



**OTC 20084**

## **Advanced Flow Assurance System for the Ormen Lange Subsea Gas Development**

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This paper was prepared for presentation at the 2009 Offshore Technology Conference held in Houston, Texas, USA, 4–7 May 2009.

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### **Abstract**

Ormen Lange Flow Assurance System (FAS) is to date the most advanced real time and simulation support system for operators, flow assurance engineers and management. The system is delivered by FMC Technologies with SPT Group and Prediktor as sub-suppliers.

The Ormen Lange field is the largest gas sub-sea development of its kind with onshore processing facilities at the Nyhamna on the west-coast of Norway.

Several flow assurance challenges must be taken care of to enable secure and stable production in deep water (down to 1100 m/ 3600 Feet), low temperature (-2°C/ 29F) at the seabed in addition to long distance (120 Km/75 Miles) to shore through rough sub-sea terrain. Such conditions highly expose the production system to potential flow assurance phenomena like hydrate formation, liquid holdup, water breakthrough etc..

Ormen Lange FAS represent a barrier breaking system and play an important role in production monitoring and operator support. The system includes the following modules:

- **Virtual Flow Metering System (VFMS):**  
Model generated values of flow rates (gas, condensate and water) as backup to physical multiphase meters, sensor surveillance and leakage detection.
- **Pipeline Monitoring System (PMS):**  
Model generated values of pipeline flowing conditions and onshore receiving facilities.
- **MEG Injection and Monitoring System (MIMCS):**  
Continuous MEG injection monitoring and optimization.
- **Production Choke Control System (PCCS):**  
Individual well production chokes control for overall field optimization.
- **Formation Water Monitoring System:**  
Monitoring and alarm generation when / if formation water breakthrough is indicated. The system is based on advanced usage of statistical process control.

Based on practical experience gained in the period from December 2007 up until now, this paper focus on the systems potential of early detection of flow assurance problems, sensor and metering surveillance and how the system is being used to solve practical day to day operational challenges.

During the last years, the status of the Ormen Lange development project has been reported during OTC, as well as in other conferences and in papers, covering a multitude of disciplines and methods in order to finalize such a grand challenge. In 2007 there was a dedicated technical session for the Ormen Lange development as part of the OTC program, /1/, /2/, /3/, /4/, /5/, /6/ and /7/.