

A mountain of a project: the Sabah Sarawak Gas Pipeline

In order to develop the rich natural gas fields beneath the South China Sea, offshore Malaysia, Petronas proposed the Sabah Sarawak Gas Pipeline. However, construction of the project has by no means been a small feat, with construction contractor Punj Lloyd overcoming undulating mountains, dense rainforests, and unrelenting wet weather.

Petronas' plans to develop the gas fields offshore Sabah involves construction of the proposed Sabah Oil and Gas Terminal (SOGT) at Kimanis, which is scheduled for completion in 2013. Once operational, the terminal will be able to receive, store, and export up to 300,000 bbl/d of crude oil, as well as receive, process, compress, and transport up to 1.25 Bcf/d of gas produced from the Gumusut/Kakap, Kinabalu Deep and East, Kebabangan, and Malikai fields.

The 512 km, 36 inch diameter Sabah Sarawak Gas Pipeline (SSGP) will transport 750 MMcf/d of gas from the SOGT to the Petronas LNG Complex at Bintulu, Sarawak. It is being constructed using API 5L X70 steel grade pipe, with a thickness range of 14, 17, and 20 mm, and will have a design pressure of 96 bar.

In 2008, Petronas awarded Punj Lloyd an engineering, procurement, construction, and commissioning contract for the SSGP, which includes:

- Cathodic protection
- A launcher station at Kimanis
- A compressor station at Bintulu
- Metering stations at both Kimanis and Bintulu
- Intermediate pigging stations at Lawas, Long Lama, and Bintulu
- 22 block valve stations
- Six future tap-off points along the pipeline.

Also included in the scope of the contract are SCADA, telecommunication, a fire and gas system, leak detection, and a gas management system.

In 2009, Punj Lloyd compiled a project team consisting of 3,000 workers from India, Malaysia and Indonesia.

Exceptional challenges

Punj Lloyd Executive Vice President P.K. Chand says that the SSGP project is one of the most challenging pipeline projects the company has ever undertaken. Some of the exceptional challenges Punj Lloyd faced included rough mountain terrain with rocks



Automatic welding of the SSGP project.

and swampy stretches, thick vegetation consisting of dense rainforests and oil palms, constant wet weather, and stringent regulatory approvals.

Steep mountains

Mr Chand says "The terrain is extremely harsh, and is made up of rocky, mountainous slopes with an altitude of up to 3,300 feet, dense forests, swamps and palm oil plantations. Steep, 76° slopes have been encountered, and the undulating terrain has resulted in 39 per cent of the pipeline consisting of field cold bends – a total of 16,380 bends.

"Thinking out of the box to find a solution to the inhospitable terrain, our project team modified trailers and sledges to suit the mountainous terrain. All the vehicles were provided with full-width off-road tyres and excavators with special track grip for steep slope locations. Our project team has also used specially designed internal crawlers for non-destructive testing of the pipeline."

In addition to the specialised equipment Punj Lloyd is using for pipe transportation, stringing, and welding, the company has also mobilised heavy-duty winches and walking spider excavators for the installation of the pipeline on steep slopes.

Logistics

As most of the pipeline route crosses challenging terrain, including hillsides, rocks, swamp, and dense forest areas, approach roads were non-existent. Punj Lloyd had to construct and maintain more than 200 km of inaccessible right-of-way (RoW), build approach roads and bridges, and develop and maintain the logging roads.

The company used air crane helicopters for the transportation of the pipes and bends, and for hauling and stringing in the 35 km stretch in Limbang, where land transportation was a high-risk activity.

Numerous crossings

Pipeline construction involved as many as 3,000 crossings, including eight major and 305 smaller perennial rivers, 27 major road crossings, 88 minor road crossings, and 20 horizontal directionally drilled (HDD) crossings.

In addition to HDD, Punj Lloyd used the conventional crossing, open-cut crossing, and thrust-boring methods to install the pipeline through these areas.

Strict regulations

Mr Chand says that under Malaysian law, the project required implementation

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The welded pipeline alongside the trench.

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of stringent regulations by the Department of Safety and Health, Department of Environment, and Department of Irrigation and Drainage

“Punj Lloyd followed all regulations imposed by these departments, maintaining the highest standards of health, safety and environment,” says Mr Chand.

Preserving and protecting the site

Perpetual wet weather presented another challenge to pipeline construction. To minimise the possibility of slope collapse on the hilly terrain, Punj Lloyd graded the RoW using benching.

“Benching is a methodology for providing stability to steep slopes encountered during grading the RoW as per the surveyed profile,” explains Mr Chand. “As the name suggests, vertical slopes are cut in steps akin to the shape of a bench. The slope between steps is maintained at a maximum of 2:1, and the elevation between each step is 4.5 m. This minimises the possibility of soil erosion and landslides. It has proved to be an effective mitigation measure and is widely adopted to tackle steep slopes.”

Proper drainage was also constructed to prevent water flow into neighbouring areas.

Mr Chand says that the dense forests in the region contain many rare species of flora and fauna, and that Punj Lloyd took immense care to preserve these species in their natural environment.

While clearing the RoW, Punj Lloyd employees came across two leopard cat cubs, abandoned by their mother. The cubs



Preparing to lower-in the SSGP.

belonged to a Borneo protected species – *Felis bengalensis*. Punj Lloyd rescued the cubs, handed them over to the nearest wildlife office and also contributed \$US3,000 to the Bintulu Development Authority for the upkeep of the cubs.

A boost for the community

Stakeholders involved in the project included timber licensees, plantation owners, tribal natives, and the general population along the pipeline.

Punj Lloyd employed public relations officers who had experience with, and in-depth knowledge of, the Sabah and Sarawak states to address the specific needs of stakeholders. The company also identified and used a number of local suppliers from both states.

“The project provided a big boost to employment in the region by training and

employing locals as skilled workers,” says Mr Chand. “Under Punj Lloyd’s corporate social responsibility programme, and in keeping with Petronas’ guidelines, the tribes along the pipeline route benefited through the development of local infrastructure, the establishment of health clinics at various camps, and assistance with the locals’ logistics requirements.”

In addition, 120 km of the RoW is inhabited by nine different native tribes that lead a semi-nomadic life and hunt with blowpipes.

Punj Lloyd sensitively dealt with the issue of native customary rights by employing locals from nearby tribal areas to regularly communicate with the tribal leaders, so that the company could address their problems. Cultural programmes were also occasionally organised for better integration and understanding of their local social customs. 🌐