



The Punj Lloyd Magazine

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Platform Compression Facilities Project Thailand





Platform Compression Facilities Project

Ajai Agarwal

Country Head - Thailand
Punj Lloyd Ltd

Introduction

Asia Pacific has been one of the most important markets for Punj Lloyd Group. After delivering prestigious oil & gas projects in Indonesia, Singapore and Malaysia, Punj Lloyd moved further in the region to explore the huge infrastructure potential in Thailand, 'the Land of Smiles'.

The company made a breakthrough in Thailand with a prestigious contract from the Fortune

500 Company, a renowned energy conglomerate - PTT Public Company. Entering a new market is always a challenge. However for a seasoned Group like Punj Lloyd, present across 21 countries, project teams are exposed to the nuances of different regions. Highly adaptable and agile, our people can bridge across language barriers or cultural gaps and establish close bonds to explore opportunities together.

A Date with PTT

On Christmas eve of 2009, the EPC contract for platform compression facilities for PTT Riser Platform (PRP) was awarded to a Punj Lloyd Group JV comprising Punj Lloyd Ltd, PT Punj Lloyd Indonesia and PT Sempec Indonesia. The project site is located in Gulf of Thailand at Erawan Field, about 440 km south of Rayong, at a water depth of 64 m.

Rising above

The PTT Riser Platform (PRP) is located to the north of the existing Erawan Riser Platform (ERP) operated by Chevron. The two are connected by a 446 ft walkway bridge. Gas gathered from offshore



fields is delivered to PTT's gas separation plants in Rayong. In the future, gas from other new fields can also be delivered into the system. To meet the demand, three new turbine / compressor units, with associated facilities, are required. The work involves complex precision of installing the new facilities in the existing earmarked spaces and synchronising them with the existing system, all within a live production platform.

The maximum flow rate required through the transmission 42" gas pipeline is about 1,900 MMSCFD, while upstream pipeline pressure at PRP is to be maintained at 2,100 psig. The multiple incoming gas sources to PRP from Arthit, JDA and ERP will be regulated at 1,100 psig.

The project is intended to supply new and additional offshore gas, currently expected to be available from offshore gas fields in Gulf of Thailand, to Rayong and Bang Pakong in the eastern region and a provision to Ratchaburi in the western region of Thailand. The gas will primarily be used as fuel gas for onshore power plants but will also serve industrial users and gas separation plants.

Precision sequencing and planning of work

Long lead items like HIPPS Valves and Gas Turbine Generators were purchased well ahead of time. Inspection was carried out by PTT,



Punj Lloyd Group JV and equipment vendors, Rolls Royce and Dresser Rand.

The weight of a single GTC module was 600 T (each) and air cooler heat exchanger module 400 T.

Considering load-out of heavy modules, a yard closest to the Laem Chabang was chosen.

Following the assembly of structure steel and piping, the Gas Turbine Compressor was installed over the modules. Punj Lloyd deployed its own work barge – Madhwa and another work barge support Station V with a capacity of 300 crew.

Gas Turbine Generator, weighing

Scope of Work

Project Management, Engineering, Procurement, Construction, Load-out, Transportation, Installation, Hook-up and Commissioning of the following major components:

- 3 Gas Turbine Compressor Units (GTC) - PTT supplied
- 1 Turbine Generator Unit (GTG)
- 8 After Cooler Units
- 1 Seal Gas Booster Skid - PTT supplied
- 2 I/U Air Compressor (1 unit base scope and 2nd unit additional work)
- Associated Structural Modifications
- Interconnecting Piping
- Instrument and Electrical Modifications
- SCADA, DCS, ESD and Fire & Gas System
- Exhaust Stacks of Compressor Units and the Generator Unit.



Proper planning and expediting major long lead items ensured that bulk material was received on time. During the major tie-in work, the platform production was suspended over weekends. In order to achieve successful heavy lift, co-ordination amongst different subcontractors and project team was precisely planned and implemented.



Careful planning ensured that work was carried out with limited shutdowns to limit the impact on gas requirement. Tie-in with the existing system was also a major challenge.



approx. 30 T, was installed directly on PRP platform by Madhwa. A transportation barge, 'Giant 15', 330' x 100' x 20', was also hired from POE, Singapore. 'Endeavour', 146 x 42 x 10 m, a heavy lift barge with a lift capacity of 1,100 MT, from NorCE was deployed for heavy lift of modules.

Load out of six modules was successfully achieved using the transportation barge. NorCE Offshore was subcontracted for heavy lift of modules.

Considering the criticality of the operation, HAZID was conducted with representation from Client, Punj Lloyd, NorCE and Mammoet.

Due to the PRP platform flare on the South, Aftercooler modules 2 and 3 could not be installed directly at their location. Mammoet was subcontracted for the skidding operation. As

skidding of equipment weighing 400 T on a platform was critical, additional strengthening was required for the platform main deck.

For the first heavy lift of the Aftercooler Module-3, it was first loaded on a pre-determined location at skidding units and thereafter skidded to its location. While Aftercooler Module-3 was being transferred to its location, cutting of sea fastening of Aftercooler Module-2 was being done.

Aftercooler Module-2 was lifted from the barge to PRP platform on skidding location while Aftercooler Module-1 was installed directly on location. At the same time, cutting of sea-fastening for GTC (Gas Turbine Compressor) Module A was done, which was directly installed over its location, post which the two GTC B & C were installed.

Not intimidated

Thailand was a new country for Punj Lloyd and the project team had to get acclimatized with the local language, especially Thailand rules and regulations, which were very stringent. All government documents are in 'Thai'.

However the company's policy of recruiting locals was a big help as young and enthusiastic Thai recruits assisted in understanding local rules, documentation and co-ordination amongst different offices. The project team received special training in language classes to understand basic Thai, enabling them to communicate effectively with local vendors and subcontractors.

Weather can have a great impact on offshore work. Rough sea, typhoon, rains etc. contributes to loss of work time.



Terrible floods in Thailand, the worst ever in last 50 years, also had an impact on the project execution as the procurement and transportation were impacted.

Brownfield Platform – As PRP platform is a live platform, Punj Lloyd had to consider and plan its activities conforming to the platform regulations. Tie-in work requires the platform to shutdown. Careful planning ensured that work was carried out with limited shutdowns to limit the impact on gas requirement. Tie-in -with the existing system was also a major challenge.

Achievements

Being Punj Lloyd's first project in Thailand, platform compression facilities will always be remembered for paving the way for new

business to follow. Soon thereafter, PTT awarded Punj Lloyd the EPC of Fourth Transmission Pipeline Project. It reinforced the strong belief and trust of PTT on our project management and execution capabilities coupled with our rich and varied cross country pipeline experience.

With proper planning and expediting major long lead items, bulk materials were received on time. To complete the major tie-in work, the platform production was suspended over weekends. In order to achieve successful heavy lift, co-ordination amongst different subcontractors and the project team was precisely planned and implemented.

On the safety front, Punj Lloyd continued to maintain its focus on safety management reaching 3.6 million safe man-hours. A letter of appreciation

was received from client on completion of 3 million safe man-hours.

PTT also awarded a letter of Appreciation to Punj Lloyd for successful completion of heavy lift activities which served as a major morale booster for the entire team. Punj Lloyd performed offshore skidding operation for the first time.

Future Prospects and Plans

Punj Lloyd is committed to serve Thailand in all ongoing and future development projects. It will continue with zeal and determination to further strengthen its footprint on the oil and gas map of Thailand. ♦



คลองกระ...

Fourth Transmission Pipeline Project, Thailand

Vishal Ummat
Construction Manager
Punj Lloyd Ltd

The Fourth Transmission Pipeline (FTP) Project was awarded to Punj Lloyd in January 2011 by PTT Public Company Limited, Thailand on EPC basis. This is a repeat contract by PTT Public Co Ltd., after successful completion of the EPC project of Platform Compression Facility.

Fourth Transmission Pipeline is a major new onshore gas transmission pipeline with a design capacity of 1,700 MMSCFD which will transport gas from the Liquefied Natural Gas (LNG) terminal at Maptaphut Industrial Estate near Rayong to a tie-in station on the existing Wang Noi to Kaeng Khoi (WNKK) Pipeline in Saraburi Province. Once completed, it will serve as a lifeline for Central and Eastern Thailand to meet the increasing demand of industry and power plants, which in turn will have a robust effect on the economy.

