MCEDD

DEEPWATER DEVELOPMENT

28 - 30 March 2023 | Millennium Gloucester Hotel | London, UK

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Qualifying Subsea Robotics Solutions: a Long, Challenging and Rewarding Journey

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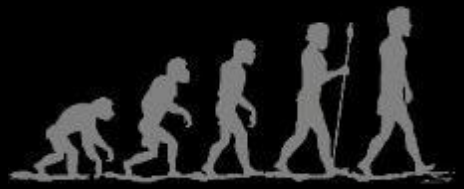
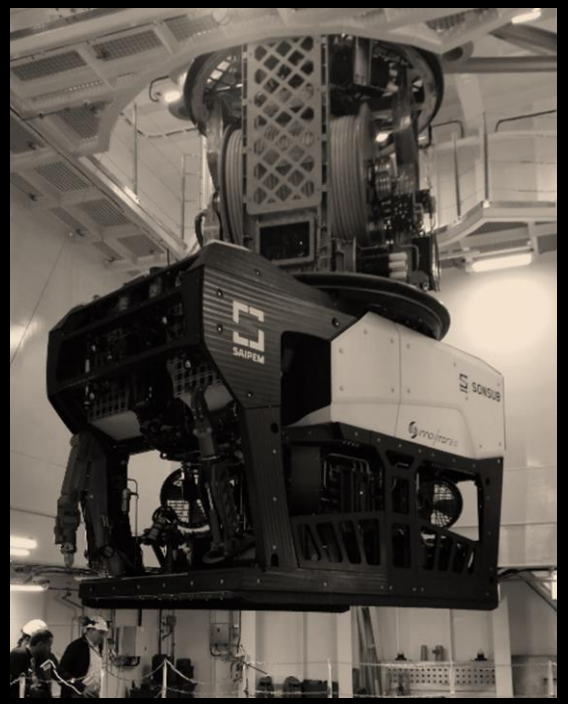
Saipem

Emergy Technologies

Subsea Robotics



from diver to diverless
from manned to autonomous



Subsea Drones:
a new generation of subsea robotics

Enabled by the emerging technologies

ROADMAP

Underwater Drone

Scope of these technologies is to support LOF for Offshore Energy Fields, enabling:

- **SAFETY**
  Remote and safe (reduced offshore persons) subsea interventions
- **CO2**
  Reduce carbon footprint
- **DIGITAL / DE-RISK**
  More accurate and frequent data collection to enable/facilitate the digital transformation of subsea assets
- **OPEX**
  Cost effective Vessel-Free Interventions and de-risk of operations

REMOTE CONTROL ROOM

- Intelligent Hybrid (AUV / ROV) Subsea Robots
- Designed to enable vessel-free subsea interventions (Subsea Resident)

SUBSEA DRONE (FlatFish)

SUBSEA DRONE (Hydrone-R)

