

Ormen Lange Langed Development

The full-length paper provides a summary of the challenges of executing the Ormen Lange Langed project. The three main features of the project-execution phase are the Ormen Lange offshore development, the Ormen Lange onshore development, and the Langed gas-export system including the gas-receiving facility in the UK.

Introduction

The Ormen Lange gas field was discovered by Hydro in 1997. The development of the field, 120 km off the midwest coast of Norway, is the largest industrial project in Norway. As of January 2007, the Ormen Lange Langed project is more than 90% complete, within budget, and on schedule for gas export by October 2007. When Ormen Lange comes on stream in October 2007, the project will contribute to the increase of Norwegian gas export by 25%. The peak annual gas production from the field of 22×10^9 std m^3 is equivalent to the total annual energy consumption in Norway. Gas from Ormen Lange will be able to meet as much as 20% of the UK gas demand. Production life is estimated to be 30 to 40 years. Ormen Lange's gas-export pipeline, Langed, from Nyhamna in Norway to Easington on the east coast of England, is the world's longest subsea pipeline, with 42- and 44-in.-diameter pipes and a total length of 1200 km. The Ormen

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Fig. 1—The S-7000 and Solitaire.

Lange field will contribute significantly to Norway becoming the second largest exporter of natural gas in the world.

Project Management

The Ormen Lange Langed field-development project is organized with a multicompany integrated project team headed by Hydro. Shell is responsible for subsurface and drilling of production wells and for preparing for operations. Statoil is responsible for the execution of the Langed project. Because of the sheer size and complexity of the project, it was organized into the following three major subprojects with different focuses and challenges.

1. The Ormen Lange offshore project consists of subsea installations approximately 120 km offshore, with templates, manifolds, and pipelines.
2. The Ormen Lange onshore project consists of the gas-processing facilities at Nyhamna.

3. The Langed project consists of the 1200-km gas-export transportation system, the tie-in to the Sleipner field, and the Easington gas-reception terminal in the UK.

Hydro organized a common project for the execution of the field development and the transportation system to secure the integrity of the Ormen Lange Langed project from reservoir to market. The Langed-project organization has been staffed with personnel from both Statoil and Hydro.

Field Development

The Ormen Lange field was discovered by Well 6305/5-1, drilled by Hydro in 1997. Four appraisal wells have been drilled. The Ormen Lange field lies approximately 2000 m below the seafloor at water depths between 850 and 1100 m. Ormen Lange has expected recoverable gas reserves estimated at 397×10^9 std m^3 , with 28.5×10^6 std m^3

The full-length paper is available for purchase from the OTC Library: www.otcnet.org. The paper has not been peer reviewed.

of condensate, making it the second-largest gas field in Norway.

The reservoir is of late Cretaceous and early Tertiary origin and consists of sand-rich turbidities. The main reservoir, Egga RU, contains sand with a thickness of approximately 50 m, a net-to-gross sand ratio of 90%, and permeability approaching 500 md. The main drive mechanism is pressure depletion.

The field is to be developed in two phases: before and after startup. The initial phase involves two eight-slot templates placed 3.8 km apart. Six wells will be ready for production in 2007, and four additional wells will be drilled in 2008. The Seadrill drillship *West Navigator* began production drilling in November 2005. Four production wells currently are drilled to reservoir top, in addition to one pilot hole drilled through the reservoir. The wells will be completed by spring 2007.

The first eight wells will be completed as 9⁵/₈-in. big-bore wells. The lower completion is planned as openhole gravel pack. Each of the 9⁵/₈-in. big-bore wells will have a production capacity of 10×10⁶ std m³/d. Production startup is planned for October 2007. The production rate will be stepped up annually from 30 to 50×10⁶ std m³/d to reach a plateau level of 70×10⁶ std m³/d in 2009.

For hydrate prevention, all wells are injected continuously with monoethylene glycol (MEG) by means of two 6-in. pipelines from the onshore plant. One line is connected to Template A and the other to Template B. A 6-in. crossover MEG line interconnects the two production templates for added flexibility.

Well fluid will be transported to the Nyhamna plant by two 30-in. multiphase lines. The two 30-in. lines are interconnected by means of a pipeline-end-termination system. Two main control umbilicals link the onshore plant to the subsea production system; one is connected to Template A and the other to Template B. A crossover control umbilical interconnects the two production templates, providing redundant hydraulic supply to all the subsea wells.

Innovative pipeline engineering and installation together with extensive seabed preparation have been key factors in the success of the Ormen Lange proj-

ect. Along its 120-km route to shore, the gas travels through a highly irregular seabed with depressions and large scattered slide blocks, passes across large fishing areas with trawling and areas with thousands of large boulders, climbs steep hills with 30° slopes, rests on a seafloor varying from the softest clay to hard moraine, and snakes through narrow subsea valleys and passages close to shore.

