

Subsea Robotics – Overview of R&D Subsea Robotics Project Experiences

Overview of Subsea Robotics Capabilities

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01.

TotalEnergies in Norway

Stavanger Research Centre
Subsea Robotics Project

Energy is life.
We all need it
and it's a source of progress.
So today, to contribute to
the sustainable development of the planet
facing the climate challenge,
we are moving forward, together,
towards new energies.

Energy is reinventing itself,
and this energy journey is ours.

Our ambition is to be a world-class player
in the energy transition.

That is why

**Total is transforming and
becoming TotalEnergies.**



TotalEnergies

TotalEnergies in Norway Renewables, CCS and decommissioning in 2023

2021 investment
650 million EUR

2021 production
219,700 boe/d

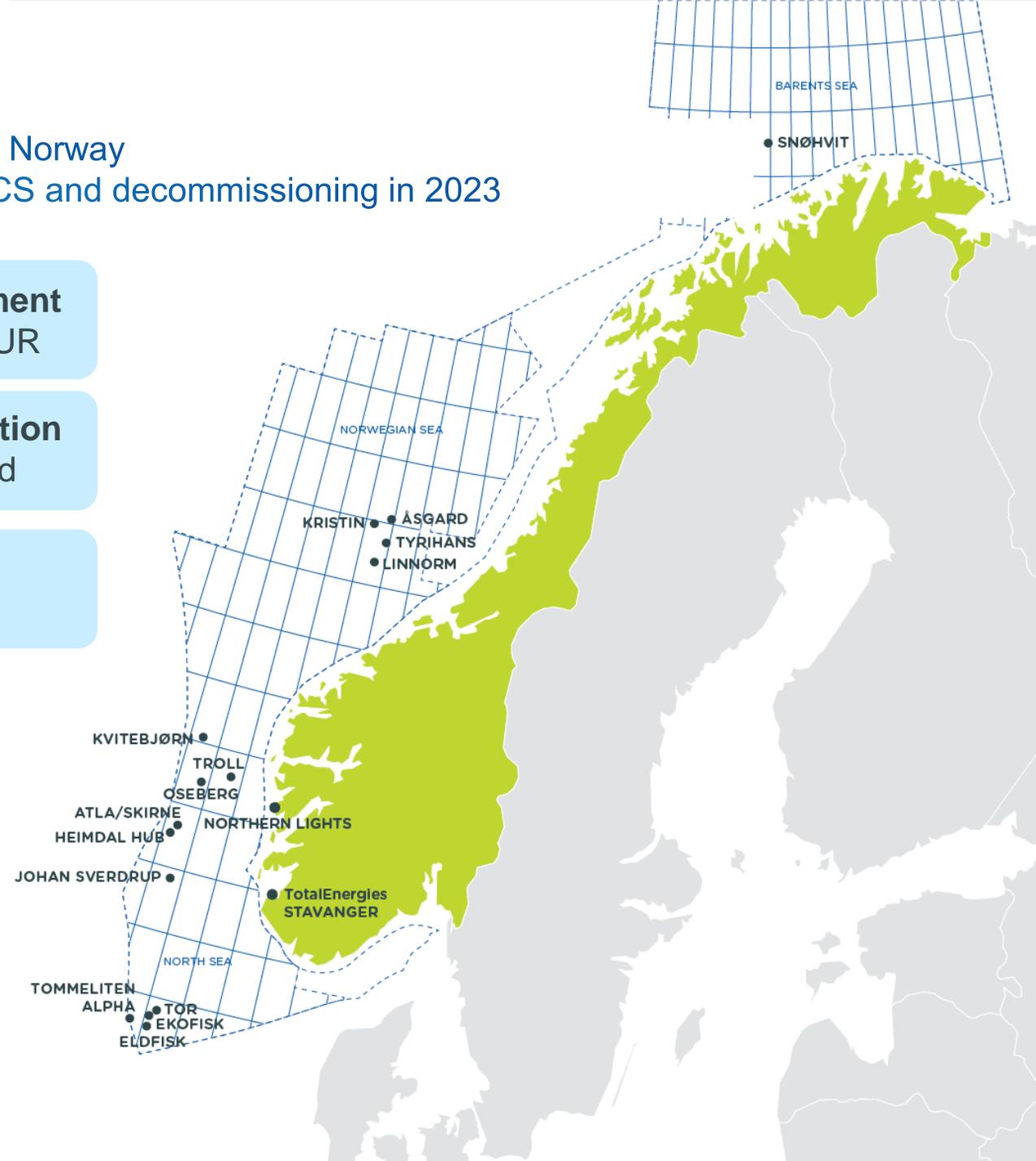
980+ million
boe reserves



Skjoldblad



Northern
Lights



Subsea Robotics R&D Project



- Deployed to Stavanger Research Centre in September 2022
- Ecosystem of
 - Developers
 - Collaborators and Partners
 - Innovators
 - Test Facilities
 - Use Cases
 - Early Adopters
- Right Environment at the Right Time
 - Acceleration of Technology
 - Acceleration of Solutions
 - Uptake by Service Providers
 - Decarbonisation of Asset Integrity Initiative





02.

