Using past learnings to drive subsea production and processing improvement initiatives

OGA UKCS Operators Technology Managers
Forum 29.1.19

Roald Sirevaag, subsea chief Engineer

Presentation outline

- Subsea Production Systems
  - Key features of present generation
  - Collaboration
  - Deepwater (1500m, 3000m)
- Subsea Processing Systems
  - Key learnings
  - New building blocks
- Remotely Operated Factories

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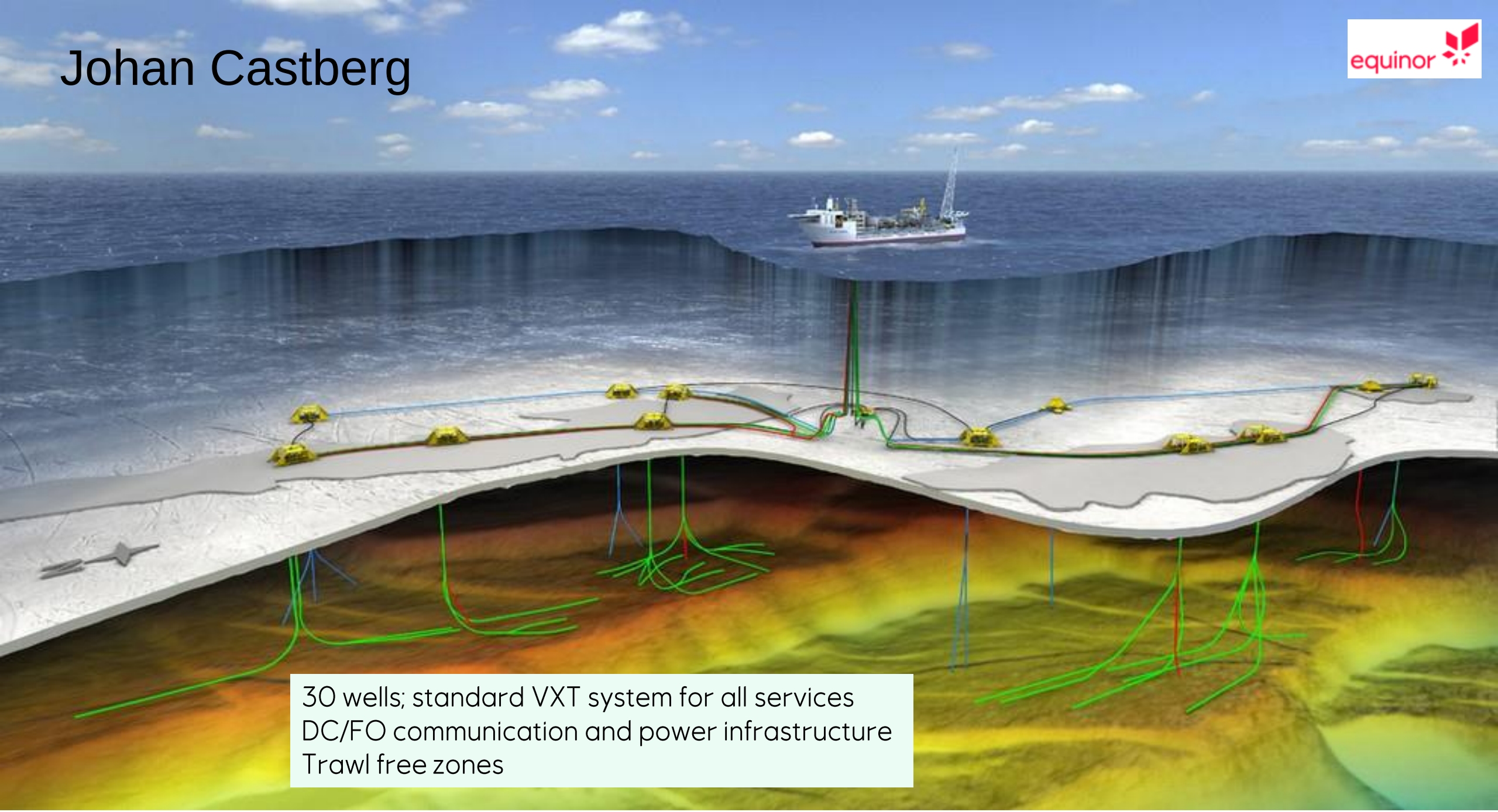
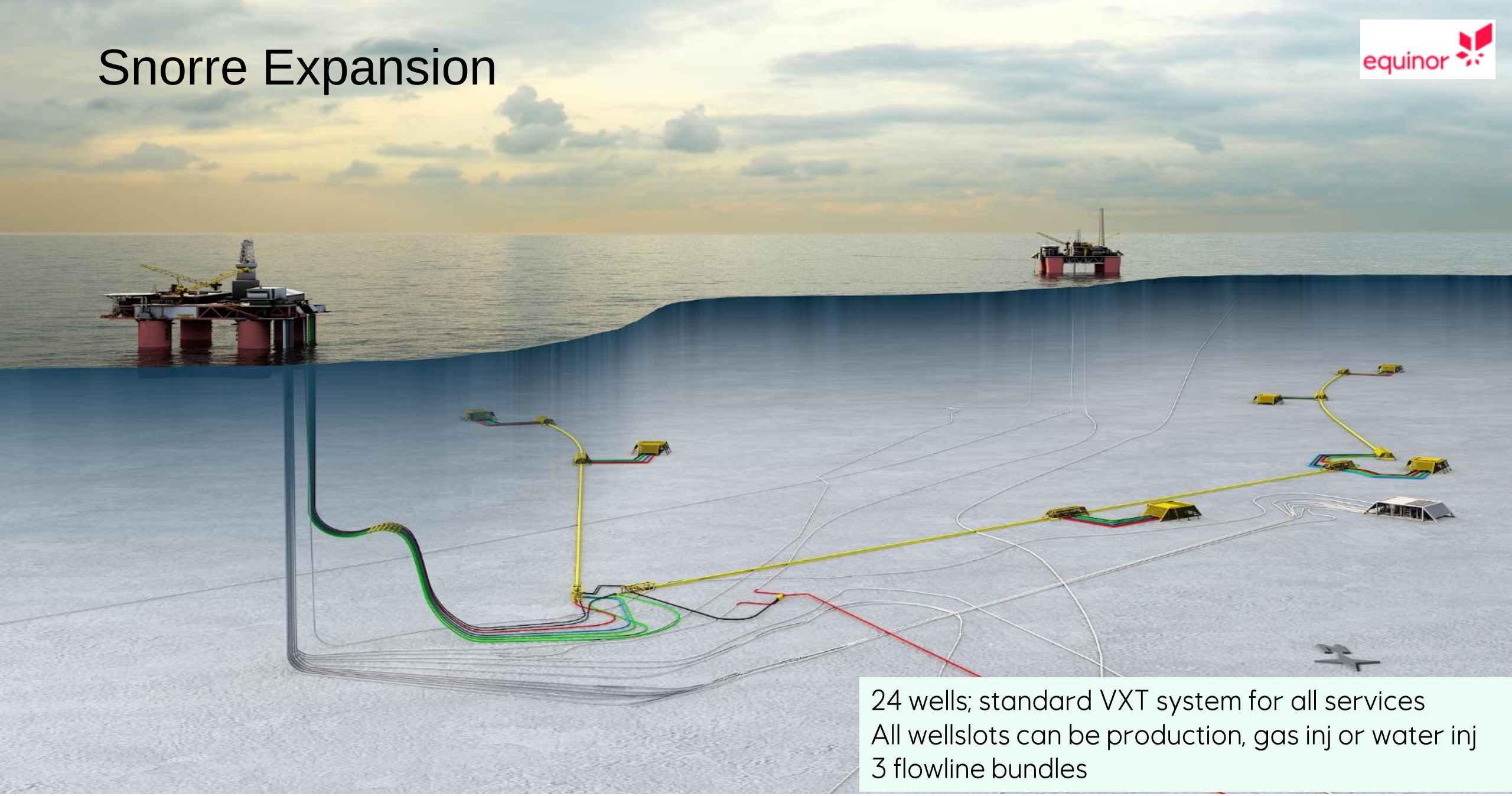
Johan Castberg



