



Fulfilling India's energy needs

Surender K Sharma, Head of Pipelines, Punj Lloyd Ltd, describes the construction of the Dabhol-Bangalore Pipeline in India.



Figure 1. ROW and pipe in trench.

The Dabhol-Bangalore pipeline is an important project for the states of Maharashtra and Karnataka in India. Besides transporting gas, the pipeline will also provide power to these states. This pipeline will be part of an integrated national gas grid for the country and will also enable development of city gas distribution projects by catering to a large number of cities and towns.

The GAIL-owned pipeline will carry regasified LNG (RLNG) from the gas terminal of Ratnagiri Gas & Power Pvt. Ltd and will supply it to industrial clusters in Maharashtra and Karnataka. It will pass through the Ratnagiri and Kolhapur districts of Maharashtra, before entering Karnataka. Here, it will traverse across the districts of Belgaum, Dharwad, Haveri, Davengere, Chitradurga, Tumkur and Bangalore.

It was a prestigious moment for Punj Lloyd when it received the pipelaying and terminal contract for the Dabhol-Bangalore pipeline from GAIL in October 2010. Punj Lloyd has



Figure 2. Lowering of pipe.



Figure 3. Boring work underground.

successfully executed several prestigious pipeline projects for GAIL in the past, which include the Thal-Usar-Thal pipeline, Jamnagar-Loni pipeline, Dahej-Vijaipur pipeline and Panvel-Dabhol pipeline, among others.

The complete construction work of the pipeline from Dabhol (Ratnagiri, Maharashtra) to Bidadi (Ramnagar, Karnataka) and two additional spur lines (from Gokak in Belgaum District, Karnataka to Goa and from Sulivara in South Bangalore District, Karnataka to Bangalore) have been divided into ten spreads. Punj Lloyd is executing seven spreads comprising 820 km of the pipeline. Spreads A and B fall in Maharashtra and Spreads C, E, F, G & H fall in Karnataka.

The Punj Lloyd scope of work includes installation, testing, pre-commissioning of the pipeline and preservation, drying, commissioning including construction of 24 sectionalised valve stations, seven intermediate pigging stations and three terminals. The scope also includes SCADA, telecommunication, leak detection, fire and gas system, solar panel system and a gas management system. It is noteworthy that the entire design, engineering, installation and commissioning of the solar power system was done in-house through the company's renewables arm - Punj Lloyd Delta Renewables. The stand-alone solar power system will meet

the power demand of instrumentation/telecom equipment load of 1000 Wp, with the facility of charging through grid.

The 36 and 30 in. diameter pipeline has a design capacity of 16 million m³/d. The scope of work also includes laying two spur lines of 18 and 24 in. diameter for Bangalore and Goa respectively. The total length of the main trunkline is 250 km with 36 in. diameter and 500 km with 30 in. diameter. The total length of the spur lines is 75 km with 18 in. diameter and 175 km with 24 in. diameter.

Execution amidst challenges

Punj Lloyd formulated a unique execution plan keeping in mind the diverse terrain and severe weather conditions. The entire pipelaying work was configured in seven independent spreads with the establishment of two central offices, each at Maharashtra and Karnataka in addition to one camp per spread. This helped in the work being highly structured, resulting in high productivity. Point spreads have been mobilised for critical locations, restricted area, Amba Ghat and city area. In addition to this configuration, these spreads have been closely monitored through video conference facilities. The video conferencing initiative resulted in greater work efficiency, detailed monitoring of the work in progress and prompt decision making.

Six mini crew were formed to tackle the tough and undulating terrain, in order to meet the required productivity. Pipe shifting was done by dozers and excavators with sledges on steep slopes. Punj Lloyd also undertook construction and maintenance of approach roads, bridges, culverts and logging roads. Punj Lloyd's huge fleet of equipment ensured quick mobilisation of 14 semi-automatic and eight automatic mainline welding crews, along with 45 tie-in crew. The company used specific welding technology like STTP (Surface Tension Transfer Process), normally used for higher grade welding on X80 pipe, for this project. Punj Lloyd is one of the first few companies in India to use this technology.

