

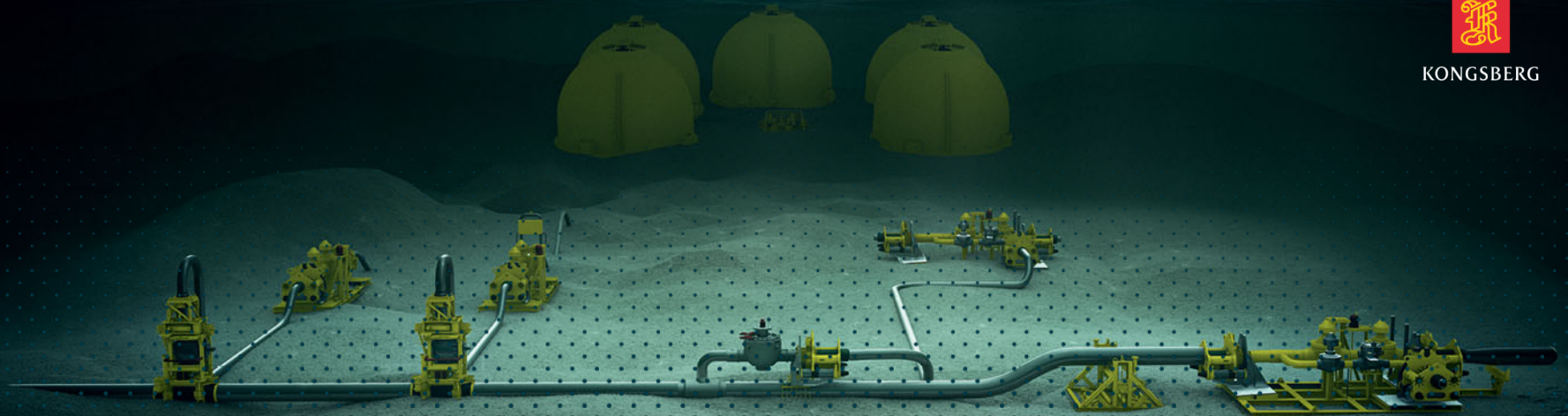
Flow assurance

# What is the state of the Art with subsea storage?

Adam Olsson – NSRI 21.04.16



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# AGENDA



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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 (CO<sub>2</sub>, NO<sub>x</sub>).

# KONGSBERG SUBSEA STORAGE UNIT



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See animation at: [https://www.youtube.com/watch?v=-8Nfyde\\_fnE](https://www.youtube.com/watch?v=-8Nfyde_fnE)



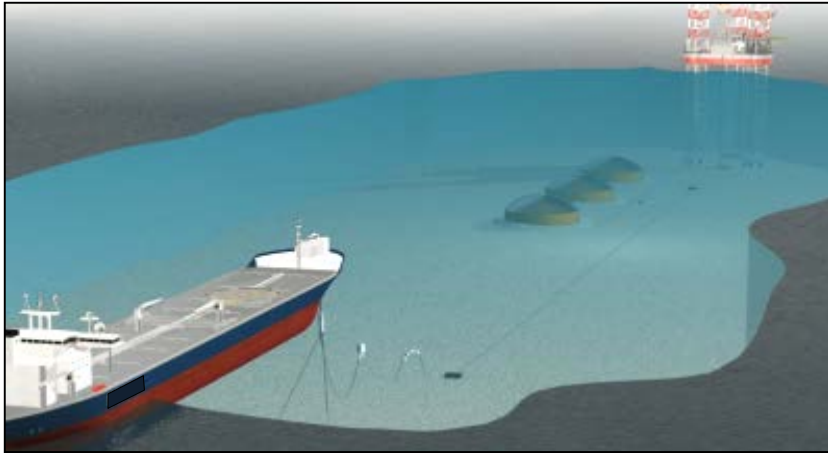
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# KONGSBERG SUBSEA STORAGE UNIT