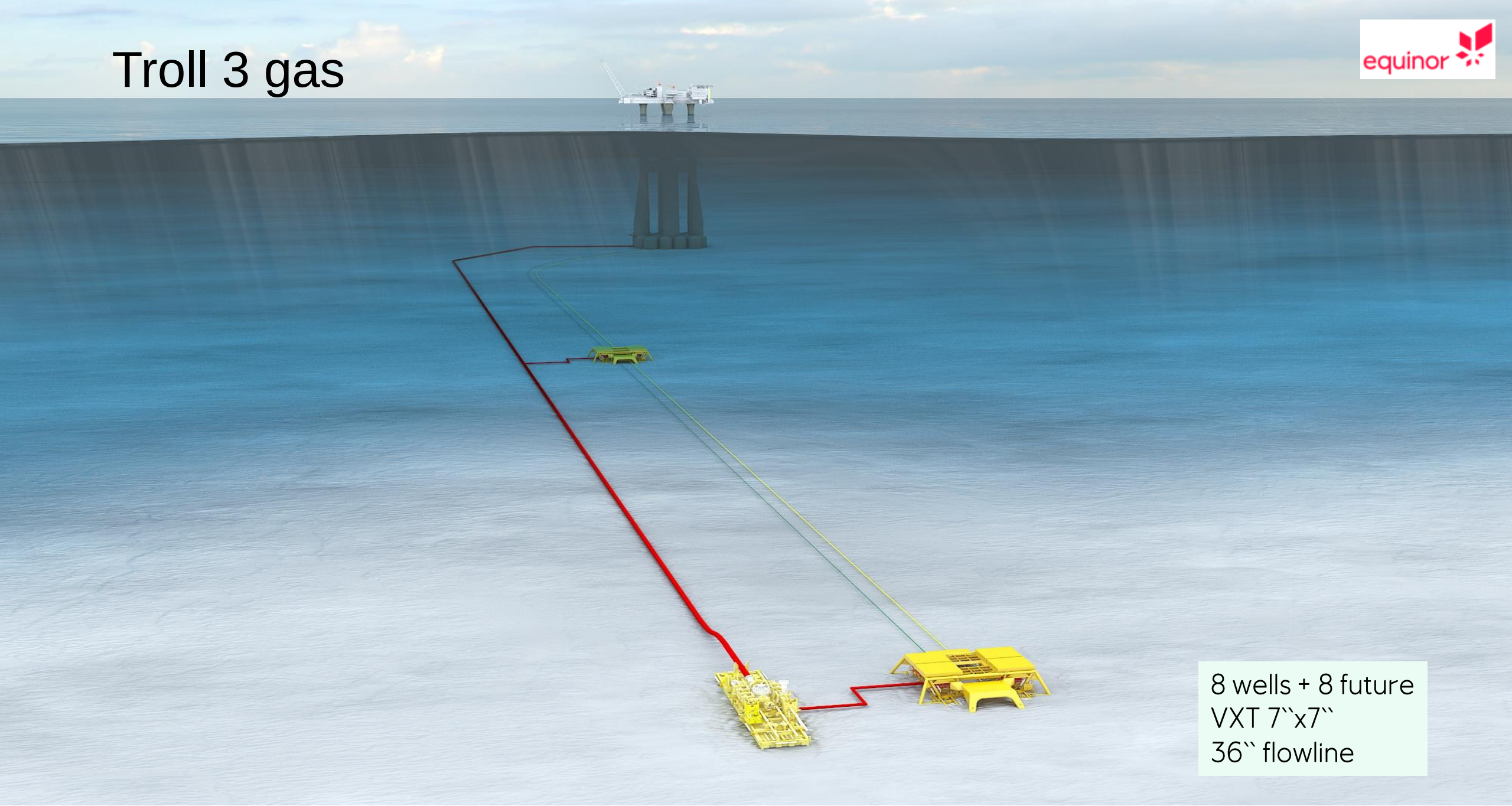
30 wells; standard VXT system for all services
DC/FO communication and power infrastructure
Trawl free zones

