

Ormen Lange leads the way for North Sea innovation with big bore, deepwater gas wells

PLANS FOR THE estimated US\$10 billion pioneer development of Ormen Lange, Norway's second-largest natural gas field, was presented at IADC World Drilling in June 2005. Two years later, at IADC World Drilling in June 2007, learnings from the execution of that development were offered and discussed.

Located 125 km offshore Norway, Ormen Lange covers approximately 350 sq km, and the reservoir sits in about 2,600-2,950 m. It contains lean gas condensate with about 528 billion cu m of gas in place; about 75% (397 cu m) are recoverable.

The wells are the world's largest deepwater wells, with 9 5/8-in. tubing enabling production of 10-13 million cu m (350-455 million cu ft) per day per well. The initial eight big bore gas wells — with a total investment of US\$460 million — will be capable of supplying 20% of the UK natural gas market. First gas is expected by October 2007, and by the end of 2007, Shell is expected to take over as operator of the production phase from **Norsk Hydro**, operator for the development phase.

WHAT'S BEEN DONE

The Ormen Lange drilling campaign began on 31 October 2005, with a total of 833 days for 8 wells. The strategy has been to drill during winter and to perform completion/clean-up during spring/summer. As of mid-June 2007, 16 conductors had been drilled and installed; four wells had been drilled on template A to top reservoir and two wells on template B; 4 Xmas trees have been installed; and two wells on template A have been completed. The first clean-up is expected to begin in July 2007.

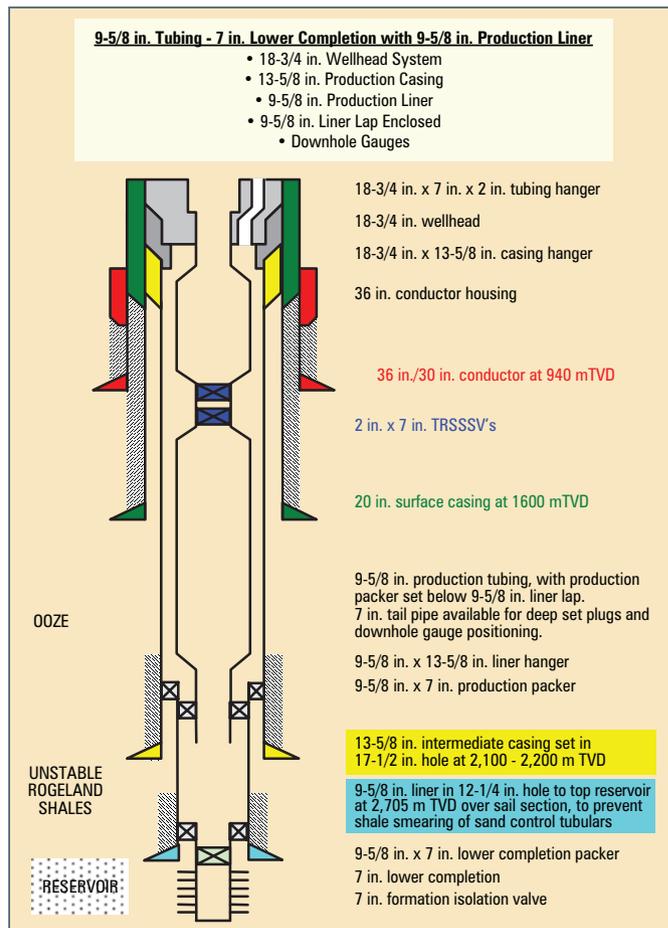
Shell anticipates having three wells ready by July 2007 and six wells by November 2007, depending on progress.

The well designs are based on 30-year life spans, maximum quality, minimum intervention and minimized capital expenditure. Initial design at the project start was to have 7-in. completion. Shell later proposed using 9 5/8-in. tubing instead, which increased the production bandwidth to 70 million cu m per day. (In comparison, Troll — Norway's largest gas field — has a production of 100 million cu m per day from almost 40 wells.) The tubing size increase reduced the number of wells for Phase I of the project from 14 to eight, allowing a cost savings of about US\$300 million and in addition, allowed for accelerated production.