The scope of the project includes laying of 294 km, 42" dia high pressure gas pipeline which will transport mixture of a gas from the LNG terminal and construction of a Gas Distribution Facility near the LNG terminal. The facilities work includes Gas Dispatching Facility (providing FTP Gas Header, Flow Control Stations, Meters and Analyzers, System Controllers, Pig Launcher with Mid Line Launcher / Receiving Station, Blow down / Vent System, ESD System), 18 Block Valve Stations along the pipeline route and

A major section of the pipeline is along heavy traffic highways with densely populated areas. As a result, space for working with equipment is extremely restricted

Punj Lloyd mobilised two Pipe Direct machines from Herrenknecht, Germany. This technology is being used for the first time in Asia and is specifically advantageous while working along the highway with constricted space conditions.



Kaeng Khoi Station with tie-in facility at delivery end of the FTP pipeline. The scope also included DCS, SCADA, instrumentation, control & communications facilities.

The project required 45 HDD (Horizontal Directional Drilling) crossings to be executed across a total length of 32 km, most of them along the highway. There was very little working space available for HDD as the pipeline is to be laid below the hard surface (shoulder) of the highway. The required space for installing conventional HDD rigs is insufficient and pipeline strings on the highway was not feasible. Further, due to the complicated and changing subsurface strata formation, progress of work through conventional HDD method was

much lower than anticipated. In view of these difficulties, Punj Lloyd mobilised two Pipe Direct machines from Herrenknecht, Germany. This technology is being used for the first time in Asia and is specifically advantageous while working along the highway with constricted space conditions, as pipe strings are made in multiple sections. The progress of HDD work with this new technology was satisfactory. Currently as many as seven HDD rigs, including two Pipe Direct machines, are deployed on the project.

The major section of the pipeline is along heavy traffic highways with densely populated areas. As a result, space for working with equipment is extremely restricted.

The space between the shoulder

of the highway and the high voltage electric lines is extremely narrow, making it difficult to lay the trench as it can damage the electric pole, unsettling its balance completely. The project team first needed to secure the electric poles, which was achieved by sheet piling.

Due to these constraints, the conventional pipeline installation method (mainline) is not applicable along the highways, and Punj Lloyd is working with poor-boy crew to attain these sections. The number of tie-ins has thus increased heavily; Punj Lloyd has deployed 10 poor boy crew for these sections and work is progressing satisfactorily.

As the ROW is along the highway, passing through populated areas, there are numerous





PTT, the flagship oil & gas conglomerate of Thailand, currently operates a network stretching over a distance of 3,635 km including 1,437 km onshore and 2,198 km subsea pipeline.



establishments like restaurants, nurseries, industries, fuel outlets enroute. Also, there are roads which connect to this main highway ROW. This resulted in a huge number of crossings (bored/open cut crossings) while installing the pipeline.

Till date, 216.6 km welding has been achieved and 198.8 km of lowering-in and backfill completed. In respect of SHE, the project has now recorded 7 million safe working man-hours without LTI, a milestone for which the entire project team is proud, the next target being 10 million safe man-hours.

Thailand's gas demand has been rising at 6-7 per cent annually, prompting PTT to secure

more supplies both from home and neighbouring countries in terms of piped gas and LNG.

PTT, the flagship oil & gas conglomerate of Thailand, currently operates a network stretching over a distance of 3,635 km including 1,437 km onshore and 2,198 km subsea pipeline. PTT's gas pipeline system connects with various gas pipelines in the Gulf of Thailand, the pipeline gird from Yadana and Yetagun, Myanmar at the Thai - Myanmar border with power plants, the gas separation plants and industrial users.

Under the system there are Dew Point Control Units, and the Common Header to standardise the quality of the entire gas from different fields in the Gulf of Thailand in order to ensure common and uniformed heat and quality. ♦

Hyderabad-Vijayawada Highway Project

S K Goyal

Vice President - Buildings & Infrastructure (India)
Punj Lloyd Ltd

The Hyderabad Vijayawada Highway Project, connecting Pune in Maharashtra to Machilipatanam in Andhra Pradesh, is a project that the people of India are likely to remember for a long time. Providing seamless travel on quality roads, the Hyderabad Vijayawada highway is like a lens through which one whizzes past dusky mud huts in serene surroundings of green fields and then in sharp contrast, arrives at the glass and concrete city buildings. Along the comfort of a four lane highway, India's many faces – the numerous villages and cities, unfold before you.

India has one of the largest road networks in the world, consisting of national highways, state highways,

major district roads and rural road.

National Highways with a length of 66,590 km comprise only 2 per cent of the national road network but carry 40 per cent of the road-based traffic.

To strengthen India's National Highways, the Central Government of India, through the National Highways Authority of India (NHAI), embarked on the National Highway Development Programme (NHDP). Phase III of this programme emphasises on upgrading 12,109 km of the national highways on Built, Operate and Transfer (BOT) basis.

As a part of the NHDP Phase III, the Hyderabad Vijayawada Road Project was awarded to the GMR-Punj Lloyd Consortium in May 2009 by National Highways Authority of India (NHAI). Commercial operations started in June 2012.

Accessibility ensured

The four laning of the Hyderabad-Vijayawada section of NH 65, fulfilled the long cherished dream of the people of eastern Andhra Pradesh to have faster access to the capital. It helped in reducing travel time between Hyderabad and Vijayawada. The highway is also a vital link in facilitating traffic movement from Kolkata in the east to Bangalore in the south. The project envisages augmenting the four-lane facility to six-lane standards in 14 years.

A Special Purpose Vehicle (SPV), 'GMR Hyderabad Vijayawada Expressway Pvt Ltd', was constituted as the Concessionaire. Punj Lloyd and GMR Infrastructure Ltd were the EPC contractors for the project. Punj Lloyd implemented 116.5 km of the Highway while GMR Infrastructure, 65 km.

Project Scope

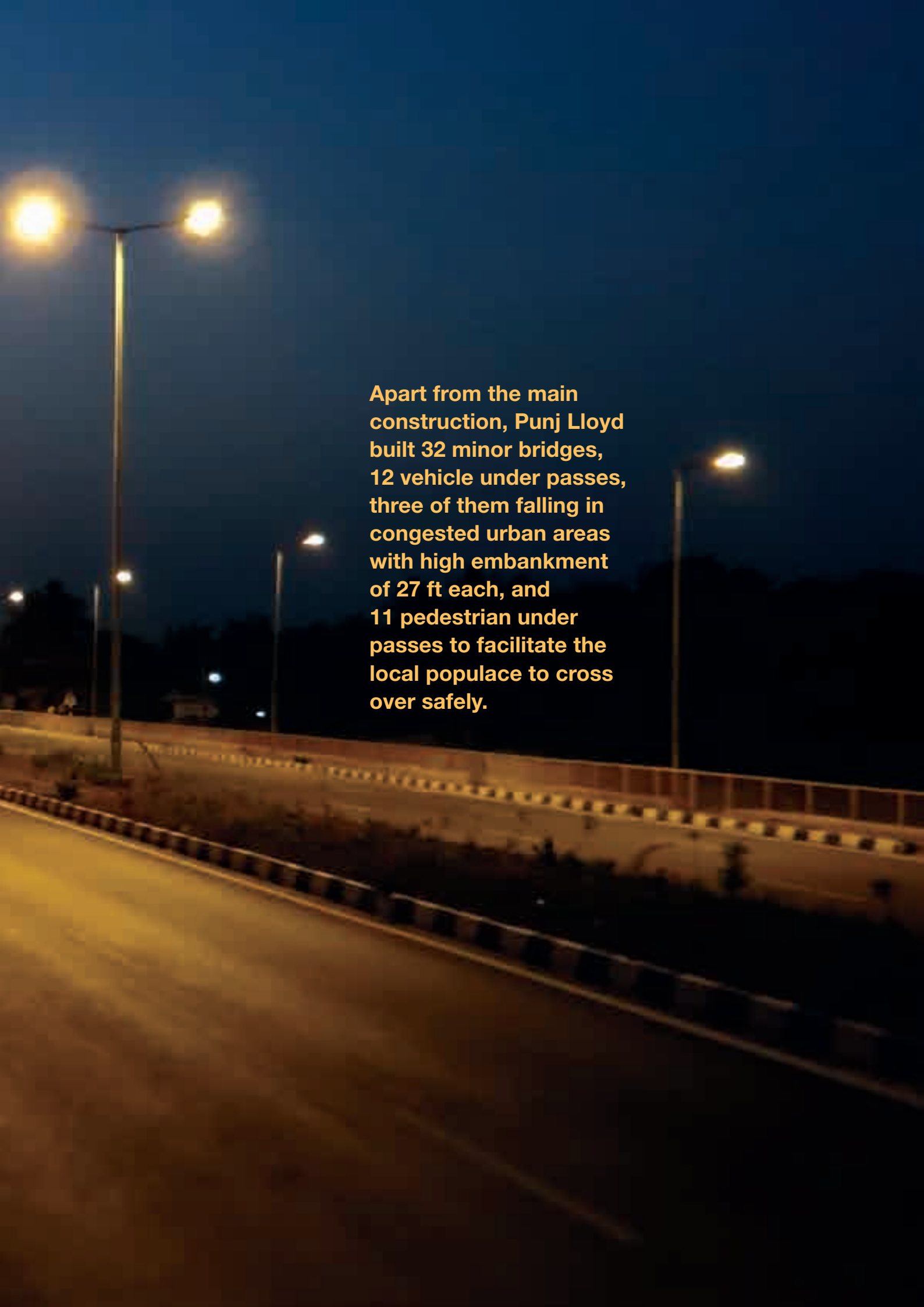
While the standards of highway construction in India and highway engineering technology are improving, construction without hindering the ongoing traffic still remains a challenging task.

