

Gjøa Development Opens New Frontier

John Sheehan, Contributing Editor

In the best tradition of Nordic polar explorers of the past, StatoilHydro is pushing into frontier territory with its Gjøa field development in the Norwegian sector of the North Sea.

Gjøa, named after the fishing vessel used by Norwegian Roald Amundsen to become the first explorer to navigate the treacherous Northwest Passage, is itself heading into uncharted waters. StatoilHydro hopes the development could open up a whole new area of the Norwegian Continental Shelf for modern day oil and gas pioneers.

The Gjøa field and the Vega and Vega South satellites will be developed at a cost of around NOK 38 billion (USD 5.7 billion) with a new semisubmersible platform, which will sit in 1,210 ft

(370 m) of water 45 km off the southwestern coast of Norway.

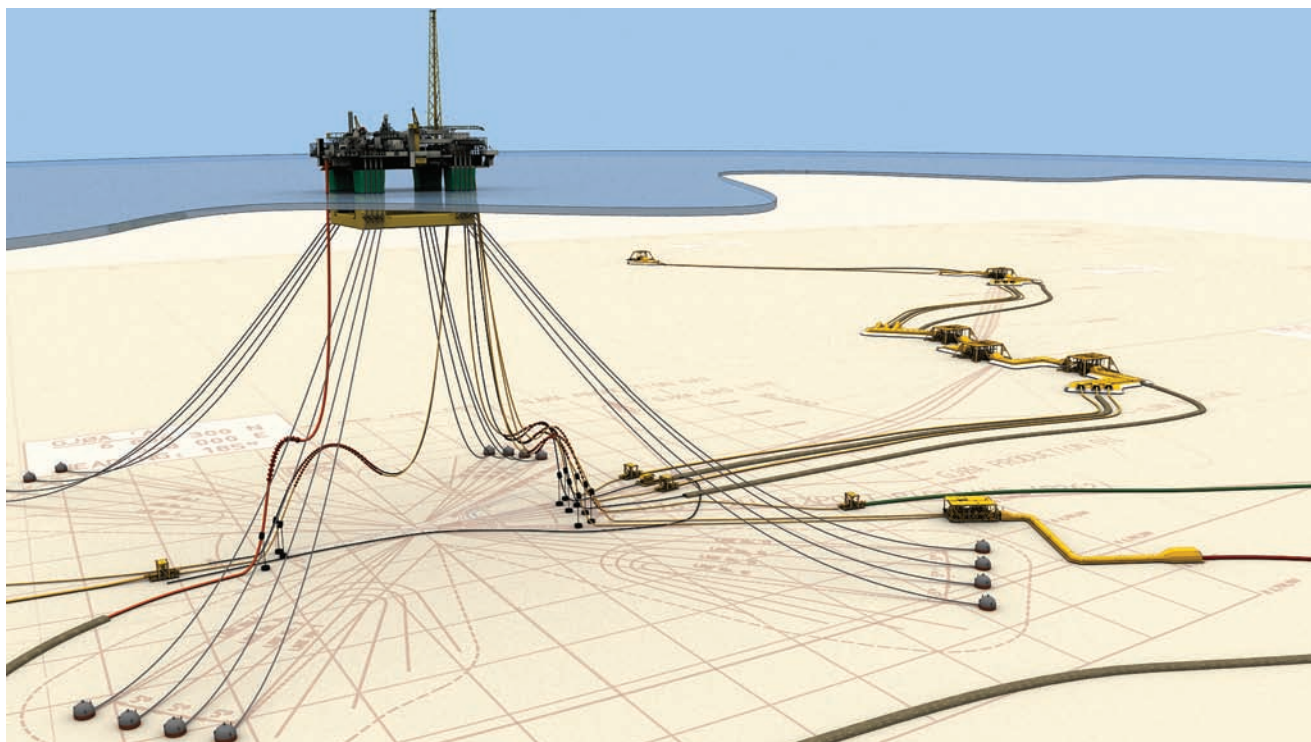
Recoverable reserves for the field are put at 82 million bbl of oil and condensate and roughly 1.4 Tcf (40 Bcm) of gas. Vega and Vega South's recoverable reserves are estimated at 26 million bbl of condensate and 636 Bcf (18 Bcm) of gas. Drilling work to tap the fields' reserves is already under way and a pilot well is currently being drilled to further delineate the field.