SUBSEA BASES

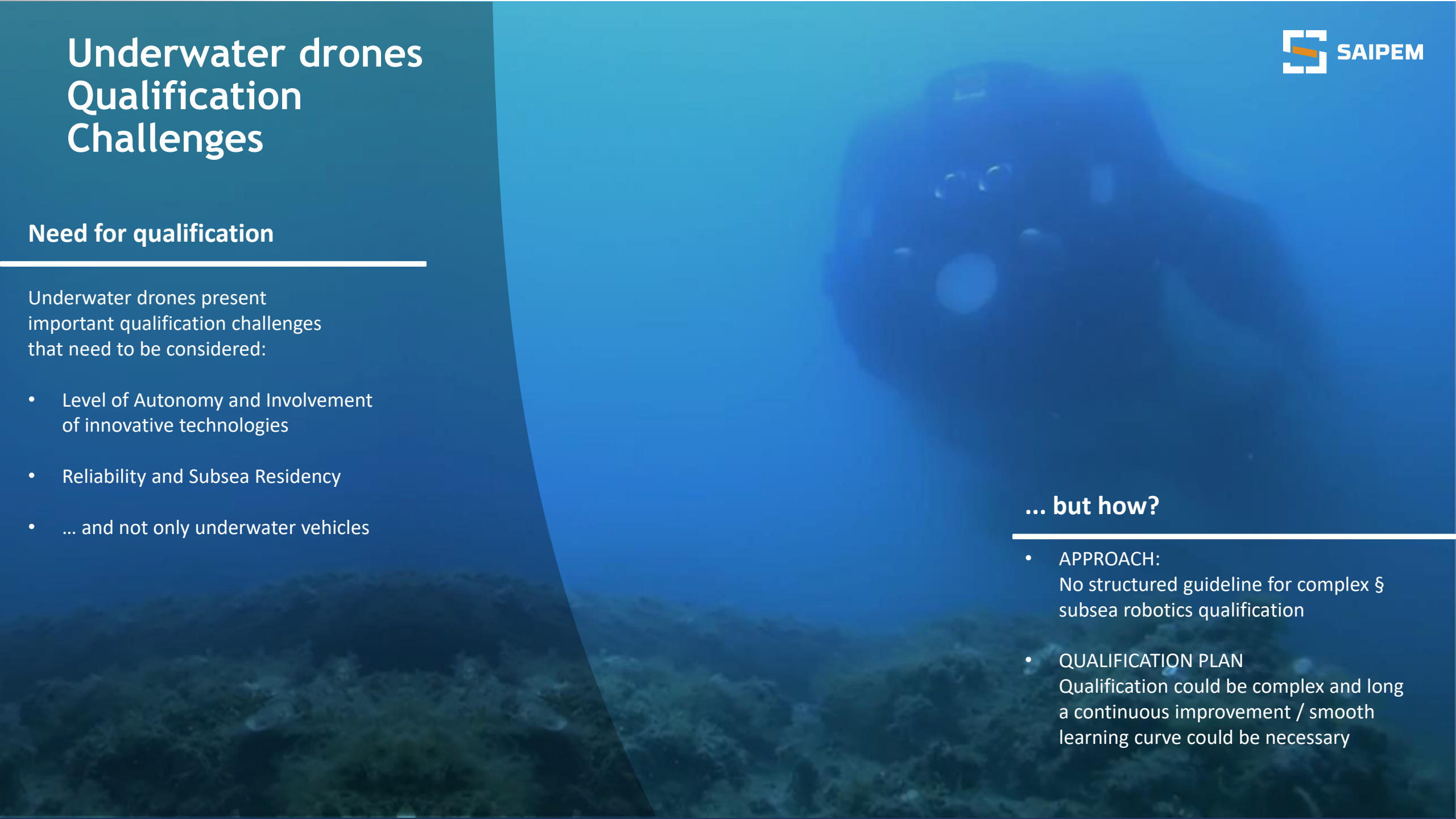
SAIPEM Hydrone

Underwater drones Qualification Challenges

Need for qualification

Underwater drones present important qualification challenges that need to be considered:

- Level of Autonomy and Involvement of innovative technologies
- Reliability and Subsea Residency
- … and not only underwater vehicles



