

LNG

the Indian link

The Dahej-Vijaipur pipeline in India was completed in late February and commissioned in March 2004. This new line travels a distance of 611 km, from Dahej, an industrial area on the West Coast near Bombay, to Vijaipur in the heart of India. It has the capacity to transport 23 million m³/d of natural gas, and allows LNG imported from Qatar (re-gasified in Dahej) to be hooked up to the existing Hazira-Bijaipur-Jagdishpur (HBJ) network for supplying re-gasified LNG to consumers along the route to the capital, Delhi. This news is exciting for a country whose demand is higher than supply, and whose preference is leaning more and more towards natural gas as a result of rampant pollution problems.

Beginnings

When GAIL India announced its plan to commission this project within nine months, many pipeline experts considered the task to be impossible. However, GAIL, along with the engineering consultant who had helped develop the plan (Engineers India Ltd), were determined to meet the objective. Achieving this goal was to mean that GAIL would satisfy its LNG commitment to Petronet LNG (a joint venture of which it is a member).

However, as with any large pipeline construction project, many participants' work had to be co-ordinated in order to achieve the incremental goals necessary for the successful completion of the project within the timeframe. The project was to be completed in four spreads; three of which, totalling 422 km, were awarded to Punj Lloyd on 5th May 2003.

Background

GAIL India was incorporated in 1984 with a mandate to develop and maintain India's gas pipeline network. Soon after, Punj Lloyd began its association with the company (an Indian transnational engineering construction company headquartered in New Delhi). GAIL and others have awarded Punj

Atul Jain, Punj Lloyd Ltd, India, describes the challenges surmounted in the construction of the Dahej-Vijaipur pipeline: transporting re-gasified LNG into the heart of India.

Lloyd several pipeline construction projects in Asia since 1983. Indeed, to date the company has laid more than 5500 km of pipeline for oil and gas companies, carrying natural gas, re-gasified LNG and crude oil.

GAIL now owns more than 4500 km of gas pipeline in India, and has ambitious plans to develop a national grid of more than 8000 km, through which clean fuel will be transported to every industry and household in the country.

In the 21st century, LNG is viewed as the green source of power for India, and Dahej-Vijaipur is considered to be a significant step towards sustainable environmental development in India. As well as helping cities such as Delhi, where the need for alternative fuel sources has become imperative, it will also help to augment energy options in the states of Gujarat and Madhya Pradesh by producing inexpensive and viable fuel options for generating electricity in remote areas. As a result of pollution considerations, GAIL India has targeted many small and medium scale industries in an effort to encourage them to use LNG as their new power captive medium, and not to rely on diesel run generators. Companies are responding. Two power plants in Gujarat have already been brought under the purview of the project, with another coming soon. Moreover, the project promises to benefit gas based power projects in Delhi, which will generate an estimated 330 MW of power.

Construction

Planning the dream is one thing, but building it is quite another, particularly within nine months. With high financial stakes, a tight timeframe, challenging terrain to tackle, and the demand for high quality workmanship that would last decades, all participants had their work cut out for them. For example, in the 40 days after receiving the award, Punj Lloyd had the vast task of mobilising for the work. Equipment was sourced from nine countries throughout the world, and the

following is a partial list of equipment that gives some idea of the mobilisation's magnitude:

- Two trenchers.
- 155 excavators.
- 109 sidebooms.
- 300 trailers.
- 1000 vehicles, encompassing trucks, buses and jeeps.

Experienced manpower was sourced from 11 countries, including some from Turkey, where the company is working on the Baku-Tbilisi-Ceyhan (BTC) pipeline. A minimum of 4500 people were involved in the work at any given time, and at its peak this figure increased to 6000. A day and night shift were worked wherever possible, including 500 engineers working 24/7.

Challenges

Landscape

The 42 in. diameter pipeline is three layer polyethylene coated X70 grade pipe (API 5L). It crosses terrain along the coastal areas of the state of Gujarat, as well as forest, mountains in the state of Madhya Pradesh and farmlands. The entire Gujarat section consisted of black cotton soil.

