



All Electric Subsea – An Electrifying Realization

Sokkeldirektoratet, Teknologidagen 06.05.2024

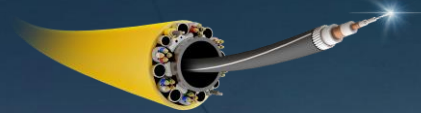
Rory MacKenzie, TotalEnergies
Glenn Roar Halvorsen, Equinor



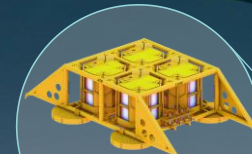
Global standardization through Strategic Partnership



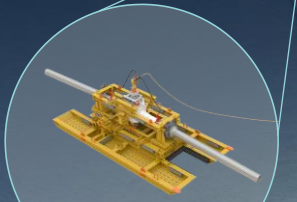
All Electric Subsea Technologies for future fields



DCFO
(Removal of Umbilical)



Chemical Storage and Injection

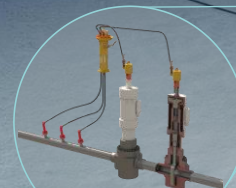


eSSIV

Subsea HPU
(SCSSV, ASV & ICV)



Valve Test Unit
(Servicelineless)



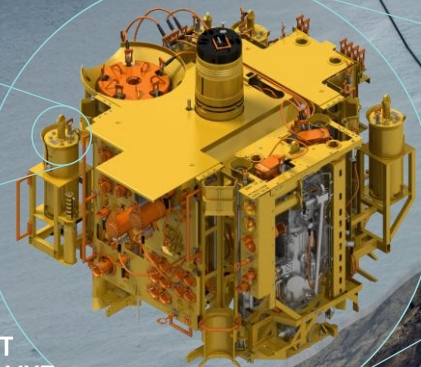
eHIPPS



Autonomous Powered and Controlled SPS System



Standard eActuation



eVXT
Electric VXT



EFS
(Electric Feedthrough System)

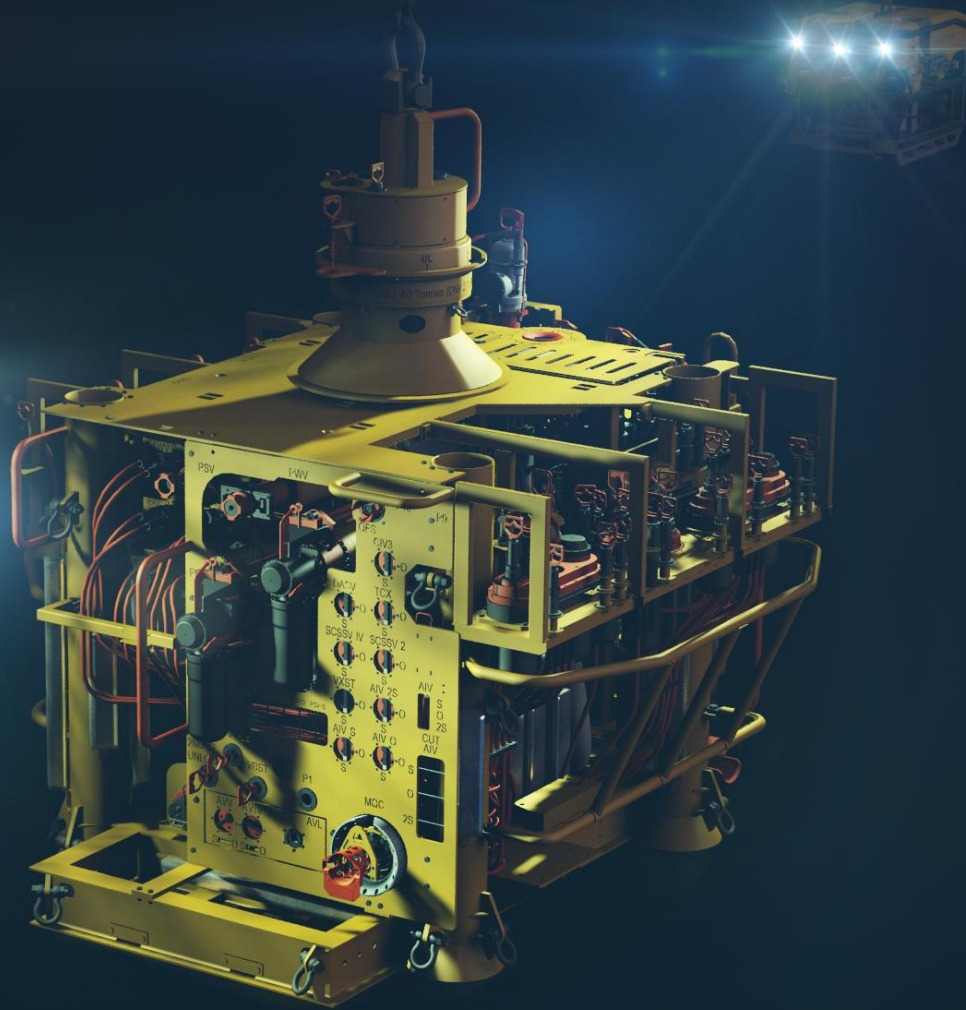


eCompletion
(eSCSSV, eICV, eASV)