To facilitate and monitor construction, Punj Lloyd compartmentalised the work into sections, the prime being the construction of two major bridges, one at river Musi, at km 126.025 and the other at river Paleru at km 190.861.

The main carriageways were constructed in small stretches and integration was achieved with no disturbance to traffic. The traffic was gradually guided back to one carriageway and then the other carriageway was constructed. To produce the quantity needed, mining

Providing seamless travel on quality roads, the Hyderabad Vijayawada highway is like a lens through which one whizzes past dusky mud huts in serene surroundings of green fields and then in sharp contrast, arrives at the glass and concrete city buildings.



A night-time photograph of a highway. The road is illuminated by several tall streetlights with two lamps each. A concrete barrier with a black and white striped base runs along the side of the road. The sky is dark blue, and the overall scene is lit with a warm, yellowish glow from the streetlights.

Apart from the main construction, Punj Lloyd built 32 minor bridges, 12 vehicle under passes, three of them falling in congested urban areas with high embankment of 27 ft each, and 11 pedestrian under passes to facilitate the local populace to cross over safely.

A new methodology to arrest soil erosion in high embankment areas was introduced. To avoid erosion, 'Geosil' squares were spread on slopes and filled with soil, topped up with specially procured grass from Jodhpur which grew fast.

was necessary. Fresh quarries had to be opened with the approval of the Mining and Geological Department of Andhra Pradesh. Agencies were identified to install and operate nine crushers to produce the GSB material.

Apart from the main construction, Punj Lloyd built 32 minor bridges, 12 vehicle under passes, three of them falling in congested urban areas with high embankment of 25-27 m each, and 11 pedestrian under passes to facilitate the local populace to cross over safely. To cater to the villagers' need to graze their cattle, nine cattle under passes were also made. Bus and truck lay byes, junctions, median openings and high tech 12 lane toll plazas were constructed to facilitate smooth traffic movement.

Bridge over Major Rivers

Construction of the six lane bridge at river Musi was one of the greatest challenges. The total bridge length of 428 m required diversion of water and controlled blasting in the hard rock river bed. Excavation had to be done to lay 3 m foundations for the erection of 3.5 m dia piers of required height due to the uneven river bed.

Construction of pier caps, each of 3 m height culminated in the required top base for girder launching.

A total of 140 precast girders, five each on either side and weighing 75 T each, were first towed on heavy trailers from the construction yard to the river bed and then launched with the help of two heavy cranes, raising them in tandem on pier 13 and two abutment caps at either end. A great achievement, planned and designed meticulously by our engineers, monitored at every level, resulted in construction without a single accident or injury in record time. Today, vehicles hurtle past at high speed on this 'S' shaped bridge.

Construction of the other major bridge at river Paleru, 192 m in length, had its own share of challenges with the river in full flood when construction commenced. It was a tremendous achievement to build on the right side while traffic zoomed on the left carriageway of the alignment.

The project team diverted the river flow towards the Vijayawada end of alignment by filling material from Hyderabad end up to a point where pier number 6 was to be erected, thus segregating the initial

construction area in the river bed.

Pier 7 & 8 were constructed from Vijayavada end by diverting the river water back between pier 4 & 6.

Launching of girders was the next major task, requiring filling the water free areas of the river, for trailer movement and creating stability of heavy cranes with their girder load. The final girder launch between pier 6 & 7 was complicated. However the team, having foreseen this had provided huge pipes for diverting the water. A total of 24 girders, each weighing 45 T, were placed on pier 8 and two abutment caps.

Not so Minor

Construction of minor bridges over the irrigation canal proved another challenge, particularly at km 165+073. Ten girders were placed using cranes on both ends with the trailer in the middle of the active carriageway. Vehicular traffic was stopped for a mere 40 minutes for placement of each girder, as holding up traffic for an extended period was not possible.

At km 169+205, foundations and pier construction above the water



level was carried out during the lean period of the irrigation canal, during 90 days of the year. A new minor bridge was constructed for traffic before the complete rehabilitation of the existing minor bridge began. Piers were erected in the lean period and the remaining work was completed while water flowed in the canal. A job well done professionally and skillfully.

Construction of 4 / 6 lane main carriageway and service roads in built up areas was no mean task. After being lashed by incessant rain in the first year of project commencement, the earth filling was organised well in time.

Along high embankments where vehicle under passes were constructed, 85,000 sqm of reinforced earth wall was constructed to retain earth and minimise its quantity.

Out of a total of 207 curves in the Punj Lloyd stretch of 116.500 km, six 'S' curves were so designed that a

motorist could easily negotiate them within permissible limits of speed.