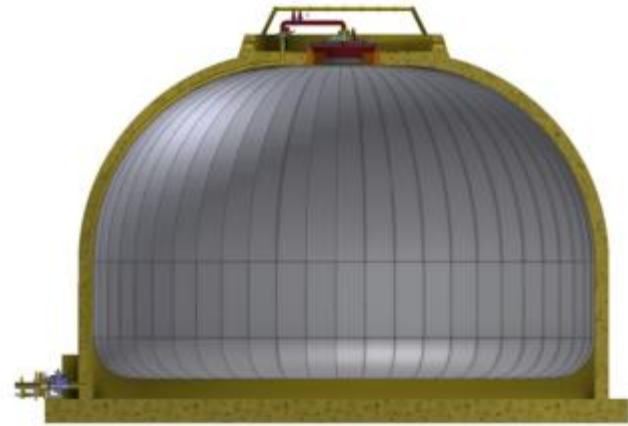
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## BUSINESS ADVANTAGES: SUBSEA STORAGE



- No collision risks.
- No extra manning.
- Low OPEX and CAPEX.
- Flexible storage capacity.
- Reduced CO<sub>2</sub>, 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.



# KONGSBERG SUBSEA STORAGE UNIT

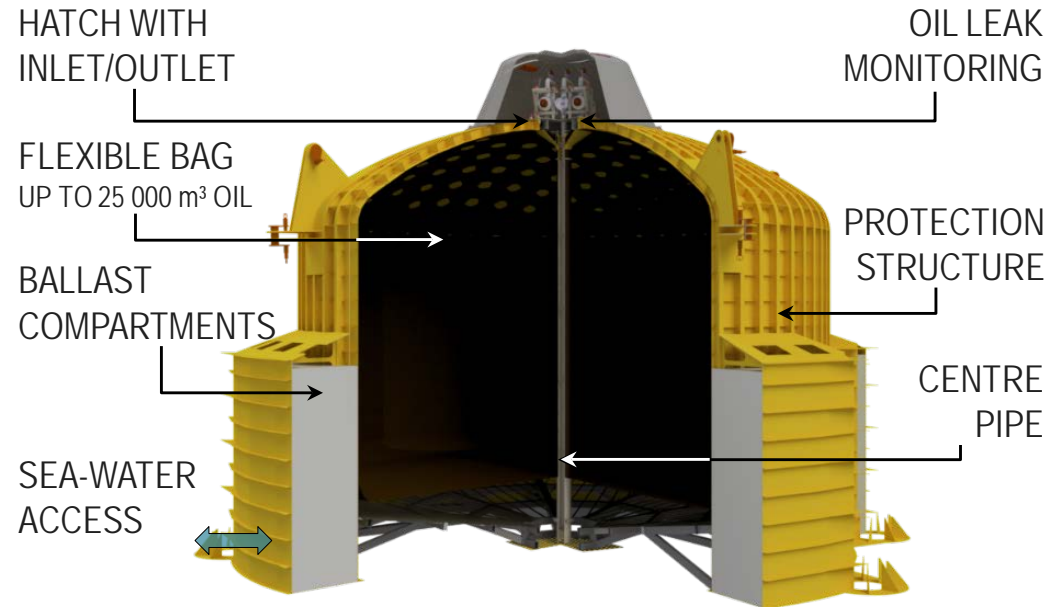
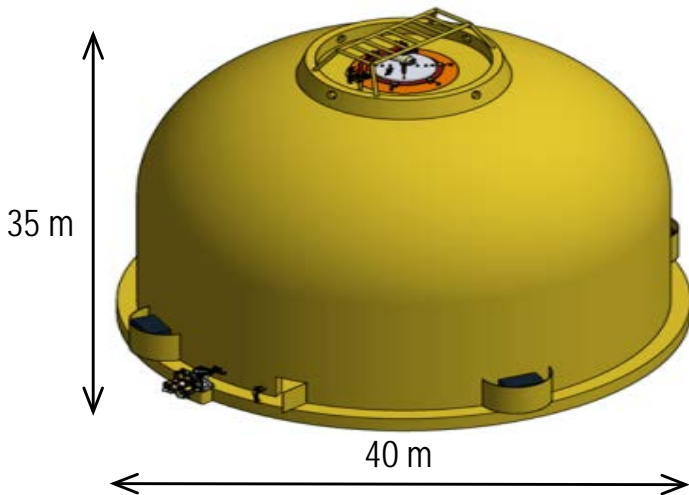


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Subsea Storage Unit (SSU) is patented technology.

