Using Field-Proven Passive Chemomechanical Solutions to Address EU Emissions Monitoring at Measurement Challenges

By Jim Gordon

The North Sea offshore industry faces significant challenges in monitoring emissions from inactive subsea wells and infrastructure, driven by the EU Methane Regulation. Article 18 mandates monitoring, reporting, and quantification for inactive, temporarily plugged, and permanently abandoned wells, while Leak Detection and Repair (LDAR) requirements emphasize risk-based surveys to detect and address emissions promptly. Current monitoring methods often rely on active power systems and data communication, resulting in high installation and maintenance costs, frequent vessel-based interventions, and increased operational emissions.

Sentinel Subsea Ltd (Sentinel) has developed the WellSentinel™ Passive Chemomechanical system, an innovative, non-invasive technology that addresses these challenges. It enables integrity verification, continuous monitoring, and early detection of emissions from subsea wells without requiring active subsea power, ongoing data communication, or complex interventions. The system uses static mechanical structures and the natural buoyancy of escaping fluids to collect and chemically detect them using specialized Triggers. Employing proprietary Passive Trigger technology, the system detects hydrocarbons (such as oil and thermogenic gas) and CO_2, responding only to the target fluid(s) and ignoring other fluids commonly found around subsea assets, such as natural seeps. Upon detection of the target fluid, a coded satellite beacon is mechanically released to the ocean surface, transmitting an alarm via satellite to alert the asset owner. Systems configured for hydrocarbon detection have been deployed in locations including the North Sea, Gulf of Mexico, Campos Basin, Caspian Sea, and Timor Sea, monitoring wellheads and producing trees at depths exceeding 2,000 meters (7,000 feet). The Passive Chemomechanical Trigger system uses a cumulative detection method, capable of identifying low flow rates—below 1 ml/hour for liquids and less than 0.01 liters per minute for gases at Normal Temperature and Pressure (NTP)—providing alerts for small gas releases, such as 3.4 grams per hour of CH_4. This approach supports proactive integrity management, aligning with EU mandates for timely emissions detection and monitoring while minimizing environmental and operational impacts. As adaptable, agnostic systems, they can be configured for various subsea setups, including wellheads, trees, manifolds, and inactive wells.

As part of the WellSentinel™ solution, Sentinel has developed a complementary Flow Diverter and Measurement Device for remote quantification and monitoring of subsea emissions. This proprietary static mechanical device channels released fluids through a controlled pathway, mechanically measuring a pre-set flow rate. Any deviation from this threshold triggers an automatic alert. By detecting variable gas flow rates, the system enables operators to remotely monitor emissions for quantification and regulatory reporting. Designed for seamless integration with existing WellSentinel™ systems, the Flow Diverter and Measurement Device extends capabilities from anomaly detection to quantification, supporting compliance with EU Methane Regulation requirements.

The system can also be deployed as an at-source visual device (via ROV or temporary structure) when an emission is detected. In this mode, it provides a direct visual indication of flow rate at the source and allows the WellSentinel™ system to be configured to respond only when

emissions exceed a specified threshold.
Passive Chemomechanical systems offer a proven, sustainable, and scalable solution to address the challenges of the EU Methane Regulation. These systems provide a flexible and effective tool for compliance, aligning with the Best Available Techniques (BAT) approach. This paper explores existing monitoring methods, describes the design and performance of Passive Chemomechanical systems, and demonstrates how this unique monitoring methodology can be integrated into North Sea methane mitigation strategies.