

## GTL to set sail

*An Oklahoma-based company plans to use its proprietary gas-to-liquids (GTL) technology to monetize stranded natural gas by putting that technology on barges and floating production, storage and offloading vessels (FPSO).*

By **DONNA MARCOTTE**, Drilling & IT Editor

**W**ith reserves dwindling and world demand roaring, there are many projects underway to produce stranded natural gas. Of course, the main problem with producing natural gas is how to store and transport it. One approach to this problem is to convert the gas into synthetic liquid crude oil at the production site using gas-to-liquids (GTL) technology so it can then be stored and transported.

Of course, there is that not-so-small issue of how to get the GTL processing

plant to the remote locations where oil and gas are being produced.

Well Syntroleum Corp. of Tulsa, Okla., developers and licensors of the Syntroleum Process, a proprietary GTL process, think they have that problem solved — at least for offshore projects. Put the GTL plant on a barge or an FPSO. Impossible you say? Read on.

### Factors that make a difference

The Fisher-Tropsch process, the basis for all GTL technology, was first developed by German scientists in the 1920s. Many industry players, including all the majors and super-majors, have working GTL projects, so what makes Syntroleum different?

There are two main differences. The first part of the Syntroleum conversion process involves mixing natural gas with air in a proprietary auto-thermal-reforming reactor to produce a nitrogen-diluted synthesis gas or

syngas. Other GTL processes require use of pure oxygen instead of air, making the Syntroleum GTL process less volatile, expensive and equipment-intensive (requiring less space).

In the second part of the process — that based on the Fischer-Tropsch chemistry — the syngas flows into a reactor containing a proprietary catalyst developed by Syntroleum, and is converted into what is commonly referred to as synthetic crude oil. The Syntroleum Process uses a single-pass reactor design with bubble slurry columns, instead of the recycle loops typically used in other GTL processes.

According to Gary Roth, Syntroleum senior vice president, engineering and chief engineer, “Our Slurry Bubble Column Reactor design is very motion tolerant. The reaction processes are very violent; therefore, the motions typically seen in offshore environment have only minimal effect on the plant operations.”



Figure 1. The Syntroleum GTL Barge, whose commercial design provides the basis for the GTL FPSO currently being designed, measures 250 ft (76 m) by 450 ft (137 m) by 11 ft (3 m) draft. Grupo Dragados S.A. of Spain is ready to help finance and build the barge. Syntroleum hopes to have a project ready for GTL production by 2009. (Image courtesy of Syntroleum)

## Another plus: a working plant

At the near-commercial demonstration GTL plant in Port of Catoosa, Okla., engineers have continued to refine and develop the Syntroleum Process, making it more efficient and ultimately smaller, in support of using the technology in a production environment. The plant, a joint project between Syntroleum, Marathon Oil Co. and US Department of Energy (DOE), contains all the components required for a commercial plant. Since March 2004, it has been producing clean-burning diesel fuel, which has been used in Washington DC metro buses and vehicles at Denali National Park in Alaska. The plant is also used to train operators for a commercial plant as it features a full size commercial operating room.

## Small footprint, big ideas

The differences in the Syntroleum Process combined with the ability to refine their technology and test different scenarios at the Catoosa plant have allowed Syntroleum engineers to develop a GTL plant with a much smaller footprint than that required for other GTL technology. The smaller footprint along with other aspects of its proprietary process (such as the use of air instead of pure oxygen and the ability of the auto-thermal-reforming reactor to produce the Fischer-Tropsch feedstock in one step) have lead to the notion, first of putting a GTL plant on a barge, and ultimately of putting it on an FPSO.

The genesis for both the barge and FPSO plans comes from work that Syntroleum did in 2001 with the US Department of Defense (DOD) for a preliminary design for a GTL FPSO to produce primarily jet fuel, designed for Sea State 3, which is equivalent to Beaufort 4 or 11 to 16 knot winds with waves at 3.5 ft to 5 ft (1 m to 1.525 m) high. According to Roth, "That design was special purpose as it was meant to be a military application. The fundamentals of that design and the completed design work on the GTL barge lead to the next step, a GTL FPSO in commercial form."

## FPSO plan

In addition to the work with the DOD, work continued at the Port of Catoosa plant where Roth explained recent technology improvements have increased the basic GTL train size from 12,000 b/d to 17,000 b/d.

Roth explained, "We also looked at integration. If you look at oil production on an FPSO, and you look at GTL production, for GTL you only need one more module on the ship to actually produce oil." Roth explained that because the GTL process is exothermic, generating heat, water, steam and electrical power, the utilities typically needed to support the production of oil and gas are supplied by the utilities section of the GTL plant.

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"When all the analysis was complete, we came up with a topside tonnage of about 35,000 tons and went to the market and looked at over 100 FPSOs, and there's about 20 with that kind of topside tonnage and the products capacity we would need to make a commercial operation.

"We visited seven FPSO providers and went back to the government with our feasibility plan. We got a very good response and as an outcome we have

signed an exclusive arrangement with Bluewater Energy Services B.V. of the Netherlands for a commercial feasibility study for an FPSO producing crude oil, condensates, liquefied petroleum gas (LPG) and GTL products, which means you're looking at a ship with a combined producing capacity of 70,000 to 90,000 b/d total production."

Roth added, "We're 2 months into a 14-month design period including a fundamental topside design with a commercial concept including the hull, topside, design process, mooring and integration into the full field development."

In addition to the technical groundwork, Syntroleum did its financial homework. Roth explained, "One of the key things we did was to look at the full commercial process including ABS certification, insurance issues, constructability issues and lending requirements. We were able to determine that if we could resolve the technical issues we would be able to produce a commercial offering."

## What's next?

As for Syntroleum's GTL barge? (Figure 1) Grupo Dragados S.A. of Spain has reviewed the design and concluded that the barge is ready for commercial development. Dragados is also ready to help build and finance construction of the barge.

In addition, Syntroleum is conducting a study with Bluewater to build an FPSO using its GTL technology. The study is expected to cost US \$2 million. Syntroleum will bear 25% of the costs and Bluewater 75%.

And Syntroleum, in a joint development agreement with Sovereign Oil & Gas, has reached another milestone in a project where they hope to deploy the GTL barge. It now has all permitting and requirements to drill its first appraisal well in the Aje field, in OML 113, located 15 miles (24 km) offshore western Nigeria. If appraisal wells support the project, oil production could begin in 2007 with GTL production in 2009. **E&P**