Environment

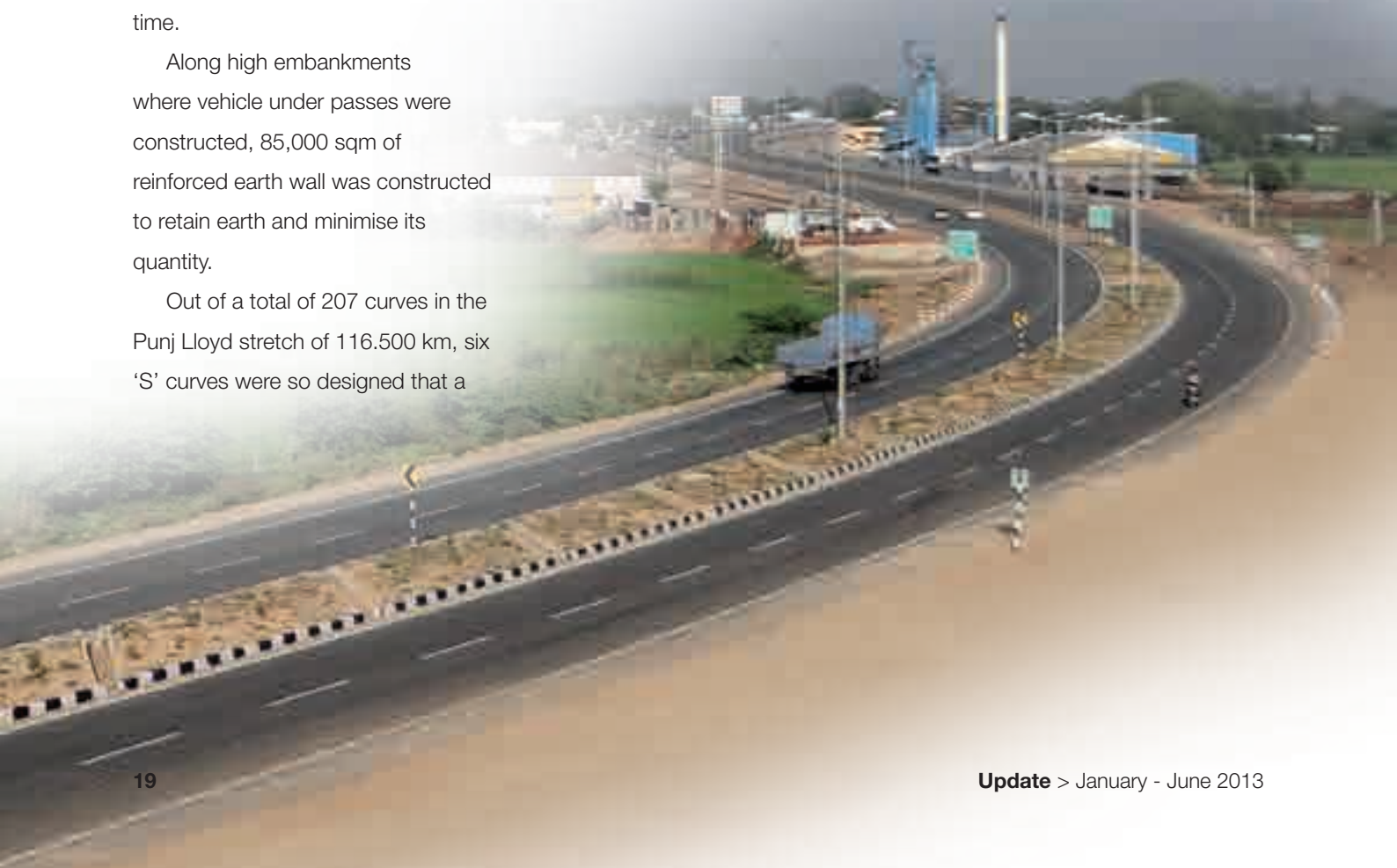
A new methodology to arrest soil erosion in high embankment areas was introduced. To avoid erosion, 'Geosil' squares were spread on slopes and filled with soil, topped up with specially procured grass from Jodhpur which grew fast.

Rain water to flush through chute drains in high embankment areas and about 38 km storm water concrete drains with covers were constructed to keep the highway clean and free from water logging.

Special emphasis was given to the service roads' separation from and merging with the highway in built up areas. A total of 41 km service roads were constructed in the Punj Lloyd stretch.

The highway was illuminated with high potential sodium vaporized lighting systems. A total of 2,400 HPSV lights were installed at various locations.

Keeping the ecology of the area in mind, extensive plantation was carried out not only on the medians but also on both sides of the carriageway.





The most difficult task was to maintain unhindered flow of traffic. Heavy traffic could not be stopped and a total diversion was not possible. This was overcome with meticulous planning.

The team co-ordinated with local and state government agencies to ensure that the work moved smoothly. 500 items of self owned equipment were deployed when project work was at its peak.

The project was a learning ground for the new graduate engineers who acquired skills of actual construction, maintenance and project management.

Project Highlights

A total of 6.2 MMT of good earth, 5 MMT of coarse aggregate, 16,000 MT of steel, 2.7 lac cum concrete work, 40,000 MT of bitumen and 6,000 MT CRMB were consumed to bring the highway to reality.

During the course of the road construction, Punj Lloyd was conscious of its community responsibility. The project was

spread in two districts – Nalgonda and Krishna of the state. In summer, water being scarce, as a gesture of goodwill, Punj Lloyd organised water tankers for the villagers at Kethepally, Inupamula. The people of Nalgonda are dependent on processed water, free of fluoride, a major water contaminant.

Punj Lloyd also constructed a small prayer ground at a mosque, a ground in Sai Temple at Nakrekal and distributed food to the needy during Thursday service at the temple.

Help was also provided for the construction of temples in villages Rayan Gudem and Mungala, besides deploying equipment for the relocation of an old temple at Inupamula. Punj Lloyd also organised safety training workshops for school going children and the villagers.

Challenges

The primary challenge was the delay





in the availability of land. The project management team was able to plan the project in such a way that idling of resources was avoided throughout the project duration.

Secondly, unprecedented rainfall during October and November 2010 affected the progress at various locations. However prompt action taken by the team in rescheduling project activities enabled meeting of deadlines. Periodic disruption in the movement of manpower and machinery, due to local agitation also affected the project. Punj Lloyd was able to overcome these issues with local cooperation.

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As is evident, the volume of

construction work was immense, keeping in mind the two major bridges, 32 minor bridges, 31 underpasses and 236 culverts.

Infrastructure

Three camps were established to complete this project on time. Each had a separate administrative office, laboratory, mechanical workshop, equipment, 160 TPH hot mix plants, 30 m³/hr concrete batching plant, wet mix plant, weigh bridge, material stock piling yard and other specialty equipment.

The successful completion of this highway project to exacting quality standards, has added another achievement to Punj Lloyd's list of accomplishments. ♦

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Entry in Kenya with a Road Project

Namit Pandey

Senior Manager - Business Development
Punj Lloyd Ltd

New Horizon

Punj Lloyd has always been proud of its entrepreneurial ability to push boundaries and venture into uncharted territory in pursuit of business. Ever since its first overseas project in Indonesia several decades ago, Punj Lloyd has enjoyed the challenges of working in diverse geographies and terrain, with reputed corporations the world over.

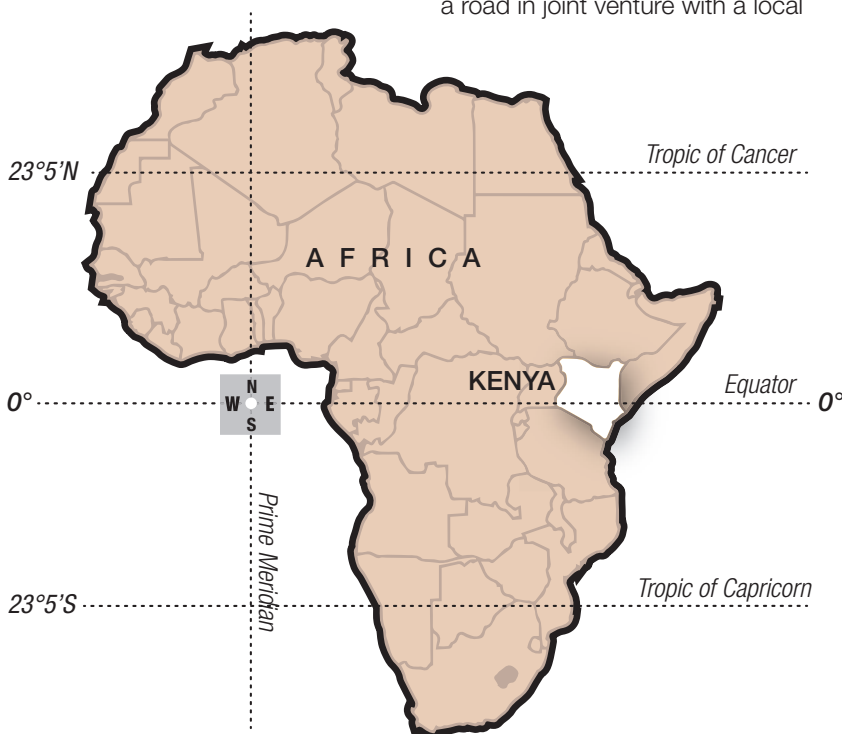
Our recent foray in Kenya marks our 21st country on the global map of Punj Lloyd's presence. Punj Lloyd is executing a project for building a road in joint venture with a local

partner in this East African country lying on the Equator.

Mount Kenya lends its name

Kenya was named after Mount Kenya, the second of Africa's highest mountain peaks.