It is full steam ahead on all fronts as Gjøa Project Director and Vice President for Field Development, Kjetel Digre, explains: "Everything is happening right now. We have just started on the actual drilling and completion program on the field.

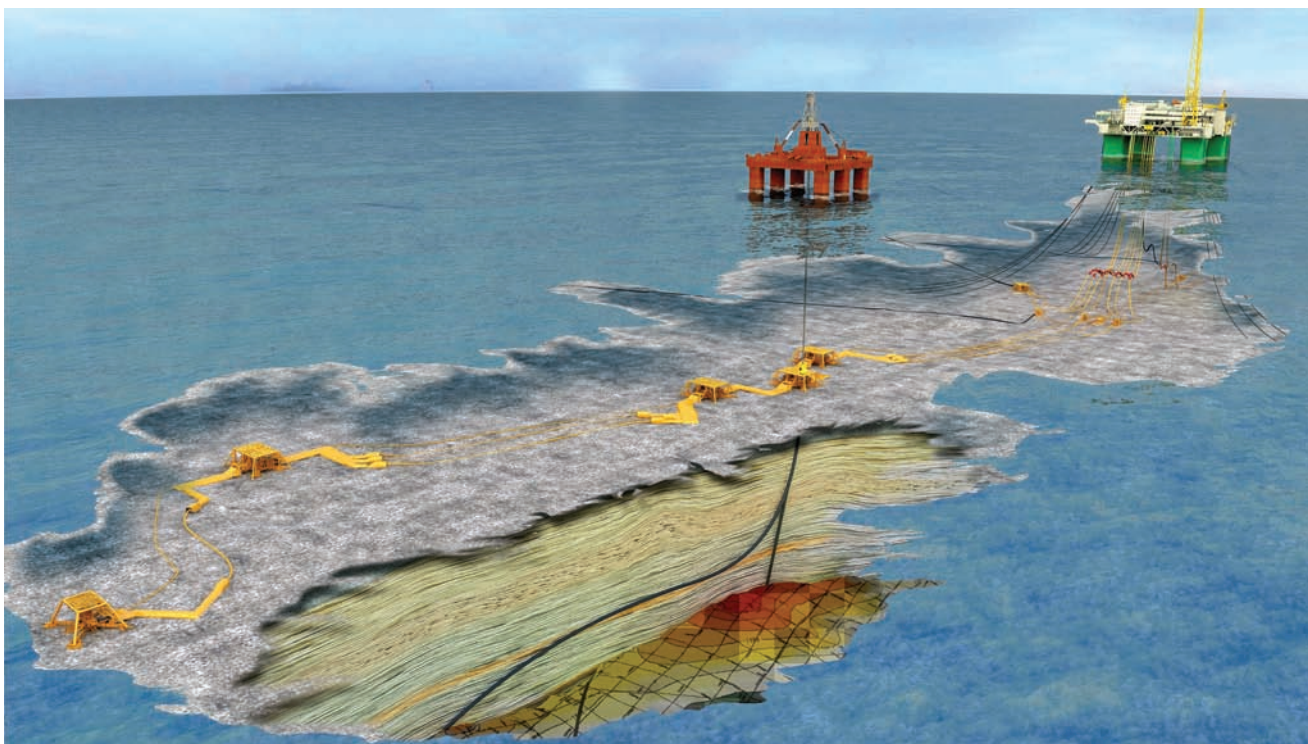
"We are just about half way through the build program, which is 58% complete. We are close to finishing the hull in South Korea. The major components will be brought to Aker Solutions' yard in spring for assembly in the autumn."

The 15,650 ton hull is being built by Samsung in South Korea and it will be mated with the topsides at Aker Solutions' yard in Stord, Norway. The topsides includes a 22,000 ton deck and the capacity to accommodate 100 offshore workers will be provided by a 1,650-ton living quarters module, with helideck. The living quarters are currently under construction at Leirvik Module Technology in western Norway.

