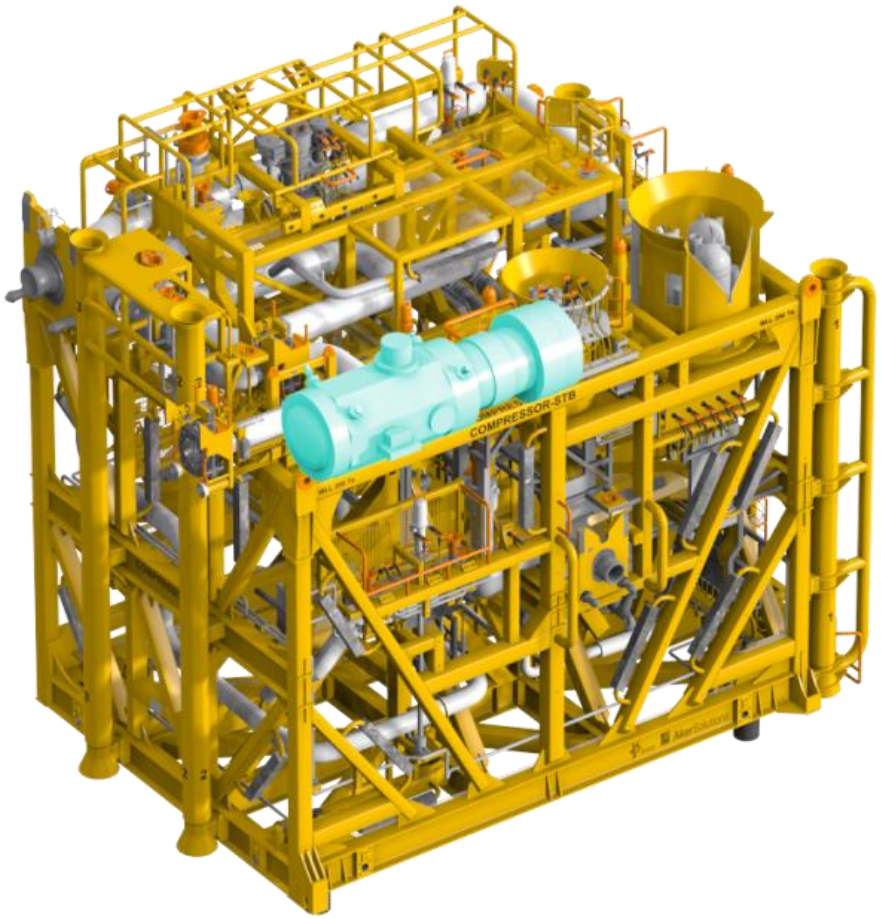
Subsea Recovery, Subsea Compression, Subsea Factory

IEA GOT Workshop 13 June, 2016, London

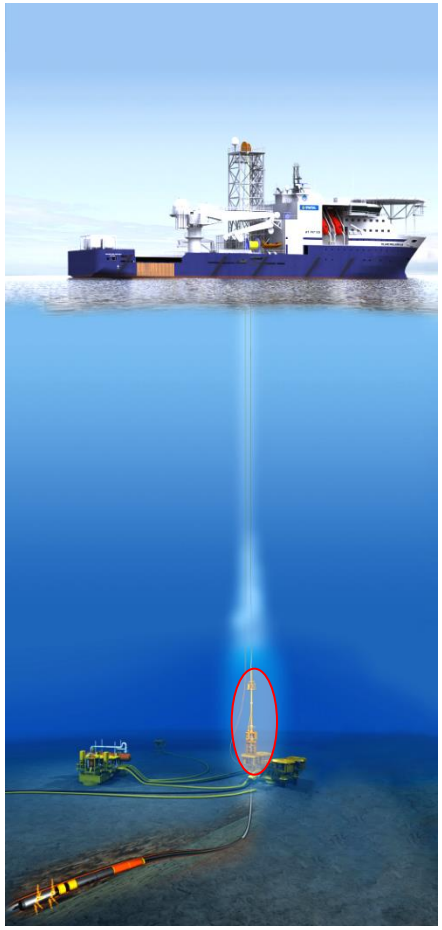
Per Gerhard Grini, Statoil

Outline

- Subsea recovery challenge
- Ligth well intervention
- Subsea Compression
- Subsea Factory

