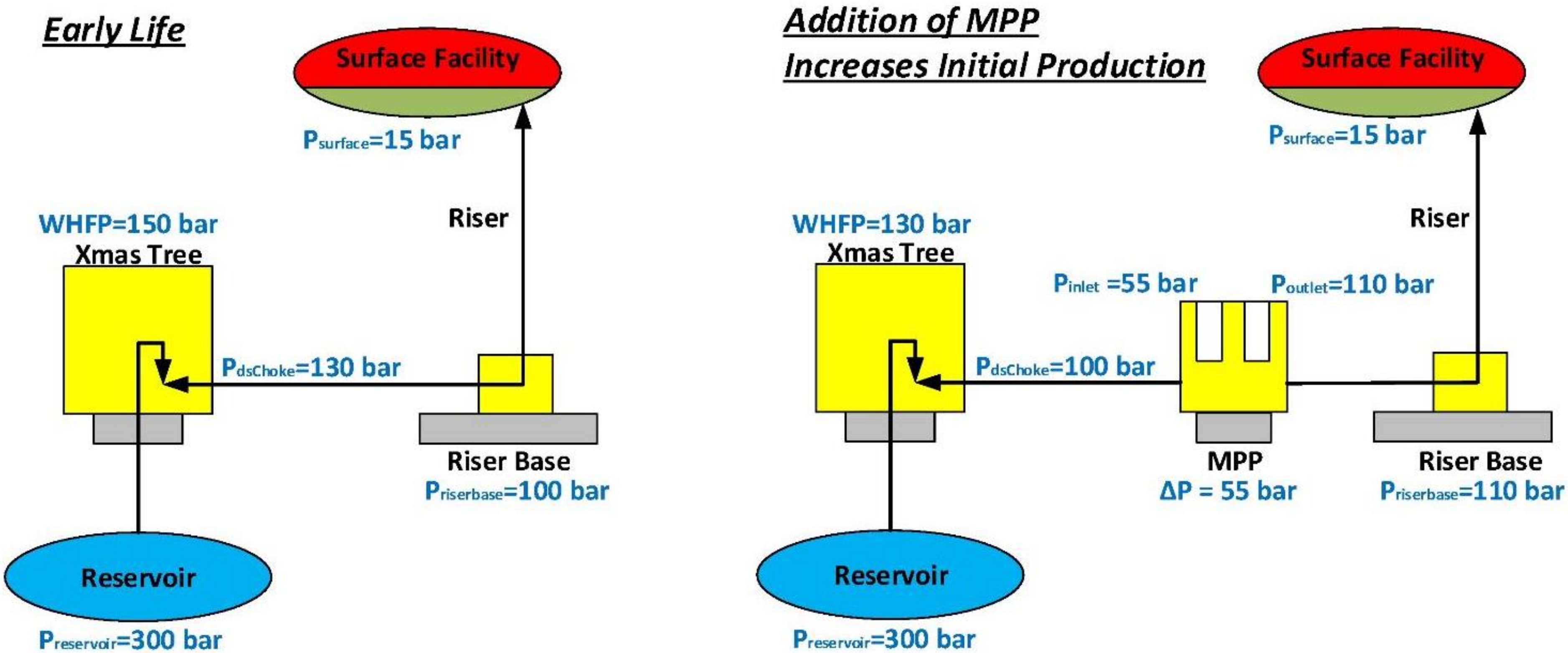
# Multiphase Pumping

- 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



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