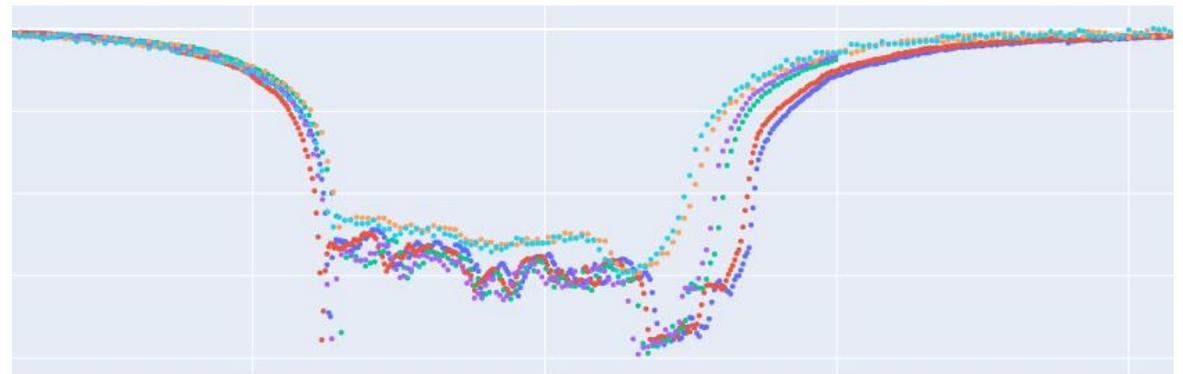
Subsea Robotics

Scope of Subsea Robotics Project

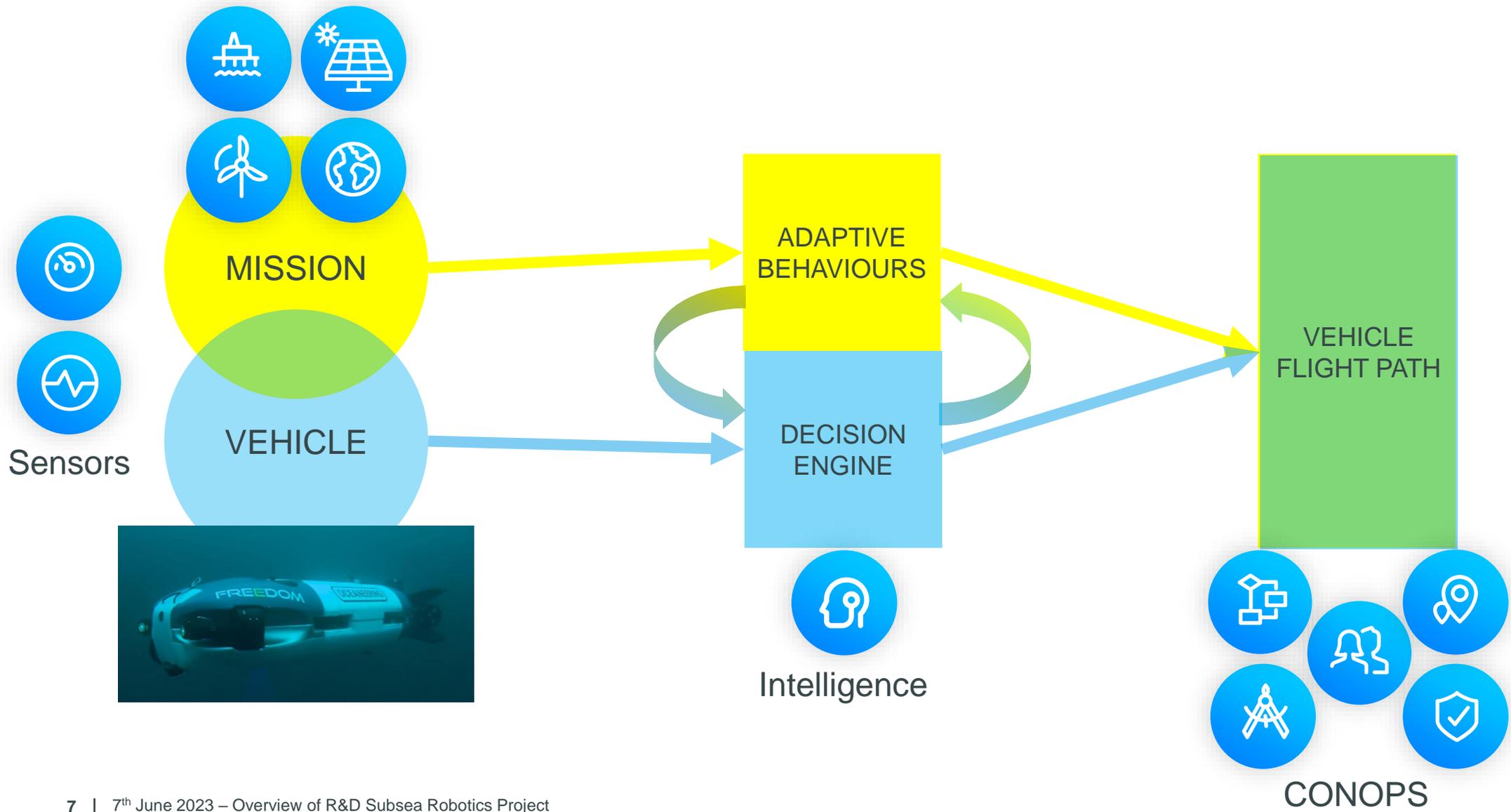
Subsea Robotics Project Scope



- Surface Elements with a Subsea Component
 - Uncrewed Surface Vessel, USV
- Subsea
 - Launch and Recovery
 - Power
 - Communications
 - Remote Operations
 - Autonomous Operations
 - Concept of Operations
 - Data
 - Sensors



MISSION PLANNING & EXECUTION





03.

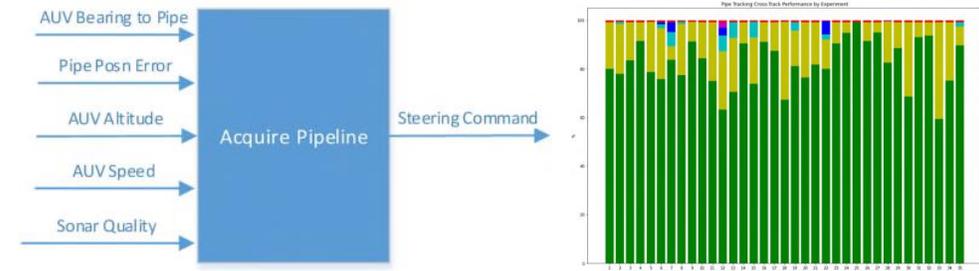
Subsea Robotics Experiences

Subsea Robotics Application and experience in Norway and Globally

Subsea Robotics Experience



- Developed a methodology to evaluate the performance of autonomous vehicles
 - Collaboration with Oceaneering, Chevron and Equinor, presented at OTC 2022
 - Applied to Freedom development at Tau from 2020
- Applied during near-shore and offshore trials
 - Freedom Pipeline Inspection AUV (North Sea and nearshore Norway)
 - Fugro USV (North Sea, The Netherlands)
 - Kawasaki SPICE AUV (Japan)
 - USV/AUV Collaboration (France)
- Evaluated maturity of available technology, using internal processes, and communicated in cooperation with the vehicle manufacturers



Oceaneering's Hybrid AUV/ROV Achieves TRL 6 in Pipeline Inspection

Posted on 29th August 2022 by sonistics

PIPELINES

Kawasaki AUV deploys SPICE robot arm for pipeline tests offshore Japan

Kawasaki Heavy Industries has completed offshore verification tests with TotalEnergies using an AUV to measure the electrical potential of subsea pipelines.