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

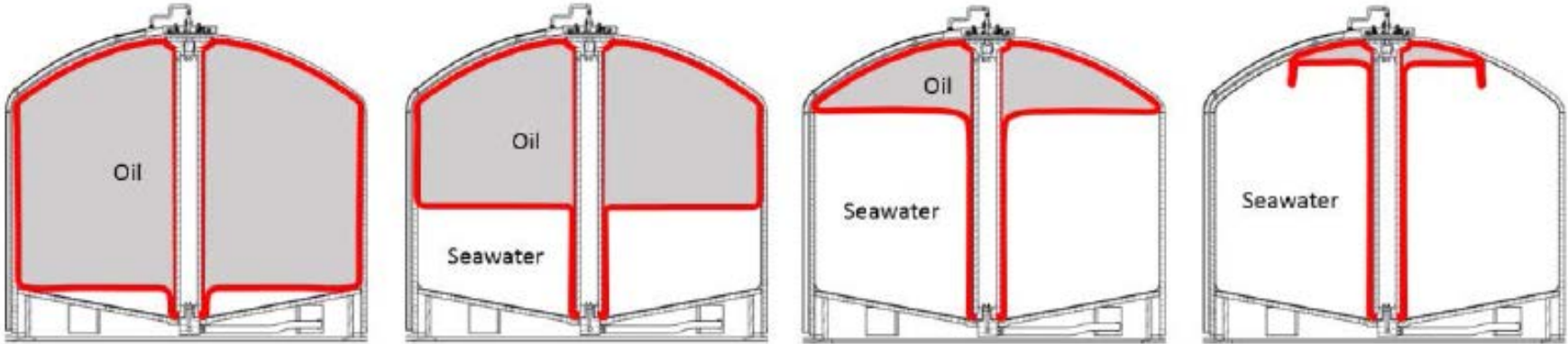
## SUBSEA STORAGE UNIT, 25 000 m<sup>3</sup> / ~157 000 BBL ILLUSTRATION



# HOW DOES IT WORK?



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FULL

EMPTY

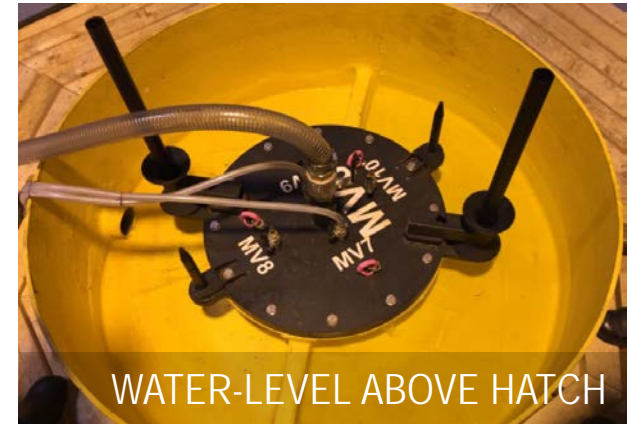
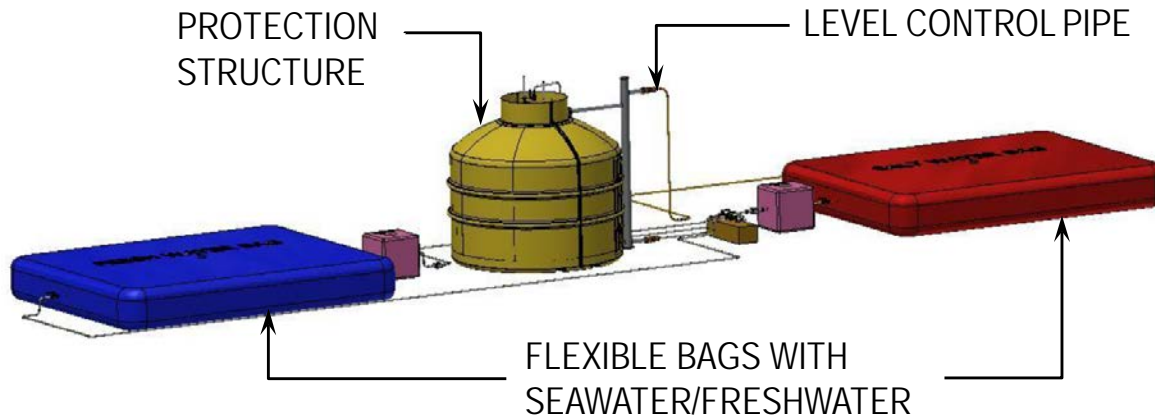