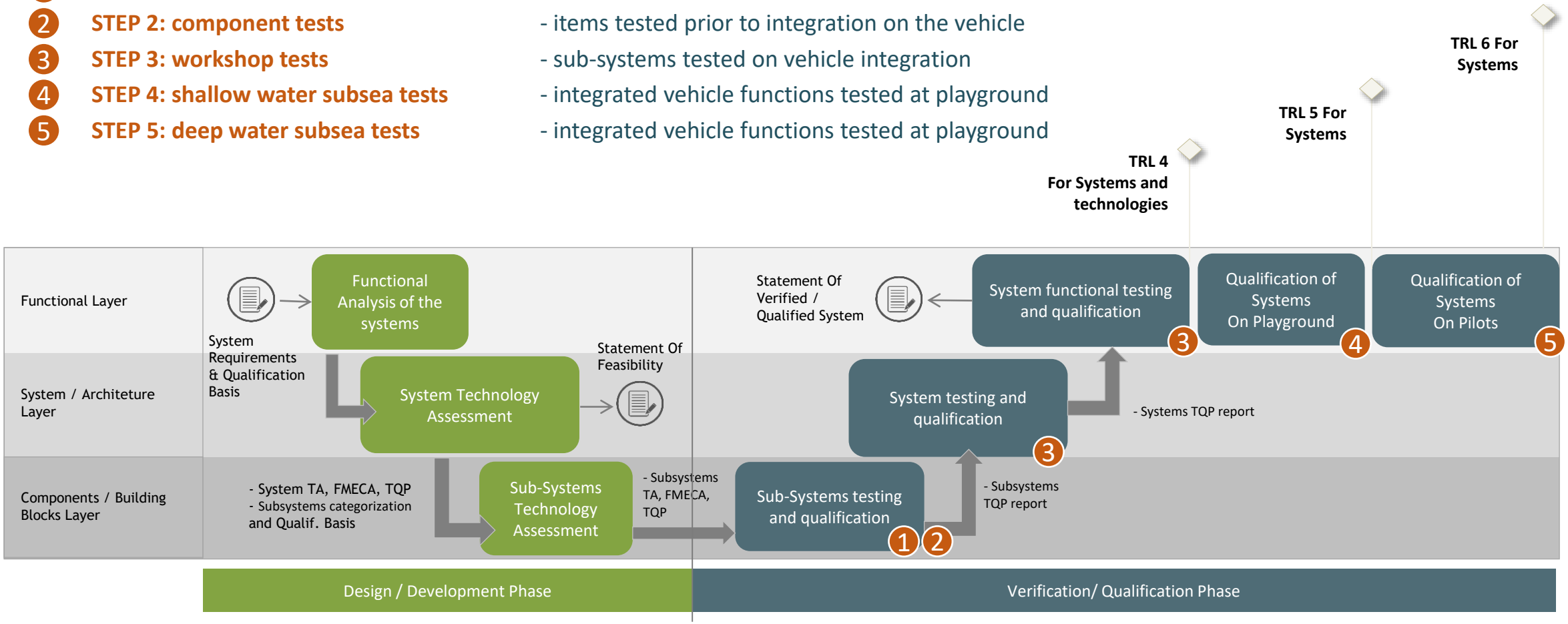
… but how?

- APPROACH:
  No structured guideline for complex § subsea robotics qualification
- QUALIFICATION PLAN
  Qualification could be complex and long a continuous improvement / smooth learning curve could be necessary

