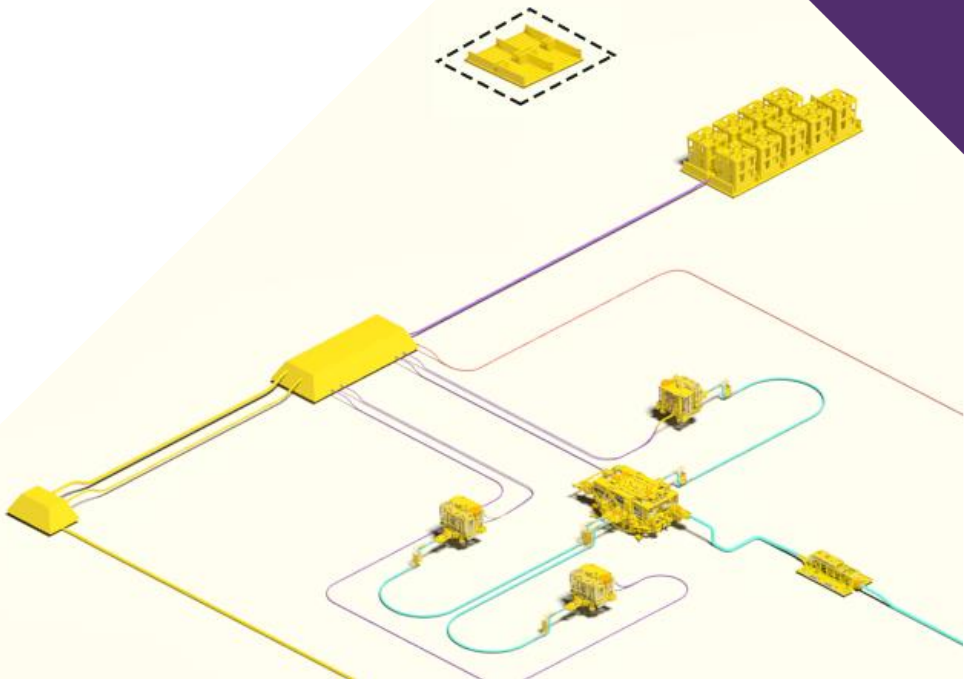
Subsea Chemical Storage and Injection collaboration project

François-Xavier Pasquet, TOTAL
Eldar Lundanes, TechnipFMC



October 2018

Agenda

1. SCS&I – What is it?
2. Project justification
3. Scope of work and project schedule
4. Examples of key challenges
5. Conclusion

1. Subsea Chemical Storage & Injection

Background

Separately studied by TOTAL and TechnipFMC prior to entering the development contract

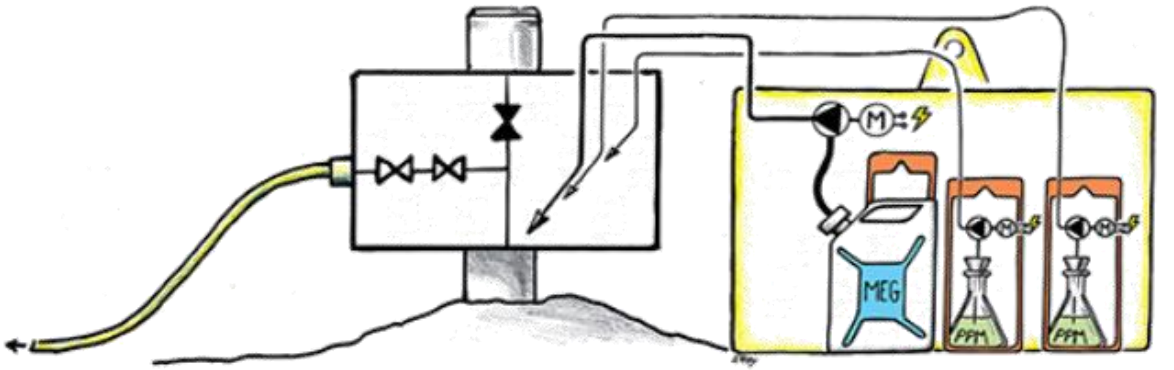
Main project objective

To develop and qualify an SCS&I station to be ready for industrial piloting in 2020-2021

What is it?