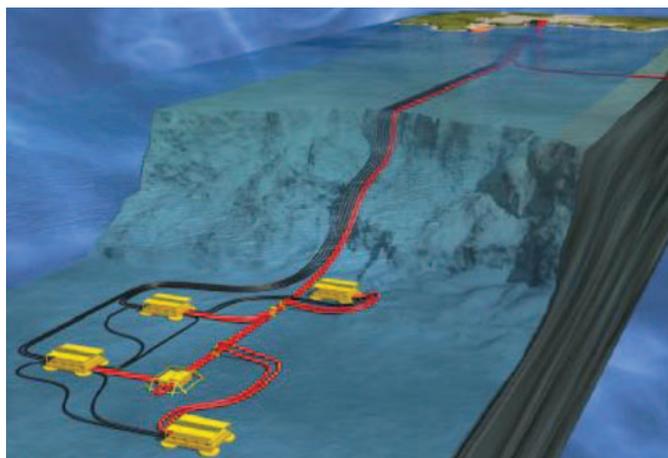
On the other hand, increasing the tubing size increases the dependency on each well, and Shell emphasized that reliability is critical on Ormen Lange.

WELL CONSTRUCTION

Ormen Lange is located in the subsea depression left by the Storegga slide, where about 500 m of the seabed was removed during the slide event. The reservoir is near hydrostatic pressure, and some overpressures are present in overburden formations. The fracture gradient is competent to hold full reservoir pressure at the 13 5/8-in. shoe. In general, the area appears to be relatively benign with a fair drilling margin. With a -2°C seabed temperature, the potential exists for hydrate formation, although precautions have been taken to prevent hydrates, and none have been seen so far.



Ormen Lange, with the world's largest deepwater wells, used 9 5/8-in. tubing instead of 7-in., allowing not only accelerated production but reduced costs due to fewer number of wells.



Nothing will be visible on surface when Ormen Lange comes on-stream in 2007 — it will be developed with seabed installations at depths of 800 m to 1,100 m.

The well concept for Ormen Lange can be seen in the top graphic above. The 9 5/8-in. casing is used as a flowing conduit. Two 7-in. safety valves are installed to enhance reliability as

well as a 7-in. horizontal Xmas tree. The wells have a maximum horizontal step-out of 2,500 m with inclinations of 45° in the reservoir section. The wells are completed with a gravel pack sand exclusion system. A water-based mud system is used, allowing the cuttings to discharge back to sea.

WEST NAVIGATOR

The rig currently being used on Ormen Lange is **Seadrill's** West Navigator, a dynamically positioned drillship with a dual-derrick ram rig, two working-class ROV spreads, and an overall high level of automation. Despite the rig's high specifications, Shell has spent 57 days and more than US\$12.3 million to upgrade the rig to specifications required for the Ormen Lange project.

The unit is contracted to Shell for the initial eight wells, with an option for four more wells. A tender was out in mid-June for another drilling rig to commence operations on Ormen Lange in 2009.

Since taking over the West Navigator from the previous operator, Shell has noted a significant change in the HSE culture onboard the rig, reflected in its HSE performance. More than 11,000 observation cards have been collected since the start of the project and by August 2007, the rig will have been LTI-free for two years. Special attention is given to dropped objects and lifting. For the latter, a dedicated lifting expert is assigned full-time to the project, reviewing all procedures, making regular offshore visits and providing visualized instructions for lifting operations. For an upcoming well test, a specialized company has been contracted for noise mapping and advise on personalized hearing protection.

Furthermore, the rig suffered significant downtime at the start of the campaign as a result of a lack of preventive maintenance. This resulted in a stand-down for safety in January 2006. Since then the rig has had an uptime of over 95%.