Snorre Expansion



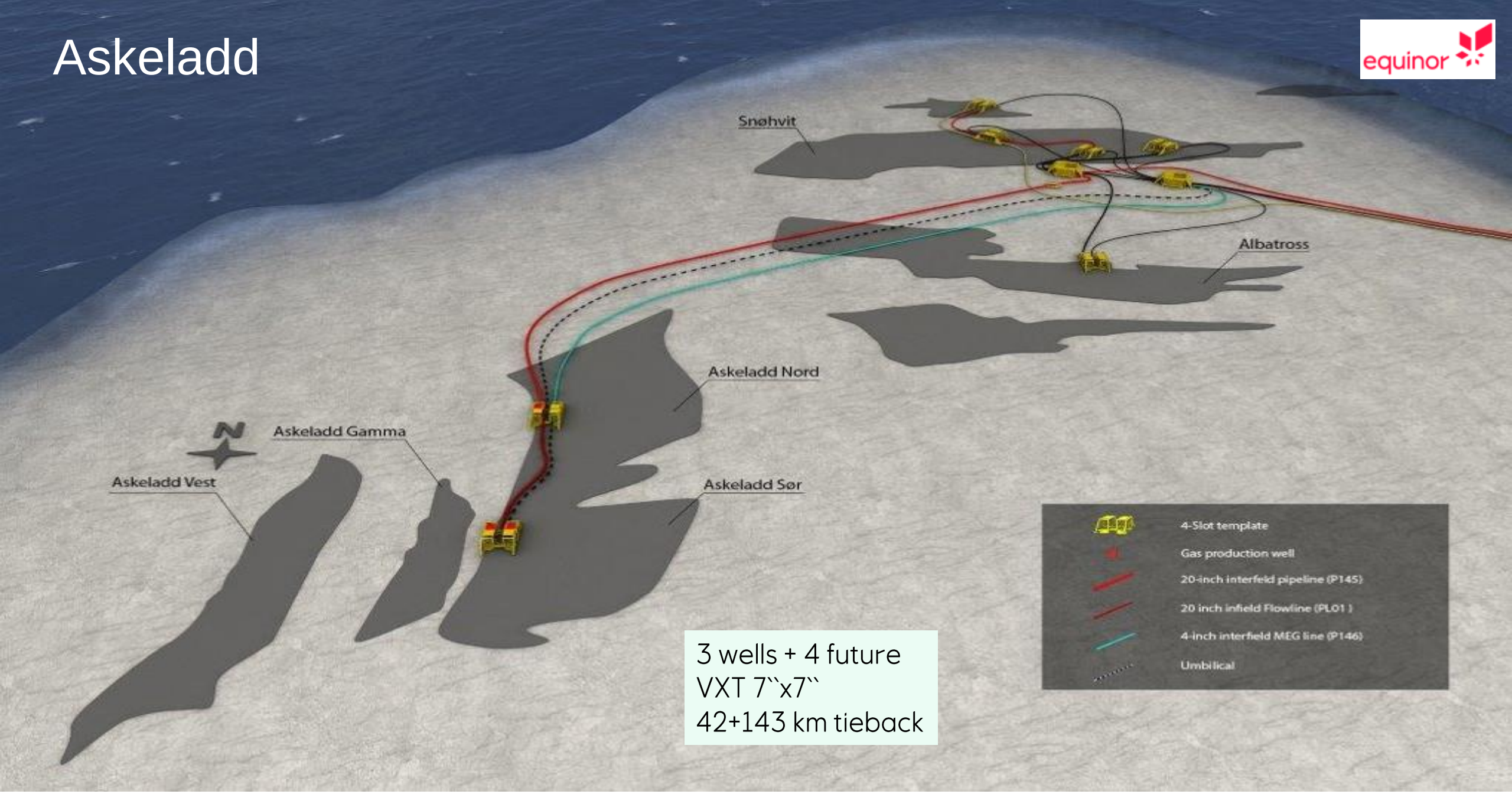
24 wells; standard VXT system for all services
All wellslots can be production, gas inj or water inj
3 flowline bundles

Troll 3 gas



8 wells + 8 future
VXT 7``x7``
36`` flowline

Askeladd



3 wells + 4 future
VXT 7``x7``
42+143 km tieback

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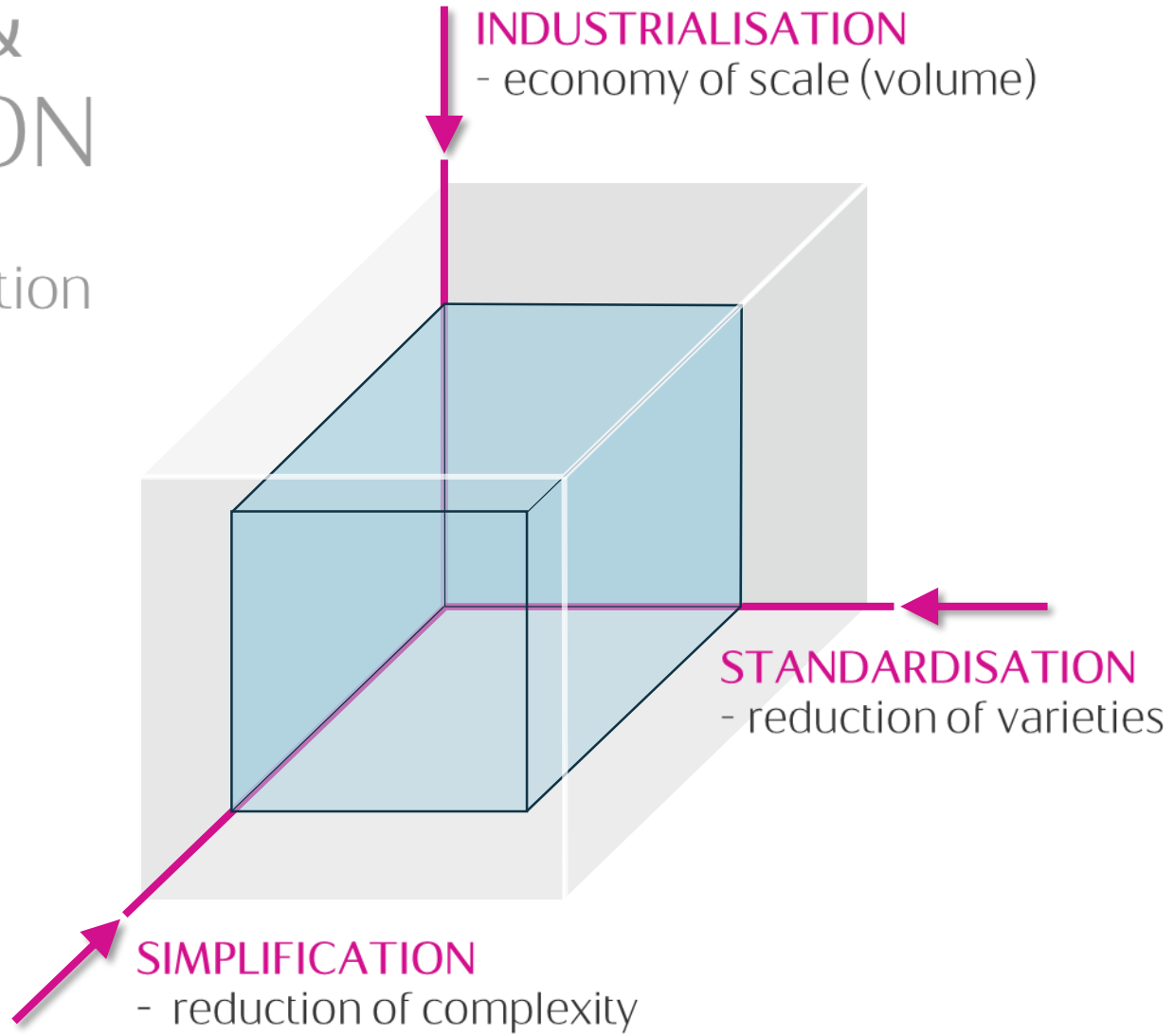
SIMPLIFICATION & STANDARDISATION