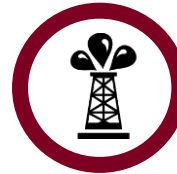


IOR by Digitalization

All-Electric Subsea Production Systems



Cost savings (CAPEX, OPEX and ABEX)



Improved productivity



Carbon Footprint reduction



Improved safety



Enhanced operability and reliability

- Simplifies subsea and topside infrastructure
- Enables longer step-outs
- Provides continuous monitoring of well barriers
- Improves energy efficiency
- Improves operational control and condition monitoring
- Removes hydraulic fluid handling, high pressure containment and release to the environment
- Reduces scheduled interventions and offshore logistics

All-Electric JIPs

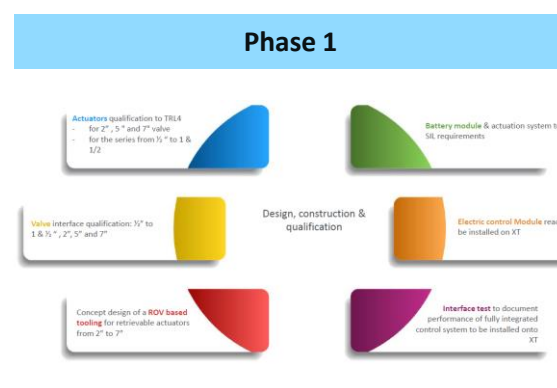
Enabling the future

Standardization of new technology requirements and specifications – across multiple operators and suppliers

Pre-qualify supply chain and manufacturing processes

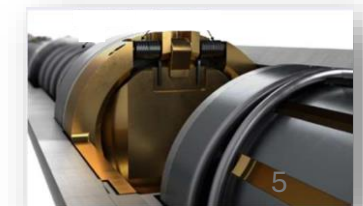
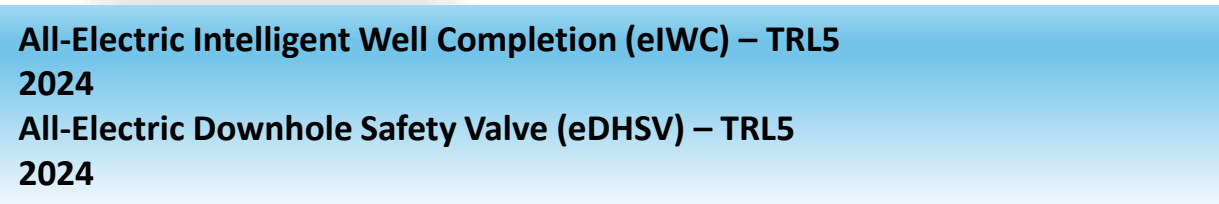
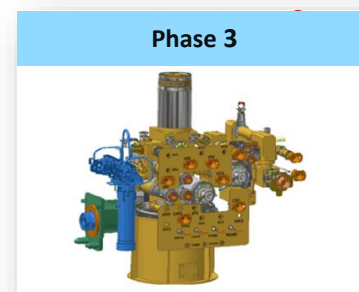
Develop a **competitive industry offering** to support future developments

Supporting interface to parallel **All-Electric Well** developments (eDHSV, eICV)



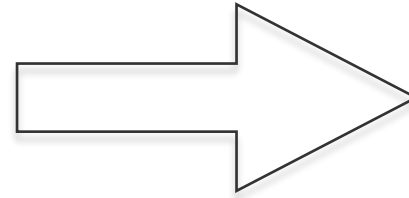
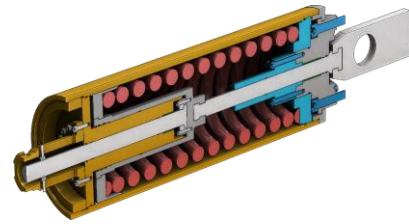
AES Technology Qualification – TRL4 2021

- All-Electric actuation system designed, built and qualified – ready for implementation into any standard XT design
- 3 JIP's – 3 Suppliers, 5 Operators
- Implementation of dedicated AE specifications