The Dahej coastline, with high water table and sandy soil, had an entirely different topography from the hard and weathered rock of Madhya Pradesh in central India. While the black cotton soil of the Gujarat turned into a veritable marsh during the rains, the rocks around Vijaipur posed a different problem. 2003 saw an unprecedented monsoon season lasting the better part of four months. While the rest of the country rejoiced after two years of minimal rain, the pipeliners on the Dahej-Vijaipur pipeline viewed the rain with dismay. They saw their tight deadline drawing nearer, with the rains showing no signs of abating. Moreover, midway through the project, GAIL decided to award Punj Lloyd an additional 86 km of pipeline from another contractor.

Environment

The project encountered a restricted right of way (ROW) through a protected wildlife forest area. Restoration was accomplished with minimal damage to the topsoil, and the construction team worked within 5 m of a live gas pipeline. The danger of this was alleviated using vibration controlled blasting. Local farmers also benefited from the work, as in an effort to foster goodwill, they were provided with water harvesting facilities and access roads to their villages. Relations

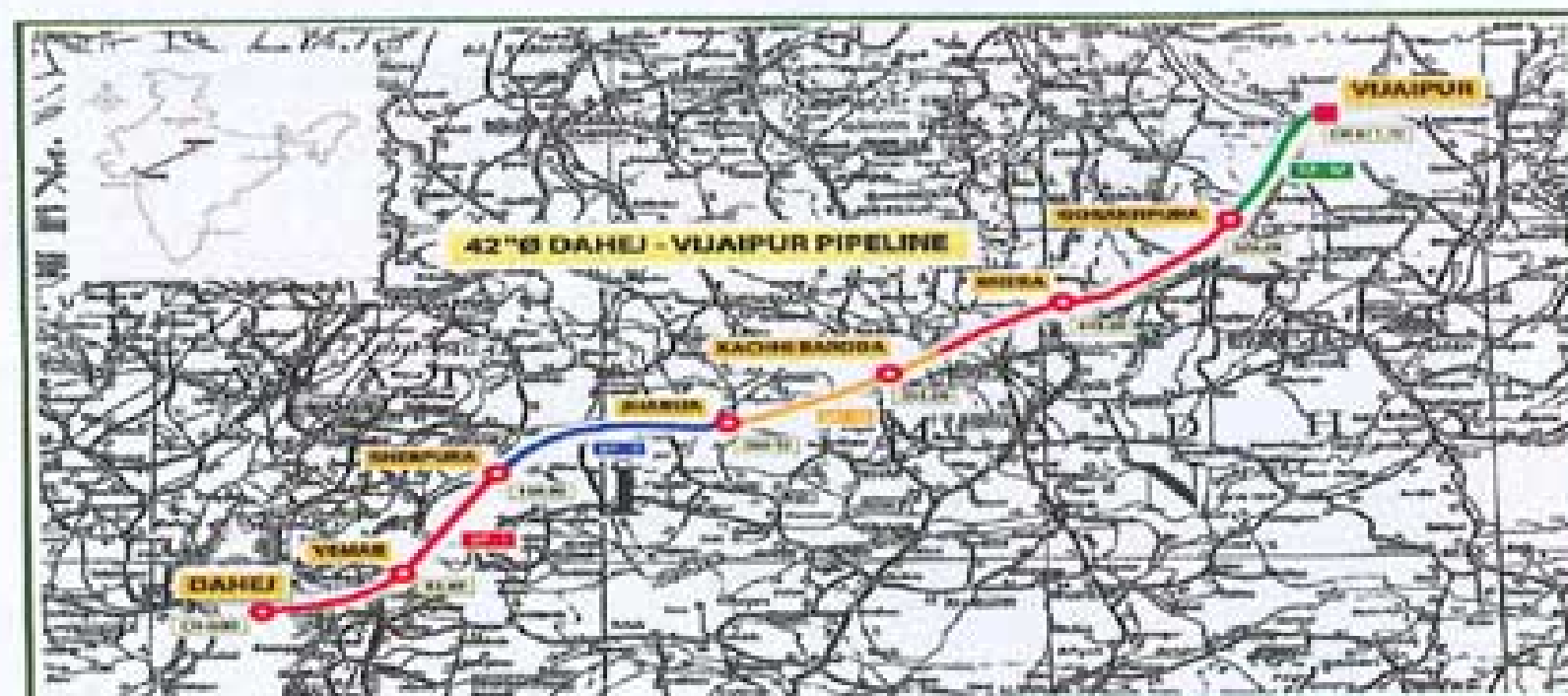


Figure 1. Dahej-Vijaipur pipeline route.

were also eased with the indigenous tribal population of central India. Intrusion was minimised.