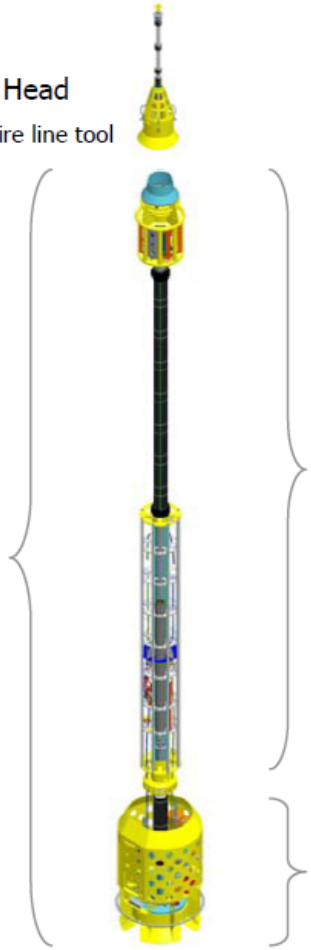


Riserless Well interventions



PCH – Pressure Control Head

Installation package #3 (w/ wire line tool string)



ULP & LUB TUB – Upper Lubricator Package & Lubricator Tubular

LS – Lubricator Section

Installation package #2

LLP – Lower Lubricator Package

WCP – Well Control Package

Installation package #1 (w/XT adaptor)

Statoil LWI operations

MSV Seawell
(2000)

MSV Regalia
(2003)

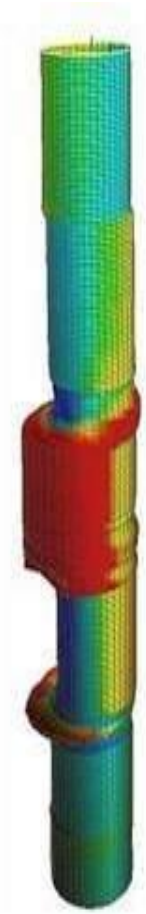
MSV Seawell
(2004 - 2005)

Island Frontier
(2006 ⇨)

Island Wellserver
(2009 ⇨)

Island Constructor
(2011 - 2013)

Typical LWI applications



LWI applications:

- **Tractor operations**
- **Data Acquisition (**PLT, Calliper, Leak detection tool, Well diagnostics etc.)
- **Perforating/ re - perforation**
- **Zone isolation** (plug/ straddle)
- **Installation of insert DHSV**
- **Scale removal** (milling/string shot)
- **Installation/change-out of subsea XT**
- **Well killing/Pumping operations**
- **Change out of gas lift valves**
- **Sleeve operations – DIACS valves**
- **P&A operations – pre-rig activities**

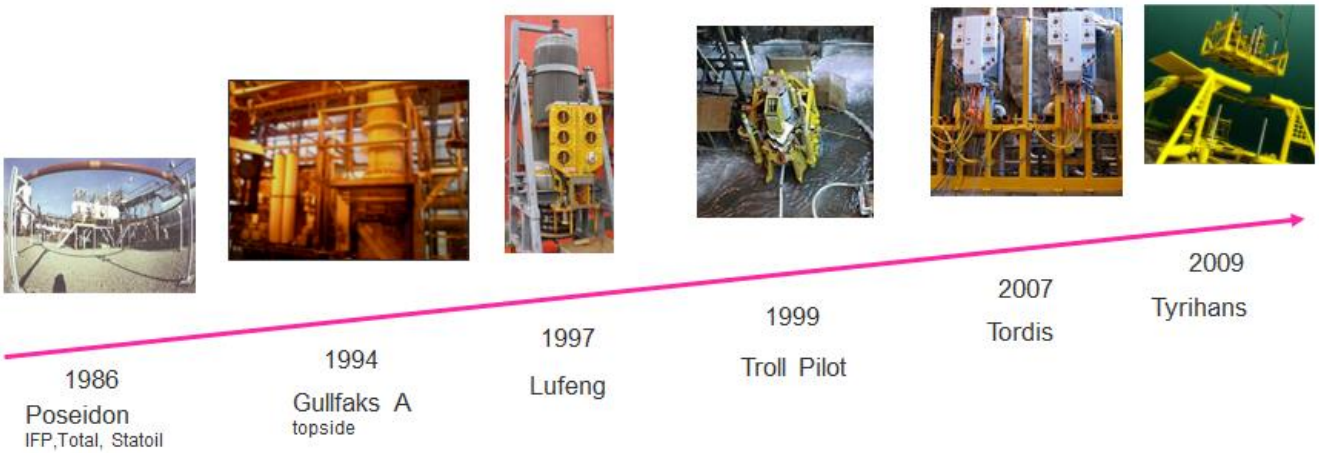
Benefit of LWI operations

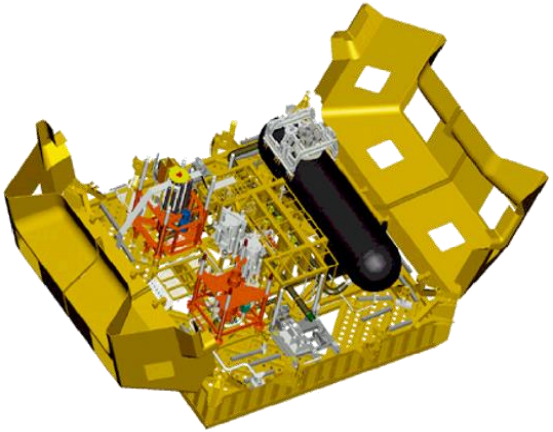
- Very good HSE - results
- Improved mobility
- Specialized vessel, crew and equipment