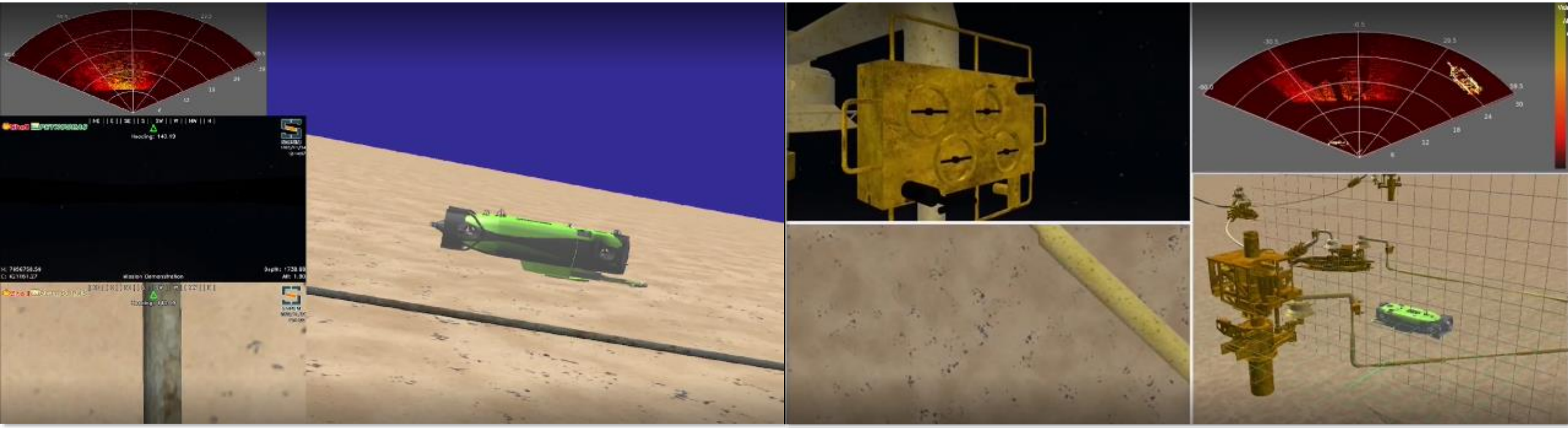
Qualification strategy
Saipem Approach

The main steps in terms of tests are

1. **STEP 1: simulation tests** - software tested on a digital twin of playground
2. **STEP 2: component tests** - items tested prior to integration on the vehicle
3. **STEP 3: workshop tests** - sub-systems tested on vehicle integration
4. **STEP 4: shallow water subsea tests** - integrated vehicle functions tested at playground
5. **STEP 5: deep water subsea tests** - integrated vehicle functions tested at playground



1 Qualification roadmap
Simulation tests



2 Qualification roadmap
Components tests

An Example:
Thruster, Bushing and Sealing endurance test (subsea residency)

- Simulated environment (sea water with suspension of sand/mud)
- Different type/design of sealing with different design (material, shape)
- Different type/design of bushings (radial and axial) with different design (material, shape)

>4 | months testing endurance
In water tank with simulated environment

>300 | Hours testing endurance of each model of BUSHING under load (6 + 6 off types)

>300 | Hours testing endurance of each model of SEALING under load (5 off types)

>200 | Hours testing endurance of each model of THRUSTER @ max thrust

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3 Qualification roadmap
Workshop tests

Dry tests:

Mainly focused to verify Electric and electronic systems and including the following main steps:

- Laboratory tests
- Workshop tests
- Water tank tests

3 | months of electronics integration test at Electronic Laboratory

6 | months of electronics integration test at workshop (dry and wet test)