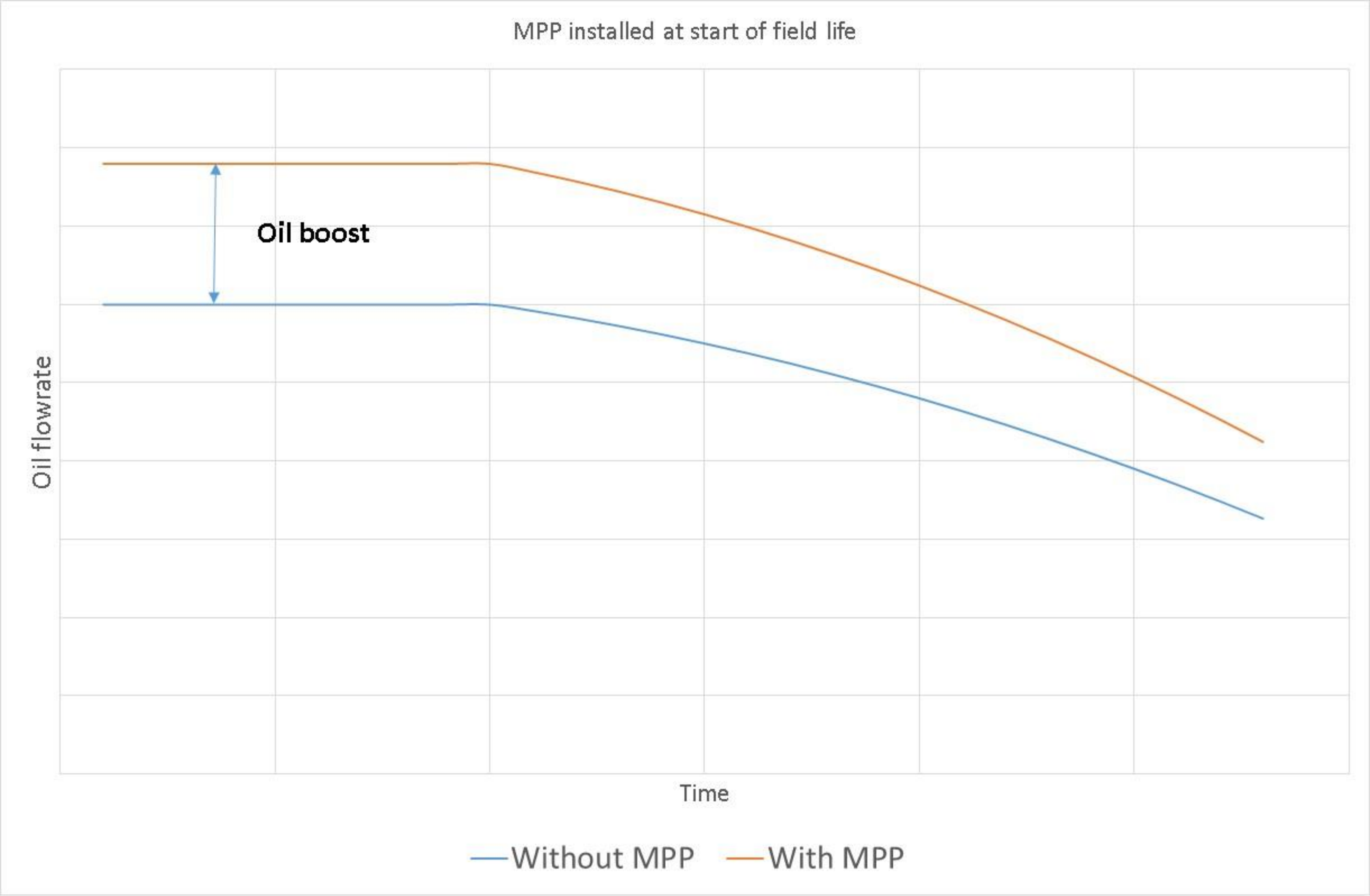
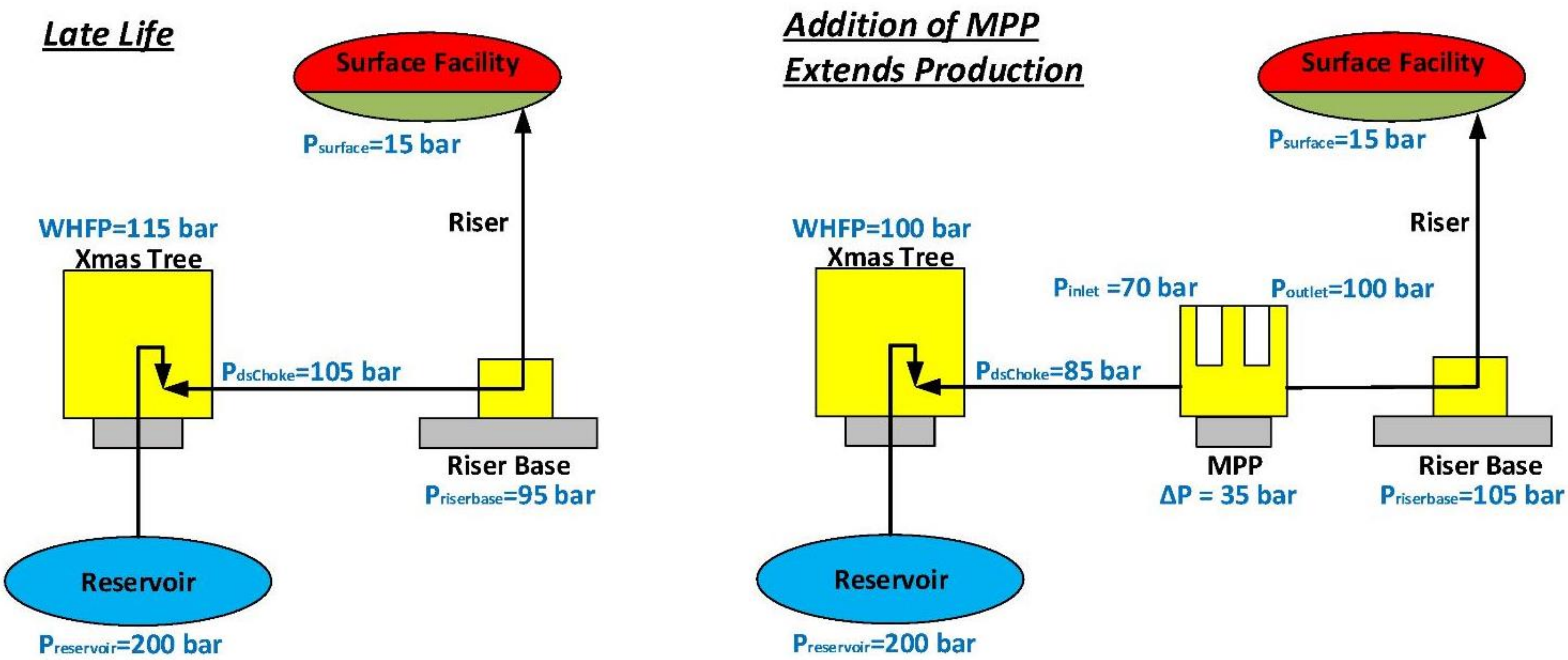
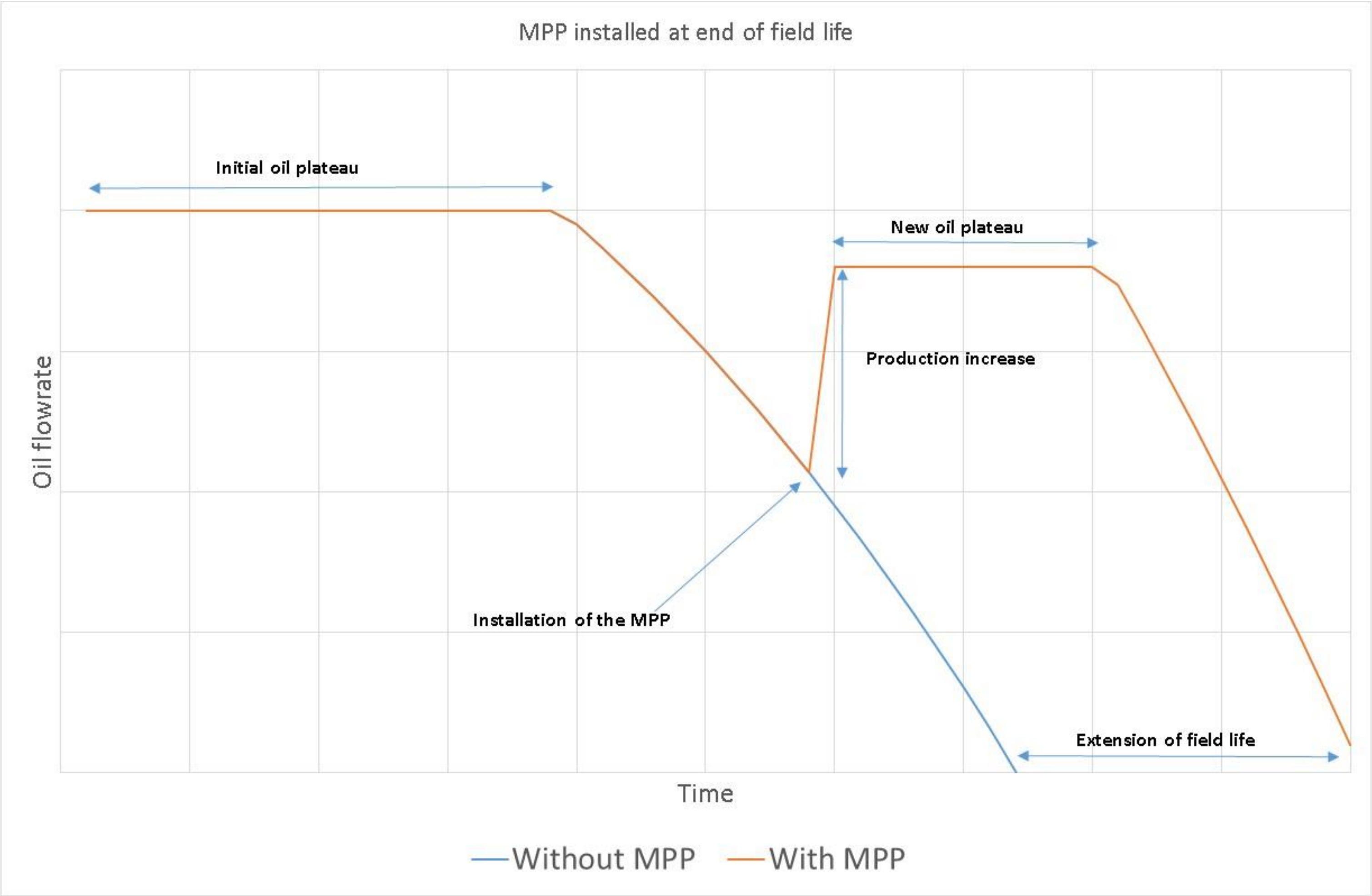
# Early Field Life - Boost Oil Recovery