=>

Intervention cost reduced by 50 to 65 % compared with anchored rigs and riser systems

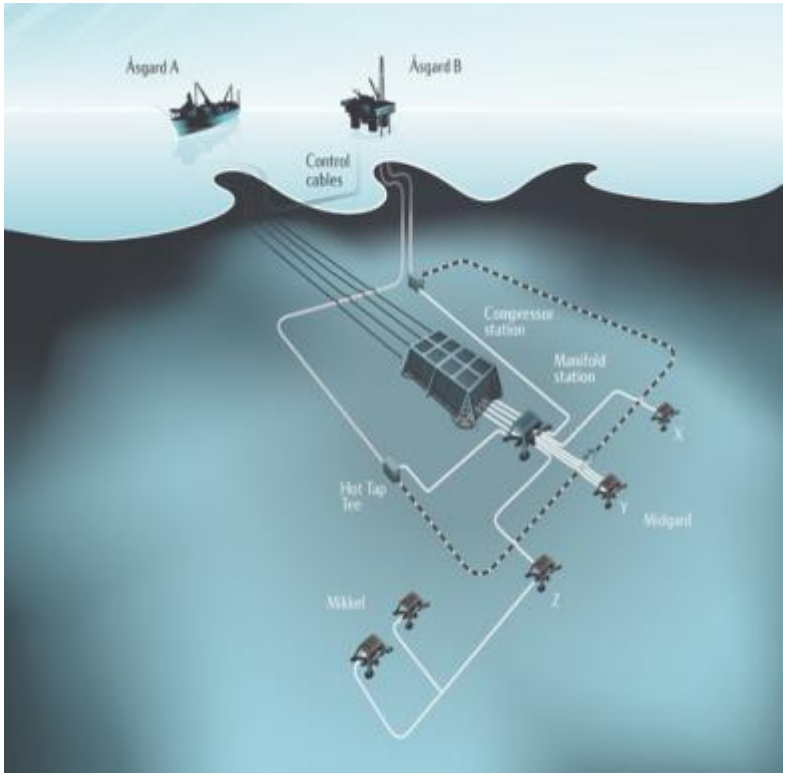
Subsea Processing experience in Statoil



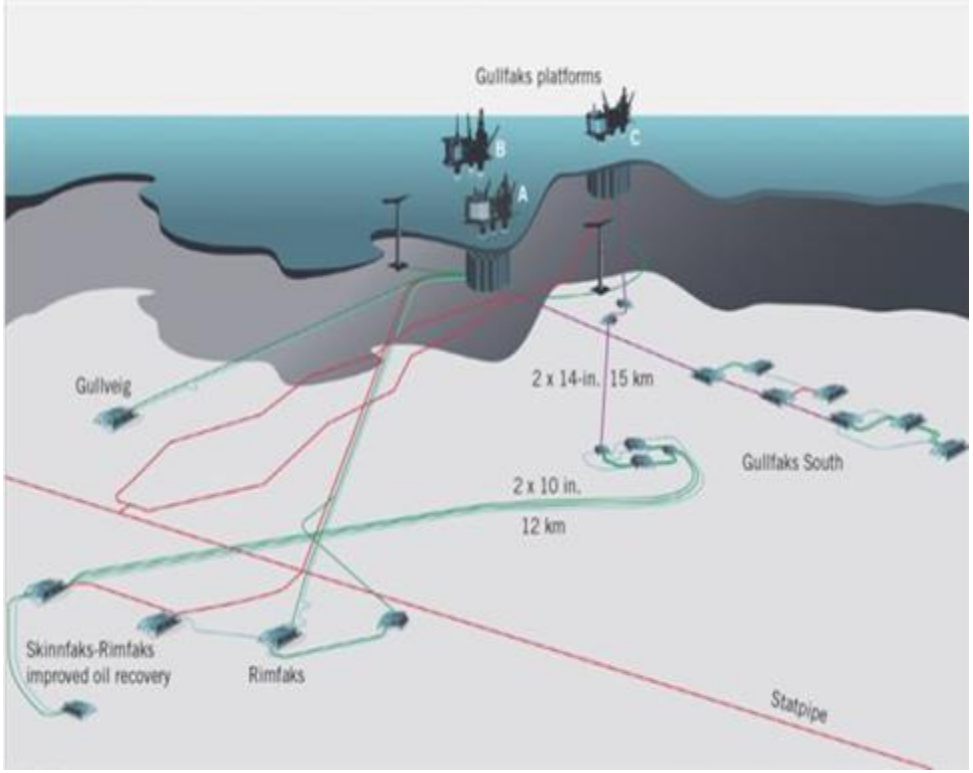


Åsgard and Gullfaks Subsea Compression Projects

Åsgard Subsea Compression



Gullfaks Subsea Compression



Åsgard and Gullfaks Subsea Compression Projects

Åsgard Subsea Compression

Gullfaks Subsea Compression

The Business Cases - 2 quite different projects

