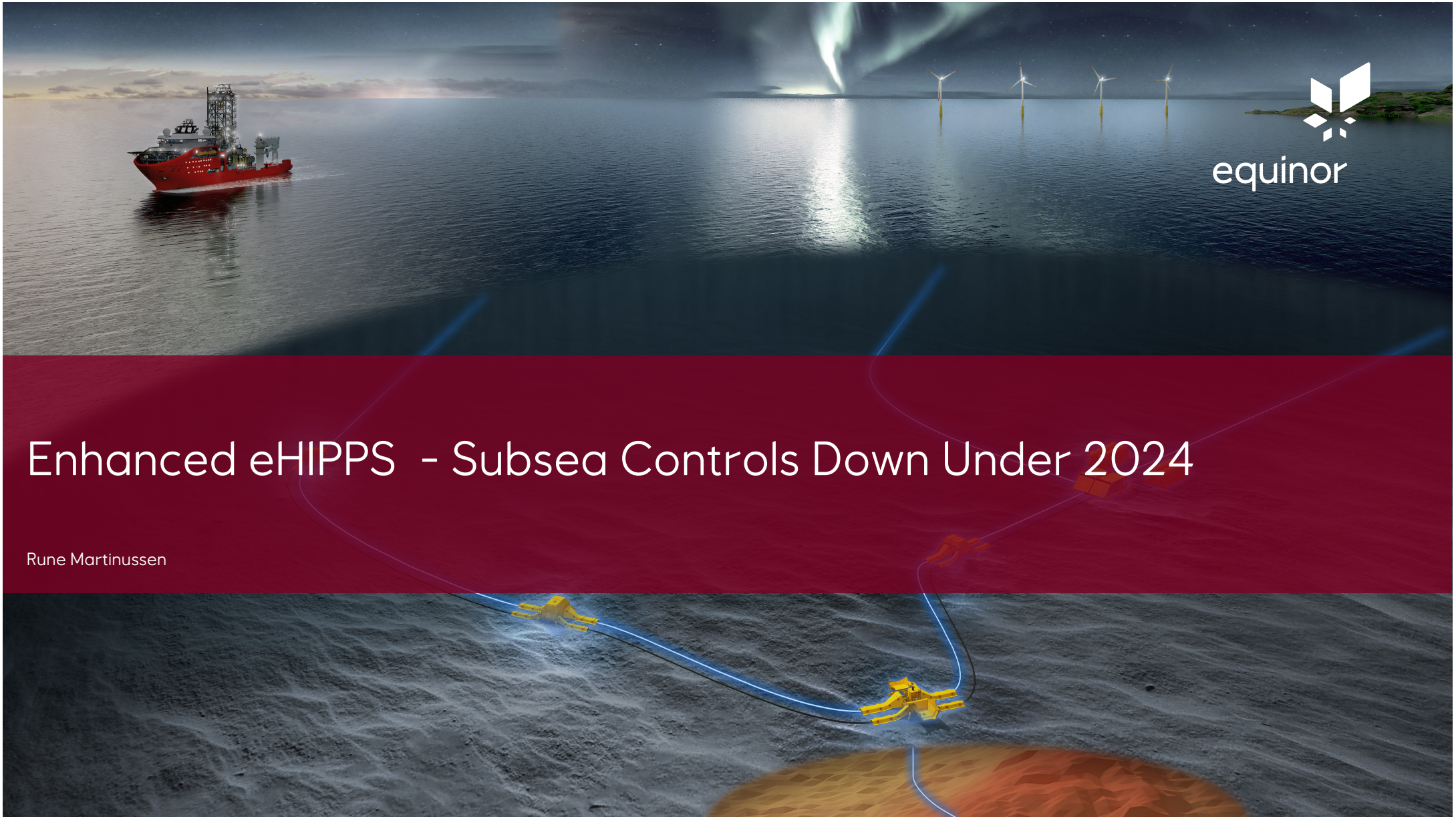


Enhanced eHIPPS - Subsea Controls Down Under 2024

Rune Martinussen

Subsea in Equinor

Norwegian Continental Shelf:

- 660 Subsea Wells
- 2 Subsea Compressor Stations
- 2 Subsea Pump Stations

International:

- Bacalhau (Brazil) – in execution
- Raia (Brazil) – in execution
- Rosebank (UK) – in execution
- Bay de Nord/Flemmish Pass (Canada) – in development

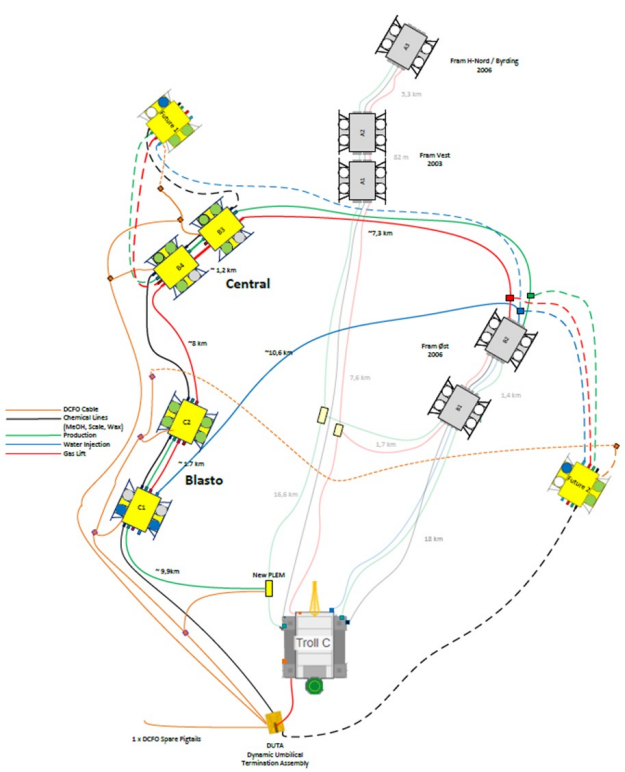
Longevity on NCS

Continue to invest on NCS -> 2035

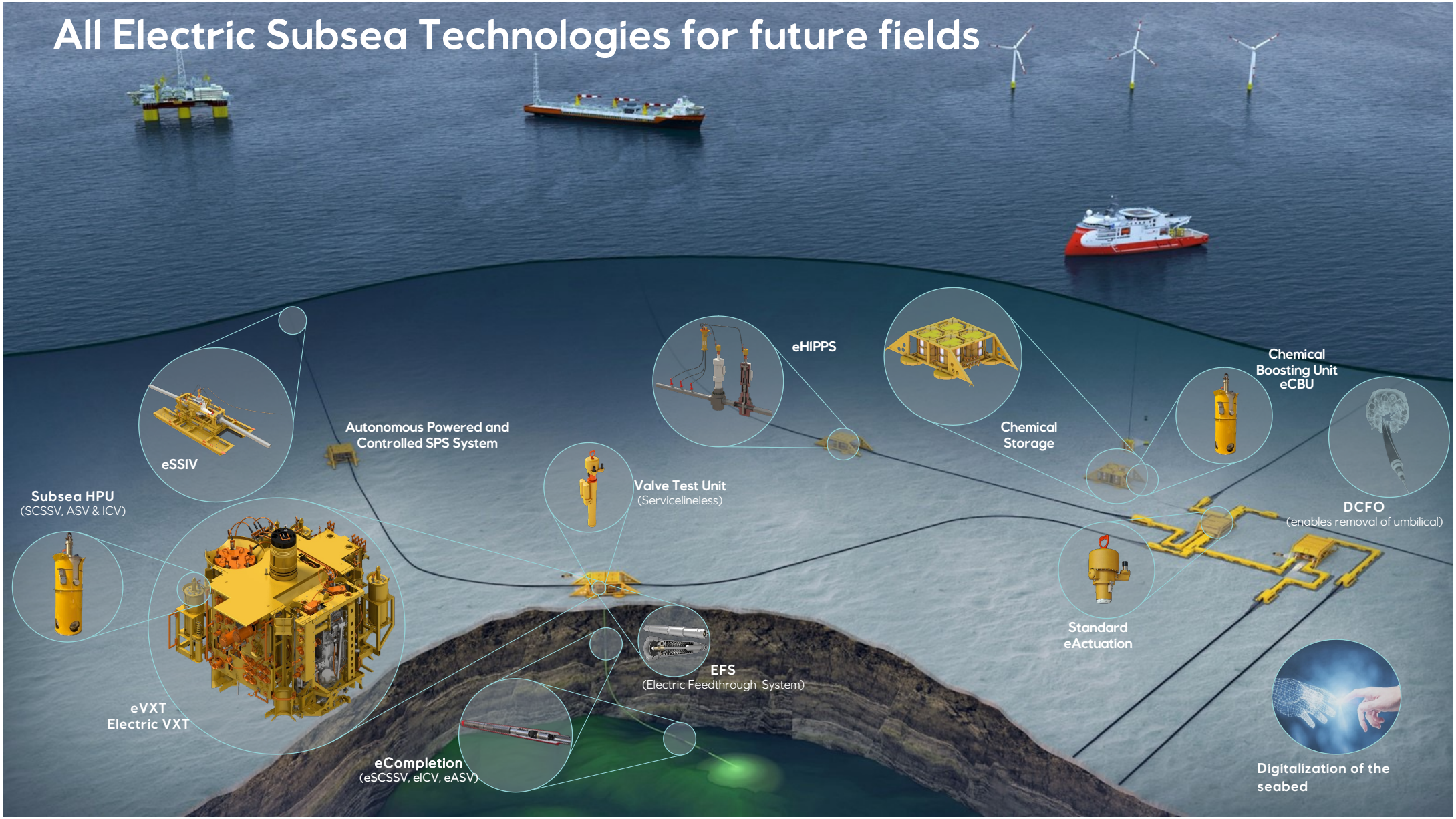
Tie-backs to existing installations

- Some HPHT- projects
- Some tie-backs with slightly higher pressure than rating of existing infrastructur
- -> eHIPPS enabler!

Fram Sør project in post DG2 development with eVXT and DCFO as base case.



Title	Option A	Option B
D 401 Rigid vs Flexible infield flowlines	Rigid Flowlines	Flexible flowlines
D-402 Infield Production Flowlines (Thermal insulation)	Rigid Wet Insulated Pipe (MLP)	Pipe-in-pipe Note: Opportunities being explored
D-403, D-415 Tie-in Concept	Continuous flowlines connected to templates by use of ILTs and flexible jumpers	Continuous flowlines connected to templates by use of ILTs and rigid spools
D-404 Leakage detection	Two acoustic leak detectors on each new template	-
D-405 Tie-in of Production Line from Central area to TRC	Central to B2 via Fram East Flowline & Riser	Central to C2 via Blasto and Fram Vest Flowline & Riser
D-406 Tie-in Water Injection Supply	From Fram East B2	From new WI PLEM at TRC
D-408 SPS Manifold configuration	Manifold w/fixed Prod/WI Slots	Multipurpose Prod/WI full flexibility manifolds
D-409 X-Mas tree Concept	Electro-hydraulic VXT (2017+)	eVXT & Subsea HPU
D-410 Umbilical (electric power and controls)	DCFO	LV AC+FO
D-414 UID power and fiber location	Space and interface for docking station at one template in Central area	-
D-416 Umbilical Chemical distribution	New distribution from TRC	Re-use hydraulic lines from Fram East supply at B2