# Late Field Life - Impact on Network Pressures



# 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

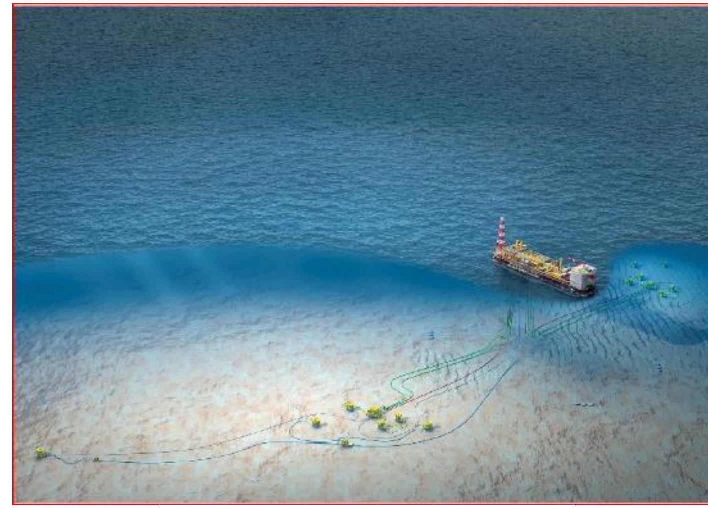
MPP 3,5 MW

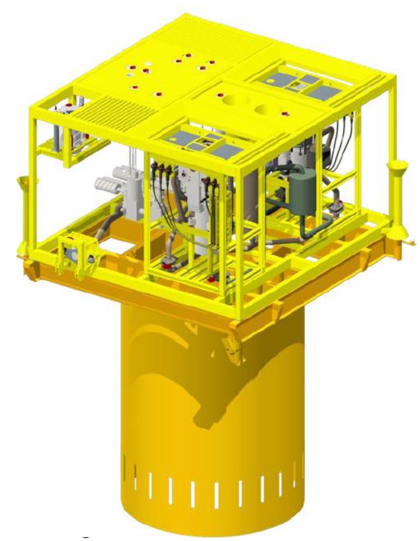
Hybrid Loop

Flow Assurance

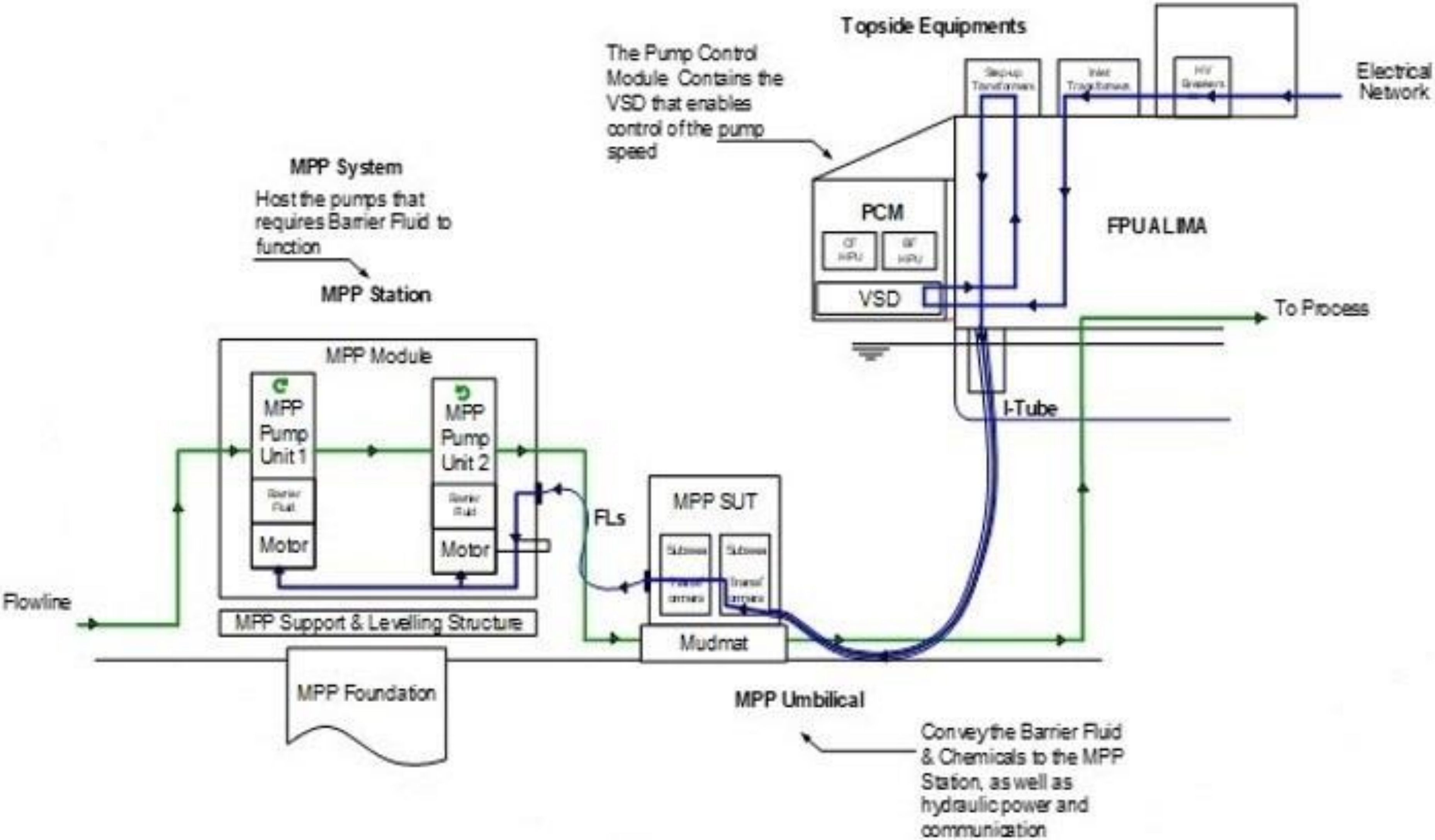
Contracts & Interfaces Packages