>400 | hours of test pressure on components hyperbaric chamber

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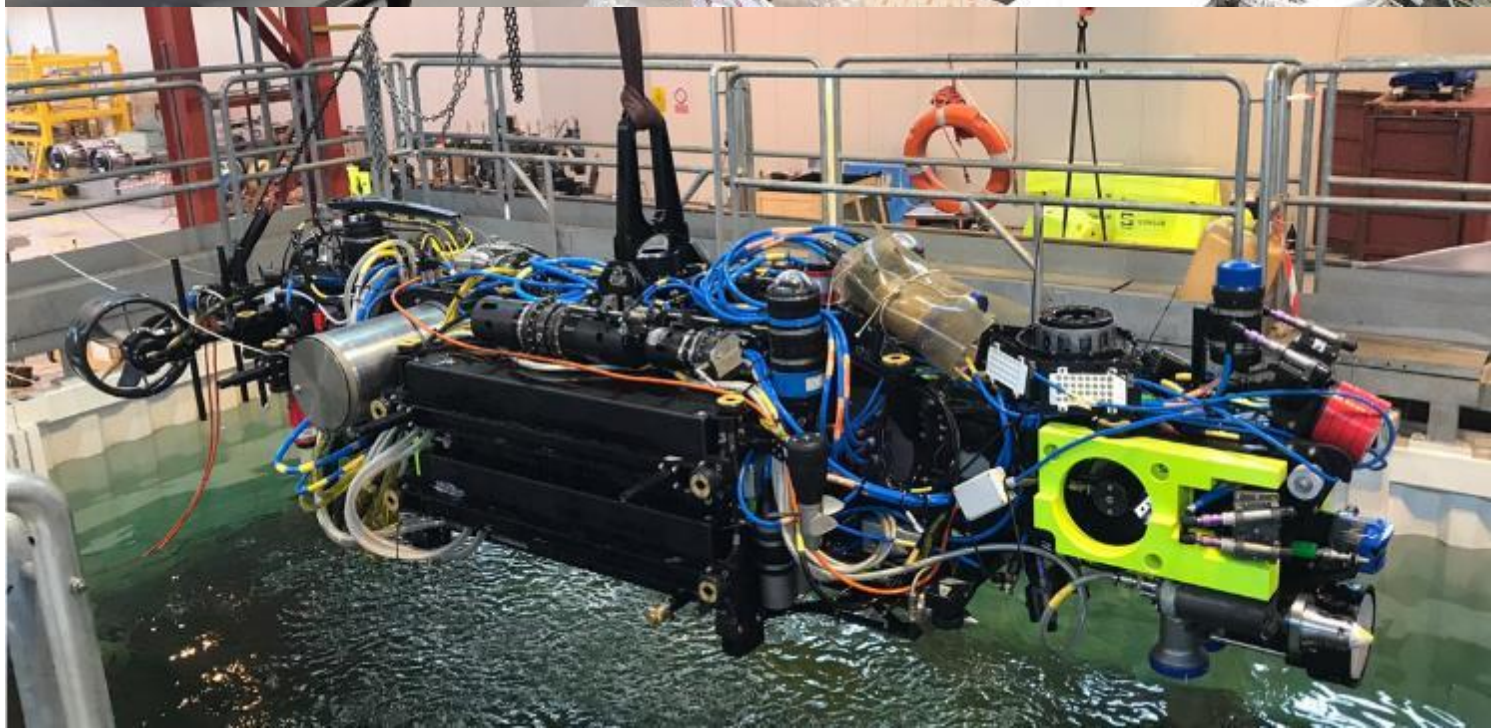

