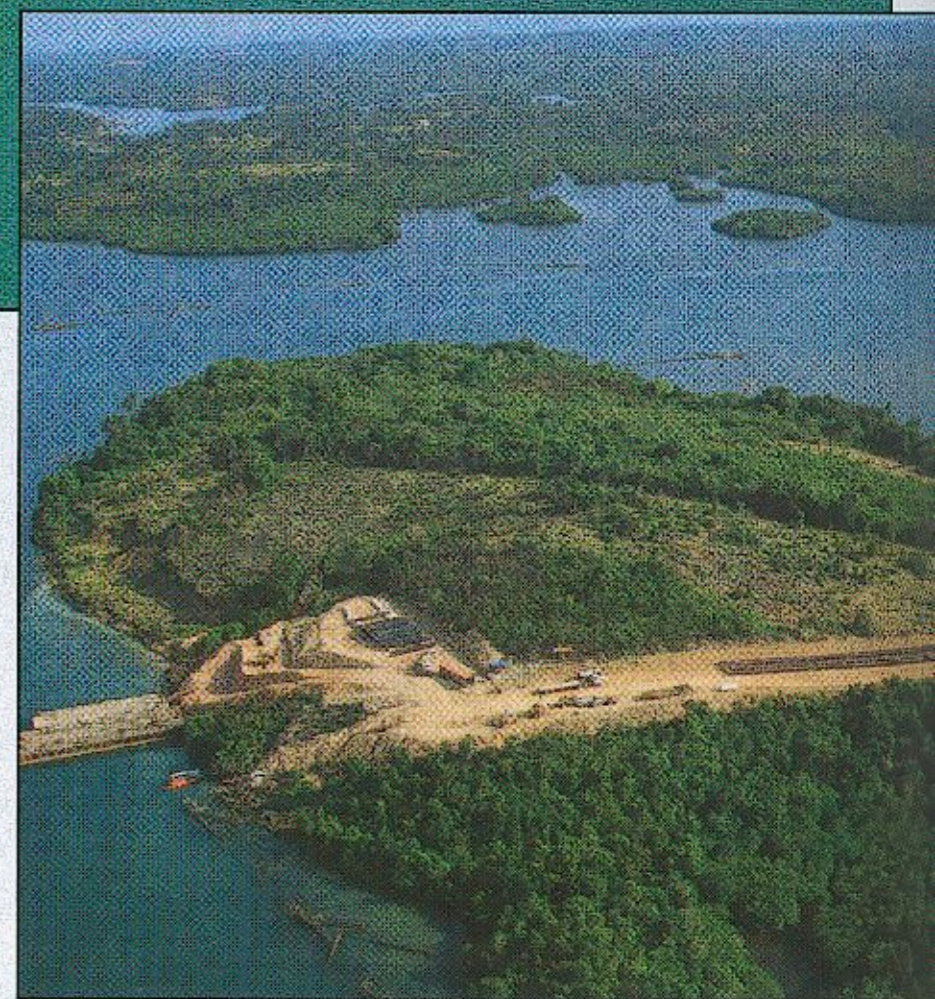