StatoilHydro is operator for Gjøa in the development phase, while Gaz de



The project could open new areas for drilling. Photo courtesy of StatoilHydro.



Recoverable reserves are estimated to be 82 million bbl of oil and condensate. Photo courtesy of StatoilHydro.

France takes over as operator when the field comes on stream. Licensees in the license are Gaz de France (30%), Petoro (30%), StatoilHydro (20%), Shell (12%), and RWE Dea (8%).

Drilling Under Way

StatoilHydro began production well drilling in February on the first of 13 wells that will be used to tap Gjøa, currently the largest development project offshore Norway. The Transocean Searcher rig, which has undergone a USD 28.5-million upgrade for the Gjøa project, will be kept busy over the coming years as it tackles nine oil wells and four gas wells on the field.

The wells will be drilled through five templates installed on drilling centers on Gjøa South, Gjøa East, and Gjøa North. The first well currently being drilled is an appraisal well in the northern segment of Gjøa, which is located in the Sogn area of the North Sea in blocks 35/9 and 36/7, a new area for oil and gas production.

“The Transocean Searcher is currently drilling a pilot well in the northern segment of the field,” said Digre. “The well will show whether or not the oil column in that segment is capable of supporting production in that area. It is

an important pilot well and we will get useful information on whether or not to create an oil focus there or concentrate on the gas.”

Oil recovery rates are expected to be just 20% from the field because of complexities in the reservoirs. But Digre expects initial drilling of the producers to provide vital information going forward.

“We will get a lot of information from drilling the initial production well. It will help us to decide whether or not to drill the wells in a certain sequence. Drilling in the first year will be crucial and quite challenging.

There are technical challenges related to the drilling of multilateral oil wells, which is something we’re focussing on. We also have shallow water pockets in the area which are overpressured and meeting them in the upper part of the oil well could lead to washout on the seabed. We have done a lot of safeguard against this possibility,” he said.

Satellite Field Tie-in

The overall plan for development also includes the Vega and Vega South satellites, which will be developed with subsea installations tied back by a 32-km, 14-in. pipeline to Gjøa, which was ini-

tially discovered in 1989. Mono ethylene glycol (MEG) will be supplied from the platform and StatoilHydro has been working to further develop technology for the MEG regeneration system that will be used.

The Vega South field comprises the gas/condensate resources of the field previously known as Fram B and is located approximately 10 km north-northwest of the Fram field.

Vega (previously called Camilla and Belinda) and Vega South will be developed with three subsea templates, each featuring two production wells, and tied back to the Gjøa platform.

Provision has also been made for the tie-ins of further discoveries in the area, according to Trond Bokn, StatoilHydro’s Project Manager for the semisubmersible platform. “We have made investments on the semisub platform to accommodate future tie-ins. We have the weight margin and area margin to add modules and we have added extra riser slots for putting in new risers if necessary. “We have made some preinvestment to make it possible for Gjøa to become a hub in addition

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In case a second fracturing treatment is needed, the pad should not be a crosslinked gel. It is very difficult to pump the pad into the existing fracture because of the high viscosity of crosslinked gel. The pad pushes the fracturing slurry with proppant already in the fracture with a piston-like movement, which makes the first pumped proppant useless. Fluid loss is not a problem because a filter cake was formed by the first fracturing treatment. Therefore, linear gel must be used to finger into the existing fracture tip and propagate the fracture as a result of its low viscosity.

Forced-Fracture-Closure Technique

In the case of multiple pay zones, it is vital to prop each pay zone appropriately. However, because of heterogeneity of stress and permeability, the propped-fracture profile may be improper (i.e., different stress or permeability of the pay zones may obtain the same fracture concentration). Placing a higher proppant concentration in the higher-permeability pay zone with a lower proppant concentration in the lower-permeability pay zone is the key problem.