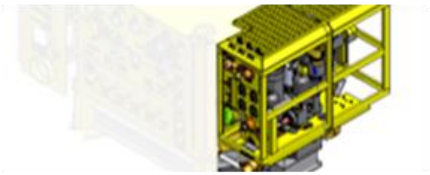
enables effective industrialisation



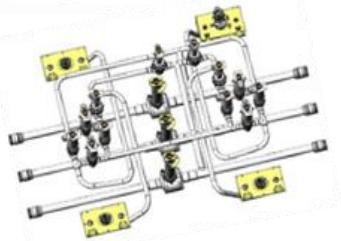
A 20% improvement on each of the S, S and I dimensions have a potential for an overall 50% cost reduction (0.8 x 0.8 x 0.8 = 0.5)

Limit variations of modules and systems

Xmas Trees



Flow Control Modules



Manifolds

Standardised components

Choke

Valves

Composite Valve blocks

Wellhead housing

Tubing hanger

Industrialised processes

JIP "topic"

JIP forgings QA & QC

DNVGL-RP-B202

JIP forgings

DNVGL-RP-0034

JIP welding

JIP documentation

DNVGL-RP-0101

All-electric - Joint Operator Specification

- Initiative kicked-off in Oct 2018
- **Target:**
  - Globally ensure early industry standardization by generation of industry aligned specification for Subsea All-Electric technology
  - API 17F implementation
- Utilizing existing requirements & interfaces as frame
- Status: Review of existing requirements ongoing
- Next step: Definition of technical core topics
  - Consensus that Functional Safety is a core topic

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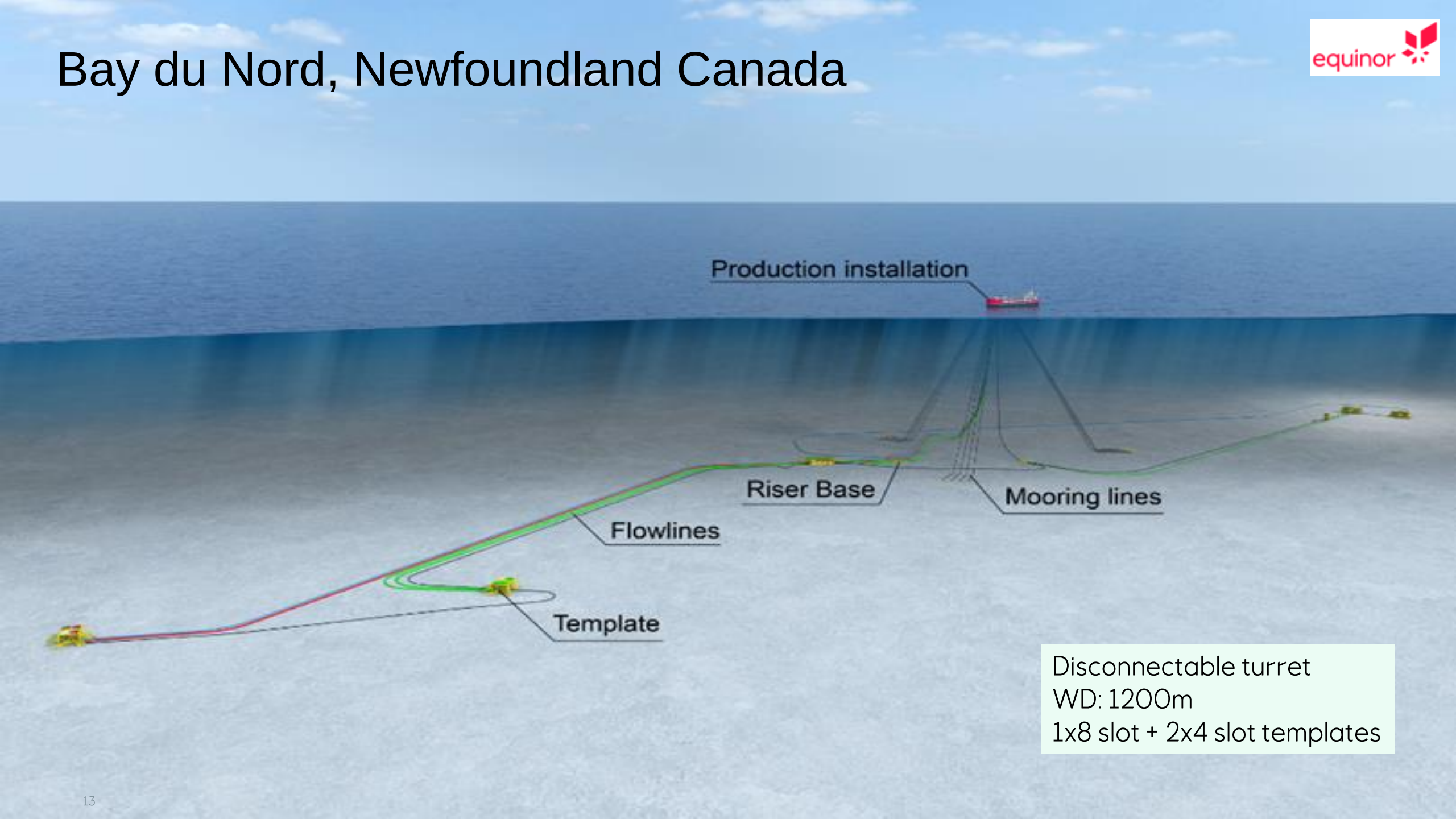
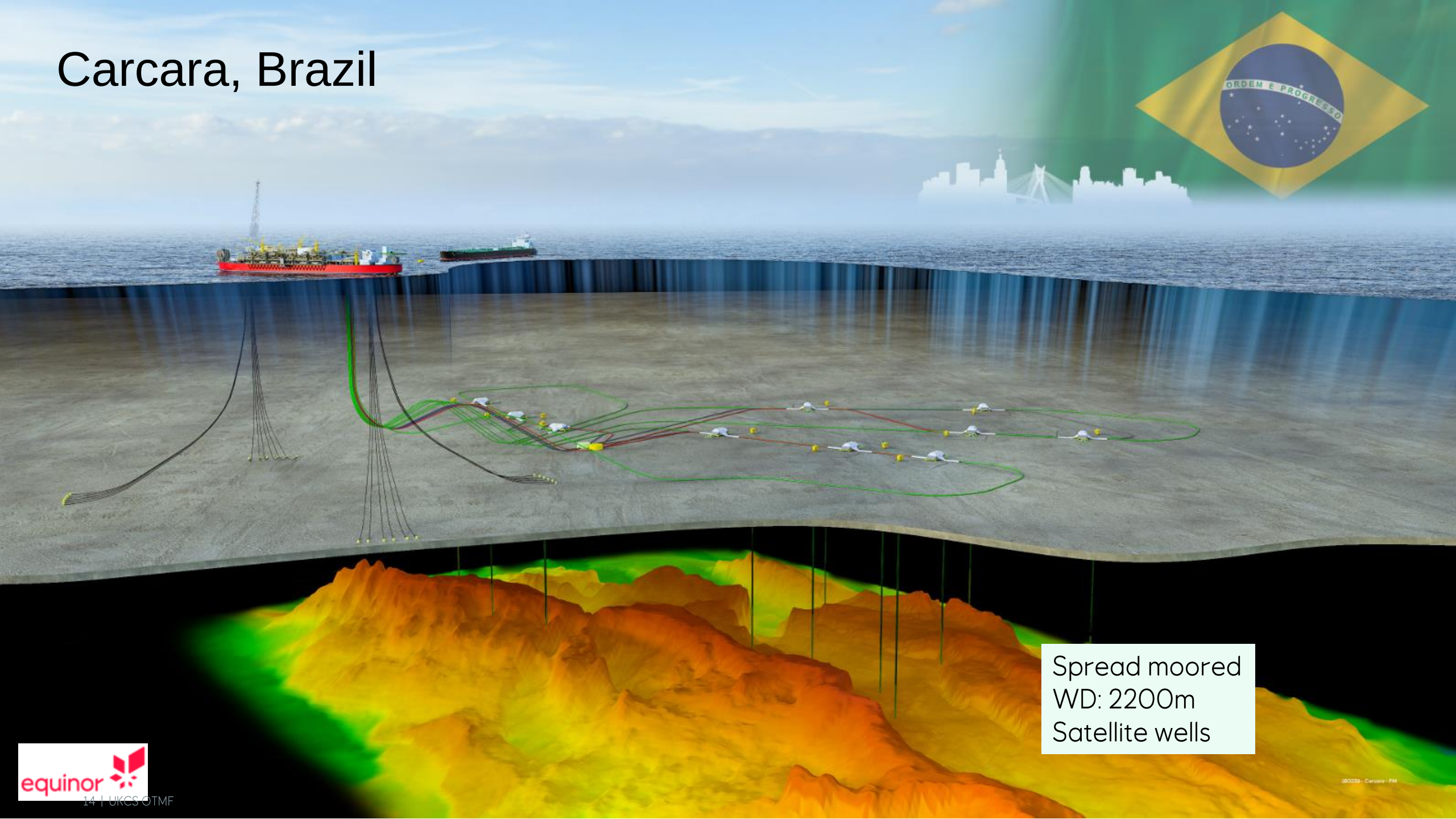
Bay du Nord, Newfoundland Canada