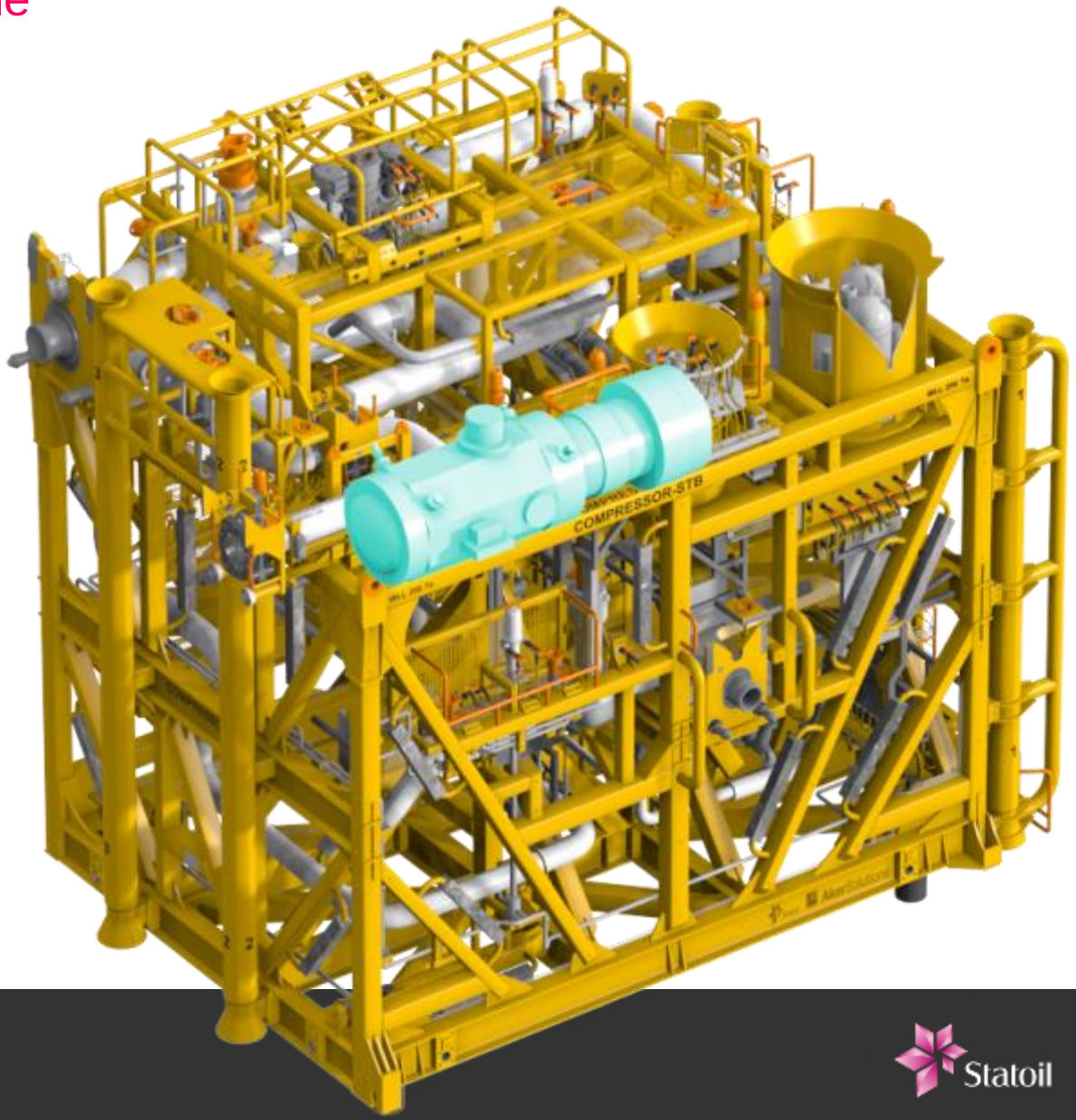
Field	Gullfaks	Åsgard
Start-up	7 October 2015	16 September 2015
Design gas flowrate	60 000 bboe/d	126 000 bboe/d
Water depth	135 m / 443 ft.	265 m / 886 ft.
Compression system weight	1070 tonnes	4800 tonnes
Step out	9 miles	25 miles
Additional recovery	26 million barrels of oil equivalent	306 million barrels of oil equivalent
Pressure boost - dP	32 bar (~460 psi)	52 bar (~750 psi)
Power	2 x 5 MW multiphase compressors	2 x 11.5 MW centrifugal compressors