Fast Track





# Moho-Bilondo MPP System Layout

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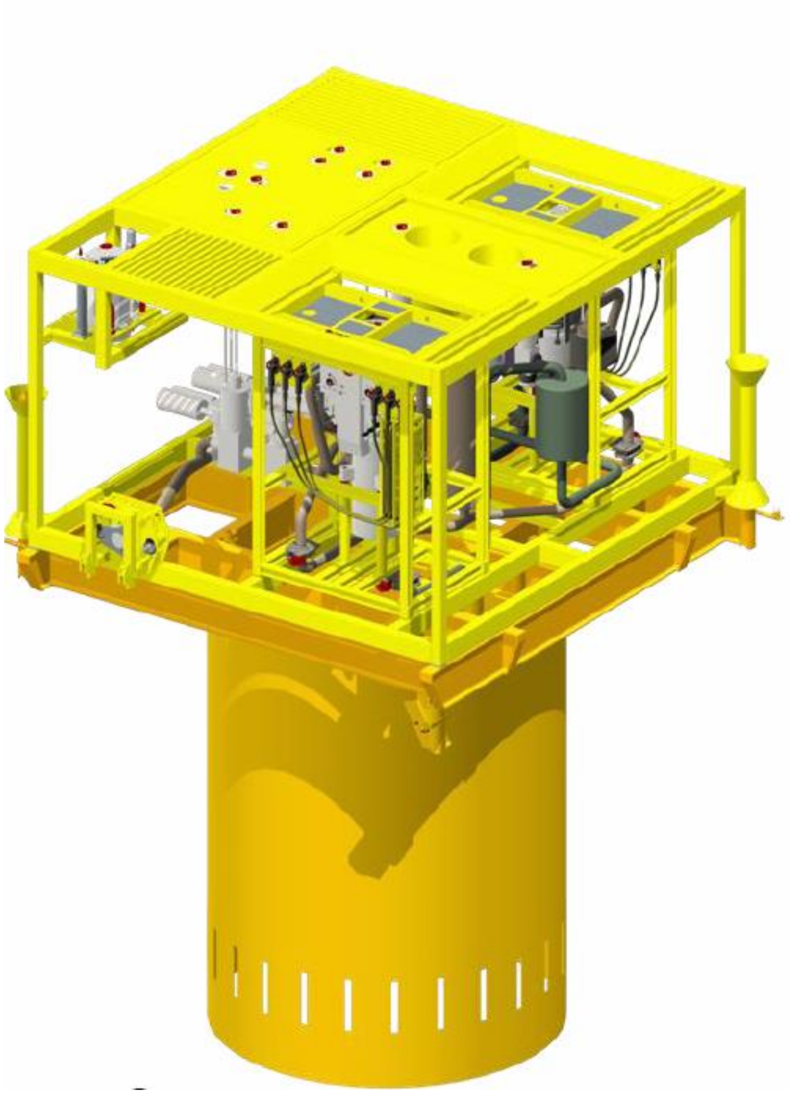
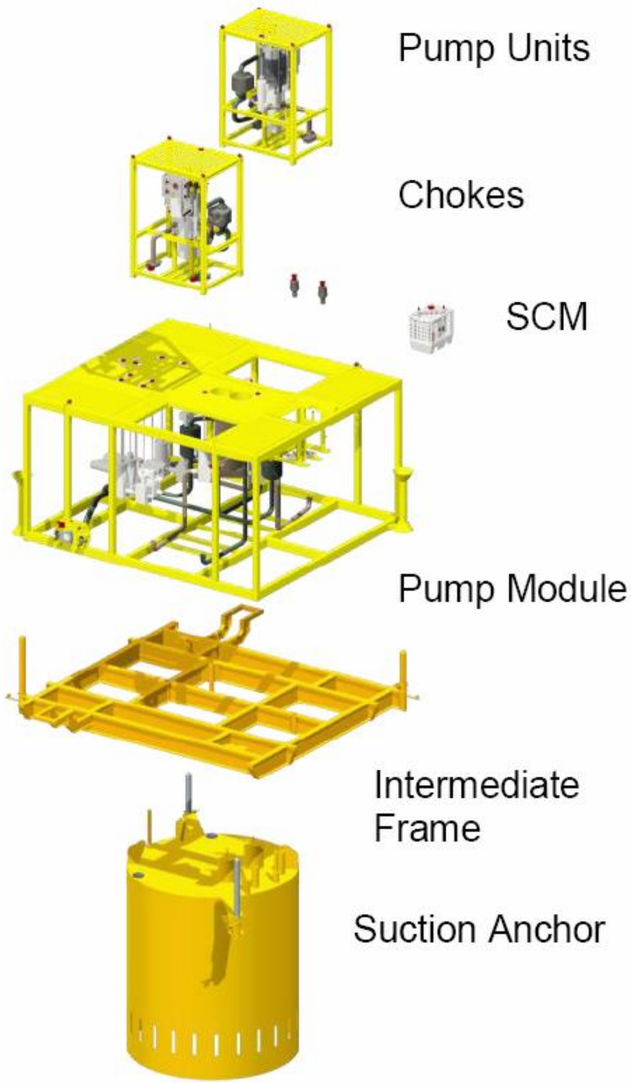
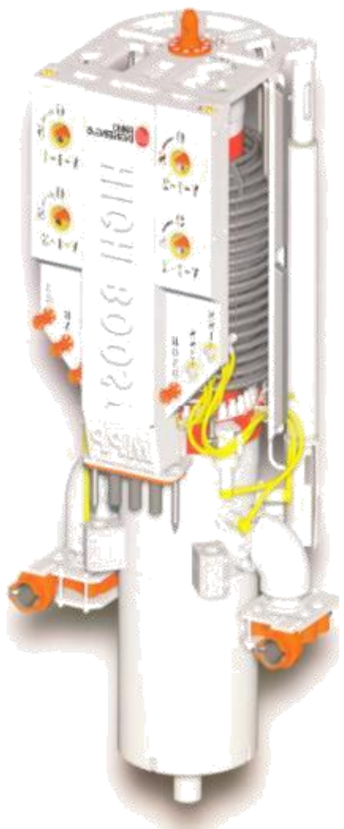
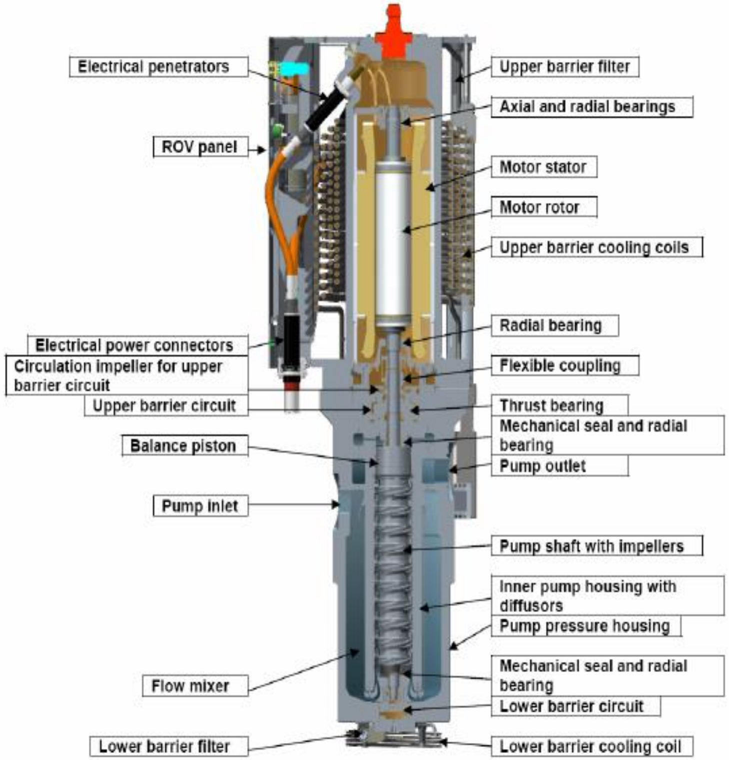
# MPP Station




