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On-demand Ocean Bottom Nodes: field testing and deployment plans

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Introduction

The idea to have a semi-permanent OBN system that would deliver on demand seismic, with better 4D repeatability and at lower cost than in conventional OBN surveys, was conceived in 2016. Such a system would be especially useful to monitor the large Brazilian pre-salt carbonate fields, where production by alternate injection of water and gas (WAG) results in small and complex 4D signals that need to be monitored on demand with sufficient fidelity to overcome the expected levels of 4D noise. The OD OBN is a seismic and geodetic seafloor node with long autonomy, of 5-7 years, capable of being controlled and harvested acoustically and optically, either by an AUV, an ROV or a surface vessel so that it may be turned on and off to record up to 500 days of seismic data at 2ms sampling. The OD OBN R&D program is being developed in phases by Shell and Petrobras in collaboration with SENAI CIMATEC and Sonardyne.

Field and Bench Testing

Field tests within this program total 1,800 days in deepwater, a luxury only possible because of Petrobras continuous OBN campaign in the Santos Basin. Bench tests range from fit-for-purpose to sophisticated mechanical and electronic tests and simulations, in air, tanks, pressure vessels, etc. Field testing has provided invaluable learnings to complement the bench testing approach. As a result, we have acquired high-quality seismic and geodetic data benchmarked against a commercial OBN; controlled the node remotely and harvested data using acoustic and optical comms by means of an AUV, an ROV and from a vessel; evaluated the housing resilience against transport and handling, and to some extent, corrosion; improved the timing protocol; modified the design to simplify assembly and improve reliability of crucial components; and debugged extensively the electronic modules and battery packs. This comprehensive field test program shows that a highly complex system requires a lot of testing to expose and fix as many bugs as possible. A systematic test scheme would not be able to reproduce all possible failure modes.

OD OBN Production Plant

A manufacturing plant for OD OBN has been designed and built. It was inaugurated in Dec. 2024 and has started production of 600 units. The plant consists of three buildings at SENAI CIMATEC PARK, in Camaçari, Salvador (Brazil), for the machining, anodization, and assembly lines. The machining line produces the aluminum parts of the node internal structure and housing; the hard anodization line protects the aluminum parts that have direct contact with sea water; and the assembly line provides Surface Mounting Technology (SMT) to assemble the main electronic and power management boards of the nodes. All parts are tested continuously including the integration step in the assembly line. This plant was designed for producing over 1,000 nodes per year with full quality control, ensuring scalability to meet future market demands.

Deployment Plans

The OD OBN system qualification will take place in the Mero field with installation of ~300 nodes in the northern part (Mero 4) and additional nodes in the central part (Mero 1 and 2), where a PRM is being installed. After node deployment, the shooting vessel from the PRM program will also shoot over the OD OBN area in Mero 4. The OD OBN data will be compared with legacy OBN data, providing a first 4D seismic image of that part of the field. The qualification is planned from end 2025 until Q1 2026, where procedures for deployment, clock synchronizations, seismic recording start/stop, and optical harvesting will be fully operated at field scale. Afterwards, the system will be commercialized for deployment in all suitable pre-salt fields and elsewhere.