Utilising technology

Three layer, heat shrinkable sleeves were used for field joint coatings, conforming to EN 12068 Stress Class C 60 UV, as specified by GAIL. The sleeve system selected as the field joint coating system for normal buried pipelines was the Raychem HTLP 80. DIRAX was chosen for pipelines that were laid by horizontal directional drilling (HDD), and Tyco Adhesives Corrosion Protection Group (CPG) manufactured both systems. The Raychem HTLP 80 fully reconstructs three layer coating at all girth welds for continuous and homogeneous performance on pipelines coated with 3LPE. The DIRAX is tough, and highly resistant to shear and peel forces induced by soil and thermal movements. 'K.B. Singh, regional manager at Tyco Adhesives CPG for India and South East Asia, co-ordinated the field service support for the project, including certification of the applicator crew and supervision on the job site', said Eric J. Aulicino (Vice President of Global Sales & Marketing, Tyco Adhesives CPG.) 'The applicator certification programme was instrumental in achieving consistent quality of the joint coating system throughout the project.'

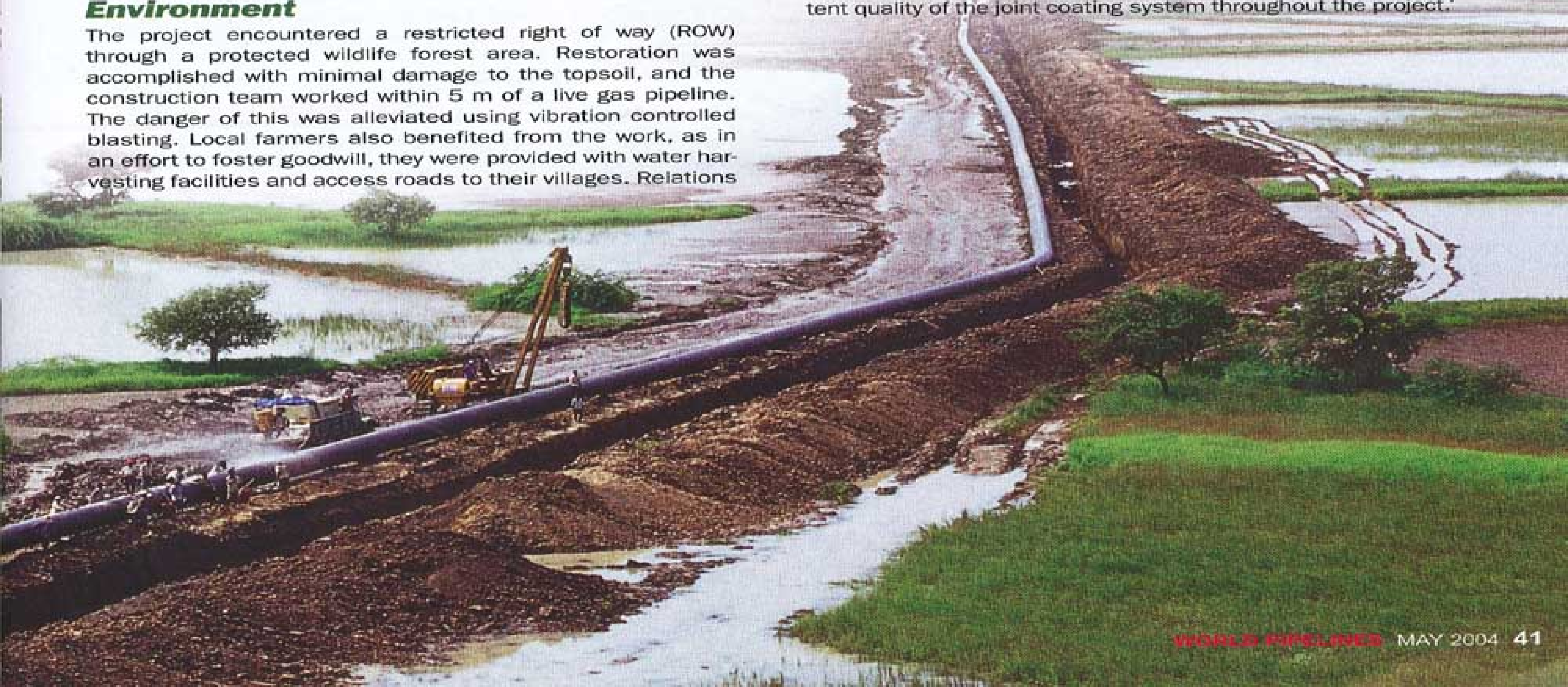


Figure 2. Preparation for automatic welding.