Pump Units
Chokes
SCM
Pump Module
Intermediate
Frame
Suction Anchor

# Pump Unit & MPP





# Subsea Separation

# Subsea Separation

- The term refers to complete separation units installed on the seabed as fully integrated and remotely operated facilities.

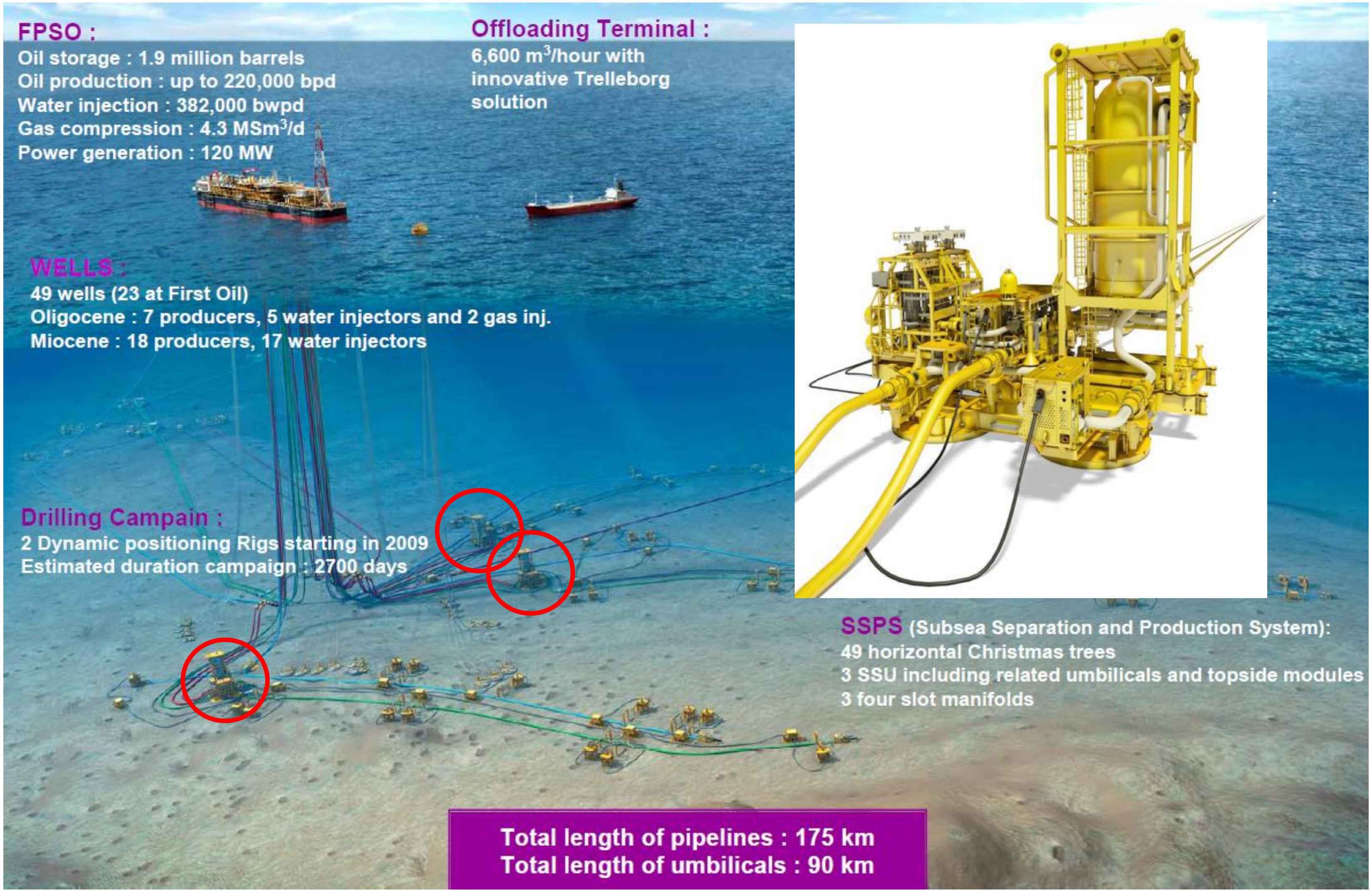
- Operations benefits:
  - Stabilised flow regime in risers
  - Improved artificial lift
  - Possibility of disposal or re-injection of water subsea