Ormen Lange will be the first large-scale offshore field development at this water depth without platforms. Heerema's *Thialf*, one of the world's most powerful crane vessels, installed the two templates in late August 2005. The Allseas *Solitaire* began pull-in of the Langeded and Ormen Lange flowlines at Nyhamna in June 2005. Saipem S-7000 completed the challenging pipelaying in August 2006. **Fig. 1** shows the S-7000 and the *Solitaire*. All subsea tie-in activities were completed successfully at the templates and the pipeline-end-termination unit in October 2006.

Nyhamna Plant

The Ormen Lange plant at Nyhamna consists of wellstream processing, gas-export compression, and condensate offloading to tankers. The process facilities at Nyhamna consist of two gas-conditioning and -dehydration trains, three export compressor trains, and one condensate-stabilization train. The plant processing capacity is 70×10⁶ std m³/d of sales gas at a 990-bar initial arrival pressure. Maximum condensate production is estimated to be 7000 std m³/d.

The gas from the field is conditioned to dewpoint and heating value according to EU specifications and then routed into the export pipeline to Easington, UK, by way of the Sleipner field. Condensate recovered from the well stream is stabilized and stored in a custom-built rock cavern before being shipped. Gas and liquid products are metered to fiscal standards before being exported.

Langeded

The Langeded joint venture, comprising Ormen Lange owners and ConocoPhillips, was established to construct the transportation system from Nyhamna to Easington. The Langeded transportation system will have a total length of approximately 1200 km and

will be the longest subsea-gas-pipeline system in the world. In March 2005, the *Acergy Piper* began pipelaying for Langeded south. The southern part of the transportation system was operational in October 2006 to transport Norwegian natural gas from Sleipner. The northern leg will be operational in October 2007 when the Ormen Lange field comes on stream. The UK receiving terminal began regular operations on October 1, 2006, as planned, and Norwegian gas started to flow through the southern leg of Langeded.

Health, Safety, and Environment (HSE)

The objective has been to complete the Ormen Lange Langeded development without injury to personnel or damage to the environment. The Ormen Lange field has been developed while striving to preserve the environment, ensure personal health, and protect assets. HSE effects have been evaluated when making all major decisions. Potential effects have been assessed against acceptance criteria, and the evaluations have been documented in project records. The Ormen Lange acceptance criteria have been aligned with legal requirements and corporate strategies of the participating companies.

In line with the objective to ensure that no injuries occur, there has been focus on safety during all operations and on HSE in all contracts. This includes management inspections, close cooperation with and support to contractors, and preparing for operations through desktop exercises, hazard and operability studies, and safe-job analysis.

For the Ormen Lange onshore development at Nyhamna, 18 000 people of 57 different nationalities have attended the introductory HSE course. Although safety is a line responsibility, Hydro has had a dedicated crew of 20 safety professionals at Nyhamna, including a site chaplain.

Procurement Strategy. Procurement of goods and services for Ormen Lange has been executed in accordance with the license documents, applicable laws, and Hydro's established procedures and principles. The principles emphasize business ethics, cost and time consciousness, good business practices, and an open dialogue with the supplier market. A procurement strategy was developed during 2003 after thorough

studies of and communication with the supplier market, both in Norway and in the international arena. There also was a dialogue with the Federation of Norwegian Manufacturing Industries. A main success factor is to establish a procurement strategy that fits the contractor market. The scope, volume, schedule, and type of contractual responsibility for each contract have to be acceptable to a number of potential contractors. The procurement strategy also describes how the overall project scope is divided into a manageable number of contracts with clear definition of technical and commercial responsibilities and interfaces between the contracts.

The procurement philosophy in Ormen Lange was to ensure competition between a reasonable number of suppliers. Limitations within the sup-

plier market were identified as a potential risk for the project. Priority was given to early information to and communication with the supplier industry, and several supplier seminars were conducted in Norway and in the UK. Information was given about upcoming requirements. The tender lists for most of the main contracts were made public to enable potential subcontractors to make contact with tenderers early in the process.

Market capacity was constantly monitored during the tender period and in the early phase of the project to minimize risk. Delivery of long-lead items and the early need for supplier information were secured through procurement of the critical equipment during the early stage of the project-execution phase.

The philosophy was to act professionally during the contract-administration phase. Internal contract seminars were arranged for company representatives, contract coordinators, project-control personnel, and other persons involved in the process. For all major contracts, joint seminars for contractors and company contract teams were conducted to agree on ways of communication, formalities in the contract, and common success targets. A planned and controlled execution of the Ormen Lange Langed development project was secured by the procurement strategy and selection of suppliers having good performance combined with proactive management and common focus on risk management.

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