A new location…for a compressor

Subsea compressor module

60T compressor⇒ 290T module

Size L 12m, W 8m, H 11m



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ÅSC – Key design drivers

- Availability requirement of 96%
- Need for «proven solutions»
- No time for «failure»

1. One complete spare set of modules «train 3»
2. Design for intervention in up to 4.5m Hs
3. Extensive test program
4. Convential solutions for non-core technologies
5. 5 days mobilization time for North Sea Giant and SHS system

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Test Philosophy

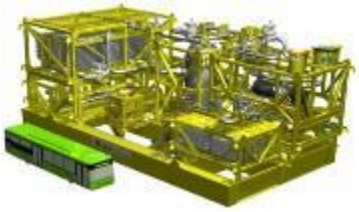
System Complexity

Technology Qualification Program ***2007-2013***

- Qualification of components according to relevant standards

Functional Unit Testing (FUT) ***2014***

- Control system – Aberdeen
- Pump - Tranby
- Compressor – K-lab



System Integration Test (SIT) ***2014***

- Trains – Egersund

Commissioning Offshore ***2013-2015***

- Topside module
- Subsea manifold template
- Subsea compression station

Compressor functional test at K-lab

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SIT-02 A/B/C

Nothing leaves until we have completed testing!!

1. Testing!
2. Testing!
3. Testing!

Main Challenge: Piping tolerances

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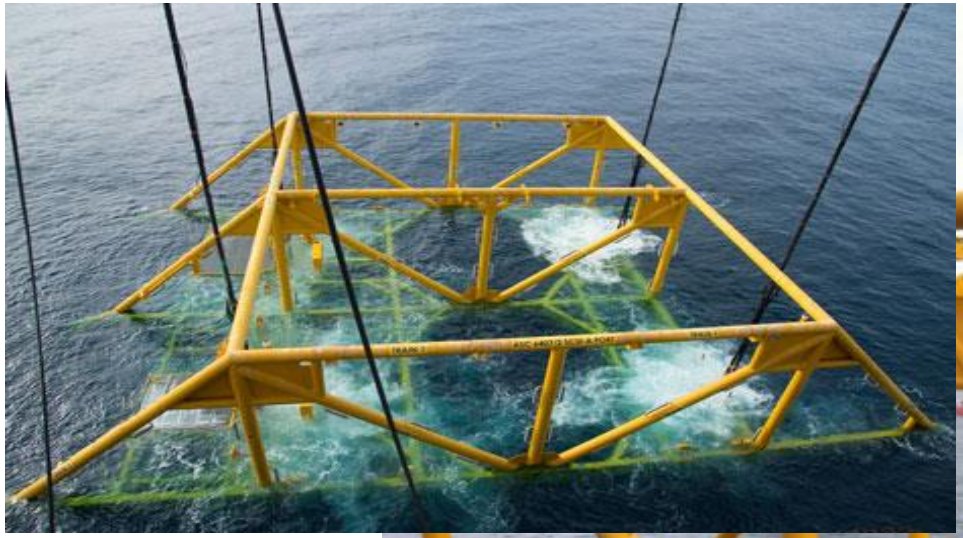
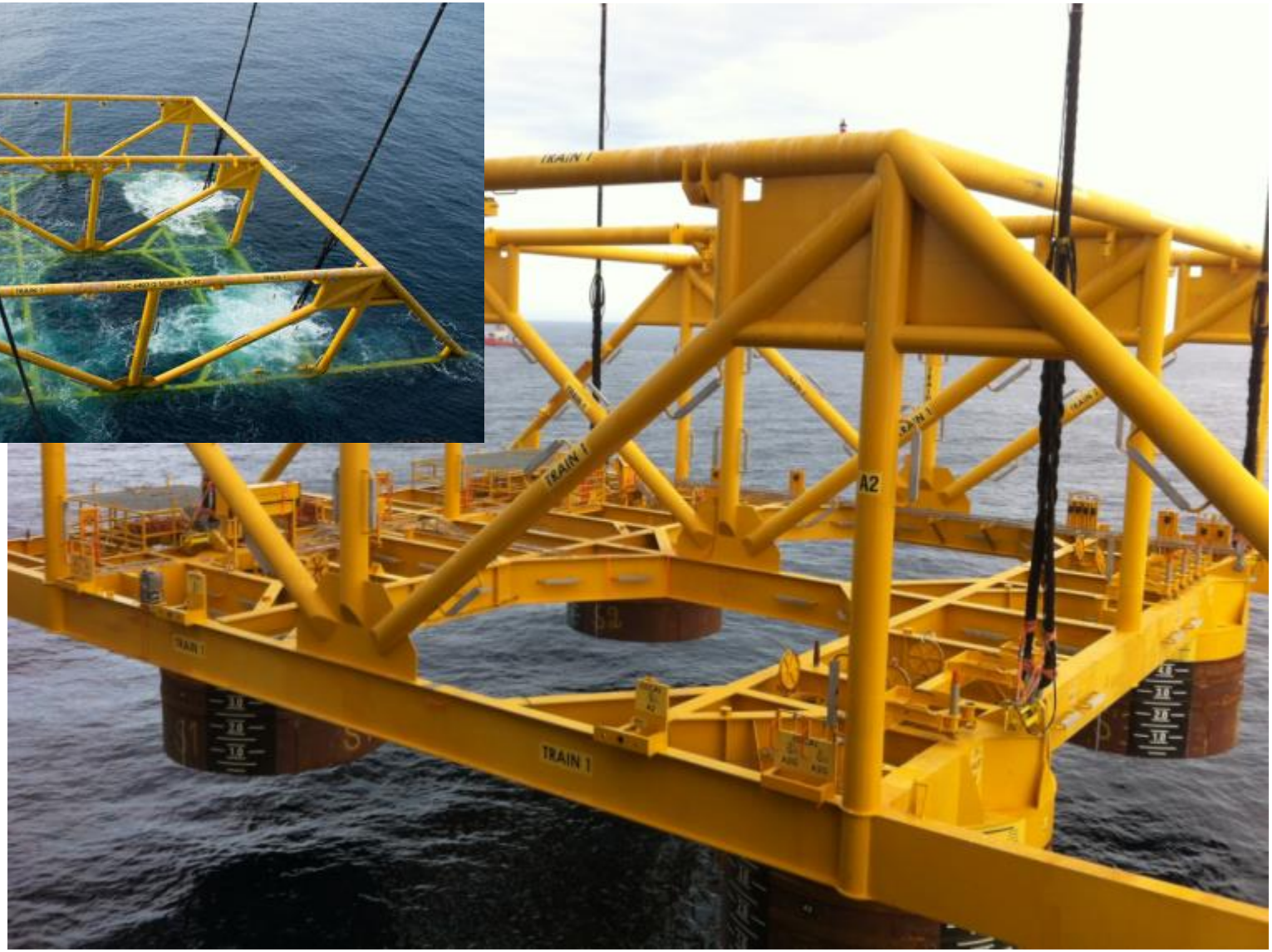
SCSt = Subsea Compressor Station template





Weight 1.800t
Weight 4.800t
(With all Modules)