4 Qualification roadmap
Shallow water subsea tests

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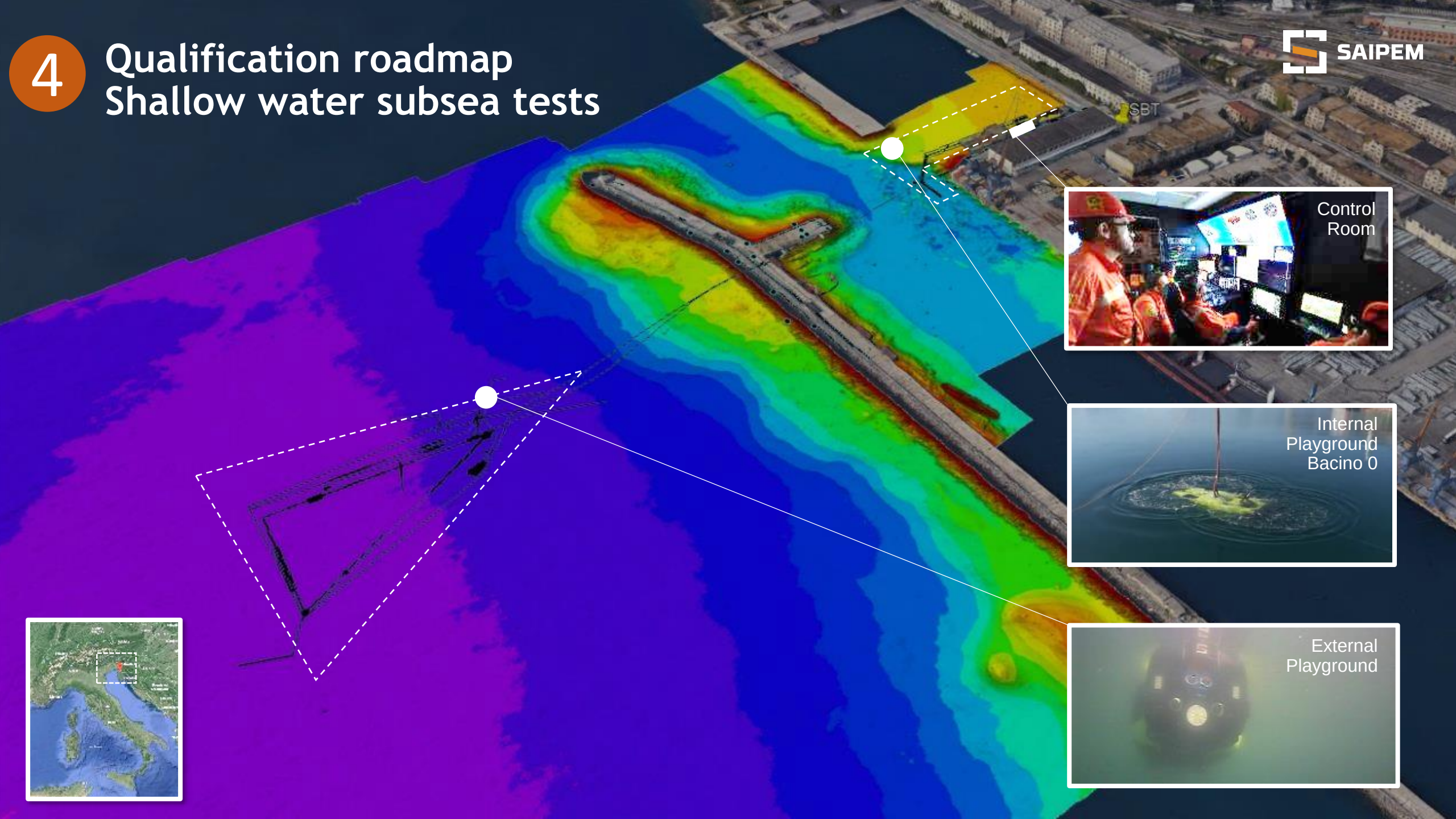


