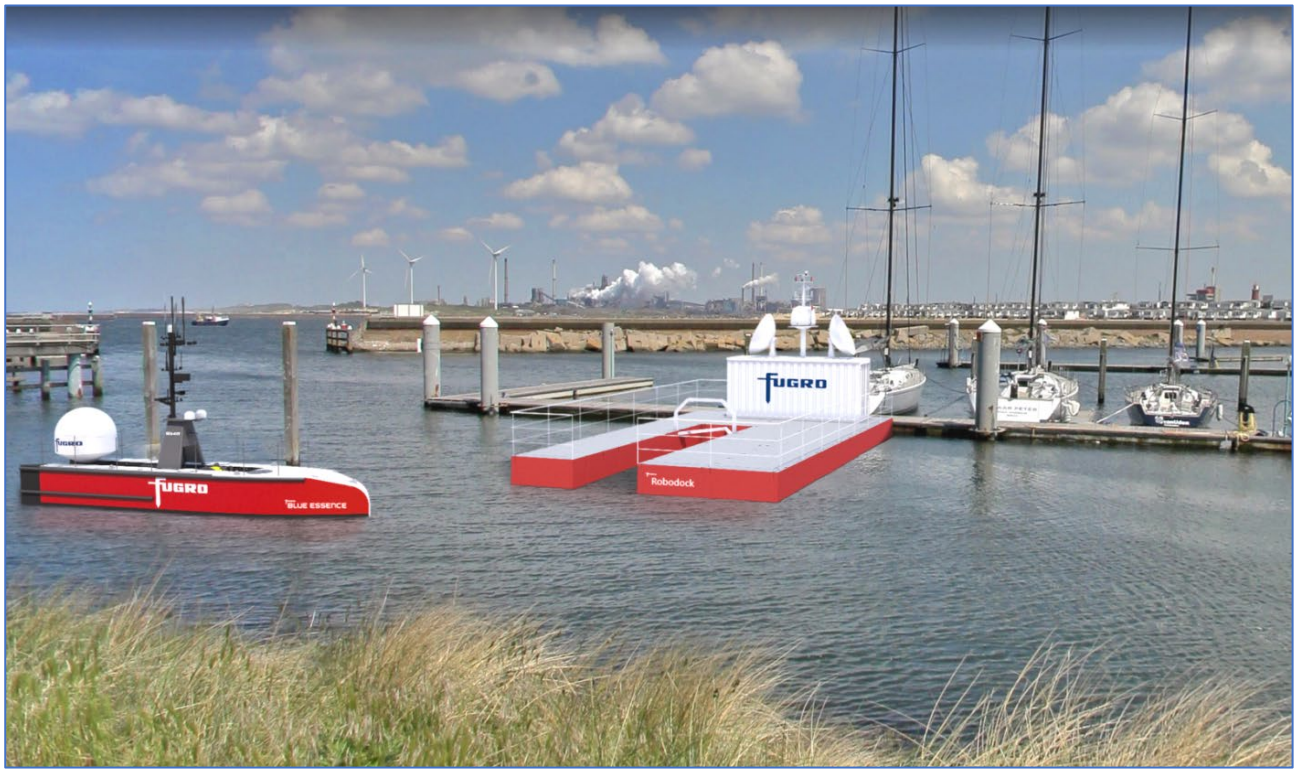
RoboDock



MOOI Public summery on Robodock project, year 4.

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Inhoud

1 Summary

The Robodock project is a cooperation project between Fugro NV, RC Dock Engineering BV, Koninklijke NIOZ, O7 Designers BV and Ørsted Power A/S

Problem analysis
With the increased availability of operational wind farms in the North Sea and the safety concerns and scarcity of qualified staff, robotic based inspection, maintenance and other services of the offshore wind assets (turbines, foundations, power line infrastructure, etc.) will contribute to lowering the downtime of installed wind turbines and lowering overall O&M costs. Further, robotic inspection system in general are smaller than crewed systems and therefore have a significantly smaller environmental footprint. However, as offshore wind farms are situated at increasing distances from the coast, deployment of the robotic systems is getting more problematic without facilities nearby that are able to support such systems. Deployment of robotics for O&M are currently limited by 2 factors:

1. The robotics still **lack autonomy.** As of yet, still human on-site interventions are needed, which contribute to higher costs of operations;
2. The robotics are all deployed and serviced from **separate systems**, which causes inefficiencies (e.g. separate communication, repowering and safety infrastructures).

In addition, the offshore wind farm operations is sorting effects on others users of the North Sea: the wind farms are limiting other functions that could be performed in the same area (e.g. fishery and nature), while the environmental footprint of O&M tasks in wind farms is currently relatively high (lots of shipping traffic for supplies).

