

Controlling Deepwater Dredging in Norway

Novapoint: an Integrated Processing



The Ormen Lange field is the largest gas field under development on the Norwegian Shelf. The gas from this location will cover 20 per cent of the UK's demand for gas. A pipeline needed to be installed between the field and the production facility in Nyhamna, Norway. Geoconsult of Norway was awarded the contract for surveying the construction work on the pipeline. The controlling system for monitoring dredging progress and producing the drawings was supplied by Vianova (Norway).

By Huibert-Jan Lekkerkerk

The Project

The Ormen Lange field is located in the harsh Norwegian sea, 100 kilometers northwest of the Møre coast, at a depth of 1100 meters. The total project consists of four major parts (see figure 1): development of the field by Norsk Hydro; building a processing plant in Nyhamna; building a pipeline between Ormen Lange and Nyhamna; and building the Langede pipeline between Nyhamna and Easington in the UK.

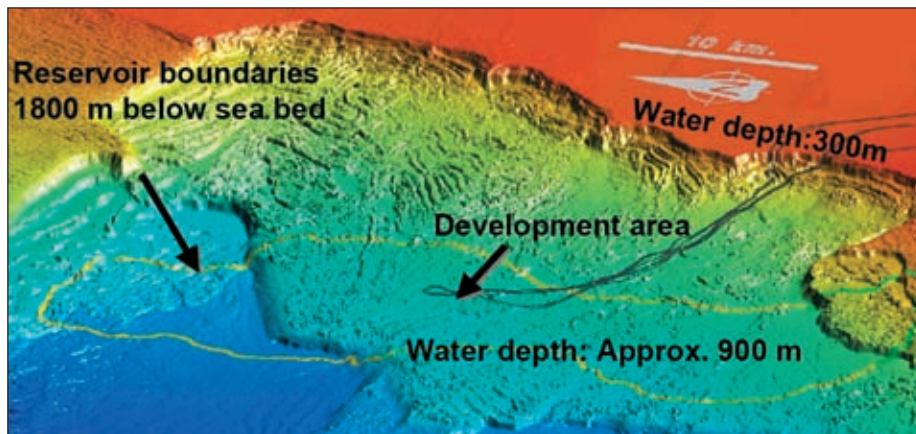
The field itself will be controlled remotely from the Aukra processing plant, 120 kilometers away, through fiber optic cables

trenched into the seabed. The untreated wellstream is transported through two 30 inch pipelines to the processing facility in Nyhamna. From there the gas is transported through the Langede pipeline. With a total length of 1200 kilometers, the Langede pipeline between Norway and Great Britain is the longest pipeline built to date. As you read this, all that remains to be done is connect the field and the controlling station with a single control cable, and complete the processing plant at Nyhamna. Production from the field is expected to begin in late 2007.

Vianova

Vianova is a Norwegian-based engineering group of around 390 people spread over a network of 19 companies. It has two main activities: consulting, and software development and distribution. Software development and engineering are performed by Vianova Systems, a company with 140 employees. Vianova is usually the first user of its own software. The software now has over 10,500+ installations, mainly in Scandinavia. In December 2005 Vianova Systems began an expansion strategy with the United Kingdom and France as its main focus.

Solution



Storegga slide. (source: www.hydro.com)