Disconnectable turret
WD: 1200m
1x8 slot + 2x4 slot templates

Carcara, Brazil



Spread moored
WD: 2200m
Satellite wells

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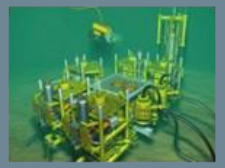
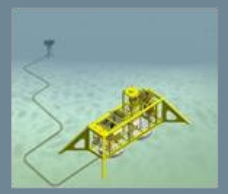


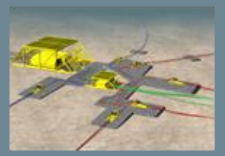
Lufeng: 1997
Subsea pump
5 x 0,4 MW
1 km

Troll: 2001
Subsea sep.
1 x 1,6 MW
4 km

Tordis: 2007
Subsea sep.
Sand handling
2 x 2,5 MW
12 km



Tyrihans: 2009
Subsea raw
seawater
injection
2 x 2,5 MW
43 km



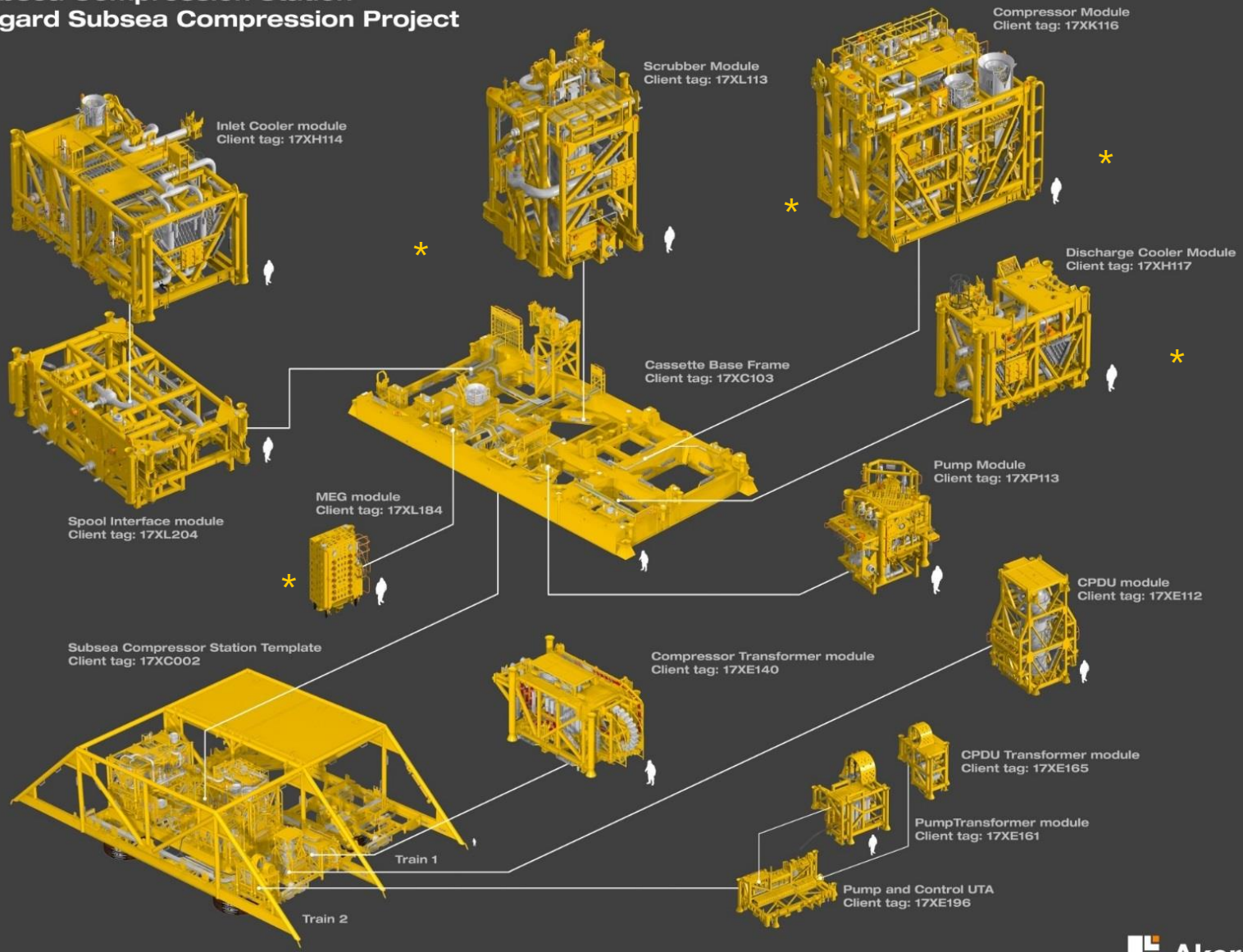
Åsgard: 2015
Subsea
compression
2x11,5 MW
50 km

