the coming years, the North American market faces a tighter market as demand threatens to outstrip supply. Shtokmanovskoye's output would go a long way to covering this shortfall.

Output from the first phase of the project would go to the US market. However, the subsequent phases have not been mapped out as yet. The field is so large that there are likely to be a number of phases, Maroe suggested three major undertakings.

"I think there is more demand in the US for LNG than phase one represents, but clearly in the longer term it is not inconceivable that some of the Shtokmanovskoye gas might go to Europe."

At present, however, the negotiations have focused solely on the first phase. This discussion is likely to progress once there is a clearer idea of the size of the market -- which will be seen when supply contracts are agreed upon and delivered.

Whichever company wins the highly-prized spot as Gazprom's partner, they are sure to have tough times ahead. Gazprom is a company which has many projects to pursue -- including part of Shell's Sakhalin Energy stake -- and the chances are that progress will be slow.

However, with the LNG market growing and set to boom in the near future, there does not seem to be a better chance to access a world class deposit.

There are many hurdles to clear but, in the end, Shtokmanovskoye will be a major success for Moscow.

Technology

Seismic's Multi-Component Future

By Ed Reed

As a result of the increased demand for oil -- and the resultant high prices -- prospecting for oil has become big business.

This has led to intense development in the service industry as companies compete to offer the most cutting edge technologies. The pace is likely to increase in the future as the scramble for energy continues to heat up.

Frequently, technology is the deciding factor between those companies which succeed and those companies that fail.

In order to boost returns from a concession, a company must be able to predict where reservoirs are likely to occur. The best way to drill a well efficiently is to know where to drill -- so a good seismic image of the subsurface is essential. Efficient seismic can improve reservoir management in addition to well placement.

Seismic technology was first used for artillery targeting in the 1930s but its use was soon transferred to the investigation of hydrocarbon deposits. Until the 1970s, seismic was two dimensional (2-D), three dimensional (3-D) seismic was first used in the 1970s and has been cited as the most important discovery in exploration and production, alongside directional drilling.

A 3-D seismic allows a company to produce a cube of information detailing the stratigraphy of an area. With the knowledge of the different layers, comes knowledge of the most productive place to drill.

Eric Blossom, Input/Output's (I/O) general director for Russia and the CIS, believes that his company has the next technological step after 3-D imaging. "Right now, we're on the verge of seeing something, as radical game-changing as 3-D seismic, happen again -- that's full-wave imaging," he told *FSU Oil & Gas Monitor.*

He explained that his company's new technique is a significant progression from the earlier 3-D imaging.

All seismic studies analyse the way in which sound waves are reflected from the various layers in the ground. A vibration is channelled into the ground -- either using dynamite or a vibrator truck -- and the returning waves indicate the area's stratigraphy.

While traditional 3-D seismic uses only the p-waves, full-wave (also known as multi-component imaging) takes advantage of the entire wave-field, including shear-waves.

"Full-wave utilises all the information that the ground is giving back. Before we weren't able to capture this information, it was lost. This new technology allows us to capture the full-wavefield and better image complex structures, offering benefits in fracture detection, lithology prediction and gas clouds illumination," Blossom said.

This last asset is an important step for the future of seismic. The old 3-D technology was unable to image beneath gas clouds. Blossom explained that, "P-waves don't travel through gas. They like to travel through solid but not through gas."

This inability to map gas layers effectively in a seismic shoot makes analysis of the subsurface that much harder. "This new technology allows you finally to see what's there -- and that's all based on being able to utilise the entire wave-field."

"Another advantage of full-wave is fluid prediction, so you not only see the 3-D cube but you can also have a better understanding of fluid existence, and maybe even type in the different layers in a particular area," Blossom noted.

I/O has a wide-ranging client base in Russia, including Gazprom, TNK-BP, LUKoil and Sibneft.

Blossom went on to note that another one of the strengths of the new full-wave imaging was that it can map the rock types (lithology), and the fracturing seen in reservoirs, which enable a company to define fluid movement within the fields.

Knowledge of fracturing is essential in order to predict the way in which the reservoir should be plumbed, with an understanding of the rock's flaws comes the ability to plan injection programmes and a reservoir management strategy.

One expert explained to *FSU Oil & Gas Monitor* one disadvantage of the new technology is that "recording takes longer -- only a few seconds each time but it adds up when you are doing 30,000 square km!" This will boost the cost, as a shoot, particularly offshore, will take longer.

He went on to note that the real problem with multi-component is the extended processing time, which of course adds to the expense of the seismic shoot, and the fact that it is a new skill set that must be learnt by those analysing the data.

"The technology is only a few years old and therefore still proving itself, but with technology advancing, the cost is -- and will continue -- to reduce," the expert commented.

While the seismic industry, as a whole, has been working on multi-component for more than 30 years, I/O started working on their new technology in 1992 and it has spent around US$100 million on research and development. The technology became commercially viable last year.

The I/O official noted that there was a rudimentary multi-component imaging system, which used analogue sensors in the past. This technology, however, was not feasible as the costs were around three times as high as that of normal surveying, the data was not such good quality and they were cumbersome to operate, he explained.

Times have changed -- full-wave has become more affordable, providing it with the boost needed to compete directly with older seismic technologies.