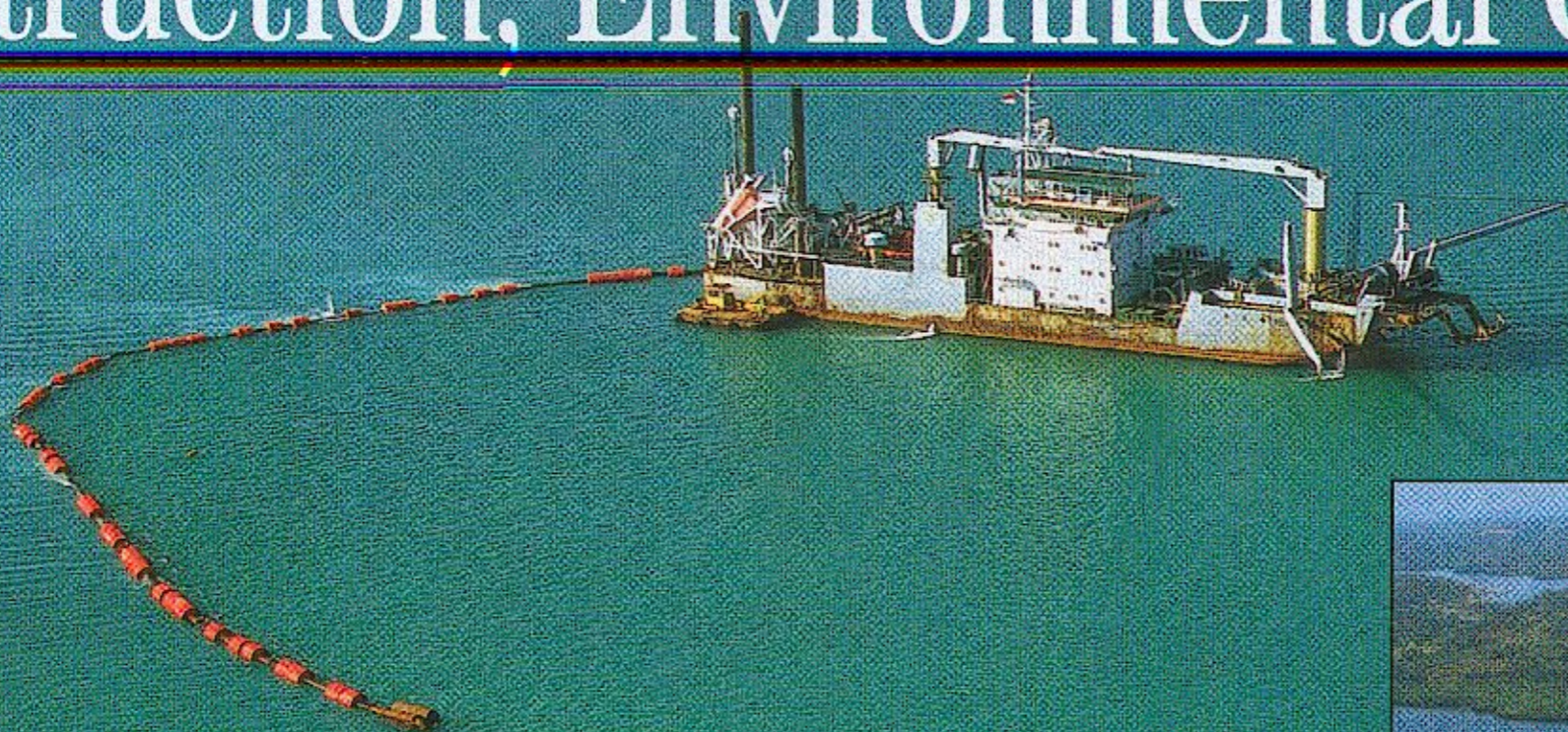