HDD at Ghatprabha River Crossing

The pipeline route includes 27 river crossings, of which eight were HDD crossings, with the longest HDD of 1500 m in the Ghatprabha River through hard rock. Punj Lloyd's experienced team of HDD personnel performed the daunting task of drilling 1600 m of rock using a single rig. The 1600 m long HDD was performed amidst heavy monsoons and floods. Four HDD crew, 21 auger boring crew and ten river crossing crew have been mobilised for completion of crossings alone. The route includes 57 railway crossings/national highways, 237 major road crossings and 276 other water body crossings.

A project of this magnitude and difficulty is being executed with great ease and efficiency through a combination of skilled and motivated manpower and unmatched expertise in pipelaying in difficult conditions. Punj Lloyd has in the past laid more than 10 000 km of onshore and offshore pipelines for the world's major oil and gas conglomerates. From mountainous terrain to deserts to

tropical rainforests and swamps, Punj Lloyd has laid pipelines where others have feared to tread.

Challenges

The pipeline route passes through the challenging terrain of Western Ghats in Maharashtra, which consists of mountainous rocky and swampy stretches and dense forest with a slope ranging from 35 to 60°. Some 200 km of the pipeline route passes through this difficult terrain. Special sledges and heavy towing equipment like excavators, side booms, high capacity dozers and tractors are being used for transportation of pipes and bends for hauling and stringing in the hilly Ghat areas.

Being a high altitude mountainous region, rain is a constant phenomenon in Ratanagiri and Dabhol from June to September. Monsoons have posed a great challenge in the execution. Deployment of heavy earthmoving equipment, trailers and sledges for pipe transportation, specialised stringing and welding equipment in mountainous terrain was a daunting task but the movement of heavy equipment was swift due to the innovative techniques adopted.

Amba Ghat crossing

Amba Ghat is the toughest section of the entire pipeline route. It is located along the Western Ghat crestline passing through the Deccan Plateau in Shahuwadi, at an elevation of 709 m above mean sea level. The area has tall evergreen forest, dense cultivated fields and hard rocky terrain. The average annual rainfall in the area is more than 5000 mm. Punj Lloyd applied its best pipeline technology and most experienced construction resources including well organised construction management teams to complete this section.

As most of the pipeline route in Maharashtra was in the hilly, rocky, swampy, dense forest area where approach roads were nonexistent, Punj Lloyd, true to its indomitable spirit, set out to construct the approach roads, bridges etc, at over 25 locations along the inaccessible pipeline route. These approach roads have been of enormous help to the villagers in the neighbourhood providing them connectivity. Almost 20% of local people have been employed on this project, giving them training and a means for their future livelihood. The hilly portion criss-crossed by several small roads, tracks and streams at short intervals increased the number of crossings and tie-in joints. The undulating terrain called for a large number of bends, amounting to almost 60% of the total number of pipes in spreads A & B. Transportation of manpower, material and equipment up the slopes was another major challenge. The pipeline required stringent government regulatory approvals for acquisition of land, State Pollution Control Board clearance for the respective states, Ministry of Environment and Forest clearance, and permission from the relevant authorities for each crossing.

Health, safety and environment

Punj Lloyd adopts the world's best practices in health, safety and environment at all its sites globally. It conscientiously maintains a healthy, safe, sustainable and pollution-free work environment of the highest standards.



Figure 4. HDD in progress.



Figure 5. Automatic welding.

Working at high altitudes on steep mountainous slopes is extremely difficult and risky. Some 4 million man-hours achieved without lost time injury on this project reflects the high standards of safety adopted.

Apart from conventional hazard identification techniques and comprehensive risk assessment, daily site risk was assessed on the spot by the site in-charge as a part of STARRT - Safety Task Analysis and Risk Reduction Talk. This was communicated to the entire crew during daily tool box talks. Three paramedical and medical doctors were available 24/7 at the site for emergencies.

A commendable achievement that saved time, money and cost of the project was the Automatic Safe Load Indicator (ASLI) provided for all mobile cranes in the project, eliminating risk and accidents during mobile crane functioning during pipeline operations.

The successful execution of this pipeline will reflect Punj Lloyd's project execution capabilities and reinforces its position as 'all terrain experts'. **WP**