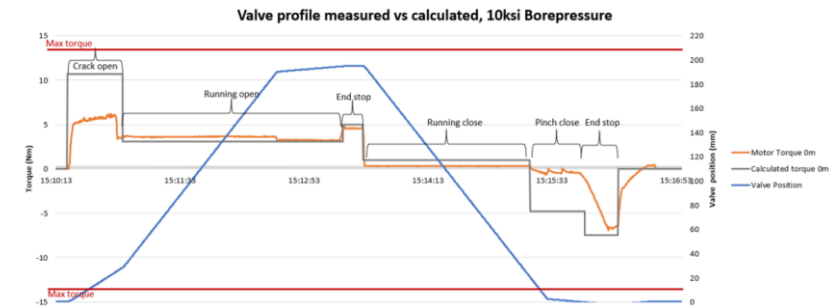
Improved functional safety

- 100 % more force on pinch close than required @ all water depths
- Fully redundant system
- Continuous monitoring of well barriers
- Fully retrievable components
- Autonomous condition-based shutdowns
- Fully retrievable components



Condition not monitored

Condition continuously monitored



7" - 1500m hydraulic vs 7" - 4000m electric actuation



Johan Castberg 7"/1500m Actuator



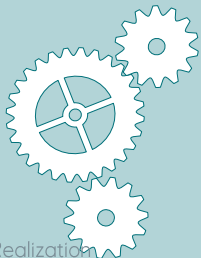
Generic 7"/4000m eActuator

Pictures courtesy of Aker Solutions

eVXT TRL 5

Enabler for field development,
selected for Project implementation
in Shallow and
Medium Deep Water

- TRL 5 HW-test performed
 - TFMC Q2-2023
 - OSS Q4-2023
- Electric Actuation System is XT and water depth independent
- Electric Actuation System is SIL compliant
- Cross industry alignment of specifications and technology requirements, resulting in standardized solution across Operators



All-electric battery-based vertical Subsea Tree



The transition to All-Electric Subsea Systems



- Topside:**
- Standardized new field integration with minimal topside modifications
 - Freeing up turret slots
 - No handling fluid and pressurized systems

- Operations:**
- New operational models
 - Standardized operation across portfolio
 - Predictable and planned maintenance
 - Increased contingency to maintain production
 - Enabler for Digitalization


Umbilical :
Removal or reduced complexity

Structures:
Reduced Complexity and Cost

New Frontiers:
Subsea the new topside

eVXT: ▪ The cornerstone for global standardization across water depth and field location

Subsea Chemical Storage:
Removal of topside and reduction of subsea distribution systems

- 
- Environment:**
- No hydraulic fluid discharge to sea
 - Reduced emission due to less transport of hydraulic fluids
 - Less carbon emissions in fabrication and operation

eCompletion:

- Optimised control functionality
- Increased production

Field Expansion:
Subsea to beach enabler

Backup

Electric XT Novelty

XT Components	EH-XT		eXT	
	Redundant	Retrievable	Redundant	Retrievable
SCM				
Actuator Distribution				Contingency flying leads
Failsafe closure	(Spring)	(Spring)	(Batteries)	(Batteries)
Umbilical distribution				If reduced to subsea cable
LB Actuator (5" 7")				Partial - Electrical components
SB Actuator (2" 1" ½")				Partial - Electrical components
sHPU – fitted on XT Option for hydraulic completion	NA			

Main XT structure and components are the same for EH or Electric XT's

- Structure, Valves, valve blocks, CI, instrumentation etc.

EH valve actuation components are non redundant and non retrievable.

- Failure modes in actuation system – hydraulic blockages, leaking seals, broken springs etc require the XT to be retrieved.

Electric valve actuation components are dual redundant and retrievable.

- Failure modes that require XT retrieval are reduced due to redundancy and retrievability of Actuators, Batteries and Controllers.

The Subsea battery systems is a high integrity power storage and delivery system that incorporates a high level of fault tolerance with multiple redundancy options.

Retrieval of electric actuation components require light intervention with ROV's.

Subsea Power storage & Delivery System: batteries

Key battery functionality:

- Integrated cell monitoring
- Integrated cell balancing
- Integrated cell isolation on fault detection
- Integrated capacity testing (75% after 10 years)

Key system functionality:

- Multiple redundancy options
- SIL rated battery management system
 - SW, HW, Design process, Testing
- Autonomous shutdown triggers on battery condition and power level
- Integrated fault tolerance



VL 51ES 5p10s battery



VL 51ES cell



High Integrity Power Storage & Delivery System