- Cost savings:
  - Reduced thermal insulation and MEG / methanol requirements
  - Potential size reduction of downstream facilities
  - Reduced size of first stage separator

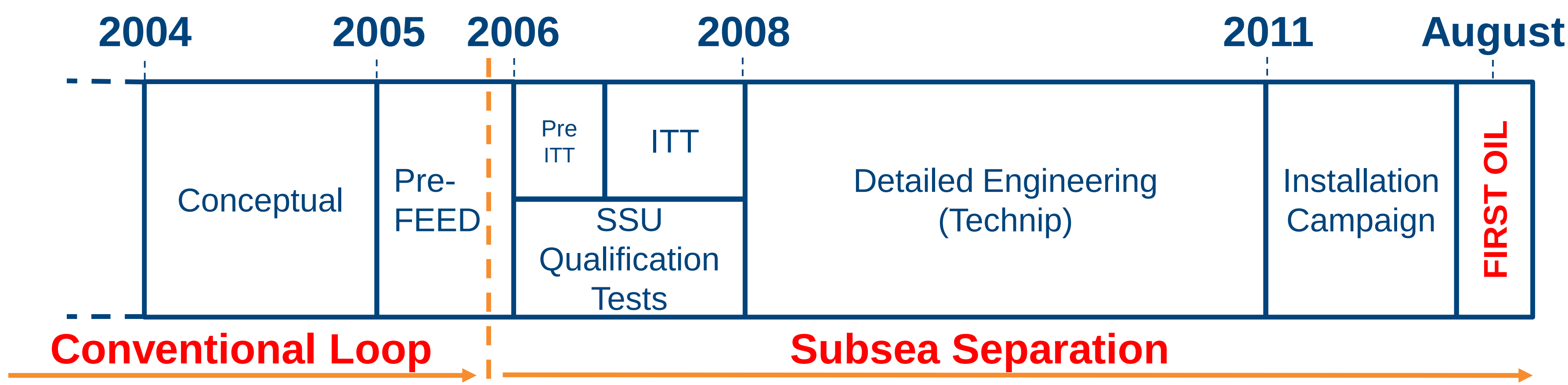
Case Study:

# TOTAL Pazflor

# PAZFLOR Field Layout



# 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.

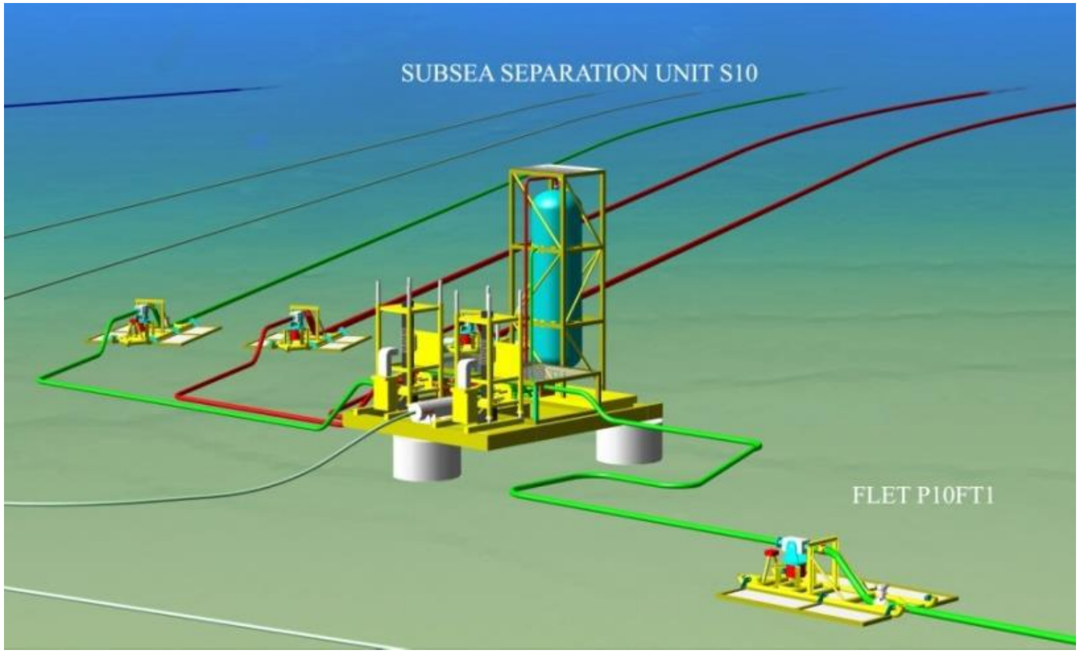
## Test 2 : Scale model with real oil (Institut Français du Pétrole)