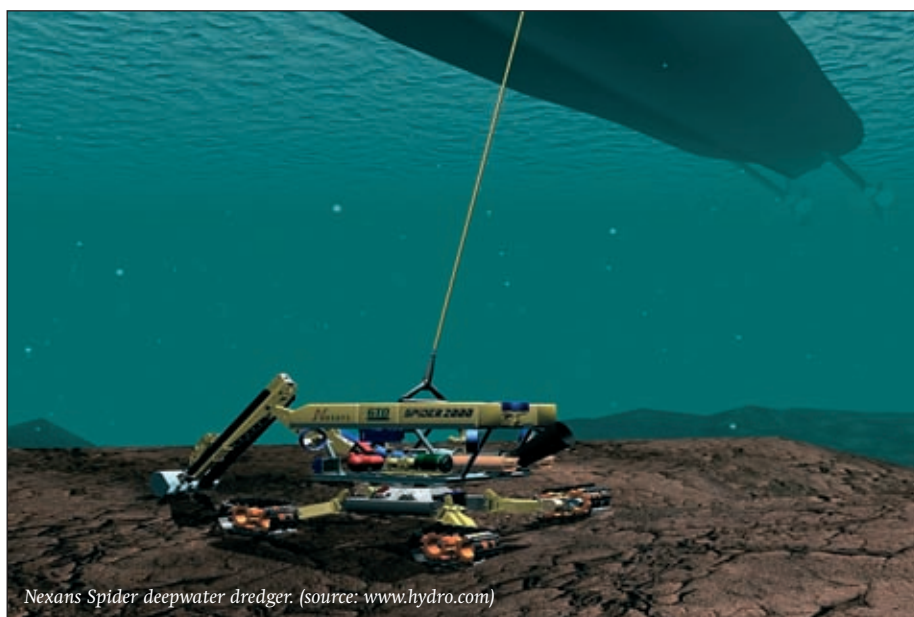
Ormen Lange – Nyhamna

The pipeline, which connects the field to the processing plant at Nyhamna, is laid through complex terrain and is required to climb from a depth of 1100 meters up a steep escarpment in the Storegga slide 20 kilometers from Nyhamna (see figure 2). The local seabed consists of peaks of hard clay with a lot of rock, often 40 to 60 meters high. The area was surveyed in great detail using unmanned underwater vehicles. Furthermore, a network of transponders was placed on the seafloor by Geoconsult, making it possible to install a great amount of rock with a precision of only a few centimeters. Some of the peaks on the proposed route had to be removed and in other locations a trench needed to be dug in order to lay the pipeline down without undue bending. For this work a

special deepwater dredger, the Nexans Spider, was developed.

Nexans Spider

The Spider (see figure 3) is a dredger specifically adapted for the environment along the proposed pipeline route. The undercarriage, modified from a Swiss forestry machine, can crawl on the steep escarpments and at the great depths of the Storegga slide. Jet nozzles attached to the shovel flush water under high pressure into the ground. This way the clay is dissolved, sucked up and sprayed away. The underwater robot is controlled from the surface using a three-dimensional virtual reality model of sea-bed and machine, enabling the operator in the MV Geobay support vessel (see figure 4) to handle the excavator with minute



Nexans Spider deepwater dredger. (source: www.hydro.com)

Geoconsult

Geoconsult is a Norwegian survey group based near Bergen. The company was established in 1979 and now has approximately 170 employees. Its main activities are offshore survey, offshore maintenance, offshore construction support and subsea engineering. The group has access to one near-shore and sixteen ocean-going survey vessels, with two new buildings under construction. The group also operates a total of 20 ROVs and a single Hugin 3000 AUV (Autonomous Underwater Vehicle).

precision in muddy waters and in near-zero visibility. The control software for the Spider was supplied by Vianova, while the support vessel and additional survey equipment and instrumentation were provided by Geoconsult.

Survey Processing

In order to check the work done by the Spider, regular intermediate surveys were performed during the dredging phase. A large amount of data was collected from the ROV (Remotely Operated Vehicle) using Reson echo-sounders. The survey results were validated and edited, to produce a grid model with a bin (rectangle) size of 0.2 x 0.2 meters. Geoconsult specified that a single survey, containing up to two million points, needed to be gridded within two minutes on an industry-standard PC similar to those used in an office environment. The resulting digital terrain model was then compared with the design trench and volumes were calculated.

Survey Results

The survey results were visualized in a number of different ways: 3D visualization of both trench and seafloor combined (see figure 5a); 2D visualization spot chart with colored contours from the difference model between model and intermediate survey (see figure 5b); and cross sections and longitudinal profiles from all the intermediate surveys and volume calculations. The combined results give a good indication of the amount of work already done and still to be done for all participants. The 3D photoreal sidelighted image in particular is an excellent tool for quick assessment of the progress of work and the quality of the terrain model.

Implementation Process

Originally the survey results were processed using a large number of hydrographic software products chained together to form a production strait. With the original solution it took roughly one working day (12 hours) to process a typical dredging site. The modeling of the digital terrain model took roughly one third of the day while the drawing production consumed one quarter of the day. The main reason for this time-consuming process was a sub-optimally-integrated software solution resulting in a large number of format conversions and data incompatibility. The system previously used to produce drawings for dredging work monitoring required a number of steps which disrupted the overall workflow. With the Novapoint solution, the survey was processed using an integrated suite of soft-

ware solutions without the need for extensive data conversion or transfer. The data from the ROV was constructed into a grid surface model using Novapoint surface gridding features. The resulting surface models were used by the robot guidance system and to produce cross-sections and longitudinal profile drawings. Customized drawing templates were implemented to ensure efficient quality drawing production. Using Novapoint, the total cross-section production processing time was reduced by a factor of four (one hour as opposed to three to four hours).



Survey Vessel Geobay. (source: www.geobay.no).

anticipate and correct any possible errors before using the new system in full scale production. It also allowed the customer to optimally integrate the new solution in their production operations, step by step, and whilst doing so reduce the stress factor for the employees involved in daily use of the system during production.

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Differences

During a three-month pilot period both the original solution and the Novapoint solution were operated in tandem. This way differences between the two solutions could be evaluated. The Novapoint solution was also made compatible to read data from the original solution: this method has been found to produce the best results for the least number of changes in the existing working environment. This transition approach made it easier to

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3D visualisation of intermediate survey (a) and proposed trench as well as 2D difference model (b).