# JIP (DEMO 2000) – SCALE MODEL TEST



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

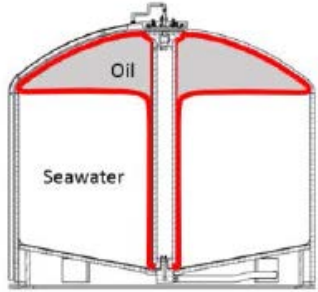


# FLEXIBLE BAG BEHAVIOUR



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## CLOSE TO EMPTY SUBSEA STORAGE UNIT:



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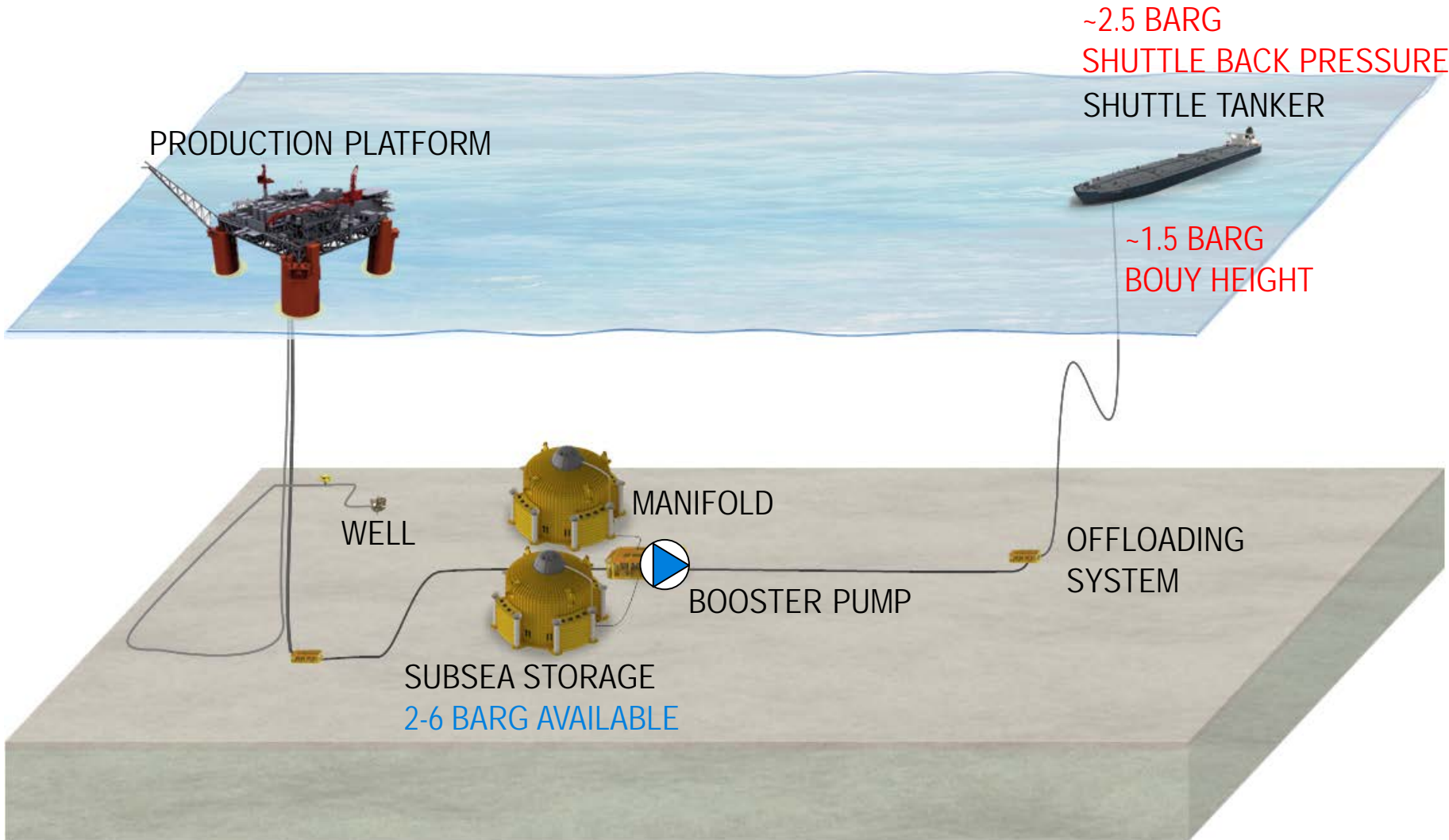
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# SSU SYSTEM TYPICAL LAYOUT