- 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



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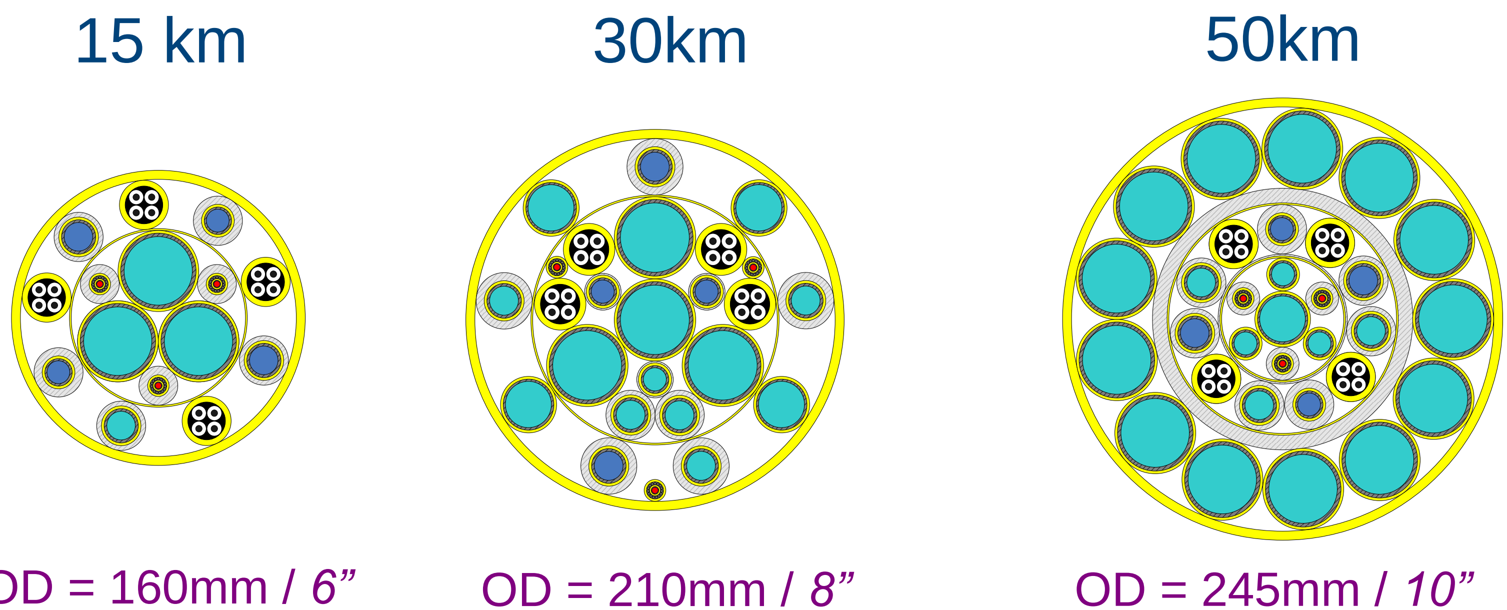
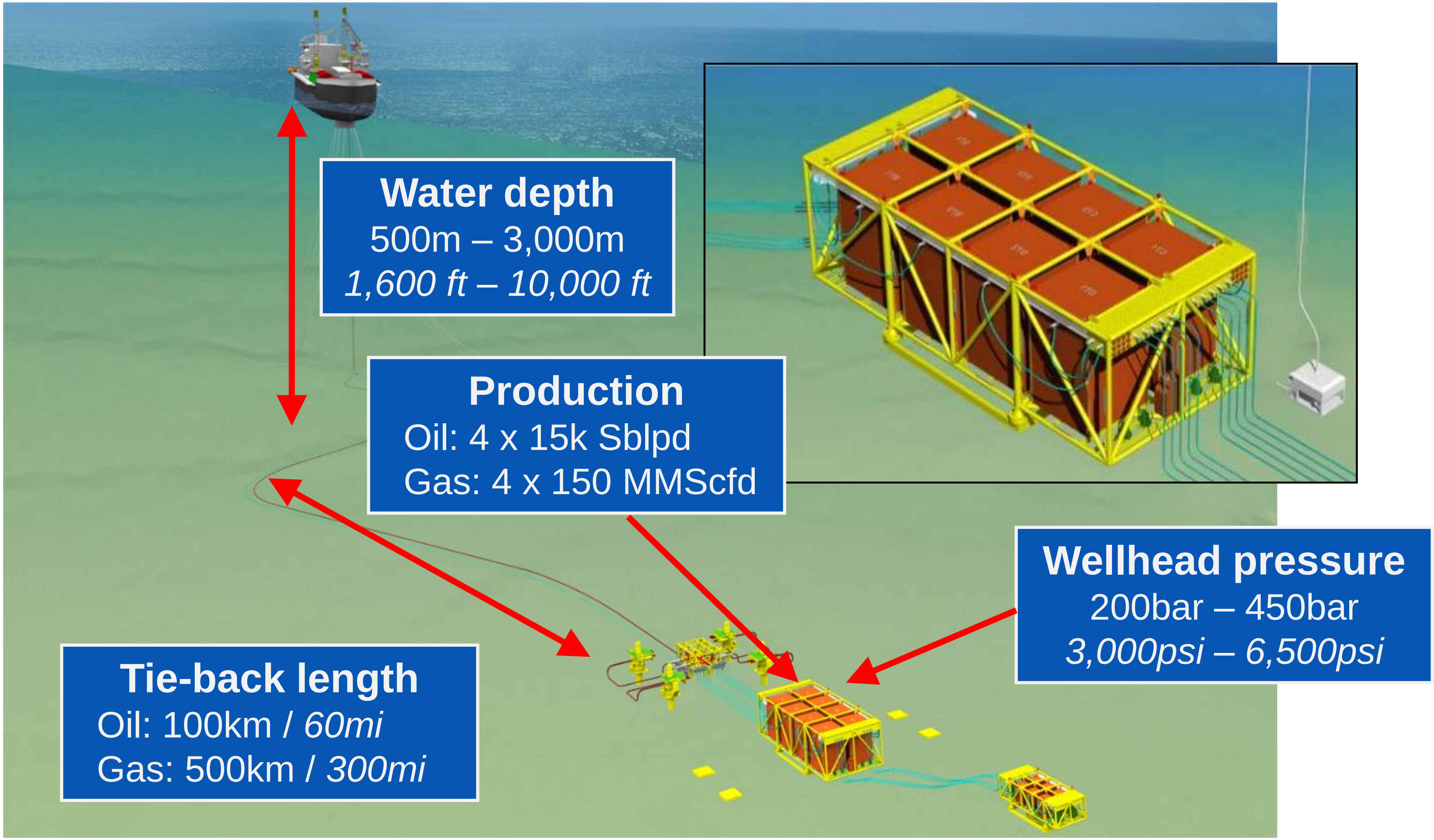
# Limitations for Long Tiebacks