Complete system for seabed storing and pumping all required injection chemicals

- Retrievable and refillable storage tanks
- Retrievable pump modules
- Distribution system for chemicals
- Power transmission and distribution
- Control system



Application areas

GREEN FIELD

All-Electric

- All-electric field developments where the functionality of the umbilical is reduced as much as possible with respects to fluids

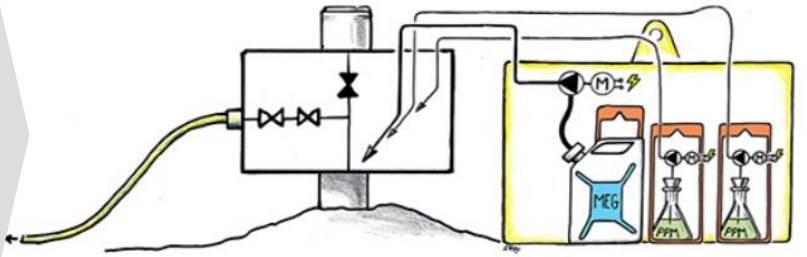
Long tie-backs

- Field developments with long tie-backs to land, platform, or FPSO
- In fields where local content is excessively driving cost, especially for umbilical

New tie-backs to existing HOSTs

- New field developments with tie-backs to existing host with capacity constrains or other owners

SCS&I Technology



Mature Field Developments

- Field extensions and add-ons
- Marginal pockets and satellite well developments

IOR

- Existing Fields which needs additional chemicals due to change in production premises
- Testing of production chemicals

Troubleshooting

- Operational premises have changed over time
- Testing of new inhibitors
- Hydrate remediation

BROWN FIELD

2. Project justification – value proposition

Improved HSE at the topside facility – eliminate storage of chemicals and high pressure pumps