LEARNING TOOLS

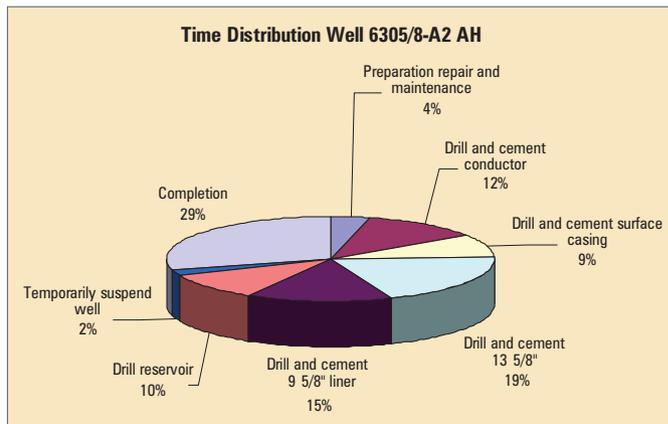
To bridge the potential competency gap for a project that's pioneering in nature, a specialized learning tool was developed by the Ormen Lange Well Delivery Team. It takes input from the project's after-action reviews and stores learnings by category and by each operation. The online learning tool offers easy access both onshore and offshore.

Partnering with **Oceanering**, an ROV simulator called MIMIC was developed for Ormen Lange that includes 3D visualization, scaled subsea model, and visibility and current input. Realistic operations simulations have made it an ideal training module for offshore ROV pilots and supervisors. In addition, an E-learning tool developed with **FMC** models operations for completions/subsea engineers. Both have contributed significantly towards increasing crew competency on the project.

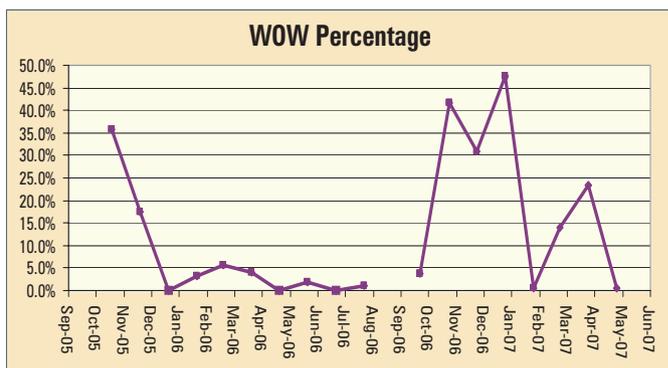
MAIN CHALLENGES

As a pioneer deepwater project on the Norwegian Continental Shelf, with harsh climatic and oceanographic conditions, Ormen Lange is one of the world's most challenging developments in the world.

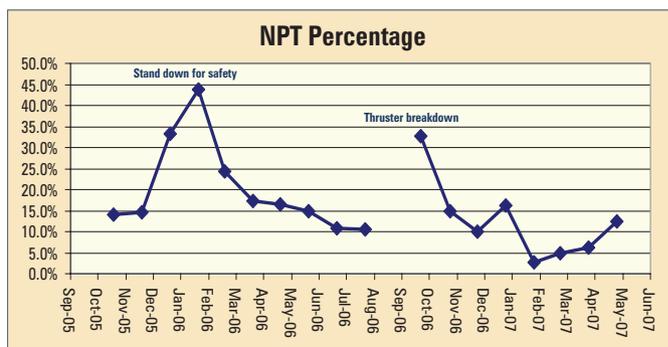
The first challenge dictated by Mother Nature where operations involving the BOP, Xmas tree, LRP/EDP, gravel pack and landing the tubing hangar are all very weather-sensitive. Wait-on-weather clearly spikes during wintertime for Ormen Lange,



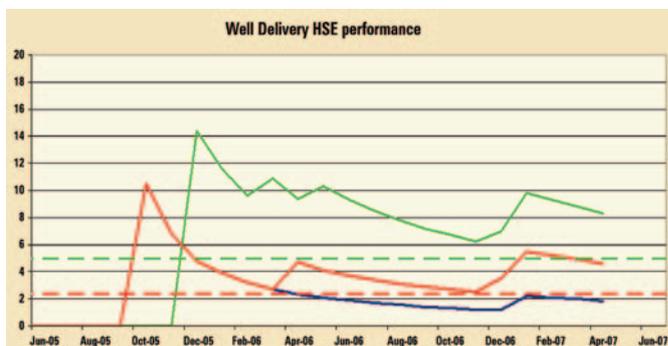
Most of the Ormen Lange project time is taken up by drilling, running casing and cementing.