Jan. 17, 2023

iXblue, TotalEnergies Test Collaborative USV and AUV Use Off France

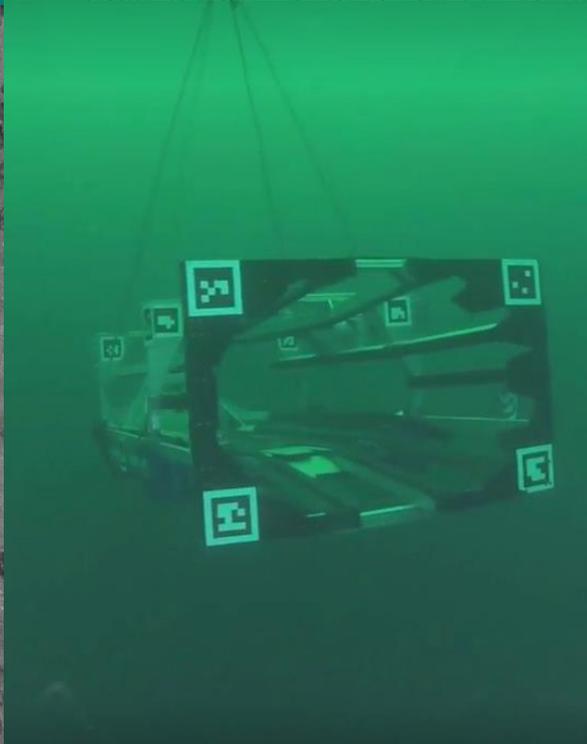
January 25, 2022



Freedom Pipeline Inspection AUV

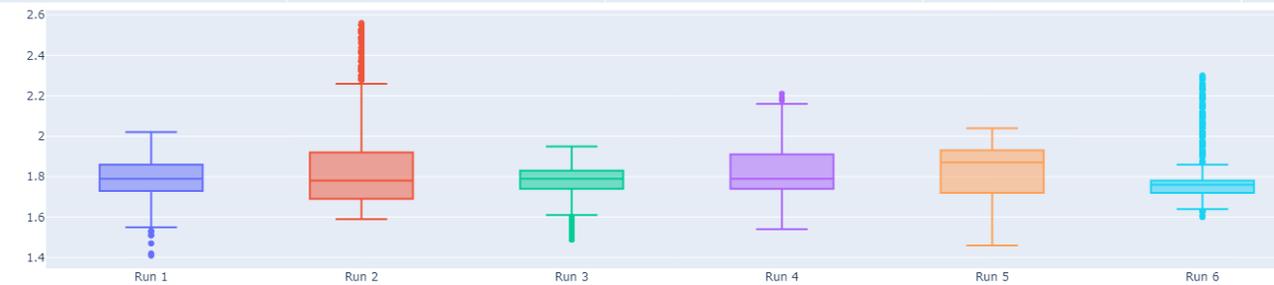
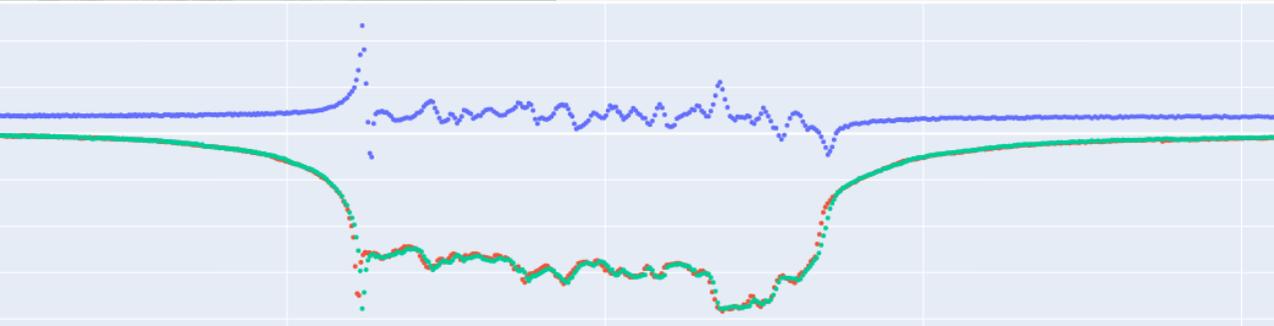
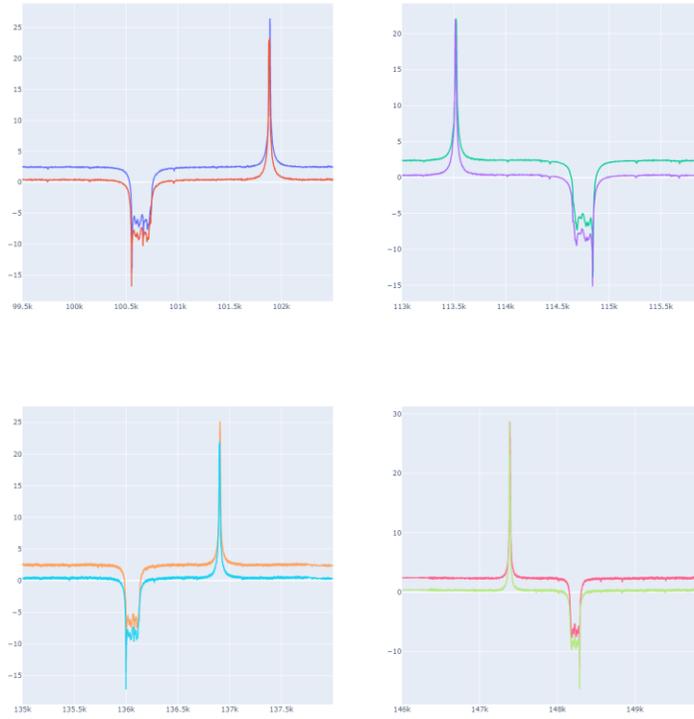