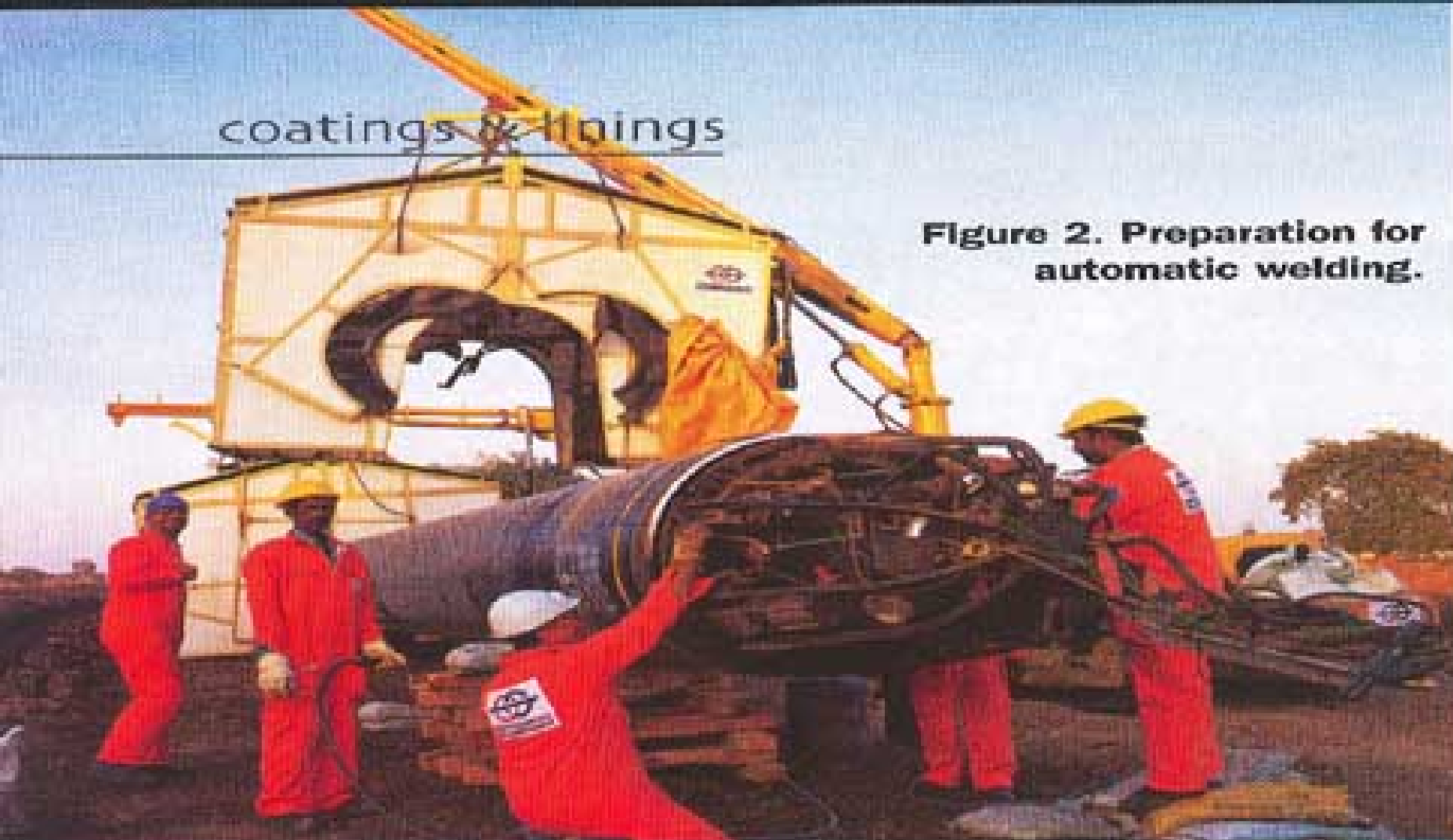


Figure 3. Automatic welding during monsoon.



Figure 4. Automatic ultrasonic testing.



Figure 5. Sidebooms in action.



The installation of the heat shrinkable sleeves was performed using LPG gas torches, thereby eliminating the use of expensive induction heaters. According to Ramanuj Gupta, Punj Lloyd Quality Controller, 'daily production of the HTLP 80 field joint coating system was in the range of 200 - 250 joints per spread'.

The project saw automatic welding and automatic ultrasonic testing techniques used for the first time in India. CRC- Evans (USA) and Pipe Welding Technology (Italy) provided services that enabled the setting of a welding record of 6 km in one day. A record for lowering was also set: 15 km in one spread in a day.

Punj Lloyd selected automatic ultrasonic testing (AUT) as the means of nondestructive testing to verify the quality of girth welds. This is basically a combination of pulse echo and time of flight diffraction (TOFD) methods, and it enables the detection, recording, fast interpretation and sizing of all the relevant discontinuities in the welds according to the relevant codes and standards of API 1104 and E-1961. The advantages AUT has over more conventional methods are its high probability of flaw detection, accuracy of flaw location and correct flaw sizing. 'We wanted a method for testing that would support the size of the project. By using AUT, each girth weld joint on the 42 in. pipe took approximately one minute to scan, and allowed all inspection charts to be stored electronically' said Sanjeev Khanna, Punj Lloyd Project Manager for the pipeline. 'This supported the goal of verifying the welds while containing the amount of time required for the verification.' Two firms carried out the AUT for the project: RTD, The Netherlands, and Weldsonix, Canada.