- 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 …



# Subsea Station for Chemical Storage and Injection



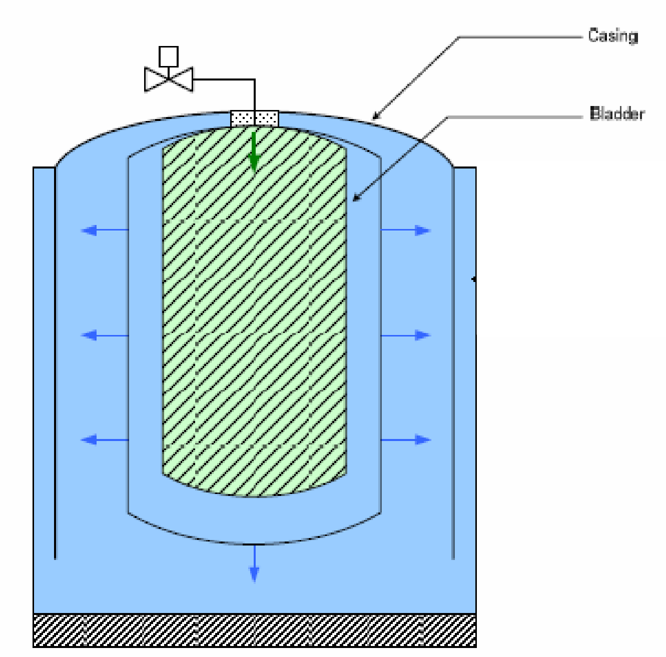
# Pressure-balanced tank design

Protective Shell:

- Structural support, protection, level monitoring and leak detection

Bladders:

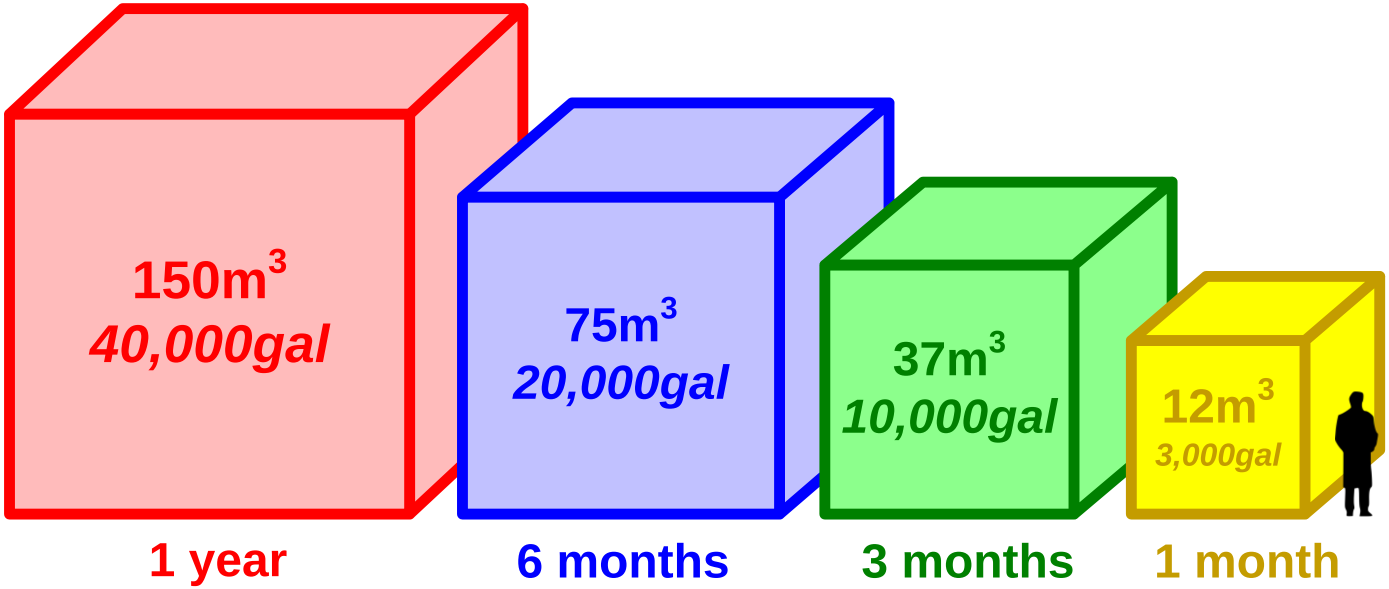
- designed for material compatibility
- shape is selected for constructability and design life



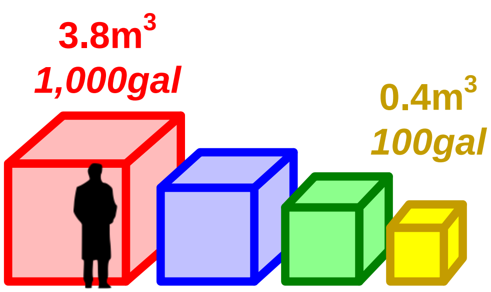


# Chemical Storage and Refilling

## 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''



Pushing the boundaries of energy production with integrated engineering.