A new method was adopted that first flows back less than 1.0 m³ of fluid to draw back the proppant from the wellbore region; then, the well is shut in for approximately 1 hour to allow natural settling as a result of different loss coefficients caused by different permeabilities (i.e., the proppant will flow from lower-permeability region to higher-permeability region, as shown in **Fig. 4**). Finally, apply a forced fracture-closure technique.

Field Application

Six gas wells were hydraulically fractured in the Songliao basin. The basic parameters and the overall fracturing-treatment parameters are detailed in the full-length paper. As in the past, the total proppant weight was normally less than 30 000 kg as a result of premature screenout, and the post-fracturing performance was less than 3000 m³/d. Therefore, the study and application of the low-damage and massive hydraulic-fracturing technique put forward in the paper had a great significance in this basin. **JPT**

to processing hydrocarbons from the Vega fields.”

There are two other finds in the Gjøa license and the nearby Agat, Peon, and Astero finds could all be tied back to the platform. Bokn stressed there are as yet no concrete plans to develop any of the nearby fields but he said Astero was a possibility.

Gas from Gjøa will be transported in a 135 km-long, 28-in. pipeline to meet up with the UK Flags pipeline for further transport to Scotland. Up to 87,000 BOPD will be shipped via a 55-km, 15-in. pipeline to the Troll field in the North Sea and sent onward through the Troll II oil pipeline to the StatoilHydro-operated Mongstad refinery north of Bergen.

The oil and gas pipelines are being laid this year and a power cable supplying electricity to Gjøa from the mainland will also be installed in 2009 and tied to the platform in 2010.

Power From Land

One of the most striking things about the Gjøa development is that the platform will be StatoilHydro's first floating platform to get its electricity from the mainland, with a corresponding reduction in emissions of 250,000 tonnes of CO₂ per year. The platform will be supplied with electricity via a 100-km cable running from the new power plant at Mongstad.

The new high-tension submarine cable is set to be laid later this year by contractor ABB.

Bokn added: “On the semisub all the electricity will be imported from shore through the power cable, which offers 40 MW maximum production. There is one gas turbine on-board which is used to drive the export compressor directly producing mechanical power for the compressor. We also produce heat from the exhaust of that turbine for the platform.”

Hooking up the power cable to the platform will not be without its own challenges, as Bjørn Midttun, Project Director for pipelines and subsea installations, explained. “The biggest challenge has been the qualification of the dynamic section of the power cable,” he said. “It is an industry first to hook up a floating production platform to a dynamic power cable.

“We also have a very steep slope near Mongstad which gives us installa-

tion challenges. The last issue with the power cable is that we are building a new vessel to install it on, which is not yet finished.”

Bokn said that using an alternating current cable has the advantage that less power-related equipment is needed on the semisubmersible than if a direct current cable had been required. Another added advantage is that the regularity of the power supply is slightly better than generating the power offshore, he said.

“By electrifying the platform with a cable, the energy that Gjøa needs will be produced with the environmental standard of the new Mongstad power plant,” Digre added. “This gives high energy efficiency and reduced emissions of carbon dioxide, nitrogen oxides, and volatile organic compounds as compared with the alternative solution.”

The coming year will see vast amounts of work being carried out on the project, with the accompanying logistical headaches that this entails. “From a subsea and pipelines point of view the installation schedule is challenging,” Midttun said. “We have some 20 vessels coming into play and in total there will be about 1,000 offshore working days with those vessels. We have numerous contractors and all this has to happen in a certain sequence. Obviously completing all the various components in time for the different vessels will be a challenge.

“We are starting installation of the pipelines in April with Saipem's Castoro 6 and we will lay about 200 km of pipe. We then have an important interface into Shell's Flags pipeline system.”

Following the flowline installation the umbilicals and risers will be tied in, while the power cable will be installed in July and August. This will be followed by all the different tie-ins of the structures.

The logistical challenges are immense and Digre hopes the 350 people working on the project will display the same skill and fortitude as the Nordic polar explorers of the early 20th century.

“We use the name Gjøa to try to build the organizational culture on the attitudes of the polar heroes. It is not just a name—our ambition is Gjøa, based on history and building for the future,” he said. **JPT**