All Electric Subsea Technologies for future fields
eSSIV
Autonomous Powered and Controlled SPS System
eHIPPS
Chemical Storage
Chemical Boosting Unit eCBU
Subsea HPU
(SCSSV, ASV & ICV)
Valve Test Unit
(Servicelineless)
DCFO
(enables removal of umbilical)
Standard eActuation
EFS
(Electric Feedthrough System)
eVXT
Electric VXT
eCompletion
(eSCSSV, eICV, eASV)
Digitalization of the seabed

Why HIPPS and what does it take

Main reason:

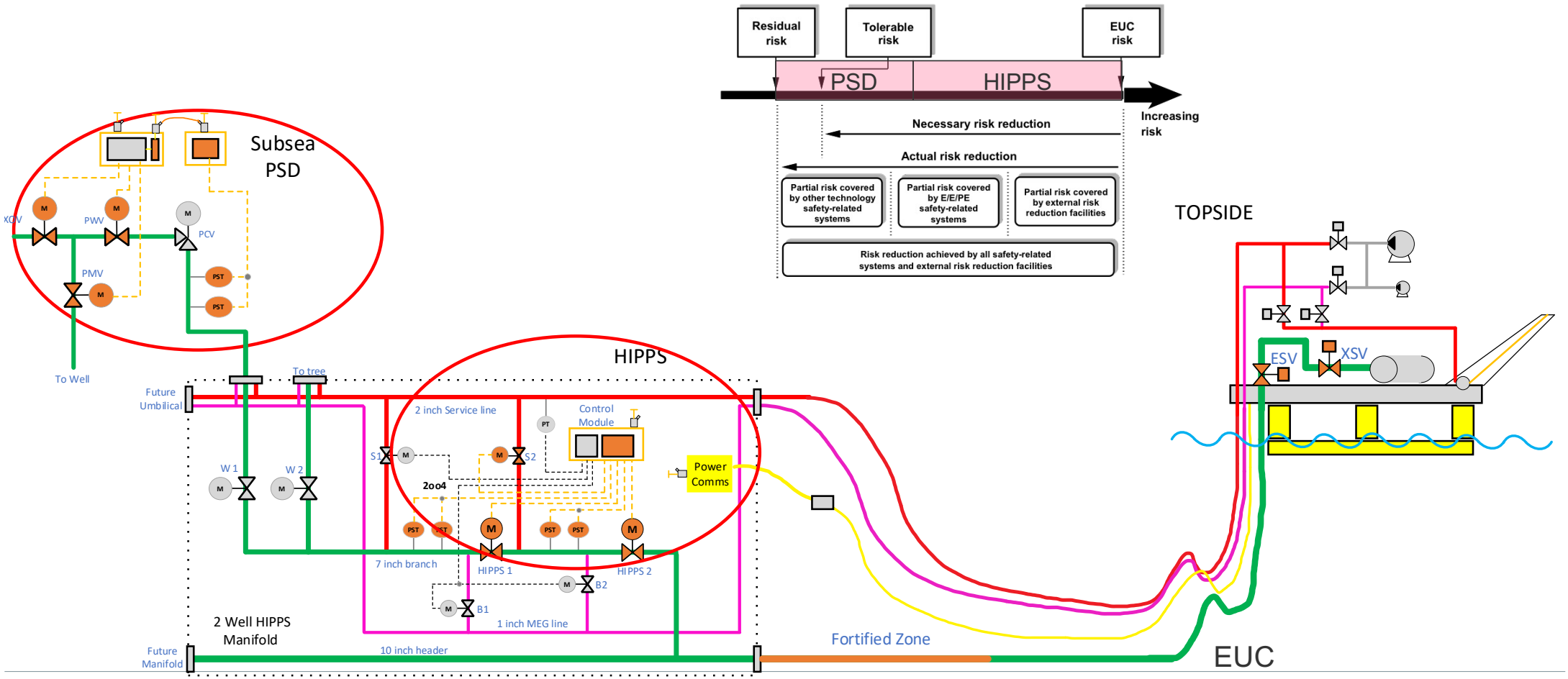
Well (or upstream) pressure is too high for the downstream production equipment.

