

# Punj Lloyd: specialising in swamp pipeline construction

In the swamps of Indonesia, Punj Lloyd has overcome challenging conditions, including extreme surface currents, around-the-clock maintenance of equipment and dangerous wildlife to construct the pipeline infrastructure required to recover the South East Asian nation's extensive petroleum resources.

Indonesia is an archipelago consisting of approximately 13,000 islands stretched out between the two continental shelves of Asia and Australia. The islands are densely populated by swamp and marsh terrain.

At the end of 2008 the country's proven petroleum reserves included 3.7 Bbbl of oil and 3.18 Tcm of natural gas. Projects designed to monetise these resources in regions characterised by swamp or marsh land have required the development of particular pipeline construction methods to effectively and efficiently lay pipeline in these environments.

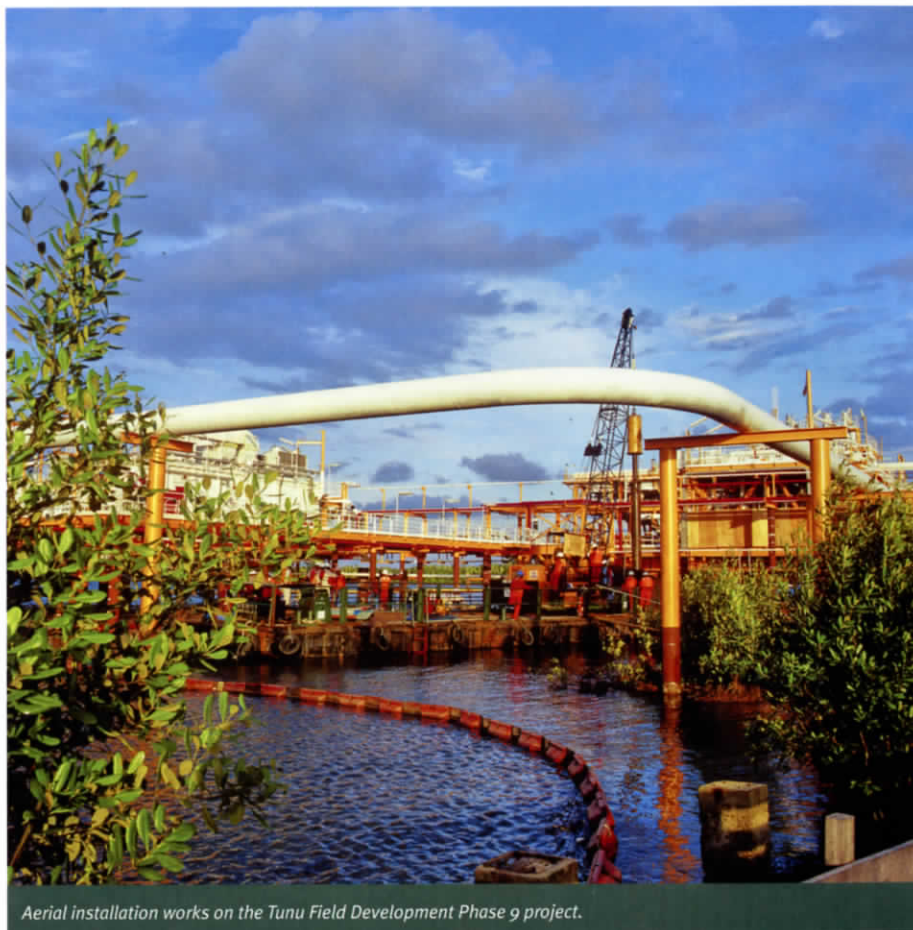
Indian pipeline engineering and construction company Punj Lloyd knows the challenges presented by pipeline construction in swamp and marsh terrain. The company was required to carry out works in these terrains for both Phase 9 of Total E&P Indonesia's Tunu Field Development, which connected satellite testing stations to the existing pipeline network, and for pipeline installation works on the Tambora Field Development Project Phase II.

## Tunu Field Development – Phase 9

Tunu is a gas and condensate field in East Kalimantan on the outer margin of the Mahakam Delta, located partially onshore in swamp terrain and partially offshore in shallow waters. The Mahakam Delta is infamous for its shallow sea with excessive surface currents while the inner delta, criss-crossed by rivers, is inhabited by salt-water crocodiles, snakes and other reptiles.

The purpose of the Phase 9 Tunu Field Development, completed in January 2005, was to enable Total E&P Indonesia to meet its production requirement with the construction of trunklines connecting new gathering stations (GTS) to the existing pipeline network, which transports the gas to the Bontang LNG terminal.