Project economics – increased production

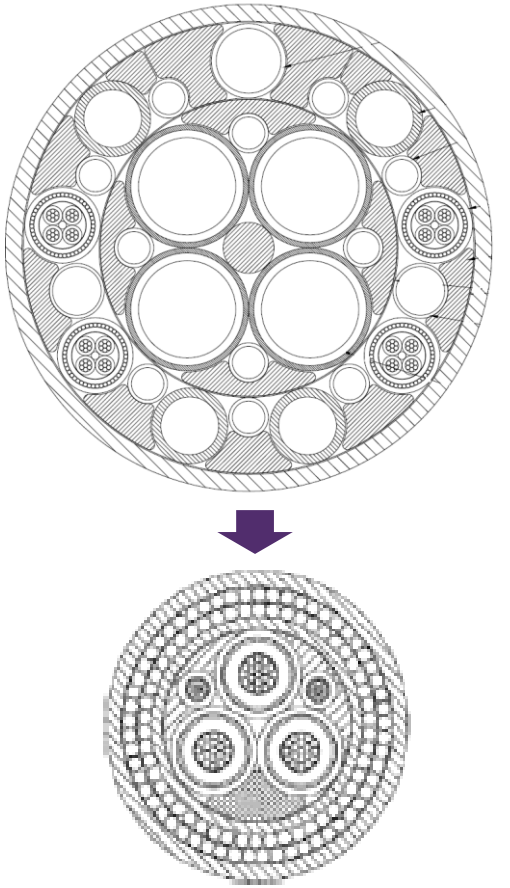
All-electric and all-subsea – enabler

LoF benefit – change or add new chemicals

Less elements in the umbilical – reduced size and weight

Smaller topside facility – space and weight savings

Less maintenance work at offshore facility – moved to shore base



3. Scope of work

Complete system approach required to reach a cost effective solution

Tanks

Technology and materials

Manufacturing

Transport and handling

Pumps

Technology

Sizing

Power system

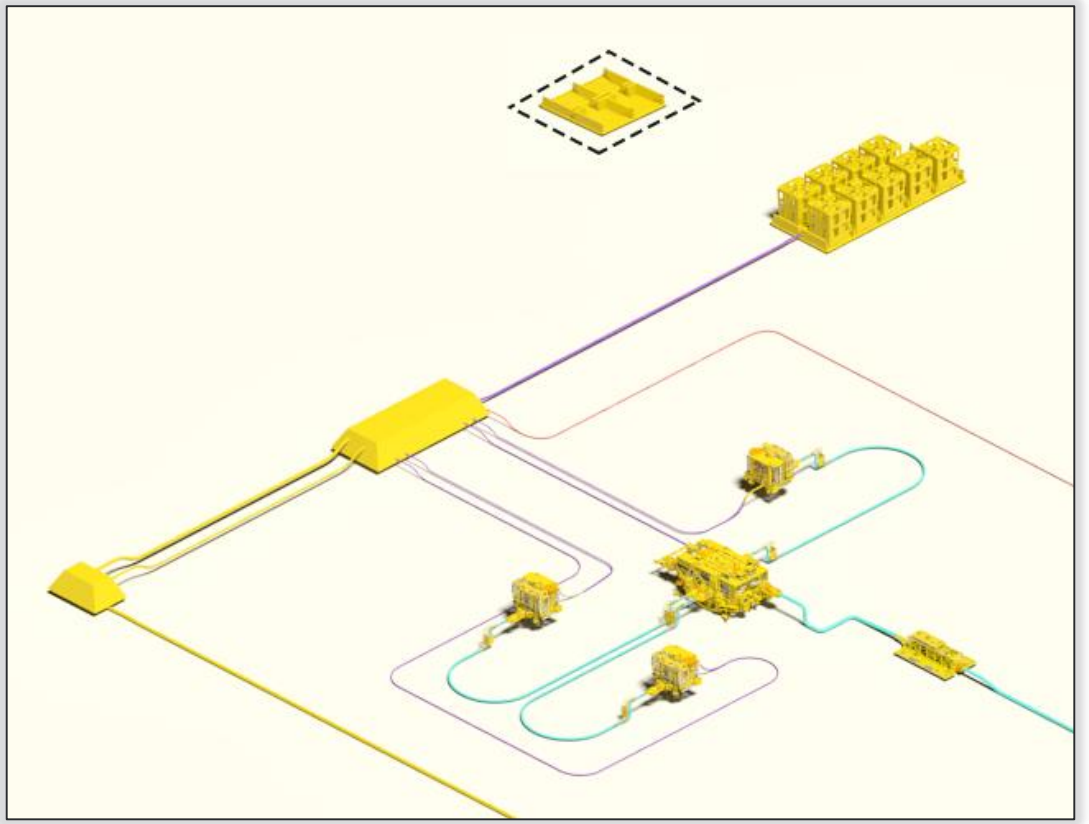
Transmission

Motor operation

Control system

System integrity

Component integrity



Structures

Light and robust

Installation

Suitable for all WDs

Chemical density

Retrievability

LoF operations

Tank re-filling

Pump maintenance

HSE

Water ingress

Chemical release

Project design premises

Water depth: **3000m**

Design pressure: **690bar**

Wells: **4 oil producers**

Storage: **6 months consumption**

Chemicals	Volumes (m^3)	Type of injection	Injection location
Corrosion Inhibitor	58	Continuous	Christmas Tree
Demulsifier	18	Continuous	Manifold
Scale Inhibitor	23	Continuous	Christmas Tree
Biocide	27	Batch	Manifold
LDHI (low dosage inhibitor)	32	Intermittent (Start-up)	Manifold
Methanol	56	Intermittent (Start-up and Shutdown)	Christmas Tree
Total volume	214		