Winning independence from British rule in 1963, Kenya became a Republic a year later. While Punj Lloyd already has a strong presence in North Africa with a number of infrastructure, pipeline and onshore drilling projects, this is the first time we have made ingress into an East African country while exploring neighbouring countries like Sudan, Uganda, Rwanda, Tanzania and Ethiopia.



Project site location

Government of Kenya has planned to invest substantially in the road sector, especially in the National and International Trunk Roads. As part of the Investment Programme 2010-2014, Loruk-Barpelo Road Project is being executed by Kenya National Highways Authority (Ke NHA) as a Class B National Trunk Road.

The project comprises part of a road running from Nakuru which is the third largest town of Kenya, through Marigat, Loruk, Tot, Lomut through Marich pass which eventually



The project comprises part of a road running from Nakuru which is the third largest town of Kenya, through Marigat, Loruk, Tot, Lomut through Marich pass which eventually connects an international trunk road leading to south Sudan.

connects an international trunk road leading to south Sudan. Travel time to the Sudan border will be reduced considerably with the completion of this project.

The road project site is in the vicinity of the Equator and is in the western part of the country. The site has moderately hot climate, though evenings are cooler. The project site is to the North-West of Nairobi, 300 km away. The road alignment is through uninhabited light jungle, mountainous in the North West.

The Start

The existing road is a gravel / earth road, to be developed to bitumen standard road within 60 m road reserve. No villages or habitation exist along the road corridor. Isolated habitation appear away from the road alignment except at

Chemoligot which is the District Headquarters of this under developed area. As one drives along the alignment, one has a feeling of being in the wilderness.

Kenya is well known for its safaris and world famous wildlife reserves such as Tsavo, MasaiMara, and Nakuru National Parks. All the 'big five' animals of Africa – Lion, Leopard, Rhino, Elephant and Buffalos are a common sight, besides Deer, Zebra, Giraffe etc. Often while traveling from Nairobi to the project site, one comes across Zebra, Buffalo, Deer, and Ostrich. It is worth mentioning that millions of animals migrate from the neighbouring Tanzania border to MasaiMara searching for food and water between June and September which is hailed as one of the Natural Wonders of the World.

Project Brief

In its finished form, the road will be a two way tarmac road, 62 km long, with 7 m of carriageway and shoulders of 2 m each on either side. Most of the road sections will be flat with mild slopes, the terrain being partially undulating. The last 15 km of alignment towards Barpelo will be hilly with hillocks on one side and valleys on the other with mild slopes. Blasting will be required for widening the hilly section. A retaining wall on the valley side and breast wall on the hill side with catch water drains and adequate culverts will be constructed.

In the 62 km stretch of road, 21 box culverts, a few cattle crossings, 170 pipe culverts are to be constructed. In addition, three major bridges have been planned over rivers - 100 m long at 26 km



established at midpoint through our 200 TPH three stage crusher. With advance planning and maintaining minimum stock level, requirements for other materials are being met.

Another challenge is availability of water for construction, the ground water table being very low. Water is available at Lake Baringo and River Ngyning at 30 km. It was found that pumping to water bowsers and transportation was not cost effective, both by way of fuel and wear and tear of the bowsers. Bore wells, as deep as 800 - 1,000 ft at most of the identified locations by the Government's hydrological team have not proved successful so far.

This problem has been overcome by an innovative mini water supply scheme in which water is being pumped from Lake Baringo up to a height of 65 m to a tank at ground level. A 4 km long pipeline was laid to bring water from Lake Baringo. The water is then allowed to flow by gravity upto the camp and beyond. The drinking water problem has also been resolved by upgrading an existing system and extending it to the camp location. Drinking water is also being supplied to a nearby school and local households to relieve their water scarcity problems.

Yet another challenge before the site administration is to maintain harmonious relations amongst various tribes and ethnic groups, which are employed as both skilled and unskilled construction workers. The workers from nearby hamlets are generally opposed to workers

over river Kegore, 120 m long at 30 km over river Nginyang, and 60 m long at 37 km over river Keleleu. Though bridges at 26 and 37 km will have 20 m span with RCC girders, over river Nginyang, the span will be of 40 m with steel girders. This has been done as the river swells heavily during flash floods after rains and carries with it uprooted trees with high water current.

Challenges

Ensuring the availability of construction material and spares for plant and equipment at the project site location which was not well connected, is one of the major challenges. Stone aggregate, the main material for road crust and concrete work are being produced at the quarry and crushing plant





road and onwards to International trunk road at Marich pass heading North West to the south Sudan border. Honourable Prime Minister, Raila Odinga launched the project on 14th December 2011 amidst a local gathering. As part of the launching ceremony, besides unveiling the plaque, he operated a dozer at the start point of the road. Tribal dances and songs added color to the ceremony. The ceremony culminated with a sumptuous lunch with local dishes for all.



from other countries and from different tribes. Punj Lloyd is however familiar with these cultural issues as most of its project site workforce is multicultural. Workers are encouraged to work harmoniously as a team and seek strength in their diversity. All workers are literate and speak good English, besides Swahili which is the official language. The workers are aware of their rights and privileges.

Launching the Project

The site location is relatively under developed. One hardly comes across any vehicular movement, though the district headquarters at Chemoligot falls mid way at 32 km. Construction of this road will lead to development of the area. This road will eventually connect to an existing National trunk

The project is making headway at a steady pace. Work in section 1 up to river Nginyang with earth work, lime stabilised sub base construction and numerous culverts is in full swing. Section 2 has also commenced with removal of top soil of the carriageway proper and road reserve. Geotechnical investigation of the bridge sites has been completed and substructure along with pile caps has been completed for a bridge at km 26. It is expected that the project will be completed on time. Punj Lloyd is committed to working in Kenya's infrastructure development for many years to come. ♦

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Punj Lloyd's MSID facility shines at Aero India 2013



The MSID has been accredited with ISO 9001, ISO 14001, OHSAS 18001, ISO 50001 (Energy Management System) and the prestigious AS 9100C Aerospace Standard.



Rahul Kapahi

Plant Head - Manufacturing and Systems
Integration Division
Punj Lloyd Ltd

Punj Lloyd has today established itself as a credible player in the Defence and Aerospace sector as a manufacturer of original defence equipment.

Punj Lloyd's Manufacturing and Systems Integration Division located at Gwalior, is a top of the line fabrication and assembly facility for defence systems. It is spread over 65 acres of land, capable of high precision manufacturing for both ferrous and non-ferrous material. In addition, the facility handles fabrication and machining of land system components, assembly, integration and testing

of weapons and maintenance and repair of existing weapons of the Indian Defence Forces. Capable of creating complex aero-structures, air frames and accessories, MSID is uniquely positioned to meet the exacting standards of the aerospace industry besides other defence and non defence requirements.

What is noteworthy is that in a short span, MSID has been accredited with ISO 9001, ISO 14001, OHSAS 18001, ISO 50001 (Energy Management System) and the prestigious AS 9100C Aerospace Standard.

Its lists of clients include HAL, Gun Carriage Factory, Nuclear Power Corporation of India, Raja Ramanna Centre for Advanced Technology and Bharat Heavy Electricals Ltd.

- State-of-the-art Metallurgy and Metrology laboratories
- Fully equipped fabrication shop including water jet cutting and stress relieving machines
- 5 axes, large bed sizes CNC machines capable of handling ferrous and non ferrous material including composites



**AS 9100C Certified
Manufacturing Facility**



MSID at Gwalior was appreciated by global aerospace OEMs for being the only high precision manufacturing facility with complete system integration capability in the private sector.

Machines at MSID

- Double Column Gantry Milling Machine: Table size: 8 x 3.5 m, Stroke: XYZ = 8 x 5.8 x 2.8 m
- Floor Type Machining Centre: Table size: 5 x 1.5 m, Rotary table Diameter 1.6 m, Stroke: XYZ = 8 x 2 x 1 m, Quill axis = 700 mm
- Horizontal Machining Centre: Table size: 3 x 2 m, Stroke: XYZ= 5 x 2.5 x 3.2 m, Quill axis = 700 mm
- Turn Mill: Stroke: XZ = 210 x 610 mm, Y = ±60 mm, Swing over saddle, Diameter = 360 mm
- Mill Turn 5-Axes: Stroke: XYZ = 1.2 x 1.2 x 1 m, Diameter 1 m
- Water Jet Cutting Machine, Stroke: 6 m x 3 m, Thickness 160 mm
- CAR Bottom Furnace 8 m x x 3.5 m x 2.5 m, max temperature 900° C
- TIG/MIG Welding
- Laboratory Equipment including CMM, Portable CMM, Spectrometer, Profile Projector, MPI Testing, UT Testing and over 250 First Principle testing instruments







Punj Lloyd in Aero India 2013

February 2013 saw Punj Lloyd showcase its aerospace defence capabilities at the Aero India, Asia's premiere air show. This year, the ninth edition of Aero India was held at Air Force Station, Yelahanka, Bangalore from 6 to 10 February.

