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Technology Qualification for the Tordis Subsea Separation, Boosting, and Injection System

R. Fantoff, FMC Technologies; T. Hendriks, CDS Engineering; and J. Elde, Framo Engineering

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Abstract

The Tordis Subsea Separation, Boosting and Injection System (SSBI) will be the world's first commercial subsea processing station of its type. The system will be installed in 2007 at the Statoil operated Tordis field in the North Sea. The system will include a separator that removes water from the well-stream, a multiphase pump for boosting the production rate, and a water injection pump for the discharge of separated water in a disposal well.

The Tordis SSBI system has been established with a focus on the use of simple technical solutions using equipment with successful operational experiences from both topside and subsea applications. Nevertheless, a technology qualification programme has been executed to qualify and document the performance of new components. This was necessary to ensure that the system had a technology maturity prior to sanction of the project at level that made sure that the business unit felt confident with regards to remaining risks.

The Tordis Technology Qualification Programme comprises of five activities; the qualification of subsea separator, performance evaluation of the subsea separator, design optimisation and testing of the multiphase and water injection pumps with respect to sand handling, testing of valves operated in sand slurry, and qualification of a 36 kV dry mate high voltage connector. FMC Technologies and key partners executed these qualification activities for the project. Statoil and other suppliers have also carried out other qualification activities that has important to achieve a satisfactory risk level for the overall Tordis project beyond the scope of supply from FMC.

This paper describes the Tordis SSBI technology qualification programme executed by FMC and partners. This includes why these activities have been important for the system to be installed subsea, the content of the activities and the main conclusions.

Introduction

The project for the delivery of the Tordis Subsea Separation Boosting Injection System is currently being conducted as part of Statoil's work for increased oil recovery at the Tordis field (Tordis IOR). This is the first commercial subsea processing system, which comprises of subsea water separation, multiphase boosting, and re-injection of water. Hence, the Tordis SSBI project is a major technology step using subsea processing solutions that are expected to be important field development tools for the offshore oil and gas industry in the future.

The focus in the establishment of the system solution for the Tordis application has been to utilise simple and, as far as possible, use well-known technical solutions. Using wherever possible experiences from both earlier subsea and topside process applications has been an important basis. However, such a new system must also use new technical building blocks that need special attention during the early phases of the project. Hence, in parallel with the FEED phase of the project, a Technology Qualification Programme (TQP) began November 2004. The purpose of the qualification work has been to:

- Ensure selection of proper concept solutions and components that will be technically available for the delivery project.
- Ensure qualification of needed components.
- Evaluate and optimise robustness of key components to achieve high reliability.

The TQP has been carried out by FMC Technologies along with the important technology partners for the project, CDS Engineering and Framo Engineering. With FMC as the system integrator, these technology partners have worked closely together in all phases of the project, through early phase FEED study, technology qualification, system engineering, as well as in the execution of the EPC project itself. In this context it is also noted that parts of the TQP activities have also been carried out at subsuppliers for specific components.

The qualification activities described in this paper are a part of a larger qualification program run by Statoil for the Tordis IOR project. This has also included activities operated by Statoil as well as by suppliers that competed with FMC for the contract award of the delivery of the SSBI system for the Tordis IOR project. This paper does, however, solely focus on the TQP activities run by FMC Technologies and technology