Project schedule

Pilot
2021

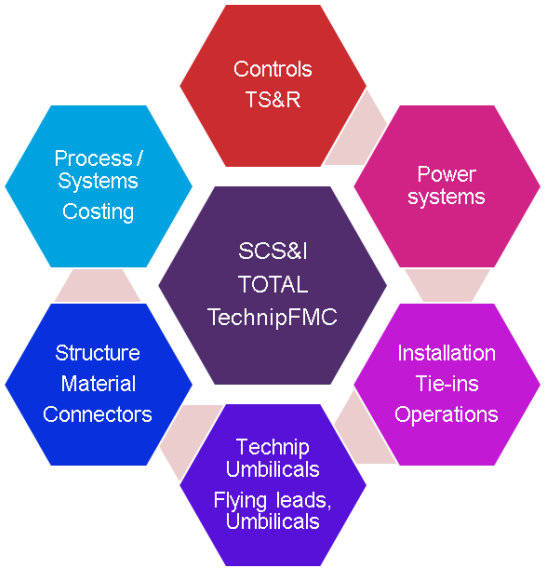
Pilot design
Manufacturing
Testing

Hardware and
Integration
2019 - 2020

Critical components
Bench tests
Integration test

SCSI Station Definition
2018 - Q1 2019

Concept definition
Aging and compatibility tests
Operability, safety and
environmental philosophies