Gullfaks: 2015
Subsea
compression
2x5 MW
17 km

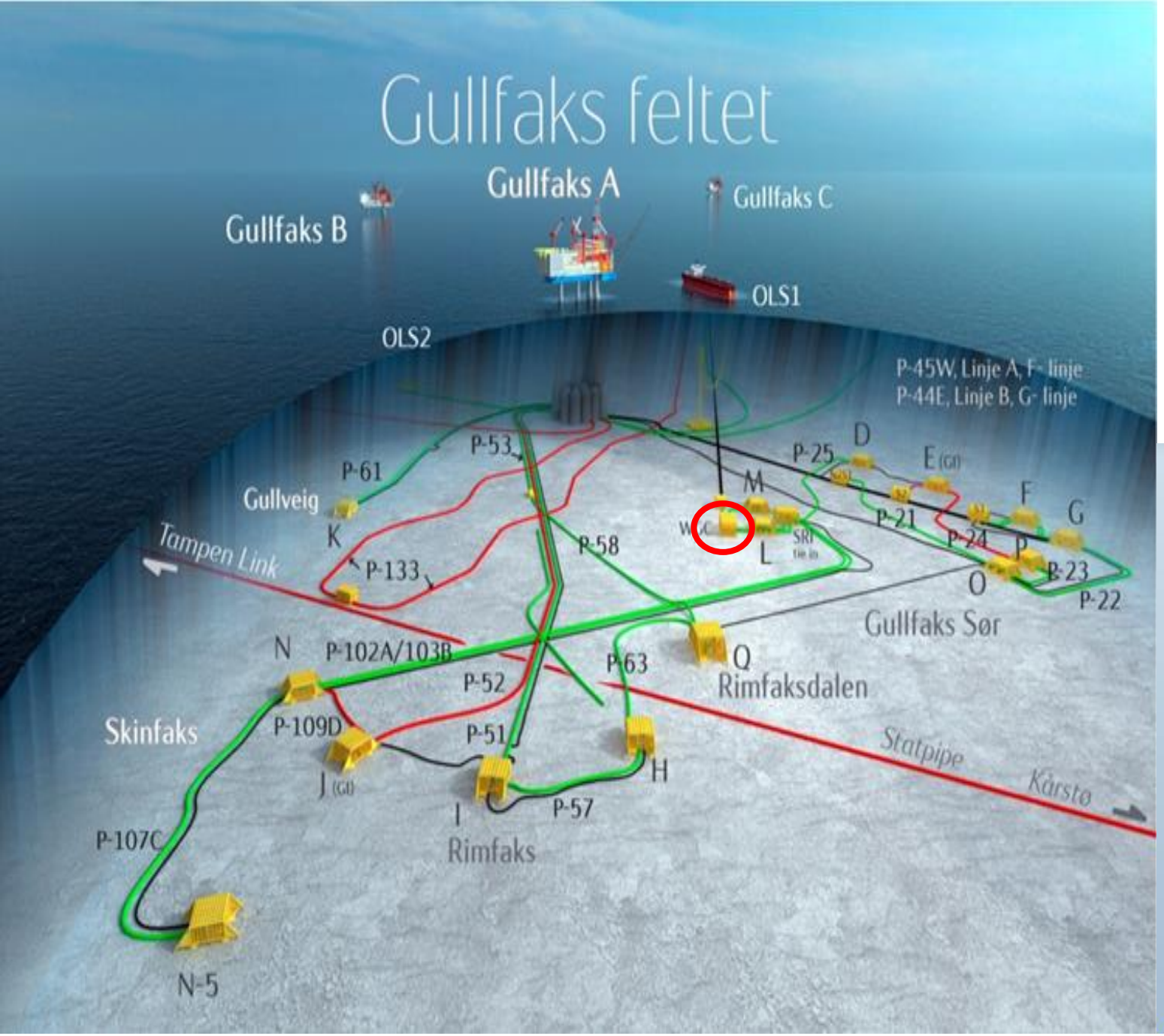
2020 NCS
Subsea boosting
Subsea
compression