A rapidly growing economy, defence preparedness and opening up of defence production to the private sector, have

given a major fillip to the defence industry in India. Prominent Indian players were seen on the grounds of Yelahanka. While Punj Lloyd designed a chalet at the venue, it also showcased its capabilities jointly with Air Works, India's leading provider of Aviation Services. Sitting at the patio of the chalet, one could witness the splendid aerobatic performance of the majestic Rafales and the Eurofighters, among others. Mindboggling loops, had the audience exclaim in rapture. The inside of the chalet had important visitors discuss business propositions and understand the company's defence set up, especially its state of the art manufacturing facility at Gwalior. Punj Lloyd is committed to the advancement of the nation with its one of a kind defence manufacturing capabilities, global partnerships and extensive global experience.

Strong Alliances

Punj Lloyd has agreements with leading global primes for collaboration in Indian programmes for a wide range of products including artillery systems, air defence gun systems, armoured vehicle technology, assault rifles and carbines. In artillery & air defence weapon systems, the Group's capability includes towed, tracked, wheeled and ultra light weapons and related sub assemblies and components.

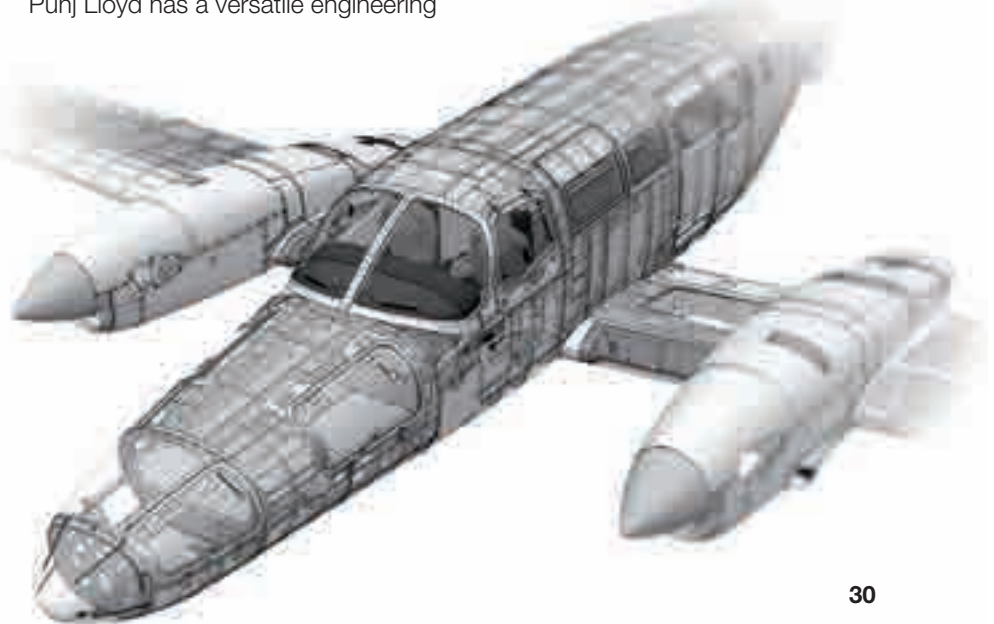
Punj Lloyd has stepped up its plans for Defence Aviation and holds licences for conversion of commercial aircraft for defence application and for manufacture of aero structure, sub-assemblies and composite components for the defence sector. Through its association with Air

Works, Punj Lloyd has access to hangars and a runway near Bangalore, capable of handling Airbus/ Boeing platforms and retrofit and integration of sub systems onto defence aircraft platforms.

Strong on-ground manufacturing capabilities are supported by equally strong backend teams. PL Engineering, a group company of Punj Lloyd has a versatile engineering

capability and undertakes design engineering, simulation, analysis and technical documentation for defence lands systems and aerospace.

PL Engineering has set up a joint venture company, Aeroeuro Engineering, an aerospace design and commercial aircraft manufacturing company. ♦





THE KEY TO GOOD DESIGN

Innovation

The power of a good design is not apparent to everyone! But design students, interior designers, design institutions or architects see the world through a different lens.

Punj Lloyd IDF 2013

Punj Lloyd truly believes that great design brings with it great power to accelerate economic growth within India. IDF will play a phenomenal role in promoting innovative, insightful design – supported by committed industry and government

“Lack of design thinking is too often allowed to compromise the quality, usability, and sensibility of India’s public spaces and infrastructure. In a nation that is urbanising as rapidly as ours, it’s critical to find new ways to curb this cycle.”



A world that can better in every respect with a little effort put into the right design! After all everything around us is design... be it the buildings we reside in, the subway we take to cross a road, or the watch that adorns our wrist.

As infrastructure creators, we understand the potential of a good design. That's why we partnered, for the second year, with the India Design Forum, a celebration of India's distinctive design aesthetic and the ways in which it continues its dialogue with the international design world. The India Design Forum had two components – starting with a Design Week – a week long schedule of cutting edge design exhibitions, workshops and curated events in venues across Mumbai, open to the public, followed by the Design Forum- a two day program at the NCPA – National Centre for the Performing Arts, Mumbai featuring talks by highly acclaimed design experts from all over the world and around India sharing how design informs our world and changes our lives, every day.



Punj Lloyd was the key partner to the event, created and conceptualised by the Coimbatore Centre for Contemporary Arts (CoCCA). Within the proceeding of the larger event, Punj Lloyd initiated various events to further inspire people into the world of design. A treat for young aspiring design students and the major highlight of the event was the first time book signing of 'Making' by Thomas Heatherwick, the creator of the Rolling Bridge in Paddington, and the Olympic Cauldron for the London 2012 Games at the special Punj Lloyd @ IDF corner.

To further encourage an attitudinal shift towards design, Punj Lloyd also hosted CINCH, an on the spot competition based on three design briefs - a foot over bridge, a product which is an amalgamation of modern technology and Indian art and an idea that could link the rural



Dean Mohsen Mostafavi called Heatherwick “one of the exciting people crossing boundaries between art, architecture, engineering. Not only is his work innovative for the different scales it represents; he gives us new ways to view daily items: from a bus to a master plan.”



Asif Khan interacting with design students at the Punj Lloyd Corner.



Oskar Zeita presents his creation to Aditi of IDF at the Punj Lloyd Corner.



Renowned architects - Sandeep Sangaru and Madhav Raman, the jury for CINCH.



Thomas Heatherwick takes a minute off from his book signing.

2013
PUNJ LLOYD CORNER
 ©

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India or bridge the gap between the urban and rural India.

The response to CINCH was outstanding with as many as 60 entries for the competition.

What could be more exciting for aspiring design students to meet great minds themselves? Punj Lloyd hence organised informal conversations with some of the top speakers at the forum. Material, technology, spaces and the immense possibilities of creation were discussed at these informal conversations with Asif Khan of UK and Oscar Zeita of Poland.

Atul Punj, Chairman Punj Lloyd Group also spoke at the Punj Lloyd - THINK panel touching upon the relevance of design-thinking in the Indian context. The panel jolted Indian minds to consider how design-thinking can contribute to solving India's societal challenges, and what leadership is required to grow a design-based culture in Indian businesses and society. In particular, the discussion focussed on how design-thinking could bring positive change to infrastructure and behavioral change in India's rapidly urban environment.

Speaking on the event, Atul Punj said, "Lack of design thinking is too often allowed to compromise the quality, usability, and sensibility of India's public spaces and infrastructure. In a nation that is urbanising as rapidly as ours, it's critical to find new ways to curb this cycle."

