ENGINEERING

# LIWAN GAS FIELDS: THINK BIG

**Husky Energy and China's CNOOC coordinated the biggest deepwater gas extraction project in the history of Asia. Mankind's energy future depends on projects like this.**

**Man's thirst for energy knows no limits. As Asia rises, its demand for energy is quickly matching the per capita consumption of developed regions. Even plumbing the depths of the deep South China Sea is an option when engineering genius is deployed by one of the world's most sophisticated integrated energy and energy-related companies, Husky Energy.**

"Liwan is Husky Energy's largest project to date and places us inside the door of one of the fastest growing energy markets in the world," said Asim Ghosh, CEO of Husky Energy. "It was a massive undertaking and is a great achievement for deepwater gas production in the Asia Pacific Region."

Husky Energy didn't do it alone. The Liwan Gas Project is China's first deepwater gas field development project, jointly developed by Husky Energy and China National Offshore Oil Corporation Ltd. (CNOOC). There was a clear division of labour in the project. Husky Energy was in charge of the deepwater part of the project, which included drilling and installing the subsea production facilities and deepwater pipeline. CNOOC was in charge of the shallow part, including building and transporting the central platform, laying the shallow water pipeline, and constructing and managing the onshore gas processing plant.

## CHALLENGES, INCOMING!

It took over a year to construct the upper part – or topside – of the central platform in Qingdao, a seaside city and part of China's heavy industrial heartland. The topside of the central platform is the heart of the whole project. All oil and gas extracted from the five surrounding undersea oil/gas fields is pressurised and processed here before transportation through undersea

pipes to the onshore processing plant in Zhuhai. Engineers claim this is economic as a single platform can process the output from several nearby oil/gas fields, reducing the amount of deep-sea piping needed to transport output to the onshore gas processing plant.

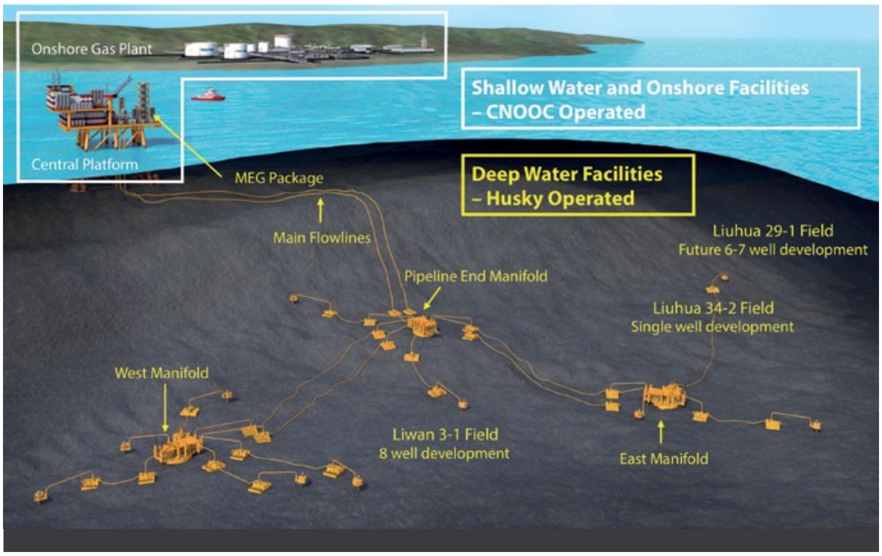
The construction site, Qingdao, is located about halfway between Shanghai and Beijing and is parallel with Seoul – nowhere near the South China Sea. The massive topside construction therefore needed to be transported by CNOOC from the factory to the middle of the ocean, thousands of kilometres to the south.

## MEGA-MOVE

The topside megastructure is larger than a football field (110m x 77m), 95m tall and weighs over 30,000 tons. It is the biggest structure of its kind in Asia and presented a transportation challenge. Engineers were scratching their heads to find a way to transport this megastructure from Qingdao to the installation site. If too big a barge was used, it wouldn't fit at the installation site. If too small a barge was used, it would be unable to carry the giant structure. No suitable barge was available in China to perform this monumental task. The mission was essentially moving an entire factory from land to the water.

Failing to find a suitable barge, engineers decided to build one themselves. The reengineering of a new barge to fit with the megastructure took another six months of effort.

When it was done, engineers faced another challenge – a 25mm difference




in height between the dock and the barge deck. Small compared to the height of the structure (95m), but any mismatch could cause it to topple and collapse when being pulled onto the barge. The whole mission would have been compromised if the tides floated the barge higher or lower than the dock by more than 25mm. With the help of electronic sensors and a senior controller with over six years experience to adjust the water flow and the subsequent weight of the barge, the megastructure was successfully loaded aboard and set off to the South China Sea.

### SHALLOW WATER DANGER

In August 2012, the lower supporting part of the central platform was placed in the sea. The difficulties in locating a 190m tall and 32,000 ton megastructure at a specific spot in the water appeared tough, but compared to the ensuing challenges, this operation was a mere warm-up.