- Greenfield
- Brownfield
- Cost
- Technical feasibility

Requirements given in IEC 61508 Components & 61511 System

1. Engineering of components, all needs a known or calculated probability of failure on demand (PFD). The components are assembled into a system aiming to achieve the required reduction of risk for overpressure
2. Absolute overview and control of all failure modes in the system -> FMECAs on all levels
3. Implemented engineering measures to avoid systematic failures -> processes

Pressure Protection System Schematics (PSD+HIPPS)



Some applicable Equinor requirements

TR1234 Subsea Valves in Subsea Production Systems:

2.6.2 Design requirements

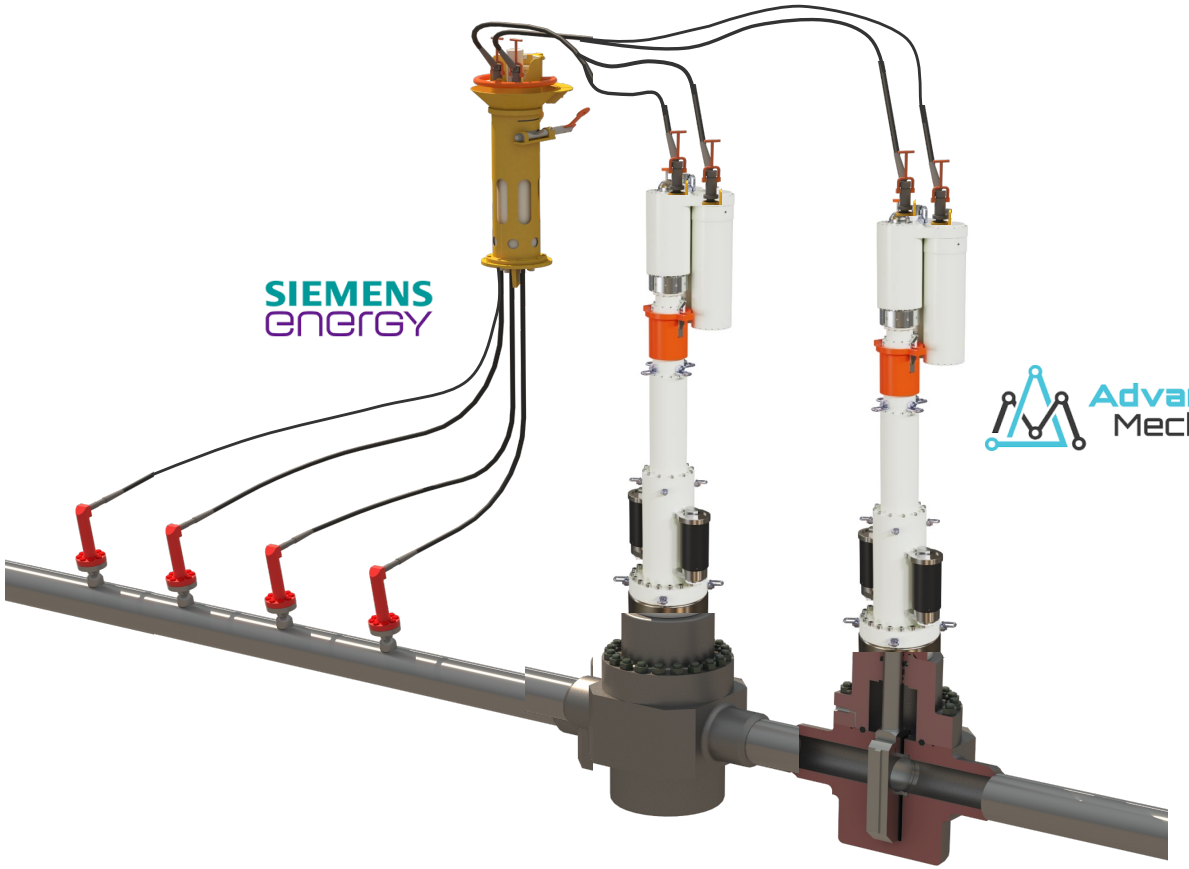
SR-34628 - Same requirements as given for header valve shall apply with the following additions:

- The HIPPS valves shall be reverse acting slab gate valves
- HIPPS valves installed in a piggable line shall be through-conduit and piggable.
- The HIPPS valve shall be fail-close and shall be designed for closing without assistance from actuation control fluid. The valves shall, unless otherwise formally agreed, be designed for closing entirely by the internal bore pressure – which is max operation pressure of the protected piping. Typical closing time will be 2-10 seconds.
- The HIPPS valve shall be equipped with a mechanical override for locking of valve in open position by use of a ROV.

TR1956 Non-conventional pressure protection systems:

SR-84928 - For SIL3 HIPPS the logic solver type shall differ from those used in the other protection layers.

eHIPPS design solution



Organized as a JIP:

TotalEnergies
GASSCO
Chevron
AkerBP
equinor

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SUBSEA eHIPPS AND eSSIV

Disclosed by Equinor Energy AS, Glenn R. Halvorsen, and Henrik Vedeld

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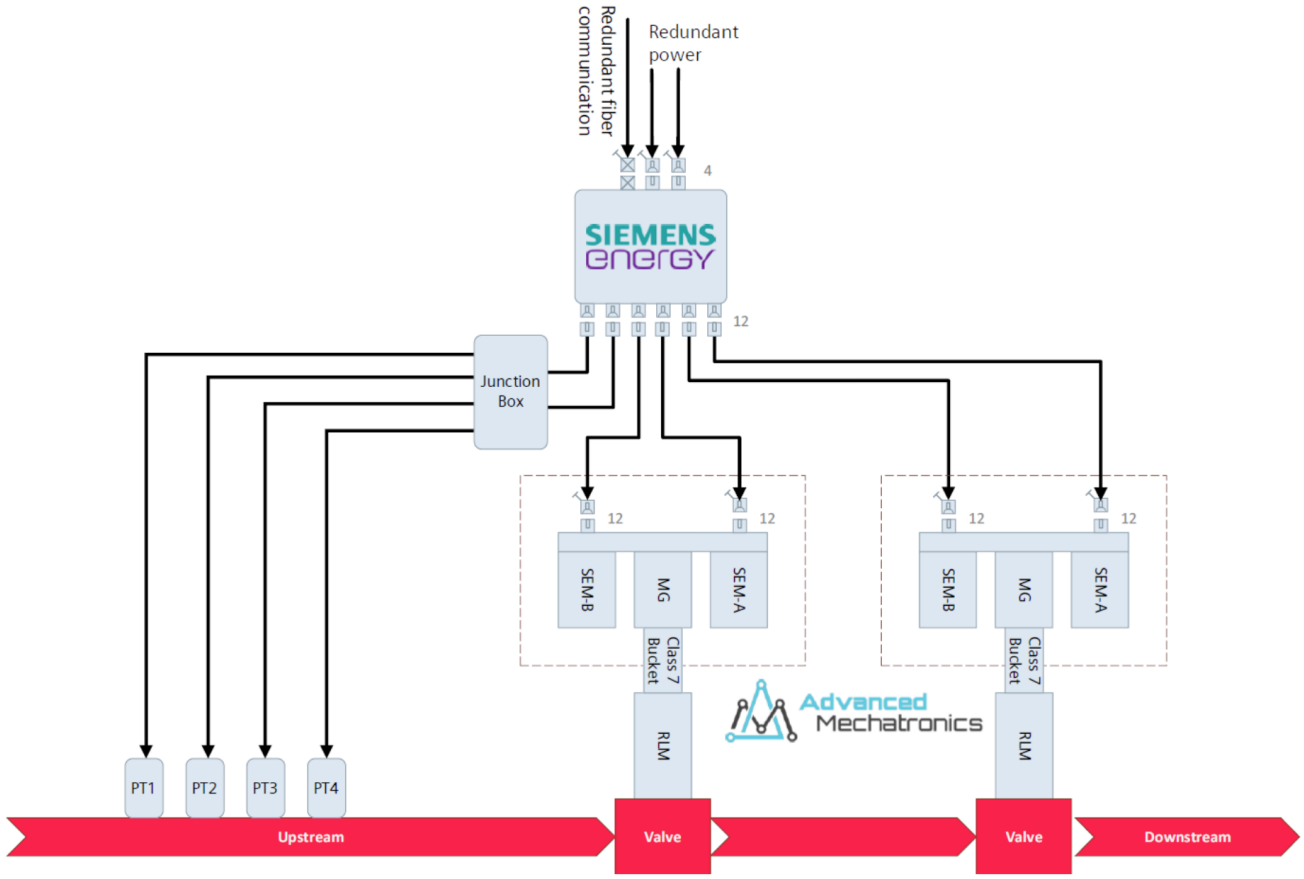
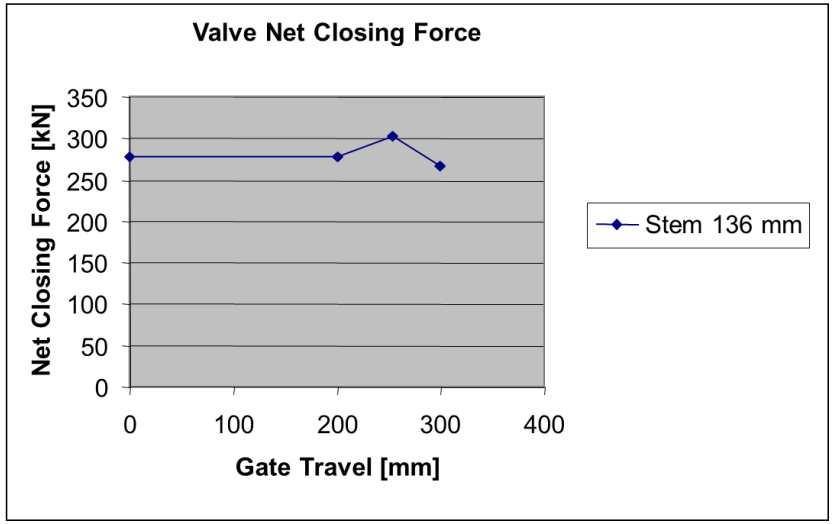
eHIPPS development block diagram



eHIPPS development

Example closing forces
(Kristin HIPPS 10” gate ventil)



Kristin HIPPS Valve Design

HIPPS Gate Valve design requirements

• Valve size	10″ ID
• Pressure Rating	740 bar (WHSIP)
• Temperature Rating	-33 - 175 °C (-27.4 – 247 °F)
• Depth Rating	380 meter
• Closing pressure	280 bar
• Closing time	12 seconds