4. Technical challenges

1. HSE

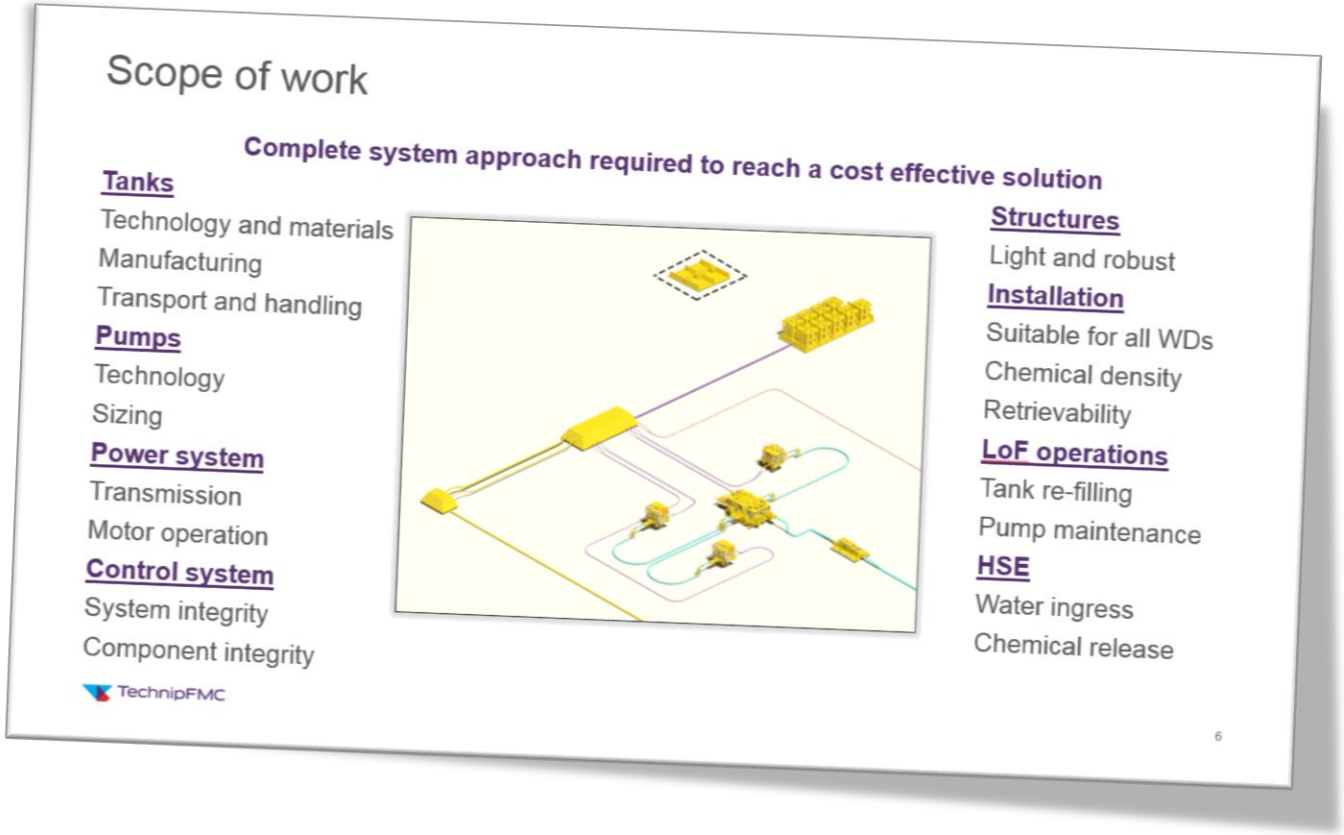
Safety barriers

2. Operations

Tank re-filling

3. Power System

Motor operation



Each topic can’t be addressed alone - A complete system approach is required

Safety barriers

Potential for both burst and collapse

Tank volumes are prohibitive for a high pressure design – wall thickness and weight!

Pressure compensated to ambient pressure

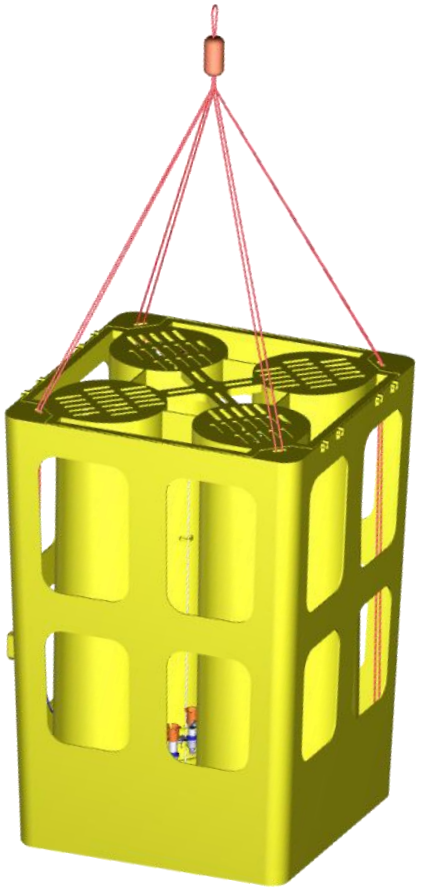
Design the system to manage;

- Potential over-pressure caused by backflow of hydrocarbons
- Potential under-pressure caused by pump suction

A full HIPPS per chemical would be a show-stopper

Need;

- Pressure monitoring and control
- Highly reliable barriers
- Precise monitoring of;
  - Chemical consumption
  - Seawater content in the chemicals