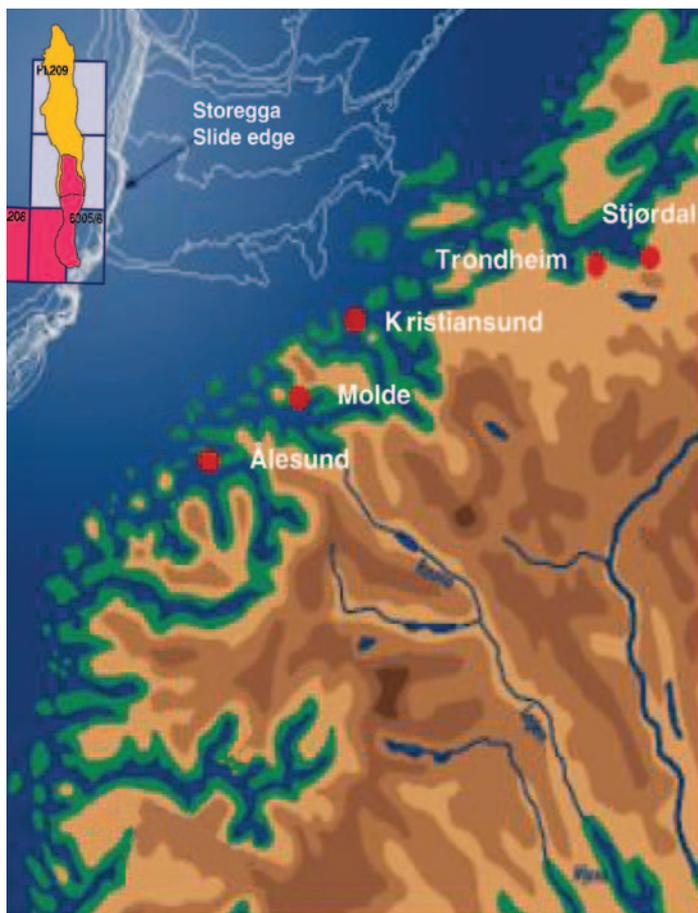
Wait-on-weather accounted for only 12.6% of overall time spent per well, with clear spikes during wintertime.



Since a stand-down for safety in January 2006, due to a lack of preventive maintenance previously, the West Navigator has had an uptime of over 95%.



Shell has noted a significant improvement in HSE since taking over the rig. The West Navigator will have been LTI-free for 2 years in August 2007.



Ormen Lange is located in the subsea depression left by the Storegga slide, where about 500 m of the seabed was removed during the slide event.

but overall it has accounted for only 12.6% of time spent per well. That's compared with 33% wintertime and 11% summertime waiting-on-weather NPT projected at start-up.

Secondly, the rig interface of a drillship with the large subsea Xmas trees and the big bore workover riser was originally underestimated but was resolved through intensive interface management, stack-up and full-scale rig interface testing.

Thirdly, the complexity of rig systems will continue to be a high-focus area, as the West Navigator's high level of automation requires an equally high level of competency and knowledge.

FUTURE

But perhaps the biggest challenge on tap for Ormen Lange will be cost increases per well, expected to be from US\$50 million to US\$150 million due to increases in rig rates, cost of services and well complexity. The easy wells have been drilled, and the more challenging, high step-out or even long-reach wells are to be tackled from now until at least 2012, with a total of 24 wells on the Ormen Lange field.

Whatever the challenges, Ormen Lange and its deepwater, harsh-environment, big bore gas wells will continue to be a leader for difficult but innovative drilling.

Check on www.drillingcontractor.org for video footage on Ormen Lange captured with the West Navigator ROVs.

This article is based on a presentation at the IADC World Drilling 2007, 19-20 June 2007, Paris.