Once the topside megastructure arrived, a new challenge presented itself – how would engineers load it onto the lower part of the central platform? The upper structure was equivalent to the combined weight of five Eiffel Towers and there was no single floating crane in the world able to lift such a heavy object.

One alternative would have been to break the structure into smaller components and to then assemble it piece by piece.

**The depth of the sea and the extreme weather presented Husky Energy engineers with challenges never before faced in the South China Sea.**

While this sounded feasible, it would have required a much longer time to finish the construction of the central platform and meant risking a delay to the project. The whole project cost over HKD3 billion. Delaying it would have resulted in an astronomical rise in costs, ranging from several hundred thousand dollars to several million dollars a day in extra expenses.

### UNDER PRESSURE

While engineers were struggling with problems on the surface of the ocean, the conditions deep under the sea presented Husky Energy with huge challenges. The company was responsible for the underwater operations, but with the immense pressures and temperatures close to freezing, the sea was a hazardous place to work. At 1,500m deep, equivalent to 30 Olympic-size swimming pools (50m) laid end to end, an area equivalent to a standard credit card experienced six tons of force. This was no place for man to thrive – or even survive.

"Principally, our golden rule is safety first," says Mr Malcolm Paisley, Manager of Deepwater Production, Husky Energy China. To live by this principal, Husky Energy deployed robotic devices called remote operative vehicles (ROVs) to work in the depths of the sea. They had to install all the machinery on the seabed, and were operated by Husky Energy engineers working at a control panel 1,500m above. "In a marine environment, the ROV is often the eyes, the hands and even the ears of the people that are designed to do the work," says Mr Tracy Mosness, Vice President of Production and Development, Husky Energy China.

Monitoring well-top conditions is vital. Husky Energy built devices right on top of the drilling wells to monitor and control the production of the wells. These devices, each weighing 60,000 tons, were attached to the wells on the seabed by the ROVs.

These devices ensured that the gas continued to flow and could begin its journey from wellhead to the central platform. That journey of 79km takes the natural gas a day, owing to the low temperature and extremely high water pressure. At that depth, temperature and pressure, chemicals can materialise that physically block the pipes. Husky Energy uses not only engineering expertise, but also chemical engineering to ensure that doesn't happen.

### INNOVATION ...

Back on the surface, engineers were grappling with the challenge of installing the central platform that would connect the deep-sea world to the surface. The engineers decided to make use of a natural force – tides. They used a technique known as 'float-over deck installation'. This was precision work with no room for error.

This complex process required the upper part of the structure on the barge to be placed on top of the lower part of the structure when the tide rose. When the tide fell, the lower water level allowed the upper part of the structure to attach to


the lower part. The technique was first used in China in 2005. Even with years of experience, the float-over deck installation was no easy job. The South China Sea is known for notoriously bad weather, and in addition, compared to Bohai where the technique was first used in China, the South China Sea is much deeper and the climate is much more treacherous. Liwan is located in the typhoon corridor and in an open ocean area. The region is swept by strong gales for over 200 days a year, making the installation task a trying ordeal.

### ... AND BOLDNESS

By the spring of 2013, engineers were waiting for a fine weather window to commence the final stage of the construction – but the weather didn't cooperate. A sudden deterioration saw the cancellation of the operation which was scheduled for 18 May 2013. On 22 May, a 30-hour window for operation opened. It was not optimal weather for work but pitting their experience against the heavy cost of delay, the engineers decided to take a gamble. They were first challenged by the malfunction of a windlass. Then a sudden heavy rain pushed the operation back two hours, further narrowing the window of operation. The Husky-CNOOC team would not give up. Persistence carried the day. After over 30 hours of work, the final construction was successful and years of effort paid off.

### BUILT AND PRODUCING!

This March, to great fanfare, Husky Energy and CNOOC launched the production of the Liwan 3-1 field with initial natural gas sales expected to be approximately 250 million cubic feet per day gross, rising to 300 million cubic feet.

The Liwan Gas Project currently consists of three fields: Liwan 3-1, Liuhua 34-2 and Liuhua 29-1. Pending final approval, the Liuhua 34-2 field will be tied into the Liwan infrastructure in the second half of this year. Liuhua 29-1 gas production could top 500 million cubic feet per day gross by 2016–17.

### ENGINEERING LEGACY

The Liwan Gas Project is an engineering marvel and it serves an environmentally friendly purpose. Compared to the calorific value generated from coal combustion, the amount of gas produced in the gas field could reduce the emission of carbon dioxide burned from coal by 5.4 million tons, equivalent to a plantation of 19 million adult trees in an area of 48 million acres of forest.

**"Liwan is Husky Energy's largest project to date"**

Mr Asim Ghosh, CEO, Husky Energy

"The Liwan project has truly been a watershed project in the evolution of Husky Energy, from being a purely Canadian company to being a truly global company in the oil and gas business," according to a proud Mr Robert Hinkel, Asia Pacific Chief Operating Officer of Husky Energy. Working with CNOOC and partners from around the globe has resulted in a pioneering effort to secure energy supplies for southern China for decades to come. It takes two hands to clap and the synergy between the two energy giants has made a thunderous sound. ☐