Punj Lloyd truly believes that great design brings with it great power to accelerate economic growth within India, and IDF will play a phenomenal role in promoting innovative, insightful design – supported by committed industry and government. ♦



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Diamond Hill MTR Station, Hong Kong (Interchange Station)



The existing Diamond Hill Station will be expanded to accommodate the interchange arrangement for the convenience of passengers

Nikki Lee

Public Relations Officer
Sembawang Engineers and Constructors

Backed with extensive experience in LRT and MRT in Singapore, Sembawang Engineers and Constructors made an entry into Hong Kong with a contract to build the Diamond Hill MTR Station extension in the Shatin to Central Link (SCL). Won in partnership with Leader Civil Engineering Corp. Ltd., the contract is worth \$212-million.

Shatin to Central Link (SCL)

Comprising 10 stations and 12 km of new tunnels, the 17 km SCL runs along the East-West corridor. Greatly enhancing connectivity and

convenience, six of these stations, namely Tai Wai, Diamond Hill, Ho Man Tin, Hung Hom, Exhibition and Admiralty, will be interchange stations to link several existing railway lines in the region.

Estimated to cost \$8.3 billion, this section is part of Hong Kong's strategic infrastructure plan to develop a railway network to meet its fast-growing future transport needs. There will be 9 car trains serving the East-West corridor, and 8 car trains serving the North-South corridors.

SCL connects the East-West corridor & North-South corridor

C1106 – Diamond Hill Station

Being the prime interchange station for both the Kwun Tong Line and the SCL, Diamond Hill Station is destined to be the railway hub for East Kowloon. Passengers travelling from Ma On Shan to East Kowloon will be able to change trains for the Kwun Tong Line at Diamond Hill Station, while Kwun Tong Line passengers will be able to change over to the SCL for destinations in the New





Territories in the north or Hong Kong Island in the south.

The existing Diamond Hill Station will be expanded to accommodate the interchange arrangement for the convenience of passengers.

The scope of work includes the temporary relocation of heritage structures such as the old pill box and former Royal Airforce hangar, and archaeological diggings required to facilitate the site; construction of a 250 m long, 30 m deep underground station with connecting passageways below a busy highway to the adjacent existing station; and coordination with interfacing railway operating systems and specialty contractors.

Modifications to the adjacent existing live station will also be required to aid the flow of passengers.

Challenges

The task of dismantling the steel frame of the Royal Air Force hangar for storage will be challenging due to corrosion and presence of asbestos in the structure.

To clear the area for construction, the pill box, an old Japanese World War II structure, needs to be relocated in one piece elsewhere. The MTR will work with the Antiquities and Monuments Office in order to determine the best restoration approach to temporarily relocate the old pillbox and conserve the hangar.

The new station also requires a 30 m deep excavation adjacent to the existing station. The challenge is to construct this excavation and limit associated ground deformations that could affect the existing station and live railway and other adjacent structures.

SCL Completion

Work for the Diamond Hill Station extension began in January 2013 and is targeted to be completed by 2018. The rest of the SCL, specifically between Hung Hom and Admiralty, is expected to be completed by 2020 in view of interfacing work, including the Wan Chai Development Phase II and Central-Wan Chai Bypass. ♦

The scope of work includes the temporary relocation of heritage structures such as the old pill box and former Royal Airforce hangar, and archaeological diggings required to facilitate the site

Jubail Export Refinery in Saudi Arabia

Port tank farm for one of the largest and most complex refineries in the world

K K Saha

Project Manager

Raman Chadha

Chief Operating Officer

Dayim Punj Lloyd

Dayim Punj Lloyd is briskly moving towards the completion of Package 9 of the Jubail Export Refinery Contract, awarded to it in 2009 by Saudi Aramco Total Refining and Petrochemical Company (SATORP), a joint venture established by Saudi Aramco and Total.

Jubail Export Refinery (JER), located at Al-Jubail on the eastern coast of the Kingdom of Saudi Arabia, has been designed for the production of white products such as diesel, gasoline, LPG, petrochemicals, and jet fuels from heavy crude oil. The petroleum products and related derivatives will

be marketed outside Saudi Arabia.

The unique location of the refinery, about 100 km north of Dammam, the capital city of the Eastern Province of Saudi Arabia, presents a two-fold advantage - proximity to both the international maritime waterways across the Gulf and to the energy sources and raw materials necessary for the facility's operation. When completed, the JER will have the capacity to process 400 KBD of Arabian Heavy Crude. The refinery will be one of the largest and most complex refineries in the world.

Arabian Heavy Crude will be supplied through the Aramco Royal Commission Interface area. Saudi Aramco will

While Punj Lloyd is known internationally for its core competence in pipelines, it is also a leader in construction of tanks and terminals with record completion of 300 tanks globally.

provide blending points and custody metering stations. The 30" dia pipeline will begin at the flanges of the metering stations. Departing from the metering stations, the pipeline will reach the scraping launcher station. From the scraper area to the Royal Commission (RC) Corridor, the pipeline will proceed underground, reaching the northern entrance of the refinery above ground on the sleeper way inside the RC Corridor. The pig

receiving station will be located within the refinery area near the crude storage tanks.

The Refinery

JER consists of several process units which are associated with plant utilities, permanent infrastructure, tank farms, pipelines, and interconnecting facilities. The construction of





this \$9.6bn export refinery comprises 13 packages with Punj Lloyd being awarded Package 9, the construction of the port tank farm.

The Refinery Port Tank Farm for JER shall provide the required loading, unloading and storage facilities in order to support the export of various products produced at the JER as well as the import of product for start-up.

The JER Port Tank Farm consists of the following units and facilities located at King Fahad Industrial Port (KFIP).

- Transfer Pipelines
- Air and Sewer System
- Port Tank Farm and Vapour of Organic Compound (VOC) Recovery
- Emergency Diesel Generator
- Port Operation Buildings
- Loading Facilities

While some of these facilities are located physically inside the Port Tank Farm, the loading facilities are located at the loading berths 54 and

62 of KFIP.

While Punj Lloyd is known internationally for its core competence in pipelines, it is also a leader in construction of tanks and terminals with record completion of 300 tanks and 9 million m³ storage capacity globally. This rich experience in various oil & gas verticals allows it to execute turnkey composite construction projects such as this, with professional ease and expertise.

The transfer pipelines in the KFIP scraper include two 24" pipelines for gasoline, one 24" pipeline for jet fuel A1, one 32" pipeline for diesel. Pipelines from the scraper receiving station upto storage area inside tank farm battery limit (BL) shall include one 20" pipeline for fuel oil and one 8" pipeline for Paraxylene. The scope also includes supply of all material and civil work such as trenching, sand bed preparation, back fill, compaction and surface finishing for underground pipelines.

The Tank Farm Area construction includes technologically diversified types of tanks including both fixed to floating roof types.

- Two storage tanks for Fuel Oil – The diameter and height of each of the fuel oil tanks are 54 and 22

m respectively, with a capacity of 42,000 m³ each. The roof of the tanks is cone roof column supported type. The roofs and shell of each tank will be insulated and equipped with tank heating and mixers. 1,221 MT of plates including structures is utilised to erect each tank.

- Two storage tanks for recovered hydrocarbons and imported products. The diameter and height of each tank is 44 and 22 m respectively, with a capacity of 28,000 m³ each. The roof of the tank is external floating type. 780 MT of plates including structures is utilised to erect each tank.
- Two storage tanks for Paraxylene. The diameter and height of each tank is 38 and 22 m respectively, with a capacity of 20,000 m³. The roof of the tank is fixed umbrella roof with internal floating type. The roofs and shell of each tank is insulated and equipped with tank heating and mixers. 662 MT of plates including structures is utilised to erect each tank.

The Plant is equipped with CCTV including devices using latest technologies such as Intruder Detection and Assessment System (IDAS) conforming to the requirements of local agency - High Commission for Industrial Safety and Security, among others Vapour Recovery Units were installed to recover and treat vapours coming from the marine vessel hydrocarbons



More than 2800 people from over 15 countries worked under the same roof for the accomplishment of this project.

loading systems. The Port Tank Farm including the operation building and utilities are spread over an area of 167,000 sqm with berth 54 & 62 around. 2.1 and 3.0 km away from the tank farm. 1.5 km and 2.2 km of the approach way to berth 54 and 62 are on jetty.