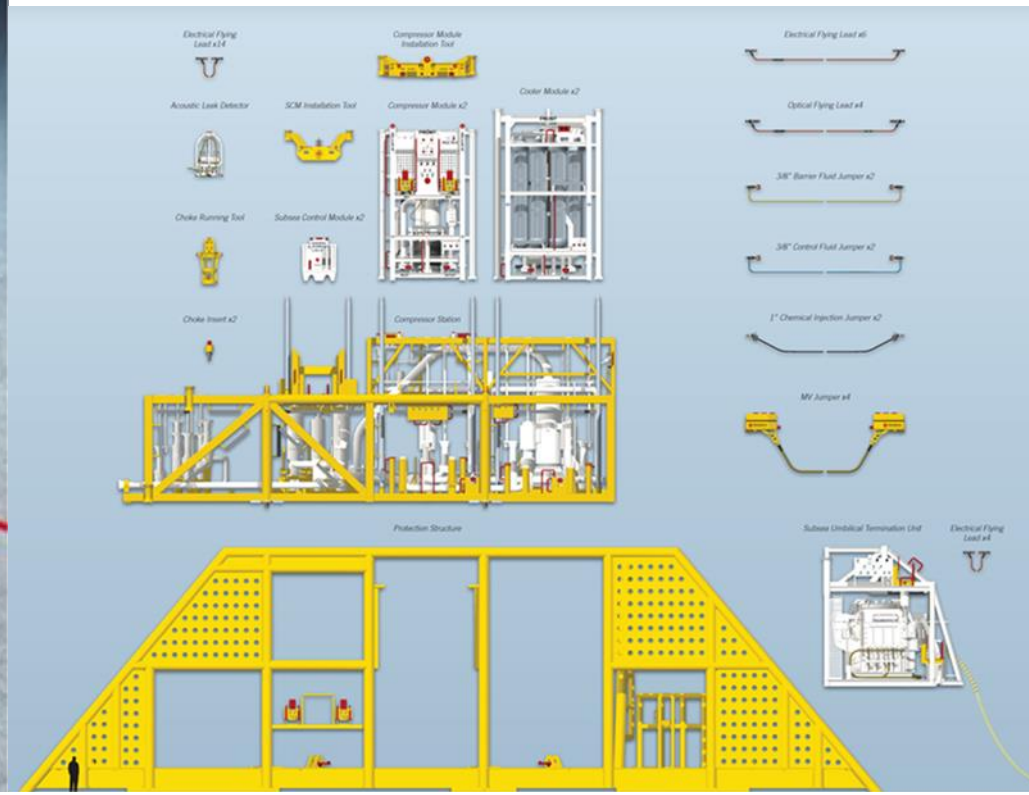
2020+ ?
DPI/DPUSA

Subsea Compression Station
Åsgard Subsea Compression Project



* Installed using the special handling system


Gullfaks feltet
Gullfaks A
Gullfaks B
Gullfaks C
OLS1
OLS2
P-45W, Linje A, F- linje
P-44E, Linje B, G- linje
P-53
P-61
Gullveig
K
P-133
Tampen Link
P-58
P-25
D
E (GI)
M
P-21
F
G
P-24
P
P-23
P-22
O
Gullfaks Sør
L
SRP
tie in
N
P-102A/103B
P-63
Q
Rimfaksdalen
P-52
Skinfaks
P-109D
P-51
Statpipe
Kårstø
J (GI)
H
I
P-57
Rimfaks
P-107C
N-5



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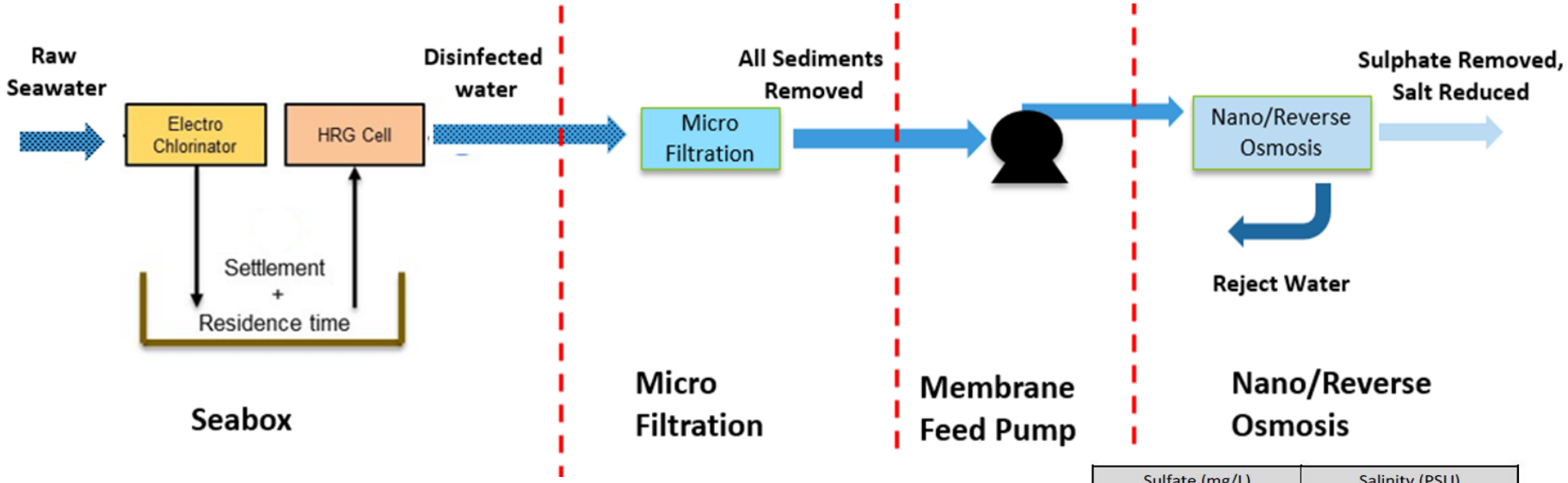
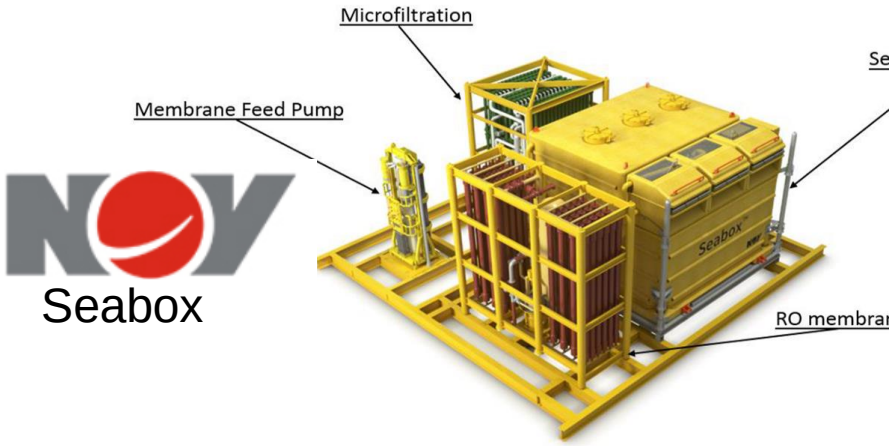
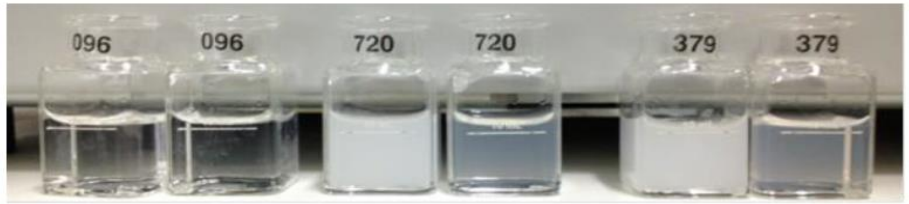
Subsea seawater treatment and injection