70 x 45m
17m High
265m Depth

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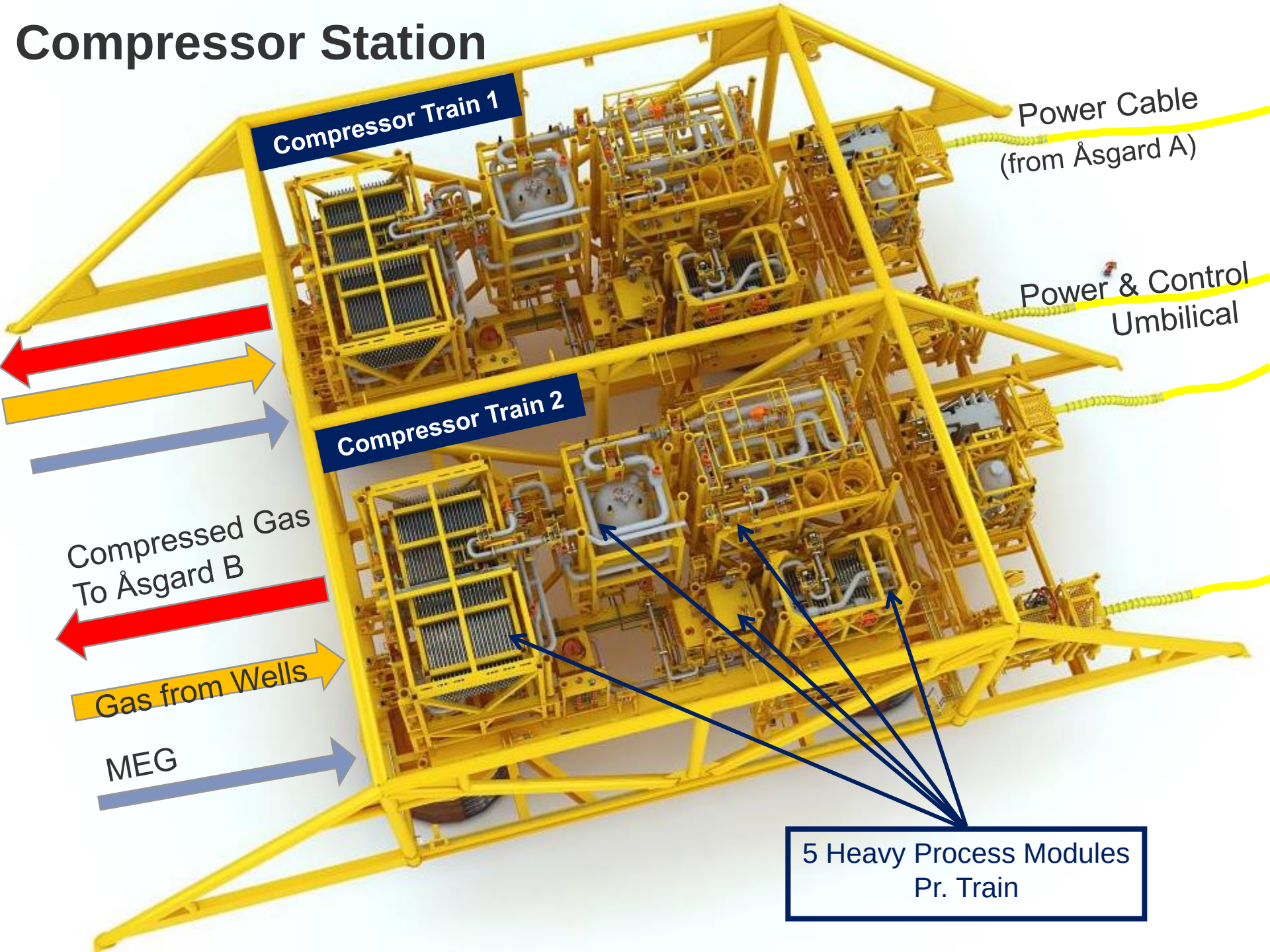
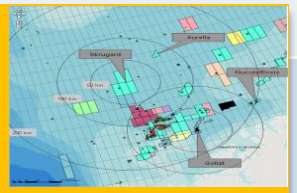
Compressor Station



The Subsea and UPP Factory