Loading Facilities

The loading facilities include Marine Loading Arms (MLA) for liquid and vapour, hydraulic units for the arms, sumps and pumps for the hydrocarbon recovery at each berth, piping and valves connected to the loading arms, and control system. The work of loading facilities of B-62 was carried out adopting offshore methodologies following all marine crew rules, regulations and local stipulations.

In completing this work, Punj Lloyd ensured adoption of stringent safety standards. As there was restriction to lay the pipelines through the access way, Madhwa Barge was brought to carry out installation of pipes on the pipe quay to Berth

62. Further, as the span between each structure on the quay to Berth 62 was 20 mts with a height of 20 mts from sea level, special type of hanging scaffoldings were erected with the help of towing boats to provide a platform for erection of pipes on the quay to Berth 62 with a live-load of 120 kg/sqm on the scaffolds.

The works in loading facilities of B-54 were also carried out in detailed manner. Berths 51, 52 & 53 which came across on the pipeway to Berth 54 are fully operational. As the quay to Berth 54 also included live lines, hot works were not permitted within 100 mts during presence of ships on Berths-51, 52 & 53. The mechanical/ structural work on the way to Berth 54 was executed diligently with economical deployment of resources, keeping in mind the non-availability of definite shipping schedule and the occupancy of ship in Berth-51, 52 & 53 almost 60 per cent of the month. A team of professional rescue divers was appointed while carrying out work.

The ROW passed through several corridors belonging to different authorities including the Royal Commission, Saudi Aramco, Shell Refinery, SABTANK, King Fahd Industrial Port, among others. All these agencies had extremely high safety standards. Also, much of the trenching work was stipulated to be carried out manually due to restriction in usage of mechanical equipment.

This project saw almost 240,000 dia-inch welding of various diameter of pipes running through pipe-racks & sleepers on land and jetties, 33,000 cum. of concreting, 2,400 MT of structural steel and 650 km of E&I Cables either direct buried or laid through conduits and trays.

The peak manpower for this project was more than 2,800 and people from over 15 countries worked under the same roof for the accomplishment of this project. An achievement of 15 million man-hours of working has been achieved by employing such multi-national and multi-lingual people. ♦

REGISTERED OFFICE

Punj Lloyd Ltd

Punj Lloyd House, 17-18 Nehru Place,
New Delhi 110 019, India
T +91 11 2646 6105
F +91 11 2642 7812
info@punjlloyd.com

CORPORATE I

78 Institutional Area, Sector 32
Gurgaon 122 001, India
T +91 124 262 0123
F +91 124 262 0111

CORPORATE II

95 Institutional Area, Sector 32
Gurgaon 122 001 India
T +91 124 262 0769
F +91 124 262 0777

REPRESENTATIVE OFFICES

Sembawang Engineers and Constructors Pte Ltd

460 Alexandra Road, #27-01 PSA Building
Singapore 119963
T +65 6305 8788 F +65 6305 8568
bd@sembawangenc.com

Punj Lloyd Ltd

21-22, Grosvenor Street, London W1K 4QJ
United Kingdom
T +44 207 495 4143
F +44 207 495 7937
farah@punjlloyd.com

PL Engineering Ltd

5-7 Udyog Vihar, Phase IV
Gurgaon 122 016, India
T +91 124 486 0000
F +91 124 486 0001
marketing@ple.co.in

SOUTH ASIA

Punj Lloyd Ltd

303, Leela Business, Park, 3rd Floor
Andheri Kurla Road, Andheri (East)
Mumbai 400 059
T +91 22 6748 7500
F +91 22 6748 7555
info@punjlloyd.com

EAST ASIA

Punj Lloyd Ltd

C1303, Orient International Plaza
85 Loushanguan Road
Shanghai 200 336
T +86 13825 175350
samarora@punjlloyd.com

SOUTH EAST ASIA

Punj Lloyd Pte Ltd

1 International Business Park
#10-04, The Synergy
Singapore 609917
T +65 6933 4999 F +65 6565 9880
asiapacific@punjlloyd.com

PT. Punj Lloyd Indonesia

Wisma GKBI, 17th Floor, Suite 1708
Jl. Jend. Sudirman No. 28
Jakarta 10210, Indonesia
T +62 21 5785 1944
F +62 21 5785 1942
info@ptpli.com

PT Sempec Indonesia

Wisma GKBI, 12th Floor, Suite 1209
Jl. Jend. Sudirman No. 28
Jakarta 10210, Indonesia
T +62 21 574 1128
F +62 21 574 1130
sempec@sempecindonesia.co.id

Punj Lloyd Oil & Gas (Malaysia) Sdn Bhd

Suite 1006, 10th Floor, Menara
Amcorp, 18 Jln. Persiaran Barat
46200 Petaling Jaya
Selangor Darul Ehsan
Malaysia
T +60 3 7955 5293
F +60 3 7955 5290
asiapacific@punjlloyd.com

Punj Lloyd Group JV

Sun Towers Building, Tower B
Unit B 2904, 29th Floor
123 Vibhavadi, Rangsit Road
Chatuchak, Bangkok 10900
Thailand
T +66 2 617 6755
F +66 2 617 6756
asiapacific@punjlloyd.com

CASPIAN

Punj Lloyd Kazakhstan LLP

Plot No. 7 "A", Atyrau Dossor Highway
DSK Region, Atyrau 060 000
Republic of Kazakhstan
T +7 7122 395 021/42
F +7 7122 395 038
plk@punjlloyd.com

Punj Lloyd Kazakhstan LLP

Room No.4-A-1, 4th Floor,
Turkmenbashi Shasly 54
Ashgabat City, Turkmenistan
T +971 5081 84492
plk@punjlloyd.com

MIDDLE EAST

Punj Lloyd Ltd

PO Box 28907, 501-504
Al Ghaith Tower, Hamdan Street,
Abu Dhabi, UAE
T +971 2 626 1604
F +971 2 626 7789
pllme@punjlloyd.com

Punj Lloyd Engineers & Constructors Ltd

Office No. 405-406, 22nd Floor
Ibn Batuta Gate Office
PO Box No. 502022
Dubai, UAE
T +971 4 457 1200
F +971 4 446 9731
pllme@punjlloyd.com

Punj Lloyd Ltd

PO Box # 55174, 18th Floor
Al Fardan Tower, West Bay
Doha, State of Qatar
T +974 407 4555
F +974 407 4500
pllme@punjlloyd.com

Punj Lloyd Ltd

PO Box 704, Postal Code 133
Office No. 21, 2nd Floor, Zakia Plaza
Bousher Area, Al Khuwair
Sultanate of Oman
T +968 2450 4594
F +968 2450 4593
pllme@punjlloyd.com

Dayim Punj Lloyd Construction Contracting Co. Ltd.

Tanami Tower, 8th Floor
Prince Turki Street (Near Corniche)
PO Box 31909, Al-Khobar 31952
Kingdom of Saudi Arabia
T +966 3 896 9241
F +966 3 896 9628
mkt@punjlloyd.com

Punj Lloyd Ltd

Office No. 61, Building 2080
Road 2825 Block 428,
Seef Tower Building, Al Seef
PO Box 65017, Bab Al Bahrain
Kingdom of Bahrain
T +973 1756 4500
F +973 1767 8500
pllme@punjlloyd.com

AFRICA

Punj Lloyd Ltd

PO Box 3119,
Goth Alshaal Alwahda Area
Tripoli, Libya
T / F +218 21 5567 0123
pllme@punjlloyd.com

Punj Lloyd Kenya Ltd

Plot No. 1870/VI/254/255/256
Kalamu House, Westlands, Nairobi
PO Box - 47323-00100
Nairobi (Kenya)
T +254 7887 11363
pllme@punjlloyd.com



Punj Lloyd GROUP

Energy • Infrastructure • Defence

www.punjlloydgroup.com

Punj Lloyd | Sembawang | PL Engineering