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# AGENDA



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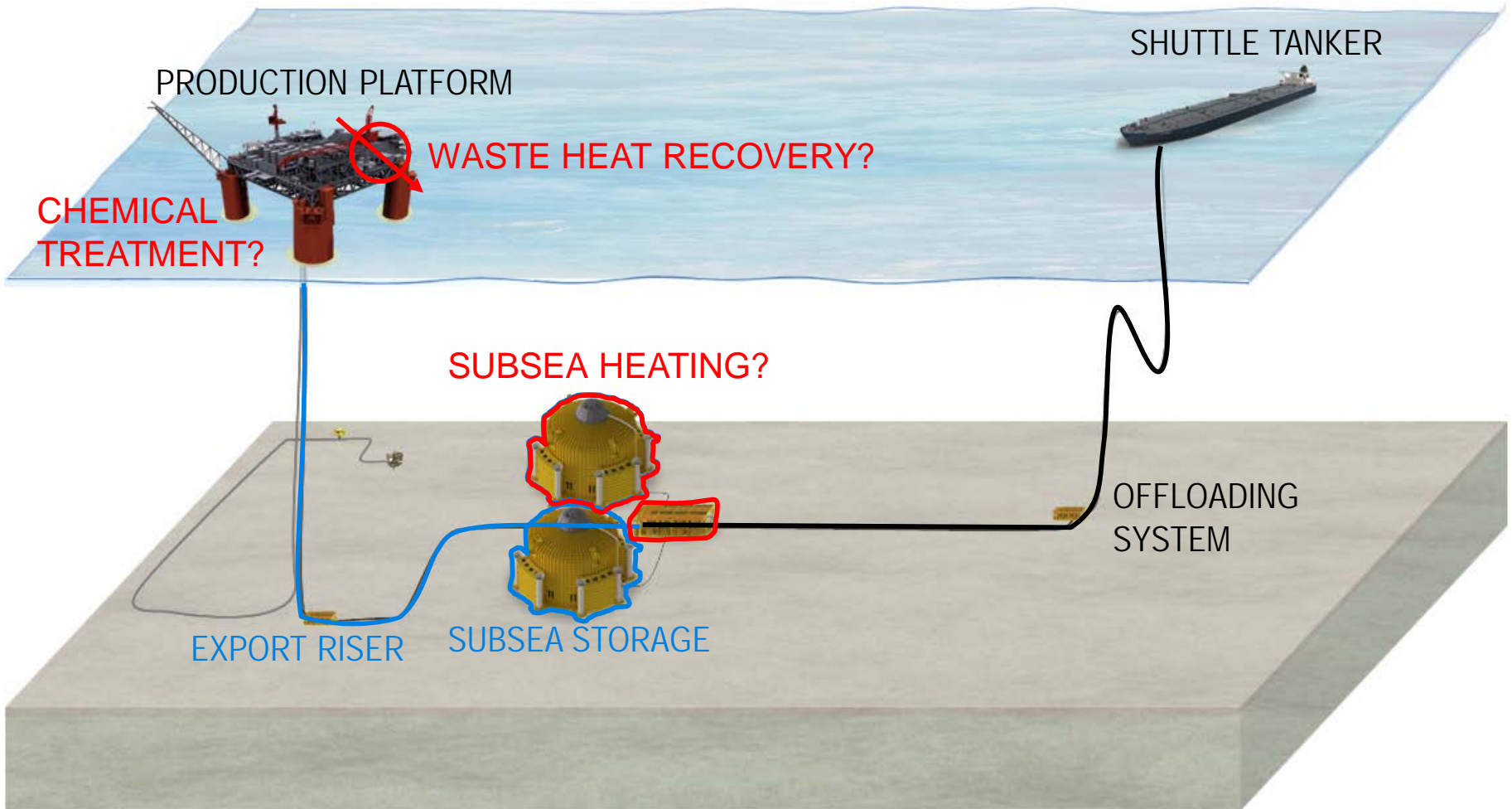
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# SSU SYSTEM TYPICAL LAYOUT



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