Crossing obstacles

As with any other pipeline project in India, this line crossed several rivers; in total 34. There were also 179 road crossings, 10 railway crossings and 236 miscellaneous crossings of obstructions and utilities. The total length of river crossed was 2890 m, and the maximum cover in the rivers was 4 m from the scour level. National highway, railway, and canal crossings were achieved using auger boring, which did not disturb traffic or canal water flow. A major canal, the Narmada, was crossed using horizontal directional drilling, with complete mud recycling for environmental protection.

Conclusion

Punj Lloyd's scope of work also included 19 sectionalising valve stations, five intermediate pigging stations, one dispatch terminal at Dahej, and one receiving terminal at Vijaipur. The company was also responsible for 36 in. diameter spurlines to GAIL's LPG extraction plant at Vagodia. This facilitates the extraction of rich gas from the Dahej terminal to feed the Vagodia LPG plant, after which the lean gas was piped back to the Dahej-Vijaipur line.

In addition, Punj Lloyd was mandated to carry out the magnetic and caliper pigging of the pipeline; the drying of the pipeline at -40 °C; inertising the pipeline with nitrogen column to achieve a dew point of -10 °C; and charging the pipeline with re-gasified nitrogen gas. Once the pipeline had reached 611 km in length, it was Punj Lloyd's responsibility to commission the entire pipeline.

In this tale of 270 days of daunting terrains, sensitive social interaction, and nearby environmental hazards, Punj Lloyd achieved 11.2 million safe manhours and 8 million safe vehicle kilometres.

Now the pipeline must stand its final test. This is the test of time, as it becomes part of the vast energy network being built to meet the sustainable energy needs of India's future.