Flow assurance

What is the state of the Art with subsea storage?

Adam Olsson – NSRI 21.04.16
AGENDA

1. Introduction to Kongsberg Subsea Storage Unit
2. Pressure Control
3. Thermal Management
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OIL STORAGE DEVELOPMENT

SUBSEA STEEL TANKS
- Oil/water contact and emulsion layer build-up.
- Pitting/corrosion.
- Several risers.
- Thermal challenge.
- High cost with double hull steel tank.

CONDEEP
- Direct oil/water contact creating emulsion layer.
- Toxic sediments.

FLOATING STORAGE
- Past 15 years: 6 collisions in tandem offloading.
- High CAPEX & OPEX.
- Personnel involvement.
- Environmental impact (CO₂, NOₓ).
KONGSBerg SUBSEA STORAGE UNIT

See animation at: https://www.youtube.com/watch?v=-8Nfyde_fnE
KONGSBERG SUBSEA STORAGE UNIT

BUSINESS ADVANTAGES:
SUBSEA STORAGE

- No collision risks.
- No extra manning.
- Low OPEX and CAPEX.
- Flexible storage capacity.
- Reduced CO₂, NOX and VOC emission.
- No toxic settling to seabed.
- Enabling technology Arctic's, subsea processing and remote fields.

TECHNICAL ADVANTAGES:
OIL / WATER FLUID BARRIER

- Flexible Bag – no emulsion layer risk.
- Double barrier against oil spill.
- Integrated leak detection system.
- No risk of contaminating cargo (oil).
- No need to design against seabed pressure.
Subsea Storage Unit (SSU) is patented technology.

Kongsberg is currently evaluating using the same technology for subsea storage of chemicals and as a settling tank for produced water.
HOW DOES IT WORK?

FULL

EMPTY

Oil

Seawater

Oil

Seawater

Oil

Seawater
JIP (DEMO 2000) – SCALE MODEL TEST

• **Goal:** Verify bag behavior.
• Test performed with air/water & freshwater/seawater.
• Replacement of bag trials.

PROTECTION STRUCTURE

LEVEL CONTROL PIPE

FLEXIBLE BAGS WITH SEAWATER/FRESHWATER

WATER-LEVEL ABOVE HATCH

FLEXIBLE BAG

SIDE VIEW MODEL

LEVEL CONTROL PIPE
FLEXIBLE BAG BEHAVIOUR

CLOSE TO EMPTY SUBSEA STORAGE UNIT:
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SSU SYSTEM TYPICAL LAYOUT

- PRODUCTION PLATFORM
- WELL
- MANIFOLD
- SUBSEA STORAGE
  - 2-6 BARG AVAILABLE
- BOOSTER PUMP
- OFFLOADING SYSTEM
- SHUTTLE BACK PRESSURE
  - ~2.5 BARG
- SHUTTLE TANKER
  - ~1.5 BARG
- BOUY HEIGHT

SMALL PRINT:
- WORLD CLASS - through people, technology and dedication
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SSU SYSTEM TYPICAL LAYOUT

PRODUCTION PLATFORM

WASTE HEAT RECOVERY?

CHEMICAL TREATMENT?

SUBSEA HEATING?

EXPORT RISER

SUBSEA STORAGE

OFFLOADING SYSTEM

SHUTTLE TANKER