Indonesian Pipeline Presents Construction, Environmental Challenges



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▲ HDD dredger at pipeline.

Dredging pontoon at work on pipeline. ►

A Case Study

A track record proven by repeat contracts in development of the largest gas field of TOTAL, an enviable HSE record and its commitment toward developing infrastructure at East Kalimantan resulted in PT. Punj Lloyd Indonesia's successful bid for the EPC project in 2002 of Panaran Pemping pipeline for the Indonesian gas transporters,

Punj Lloyd, an Indian engineering construction company providing turnkey solutions for onshore and offshore pipelines, cryogenic tanks and terminals, moved into the Asia Pacific in 1993 by opening an office in Jakarta with an eye on hydrocarbon-rich Indonesia. In 1997, a local company was incorporated, PT. Punj Lloyd Indonesia.



◀ ROW
across
Panaran
Pemping
pipeline.

PT. Perusahaan Gas Negara. The project funded by ADB was secured against stiff international competitive bidding.

The Gulf Grissik Corridor Block in south Sumatra, the Gulf South Jambi Block and Santa Fe Jabung Block includes several gas fields with proven reserves. The Panaran Pemping pipeline was planned to transport natural gas to potential markets, Caltex in Duri and industries in Batam Island and to Singapore Power.

The Panaran Pemping pipeline is a crucial link of the Grissik-Sakaran-Batam-Singapore pipeline. The pipeline was completed in 2003 and connects the Indonesian islands of Batam, Tanjung Kubu, Teluk Dalam, Lumba Besar and Pulau Pemping by a 31-km, 28-inch diameter onshore and offshore gas pipeline for PT. Perusahaan Gas Negara.

Hopping Islands

The Panaran Pemping pipeline is a 28-inch diameter natural gas pipeline with a design flow rate of 665 MMscf/d. The total length of this pipeline was 31 km out of which two sections totaling 10 km were laid offshore in water depth of 25 meters. The pipeline was designed for 1,650 psi at 1,500 F (ANSI Class 900). The construction materi-

◀ Terminal station on Panaran Pemping island.

al used was API 5L Gr. X65. The wall thickness is 0.5-inch for the onshore sections and 0.625-inch for the offshore sections. The complete pipeline has an internal epoxy coating as well as an external coating comprising of three layers of polyethylene. The offshore and swamp sections have an additional concrete weight coating. The pipeline was provided with a cathodic protection system using magnesium sacrificial anodes for the onshore sections and aluminum alloy sacrificial anodes for the offshore sections.

PT. Punj Lloyd Indonesia had complete responsibility for this project, including engineering, procurement and construction. Besides the main pipeline, the scope of work included supply and installation of a fiber-optic cable (96 fiber) along the pipeline route as well as various facilities such as a cyclone separator scraper traps, shutdown valves, power generation and distribution equipment, piping, instrumentation, and civil work including various buildings at Panaran and Pemping Stations. Two HDD crossings, each around 550 meters long, were executed as part of this project to cross the straits between the islands.

The project schedule required mechanical completion to be achieved within 13.5 months of being awarded.

Project Challenges

The pipeline was extremely challenging

as builders had to overcome the inaccessibility of islands, environmentally sensitive mangrove forests, live coral reefs, undulating terrain both in onshore and offshore sections and a rocky seabed with granite rock. The project involved onshore and offshore sections of pipelaying and construction of two terminal stations on steep hilltops involving 500,000 m³ of earth work. The islands were inaccessible by offshore means because of swampy mangrove belts around them.

An access channel 1,100 meters long was dredged for mobilization of equipment. The company completed the pipeline after having worked in the busiest shipping channel connecting Singapore and Indonesia and crossed a river through difficult terrain by horizontal directional drilling. About 150,000 trees were planted on the hilltops of the islands to restore the tropical forests.

Onshore Wonders

The onshore section of the pipeline earned itself the name of "Hopping Island Project" as the 20.5-km stretch was spread over five islands. This does not begin to describe the logistical nightmare it gave Punj Lloyd. Normally, one associates an onshore pipeline with a long regular stretch of right-of-way (ROW). However, this stretch traversed dense tropical rainforest, undulating slopes across the islands, river crossings,

swamp and marsh until the next island with equally difficult terrain. Whereas jeeps are the regular mode of transport on onshore pipeline sites, here one also had sea trucks and speed-boats ferrying manpower from island to island.

Speed trucks would take 30-60 minutes from one island to another, depending on tides and distances. Equipment to each island had to be transported by barges and excavators were mounted on pontoons to ford the swamps surrounding the islands. The entire gamut of Punj Lloyd's amphibian equipment was put into action. This included flexiyoque work barges, push-pull pipelay barge, swamp excavators, swamp cranes and marsh buggies carriers. Extensive access dredging was done to enable shallow water spread mobilization to the river crossings.