‘Cleaner- Leaner-Smarter‘

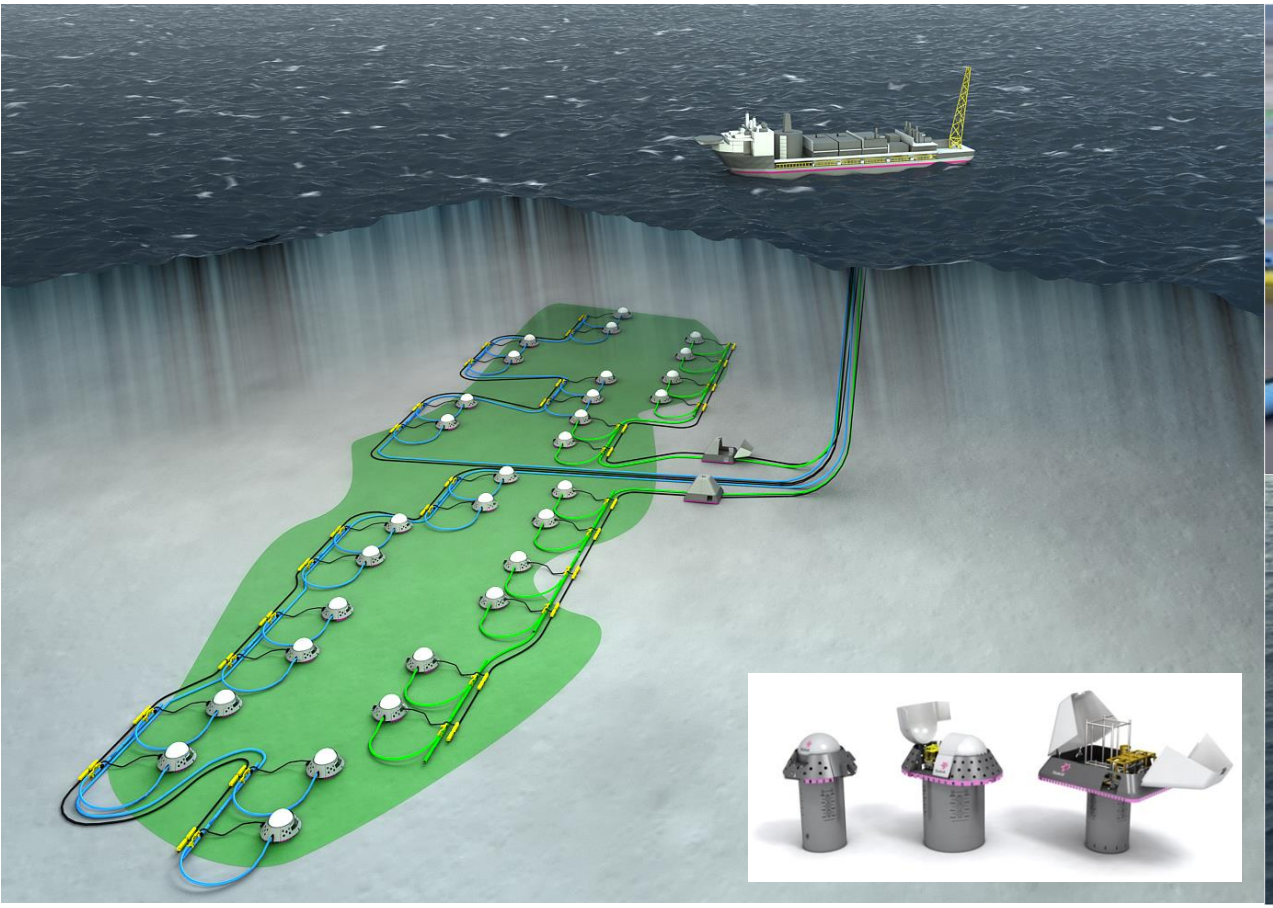
COST efficient Technology Solutions
COMMERCIAL MINDSET Implementation
Industry Collaboration to reduce cost
CARBON EFFICIENCY Reduced Carbon Footprint