Purpose of the project
This project will introduce the **RoboDock** platform, which will revolutionize the way in which offshore wind O&M and other field related activities are being organized and executed. RoboDock will provide for a protected, safe docking point, where robotic systems that are used for O&M tasks can be held (docked), refueled or recharged and upload acquired data, and where they can communicate with control and operation centers onshore. Primarily, RoboDock will support different types of O&M related robotics for offshore wind:

1. Subsea: ROVs and AUVs that are used for inspections and repairing of subsea cables and wind turbine foundations;
2. Sea surface: Unmanned Surface Vessels (USVs) that are used for wind site surveys, monitoring of monopiles and security observations;
3. Airborne: UAVs and drones that are used for blade and nacelle inspections and replacement of light wind turbine parts.

The solution will lead to **lower societal costs**, as operational reliability will be increased by presence of multiple inspection and repair robots on-site, leading to early identification of potential problems and fast deployment for repairs, which is reducing downtime. The efficient sharing of infrastructural

facilities for multiple robotic systems will further lower the societal costs. The positioning of the Robodock closer to the project site will allow for more sustainable project execution due to less distance to be travelled.

2 Results within year 4

Project partners continued the execution of the project during year 4. The concept of the Robodock platform was further developed and detailed for more complex operation (e.g. aireal drones, improved docking en fuel options).

Currently the RoboDock project is running for 4 years now and yielded the first tangible sub-results (prototypes of the solution). Furthermore the entire concept was reviewed which led to additional ideas to enhance its capabilities. We aim to increase the usage of the concept within the offshore wind/energy sector. Improve situational awareness is requested more frequently and the combination of an USV and the robodock platform are expected to provide this. This underpins the potential of this innovation and possible future use within or near offshore wind-farms.

The Robodock platform will be able to provide a solid solution to monitor and offshore wind-farms above as well as underwater. Beside environmental monitoring the Robodock concept can also be used to monitor physical activities within and near the offshore windfarm, and can thus contribute to safety and security of offshore energy assets.

The RoboDock concept will be a relative low-cost, but rugged shallow water mobile platform that can host various offshore robotics. It will incorporate storm-resistant docking points, automated launch and recovery systems for USV's or ROV's, charging points and an advanced communications and positioning hub (allowing for increased positioning accuracies and redundant communication infrastructure for the robotics deployed). Autonomy of the system en solutions used within it was furter developed. To enable fail-proof handling and refueling of the USV, increased autonomy of the system (combination of LARS and USV) is essential.

Testing.
Sadly we had to postpone the planned tests from Q4 2024 and now aim to conduct these in march/April 2025. We had to postpone the final tests of this project due to the fact the Fugro USV, that is needed for the tests, was busy in other projects.
Although the project encountered some delays during the last year, project partners (Fugro NV, RC Dock Engineering BV, Koninklijke NIOZ, O7 Designers BV and Ørsted Power A/S) are confident to be able to finalize the development within the current timeframe (before the end of May 2025).

3 Short description of activities

The project is being implemented in three distinct phases. Such a step-wise approach allows for intermediate learnings and possible adaptations, while visible results can be achieved relatively fast and shown to all relevant stakeholders.

The project's phases/activities are the following

- Phase 1 (Result 1 + 2) of the project is completed. In 2022 a first Robodock prototype was developed, build and tested in the IJmuiden harbor.
    - Pontoon elements, nose piece and connections built
    - Robodock mobilization and construction into harbor
    - Magnetic docking system developed
    - Docking with magnets successfully tested, via manual operation, under different ballast conditions
    - Demobilization of the system after two months in the water

An improved version of the prototype was tested during a second test period in the IJmuiden harbor in April 2023. Scope of these tests included:

- Buildup of Robodock pontoons with more pontoons
- Improved nose piece connection
- Improved magnetic docking system, automatic / remote operable, autonomous systems
- Addition of prototype refuel system and testing mating to a dummy connector on the vessel
- NIOZ environmental sensor integration in the USV
- Addition of data offload concept was attempted but due to supplier problems and excessive cost, it was decided to not include this in the test program.

Availability of Fugro USV's is limited to windows in between commercial work. This means testing options are extremely limited. Also, USVs are expensive to use for testing purposes only. Fugro researched the options to invest in a prototype USV, just for testing purposes, but did not proceed while we can use the commercial USV's in between jobs. This requires some flexibility within the R&D organization.

- Phase 2 (Result 3 + 4): Based on the positive tests of the first prototype the consortium continues to on the design of different functional improvements of the ROBODOCK concept. Additional functions (such as ecological research/NIOZ application, fuel/refuel system) were integrated and build within the prototype and were successful tested on basic functionality in April 2023. Further insight in market developments as well as results of the test program led to an evaluation of the scope for Result 4, Phase 2. Additional features of automatic vessel control as well as launch and recovery of additional tools and vehicles is further developed in 2024. The improved prototype,

is build in 2024 and was ready for testing at the end of September 2024. Because no USV was available test are postponed to 2205.

- Phase 3 (Result 5): when the additional capacities have been validated during the tests (2025), the consortium in parallel finalizes the design of an actual ROBODOC platform for offshore applications.

In addition, there are parallel activities (under result 6) executed that comprise the enabling supporting actions for the non-technical issues that will need to be tackled in this project, such as the regulatory framework.

4 Publications

Within 2024 there were no new publications on the project.