Operations

Tanks are refilled onshore

Module weight within vessel capacity

Target weight <70tons

Safe handling of tank modules

Chemical dependent

Filling

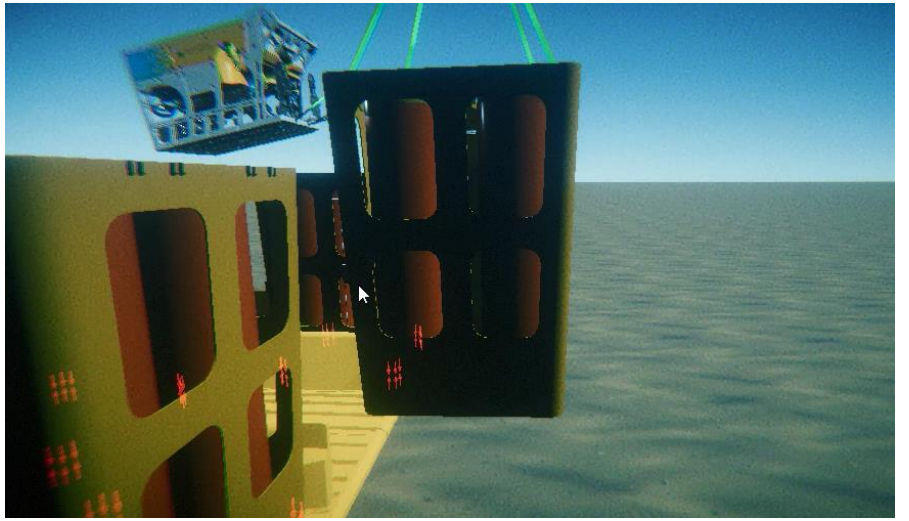
Transport

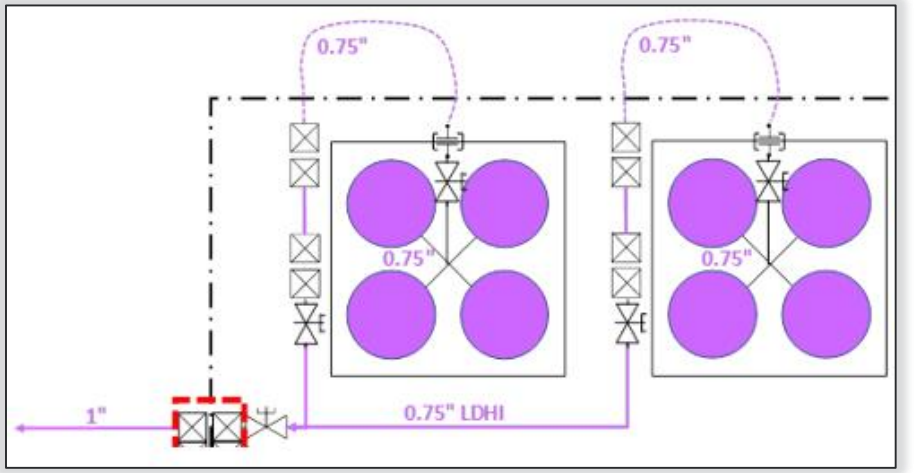
Installation

Retrieval

Frequently operated connection points

Wear of coupler seals - replaceable





Motor operation

High volume batch injected chemicals – several volumetric pumps in parallel

Scaleable concept

Same design for multiple chemicals

3-phase motor – 15kW and 55kW pumps

Several concepts for motor operation evaluated;

Hardware requirements (switches, penetrators etc)

TRL - general

TRL – subsea

Alternatives

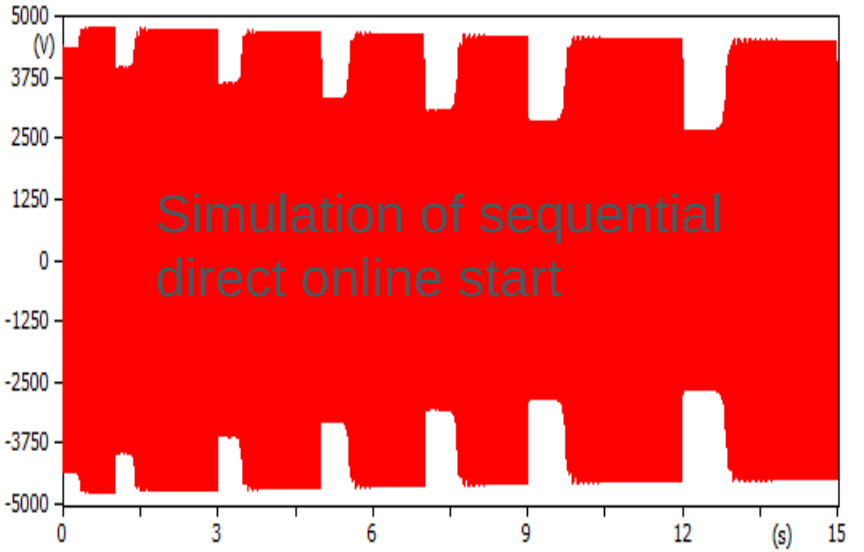
Direct online start

Y-D start

Soft starter

Auto-transfer

Variable Speed Drive - selected for pump qualification



5. Conclusion

New technology - still safe and reliable

Designed for subsea application to ensure a cost effective solution

No show-stoppers

Next step: Qualifications

<u>Collaboration with the operator</u>

1. **Establishes ownership and committment**
2. **Enables bolder, disruptive thinking**
3. **Complimentary competencies ensures a technical solution which is robust, reliable, and cost effective**


TOTAL


TechnipFMC