- Developed in collaboration with Oceaneering & Chevron
- Demonstrated in collaboration with Chevron & Equinor
- Norway context:
 - Development testing, Tau 2020 onwards
 - Nearshore testing (SW Norway 2021 onwards)
 - Leak Detection demonstrated 2023 (Tau)
 - CP Integration demonstrated 2023 (Tau)
 - Industrialisation anticipated 2023
- Pipe Following
- Adaptive Behaviours
 - Obstacle Detection & Avoidance, Freespan Detection & Inspection, Leak Detection, Docking, Burial Re-acquisition





Large Defect with both sensor readings, 1 September 2022



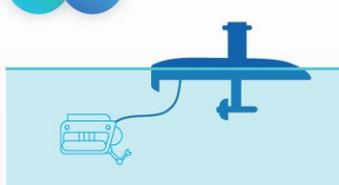
SPICE AUV



- Integration of TotalEnergies patented sensor, LightTouch to detect pipeline coating defects
- Use of SPICE AUV (Kawasaki) with robotic arm
- Validated integration, performance of AUV and performance of sensor
 - Capable of detecting coating defects repeatably
- Stable Flight Envelope of AUV presents necessary stability to deploy sensors in close proximity to pipeline
 - Low altitude (< 2m)
 - Presents opportunity for evolution of near-field effect sensors to be reliably deployed
- LightTouch Industrialisation anticipated 2023



USV



USV + ROV



USV + AUV



1 inspection vessel
= 80  per day
350 000
hours/year



USV



- Use of standalone USV for positioning and survey applications
- Deployment and Remote Operation of eROV for Asset Integrity IMR worksopes
- Support for use of USV collaborating with AUV
- USV deployments planned for 2023 to validate use for IMR in shallow water
 - USVs could replace surface vessels for all positioning support activities from 2024
 - Future intent to independently support and deploy AUVs
 - Improve Safety of Operation
- Potential to Decarbonise Asset Integrity





04.

Conclusion

Subsea Robotics Strategy



Offshore

Reduce people exposure to daily multiple risks



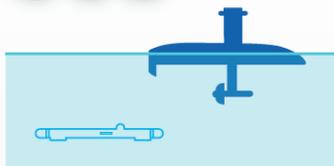
R&D Upstream Solution in development



USV



USV + ROV



USV + AUV



Strategy of Subsea Robotics Project



- Contribute to JIPs and Industry initiatives to generate normalisation of the use of Emerging Technology
- Collaborate with Operators to normalise requirements and safely accelerate viable solutions ready for demonstrations
- Engage with Local Innovators to validate the use of Emerging Technology
- Support innovation enabling the Decarbonisation of Asset Integrity
- Identify transverse synergies across Subsea applications
- Improve Quality, do more with less, without reducing the quality available today
- **Reduce GHG, reduce risk, improve quality of Inspection**

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