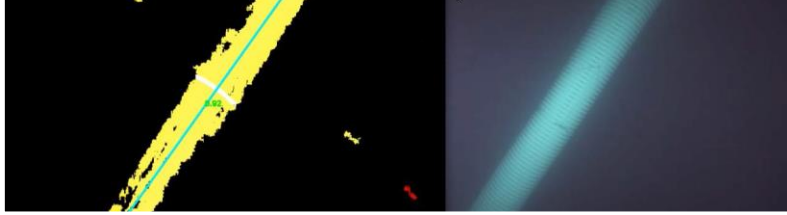
4 Qualification roadmap
Shallow water subsea tests

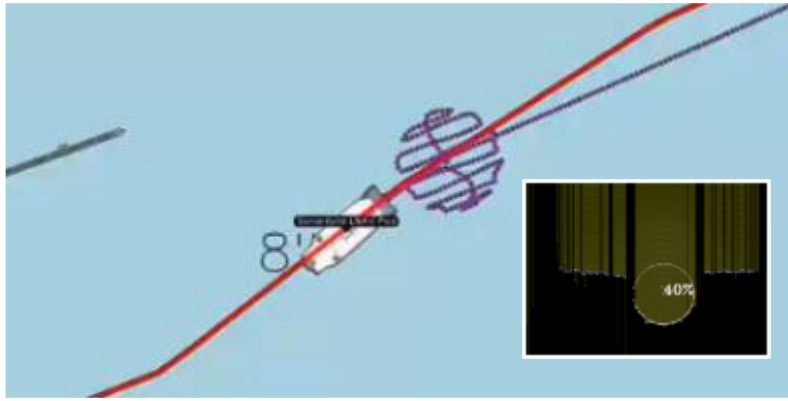
2500+
total hours testing at sea

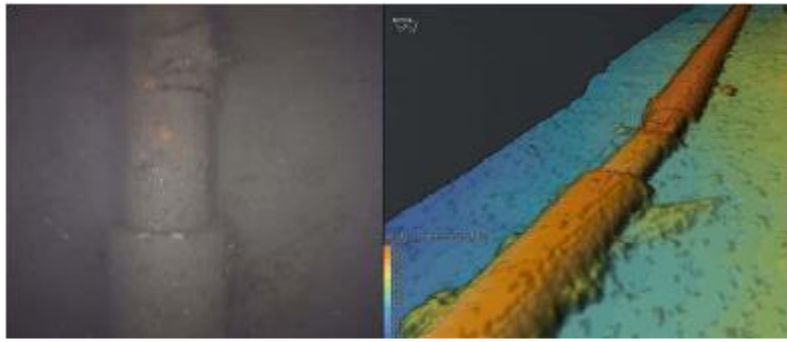
100+
hours while performing
pipeline tracking and following

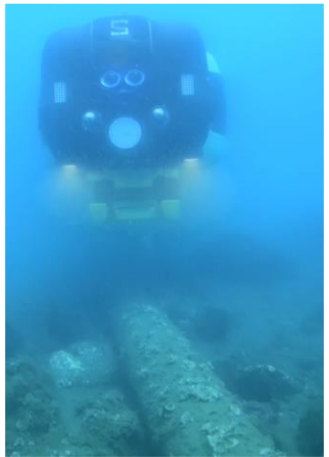
180+
garage in/out maneuvers

200+
total number of dives









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4 Qualification roadmap
Shallow water subsea tests

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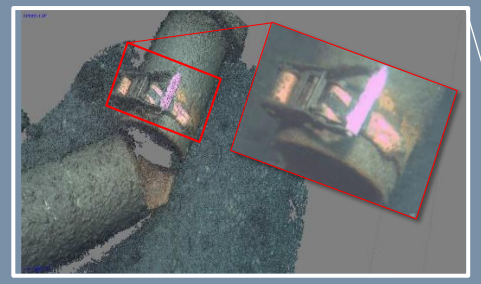

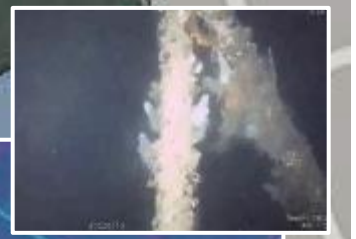

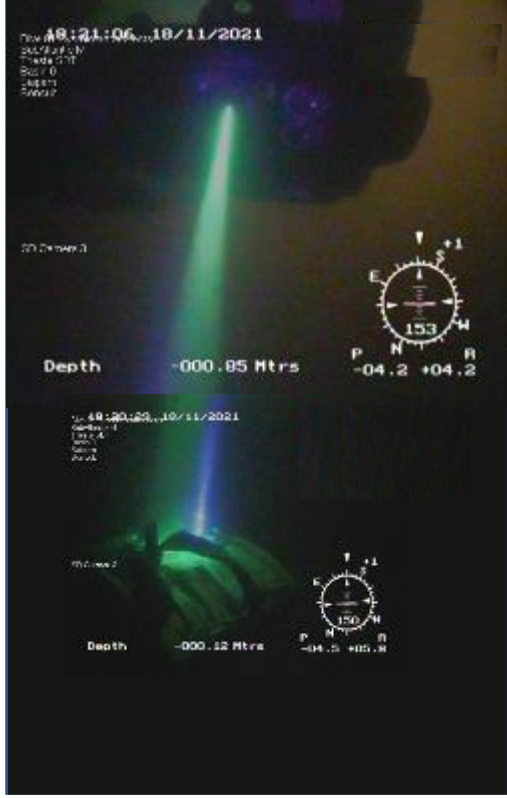

5 Qualification roadmap
Deep water subsea tests

First deep water use of a UID (more than 1700m) to perform:

- Pipeline inspection
- Riser inspection
- Structure Inspection
- ODBN data harvesting

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Conclusions

Qualification of an underwater drone is challenging:

1) Long process
2) Requiring complex testing facilities
3) Deep water tests are critical

Required next steps:

Increase maturity by means of a continuous deployment in deep water conditions!!!

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THANK YOU!

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