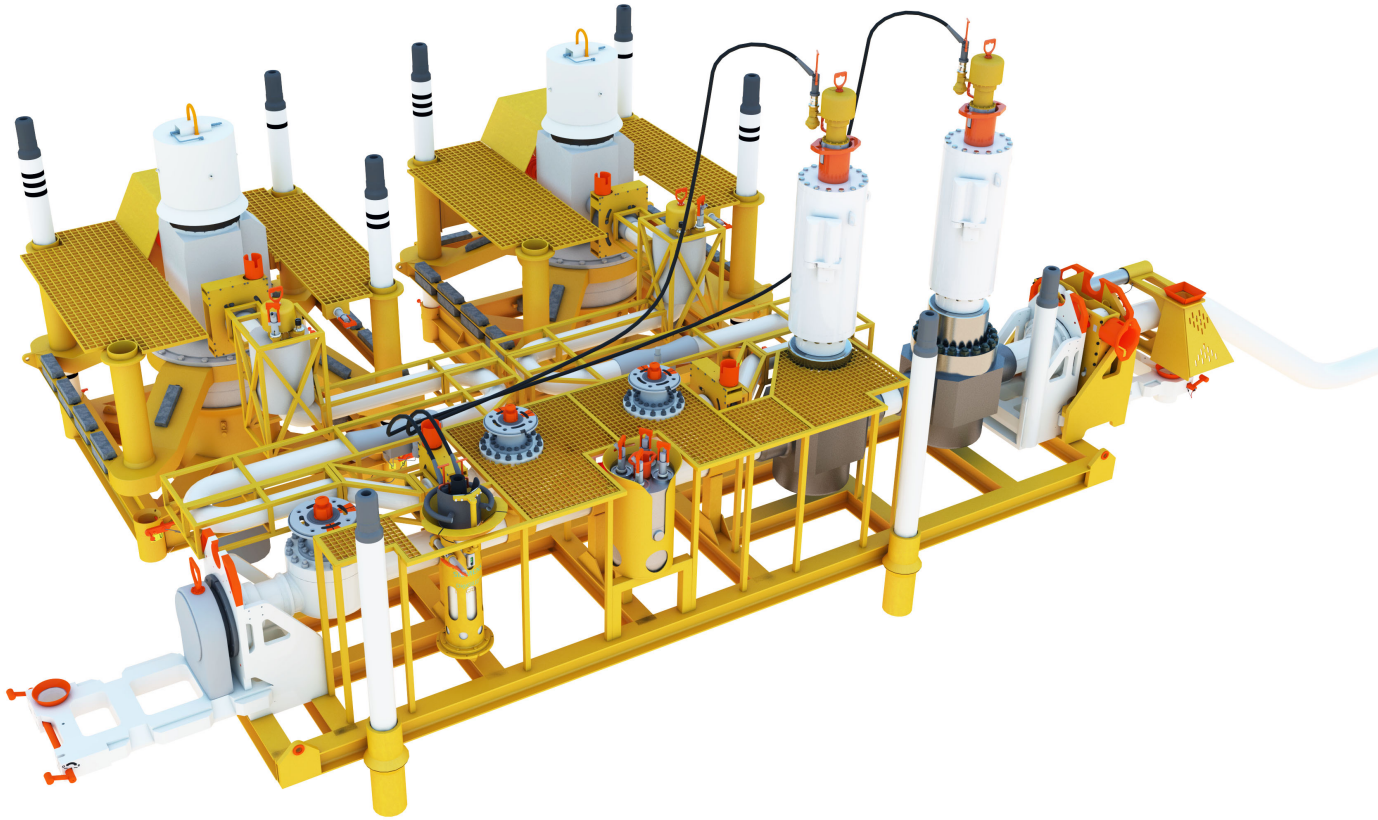
Weight: Valve and Actuator 10900 kg
Height: 5245 mm (17.2 ft)

eHIPPS development – assessments and summary

Parameters	Conventional HIPPS (Morvin/Kristin)	eHIPPS	Comments
SIL rating	SIL 3	SIL 3	Current numbers shows an increased performance on eHIPPS (PFD)
Fail Safe	Yes (pressure and spring)	Yes (pressure and motor)	Not a SIL rated function for eHIPPS.
Voting	2oo4 Non-redundant	2oo4 Redundant	
Self diagnose	Low	High	All the benefits of electric systems
Testability	Low	Med	

TRL 4 target by Q2 2025

eHIPPS in a 2-Slot Template System – example only



Thank you!

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Børge Pettersen, Equinor
Hans Christian Schøien, Equinor
Henrik Vedeld, Equinor