Offshore Obstacles

Extremely undulating and hostile seabed comprised of hard rock, soft rock, and clusters of live coral and very shallow shore approaches were some of the offshore obstacles encountered. The pipeline was laid in a pre-dredged trench and approximately 300,000 m³ of dredging was accomplished within a time frame of 10 weeks. Five major dredging units were deployed comprising cutter suction, dipper and grab dredgers to complete the seabed preparation.

Because the offshore pipeline links four islands, it involved four shore approaches. The shore approach sections were pre-laid in swamp trenches and then pulled offshore with a winch barge. The lay barge then recovered and pulled this section onto its welding station and pipelaying began.

The offshore section of the pipeline was 10 km in length and was laid to a maximum depth of 24 meters with currents in excess of four knots. The company had expanded its equipment base to facilitate timely completion of the project. With its entry into the arena of offshore contractors, Punj Lloyd invested substantially in offshore pipelaying equipment.

The ultimate challenge was the "golden tie in" when the offshore pipelaying operations reached the other end and the pipeline was then recovered from the seabed and welded to the inshore section. The inshore section, which was laid in shallow waters, was recovered using two flexifloat barges. A special platform was fabricated at the base of the pipelaying barge, near the overlap of the pipe, to carry out the fit up, welding and radiography for the tie-in joint. Incidentally, this tie-in is the quickest golden tie-in achieved within three hours, despite strong currents and receding tides.

After the tie-in joint was made, the extremely critical lowering operation began. Lowering was synchronized so that no exces-

sive stress was put on the pipeline, which was now a length of 72 meters. The as-laid survey of the pipeline was carried out and it was ascertained that the pipeline was laid efficiently without any excessive stress.

Horizontal Directional Drilling

One of the most demanding and challenging sections of this project was the 548-meter long HDD crossing between Taluk Dalam and Tanjung Kubu Island.

An American Auger 120-ton rig was mobilized for the crossing. The geological soil investigation report was studied by pipeline engineers, which specified gravel, clay and silt. Accordingly, reamers and cutters were mobilized to the site. The day the pilot hole was started, weathered rocks were encountered. A mud motor and hole openers were ordered on an emergency basis and were airlifted from Inrock UK.

The drilling job began on April 2003, the mud return line was drilled and the 4-inch pipe was pulled in the same day. The rig was shifted five meters to the right in 12 hours and the 9 7/8-inch pilot hole was drilled in two shifts. After completion of the pilot hole, the reaming process began, which was in steps of 17½-inch, 26-inch, 32-inch, 36-inch and 42-inch.

The strata were inconsistent weathered rock and clay. While reaming, the chunks of weathered rock would fall, making reaming operations difficult and causing the hole to collapse. Also due to the

inconsistent strata, the hole openers would get jammed but were recovered after the parallel string was pushed on the top of the drill string to clean the hole in the front with the donought. It took almost a month to ream the inconsistent ground before the 42-inch diameter hole was finally reamed and was ready for the pullback.

A dummy pipe of 28-inch and 36-meter length was pulled before the main pipe just to make sure that the hole reamed was consistent and on receipt of the dummy pipe on the rig side, the main 28-inch product pipe was pulled within four hours with ease. With expert manpower deployed on the job site and with their technical experience, the HDD crossing was completed in two months, June 2003.

PT. Punj Lloyd Indonesia completed the pipeline in a time frame of 12 months with 1.89 million safe man-hours. **P&GJ**

Scope of work.

- Detailed engineering and design for pipeline, OFC, two stations
- Procurement of all project material
- Fabrication, installation, testing and pre-commissioning of pipeline, fibre optic system, launcher and receiver stations.
- Offshore pipeline 10 km
- Swamp pipeline 9.5 km
- Onshore pipeline 11.5 km spread over five islands.