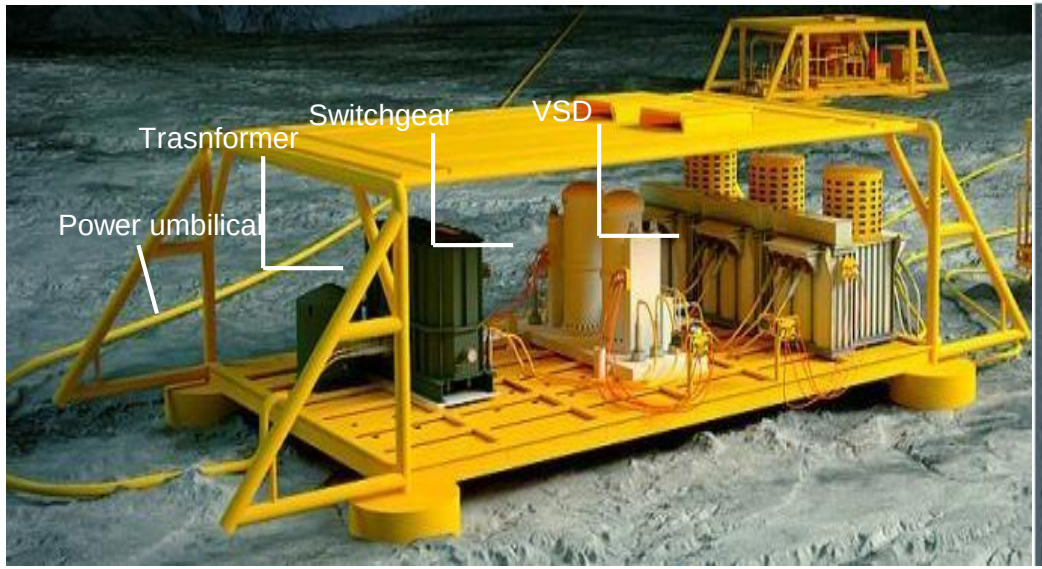
		Sulfate (mg/L)	Salinity (PSU)
Raw	Raw seawater	2000	35
HF	Before RO	2200	35
	After RO	<2	6
SWIT	Before RO	2000	35
	After RO	<2	8



Siemens Subsea Power JIP

- Started 2011
- Subsea power distribution
  - Switchgear (36 kV)
  - Variable Speed Drive (6 MVA)
- TRL 4, 2019

- Key Milestones
  - Shallow water test start in 2018



SIT at Dora, Trondheim Norway, November 2018

ABB Subsea Power JIP

- Started in 2013 -> TRL 4, 2019
- Subsea power distribution:
  - 30 years design life, 3000 m water depth
  - Switchgear (36 kV), 2-6 feeders
  - Variable Speed Drives for pumps and compressors
- Long distance power transmission:
  - Subassemblies tested for Low Frequency AC

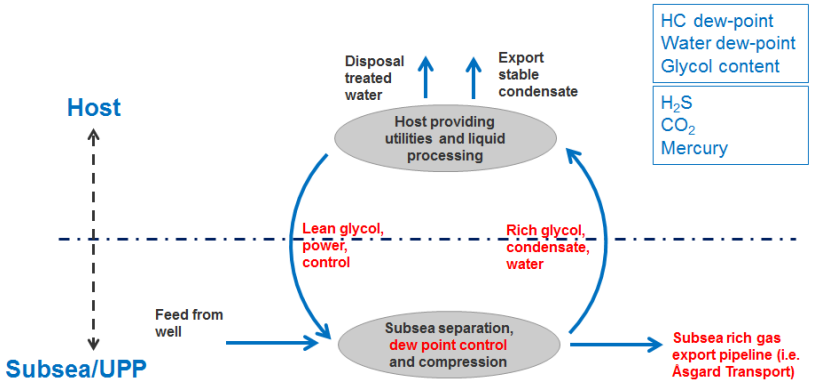
Variable Speed Drive

Paralleling of 2 drives, 18MVA

Subsea Switchgear

Shallow water testing

Gas-2-Pipe™ concept



General concept description

- Gas is processed to rich gas quality in a *Subsea Factory* or a *Unmanned Platform.*
- Utilities (power, control and MEG) are imported from a host.
- Gas is compressed and delivered directly to a pipeline.

Business potential

- Enabling technology for tie-back when gas processing host capacity is a constrain
- Reduce capex intensive topside modifications
- Utilizing established infrastructure and host facilities in a flexible way

Technology qualification:

- Qualification of key technology elements is ongoing

Other Technologies / Solutions needed/being worked

- Subsea produced water handling (re-injection or emission)
- Compact dewatering/degassing of oil
- Subsea storage – crude oil and chemicals
- Sensors

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Roadmap UID™ intervention

UID™ intervention capability and complexity

Increase PE, reduce OPEX, POB, CO_2 footprint, reduced HSE risk

ROV Onshore Control centre

Resident ROV

E-ROV, Eelume, RROV pilot, others

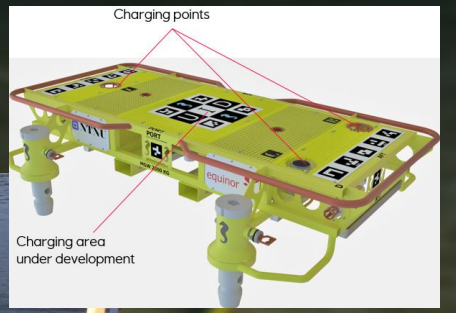
Subsea docking station – standardised interfaces

Semi-autonomous resident light WROV

Network of subsea docking stations

Reliable UID™ systems on the NCS (multi use)

3D models of subsea system



Roadmap towards an unmanned Remotely Operated Factory - ROF™

Innovation, technology and digitalisation for a future-fit portfolio

Åsgard

In operation

Subsea compression

Hywind Scotland

In operation

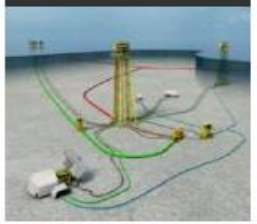
Offshore floating wind

Oseberg Vestflanken 2

~~*Ongoing*~~ *In operation*

Unmanned Wellhead Platform (UWP™)

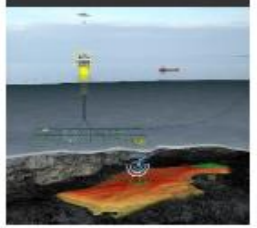
Krafla/Askja



Unmanned production platform, supported from host (UPP™)

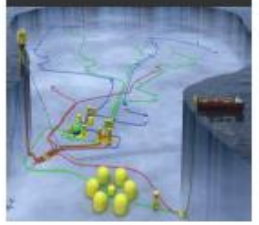
DG2 Jan 2019

Peon



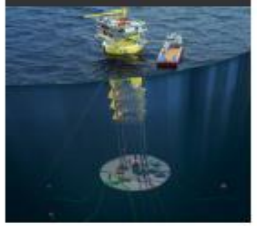
Stand alone gas/condensate development

UK and Barents



Stand alone remote oil and gas field developments

Brazil



Ultra deep water UPP™

Field of the future potential[1]		Automated drilling potential[2]
Capex[3]	Opex	Cost
-30%	-50%	-15%

1. *New concept compared to conventional facility.*
2. *Automated drilling compared to conventional.*
3. *Facility capex.*

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