For successful execution of this project Punj Lloyd deployed its fleet of marine



*Aerial installation works on the Tunu Field Development Phase 9 project.*

equipment, comprising purpose-built barges, amphibian equipment, shallow tugs and dredgers with a draft of one metre.

The tie-in of the two strings was carried out in the onshore swamp trench. The pipe pull head was at kilometre point 1,350, which meant a total of 750 m of pipe section was pulled offshore. Four flexi-yoke barges with 32 t safe working load were deployed along with two swamp excavators to carry out this specialised tie-in onshore.

The onshore activity was tide-dependent and the movement of flexi-yoke barges was possible only during the high tide. Tie-ins and other associated activities such as radiography and field joint coating were performed at low tides.



*Cranes lift pipes into position on the Tambora Field Development project.*



*Pipelining through swamp waters on the Tunu Field Development Phase 9 project.*

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Trenching work on the Tambora Field Development.



Barge equipped with crane.

## Tambora Field Development

Punj Lloyd was also awarded an engineering, procurement and construction contract to construct a 24 inch diameter gas pipeline as part of Total E&P Indonesia's Tambora Field Development, which was completed in June 2006.

Located in East of Kalimantan, on the inner margin of the Mahakam Delta, the Tambora project involved pipeline construction in swamp and marsh terrain.

The project involved the installation of a gas pipeline network comprising a 24 inch diameter trunkline from the then newly installed GTS 4 Station, to the existing STP 3 located at the central processing unit of the Tambora field.

Eight inch diameter flowlines with 2 inch diameter piggy back lines connect gas wellhead platforms to the GTS 3. These lines also comprise five horizontal directional drilled (HDD) sections, four of 24 inch diameter and one of 8 inch diameter.

The immediate requirement was to reroute the three existing 6 inch diameter flowlines to install new facilities, which involved piling, pipelaying, welding, NDT, testing and coating in the swamp.

Construction materials required at the marsh locations were transported through landing craft, tugs and barges, while personnel staff lodged in long boats and moved around the sites with the aid of speed boats and sea trucks. The water front and the jetty facility at Sungaipurun yard were widely utilised.

The installation involved right-of-way clearing of dense, marshy plants along the pipeline route.

Specialised swamp equipment was extensively used for swamp sections,

where the swamp was generally 2 m deep. Piles were driven in these sections and prefabricated structures were installed to support the pipes. At HDD locations, the strings were prefabricated.

For this activity, lifting equipment such as cranes was required and swamp equipment was used extensively.

Work was carried out by positioning the equipment and material throughout the alignment of the aerial section of the pipeline, while the traditional installation method of push-pull was undertaken from one location only.

At HDD locations, the strings were prefabricated on these aerial sections.

Temporary jetty and platforms were installed at all these locations for resources and material mobilisation and demobilisation and the HDD strings were pre-tested before pull back and were placed over rollers to facilitate smooth pull back.

Dredging at river crossings used a clamshell barge and the prefabricated river-crossing spools were installed by a river-crossing work barge, which had been fitted with davits at the Sungaipurun yard.

Punj Lloyd President – Offshore V. P. Sharma has successfully executed projects in the swamp terrain for more than a decade. Speaking on the construction challenges in the swamp terrain he said “The major challenge which we continuously face in the swamp terrain is working in an environmentally sensitive region so as to preserve the endangered ecosystem. All project-related work has to be executed keeping in mind the protection of the rare flora and fauna.

“Long years of working in the swamp region have taught me new methods of overcoming challenges. I have spent 11 years working in the Mahakam Delta where every project taught me new ways and methods to conquer hurdles.”

### METHOD OF CONSTRUCTION

#### 24 inch diameter trunkline

Pipe bridge: 7 Sections – 3,916 m  
HDD crossing: 4 Sections – 5,494 m  
Open cut river crossing: 1 Section – 64 m

#### 8 inch diameter flowline and 2 inch diameter piggyback line

Pipe bridge: 8 Sections – 7,809 m  
HDD crossing: 1 Section – 914 m  
Open cut river crossing: 3 Sections – 365 m

#### 6 inch diameter flowline re-routing

Pipe bridge: 3 Sections – 1,300 m

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In terms of environmental considerations, the discharges from the project activity had to be controlled to prevent water pollution which would adversely affect living organisms, materials, and even cause deterioration in the quality of water.

Remoteness of the location was a major challenge for the project team, restricting mobilisation of personnel and machinery.

The complexities of swamps and marshes were considered throughout the entire project – from the selection of appropriate marine vessels to survey the right-of-way, to the logistics of trench excavation, pipelaying, welding and non-destructive testing (NDT), coating and tie-ins, river crossings, floatation of the string, pulling cable, tie-ins and riverbank re-instatement.