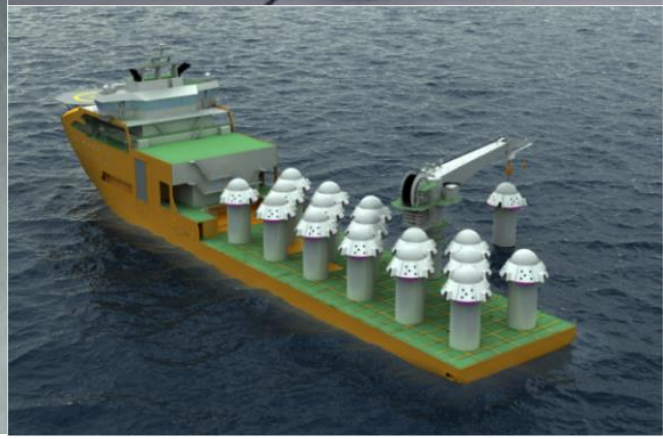
Most Carbon efficient O&G Company

PRODUCT LINE	BUSINESS NEED	CONCEPT/FOCUS	KEY CUSTOMERS
BROWNFIELD FACTORY	**50 % reduced facility capex** **60 % recovery from existing fields**	**Simplification & Standardization** Reduced cost of Subsea Production and Processing through industry collaboration **Simplified Subsea Compression & Boosting** Subsea Wet Gas qualification to reduce cost of subsea compression	**DPN Brownfield and Greenfield**
SUBSEA-TO-HOST FACTORY	**Reducing CAPEX/OPEX through less topside modifications** **Increase tie-back optionality by de-bottlenecking**	**Subsea Power & Controls** Reduce capex, Flexibility of new tie-backs, Enable long tie-ins **CO2 measures** CO2 calculator, Subsea Storage and Green Subsea Processing **Gas-2-Pipe™ System** Concept where gas is delivered directly to pipeline - utilizing established infrastructure in a flexible way	**DPN Brownfield and Greenfield**
 EXTENDED REACH FACTORY	**Allow subsea production and transport to host** **up to 250 km for gas** **up to 100 km for oil**	**Lean Extended Reach System** Low cost development solution based mainly on Smart Flow Assurance and Multiphase Flow **Subsea Produced Water Treatment** Produced water separation and treatment to enable re-injection or discharge	**Barents Sea area** **East Coast Canada** **East Africa/Tanzania**
DEEP WATER FACTORY	**Enable production from new fields to existing host /new facility down to 3000m water**	**Deep Water Portfolio (Brazil - RCR)** Deep Water separation and Subsea water treatment, Robust ESP development Production systems (Pipes/Risers)	**Brazil** **East Coast Canada** **East Africa/Tanzania**

Cap-X™- new challenges, new solutions

Standardisation, simplification and lower cost in practice





Acknowledgements regarding Gullfaks and Åsgard Compression projects

Gullfaks partners:

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Petoro AS

ENI Norge AS

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Operator Statoil