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Giant Permanent Reservoir Monitoring Technology in Mero field (Pre-Salt Brazil)

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ABSTRACT

Mero is one of the largest fields in Brazil's pre-salt region, located in the Libra area in the Santos Basin, 180 kilometers off Rio de Janeiro's coast. Discovered in 2010, it was the first concession under Brazil's production sharing regime. The field is renowned for its high productivity with excellent quality oil and low contaminant levels, such as sulfur. Located in waters 2,000 meters deep, Mero's reservoirs sit approximately 5,000 meters below sea level. The field features high-quality carbonate reservoirs typical of the pre-salt region, offering excellent connectivity and storage capacity.

Development of Mero involves a series of FPSO systems, each capable of processing 180,000 barrels of oil daily and compressing 12 million cubic meters of natural gas. The Libra Consortium, led by Petrobras with a 40% stake, includes Shell Brasil (20%), TotalEnergies (20%), CNPC (10%), and CNOOC (10%) as partners, with Pré-Sal Petróleo S.A. managing the production sharing contract.

Brazilian pre-salt carbonate reservoirs present significant challenges for 4D seismic monitoring, primarily due to thick overburden salt bodies, igneous intrusions at the reservoir level and the acoustic nature of carbonates. The complexity of detecting low-impedance signals is further compounded by the injection strategy employed. The Mero field utilizes a Water Alternating Gas (WAG) system, allowing individual injection wells to switch between water and gas injection. To address these signal detectability challenges and optimize field production, the Libra Consortium conducted a comprehensive evaluation of available industry technologies. After careful consideration, a fiber-optic Permanent Reservoir Monitoring (PRM) solution was selected for installation in the Mero field. This decision marks a significant milestone, as it will be the first deepwater pre-salt PRM system deployed offshore Brazil. The implementation of this advanced technology is expected to enhance reservoir understanding, improve production strategies, and ultimately maximize field recovery in this complex geological setting.

The PRM project is structured in two distinct phases. The first phase, set for 2025, will focus on the core producing areas of Mero-1 and Mero-2. This initial stage involves the installation of an extensive system comprising 440 km of cables and multiple backbones, which will incorporate over 4,500 receivers. The seismic grid for this phase will see a significant densification compared to the 2018 baseline OBN (Ocean Bottom Node) acquisition. While the previous grid used a 500m x 500m configuration, the new setup will feature a more detailed 100m x 500m grid in the inline direction. The installation of these seismic cables is scheduled for the second quarter of 2025, with the first 4D seismic campaign following shortly after in the first quarter of 2026. The second phase of the project, planned for 2027, will expand the coverage to encompass the remainder of the field. Currently in the planning stage, this phase aims to extend the system to the Mero-3 and Mero-4 areas. To maintain consistency and optimize data collection, the second phase will utilize the same grid configuration as established in the first phase. This comprehensive approach ensures thorough monitoring of the entire Mero field, enhancing reservoir management capabilities and optimizing production strategies. The seismic data from the monitoring system would be processed using latest available technology in the industry, such as 4D FWI imaging, joint acoustic and elastic inversions, PS wave processing and others. The permanent fiber optic nature of the cables would also allow research projects for passive seismic and tests of different seismic source at various time.

The PRM system is expected to significantly improve reservoir management through continuous monitoring and data-driven strategies. It will optimize well locations and smart completion control, leading to increased oil recovery rates and maximized long-term production potential. This advanced technology is anticipated to provide sustained operational efficiencies and improved economic outcomes, positioning the field at the forefront of innovative reservoir management. The implementation of PRM technology will ensure the field's competitiveness, productivity, and relevance in the industry for years to come.

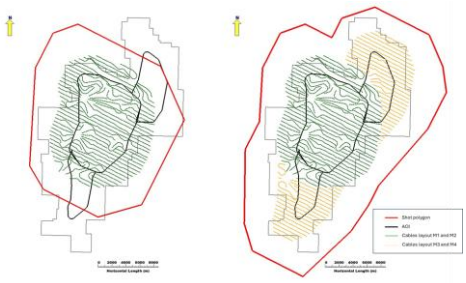

Figure1: Phase 1 and 2 cables layout

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