



**Petroleum Product Pipelines and associated facilities from
Mahul (Mumbai Suburban District) to Rasayani (Raigad District)
in Maharashtra**

PROJECT REPORT

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1. EXECUTIVE SUMMARY

Bharat Petroleum Corporation Limited owns and operates a 12 MMTPA Refinery at Mahul village, Mumbai. This compact Refinery is the only Refinery in the country without evacuation of products by Rail. In order to debottleneck, expand / add value added products, BPCL is in the process of acquiring about 700 Acres of land at Rasayani, Raigad District, Maharashtra which is about 45 Kms from the Mumbai Refinery. The expansion of refinery centric facilities envisaged at Rasayani includes Petrochemical facilities, White Oil Rail loading facilities & Lube oil Blending plants. The Petrochemical facilities envisaged requires raw materials like Propylene, Ethylene, Unconverted Oil (UCO) and Naphtha. The proposed Lube Oil Blending plant will receive Lube Oil Base Stock (LOBS) through pipeline. The proposed Naphtha pipeline is also proposed to be used for other white oil product for having a Railway wagon loading facility at Rasayani, thereby developing this important mode of evacuation for BPCL's Mumbai Refinery. The proposed pipelines from BPCL Mumbai Refinery to Rasayani with the capacity proposed is given below.

Sr.No.	Product	Pipeline Size	Capacity in MMTPA	Purpose
1.	Propylene	8"	0.45	Feed Stock to Polypropylene plant
2.	Lube Oil	10"	0.45	Base oil for Lube plant
3.	UCO	10"	1.0	Feed Stock to Polypropylene plant
4.	Multiproduct Pipeline	18"	6.4	Feed Stock to polypropylene plant and for Rail Loading to BPCLs upcountry locations

PROJECT REQUIREMENT & FACILITIES

The project envisages construction of above mentioned pipelines from Mumbai Refinery to BPCL Rasayani. The pumping facilities will have suitable capacity VFD drives (1 W + 1 S) at Mumbai to meet the required throughput. The system shall have dedicated Tele-communication system and Supervisory Control and Data Acquisition (SCADA) system. The aim of SCADA is to ensure effective management and supervision of the pipeline operating from a centralized location using Remote Telemetry Units (RTUs) located in SV (Sectionalizing Valve) Stations / Dispatch / Receipt Terminals of the pipeline. This system is also used for leak detection. The proposed pipelines shall be protected against corrosion externally by Impressed Current Cathodic Protection system and internally by dosing with Corrosion Inhibitors.

ENVIRONMENTAL ASPECT

Ministry of Environment & Forests has recommended that all bulk quantities of Petroleum Products be transported through well-designed pipelines to minimize risks in transportation by rail and road.

Transportation of petroleum products through pipeline is superior to other modes of transportation due to the inherent advantages of increased safety, reliability, reduced rail / road traffic congestion, minimal product loss in transit, lower energy consumption etc. Besides, pipeline projects are environment friendly by minimizing fugitive emissions / in-transit risk.

2. PROJECT DESCRIPTION

The proposed pipelines shall have the facilities as per the OISD 141 / PNGRB T4S standards along with the facilities related to Safety, Security and operation convenience so that seamless operations of Pipeline can be achieved. The facilities may be listed as follows:

- a. Mumbai Dispatch Station
- b. Pipelines from Mumbai Refinery to Rasayani
 - i. SCADA & Leak Detection System
 - ii. Telecommunication system
 - iii. Cathodic Protection System
 - iv. OFC based Pipeline Intrusion Detection System
- c. Sectionalizing Valve station
- d. Rasayani Receipt Station

SALIENT FEATURES OF THE PIPELINES

- Total length of each pipeline : 42 Km
- Onshore Length : 27 Km
- Offshore Length : 15 Km
- Dispatch / Pumping Station : Mumbai Refinery
- Receipt station : Rasayani ,Dist. Raigad
- SV station : 2 nos

PIPELINE

The pipeline will be designed and constructed in accordance with ANSI B31.4, OISD, PNGRB and any other applicable standards. Requirements of API Codes will also be met for the construction and laying of the pipeline. Pipeline thickness will be increased at road / rail / water body crossings as per the standards & guidelines of statutory authorities.

RIGHT OF USER

Pipeline Route shall be acquired as per the Petroleum and Minerals Pipeline Act, 1962 and rules laid down under the act. The ROU shall be acquired of width of 24 m which is suitable for laying the Pipeline and movement of Heavy Equipment's / Pipe Layers and Inspection Vehicles.

The pipeline will be buried at a depth of approx. 1.5 meter except at critical areas like river / rail crossings etc. where the depth will be more depending upon the design factors and statutory requirements.

CATHODIC PROTECTION SYSTEM

The Proposed pipelines shall be designed with the Permanent cathodic system in addition to anticorrosion coating. The Permanent CP system shall be designed in accordance with relevant codes, also temporary CP system shall be designed to protect the buried pipeline during construction / laying activities. However, the Permanent Cathodic Protection system i.e. sacrificial anode or impressed current shall be brought into operation after pipeline construction.

The Cathodic Protections system shall be designed on the basis of soil resistivity surveys of the route, pipe Line parent material and surface area. The Enroute CPPSM / CPTR Panels shall be installed preferable in SV stations along with anode bed for impressed current protection of the pipe line.

TELECOMMUNICATION SYSTEM

Pipeline shall be designed with the dedicated Telecommunication system to operate & monitor pipeline operations as prescribed in relevant standards / codes. The system shall be provided to cater the following requirements:

- a. Voice communication between Sectionalizing Valve Stations, Dispatch and Receipt stations for coordination, reporting and announcement regarding the pipeline Operations, safety and security matters.
- b. Data communications between SCADA server and RTUs
- c. CCTV surveillance system at SV stations, Receipt and Dispatch station
- d. EPABX telephony
- e. Video Conferencing between manned / Control station etc.

3. ENVIRONMENTAL / SAFETY ASPECT

MERITS OF PIPELINE TRANSPORTATION

The pipeline mode has been found to be superior to other modes of transportation due to the inherent advantages of increased safety, reliability and reduced rail / road traffic congestion, minimal product loss in transit, lower energy consumption etc. Besides, the pipeline project has been proved to be environmental friendly by minimizing gaseous emissions and in-transit hazard of movement of petroleum products as compared to other modes of transportation such as rail and road. The pipeline system will not have any adverse effect on the ecological balance and environmental conditions, since the pipeline will be completely buried underground.

Ministry of Environment & Forests has also recommended that all bulk quantities of petroleum products be transported through well designed pipelines to minimize risks in transportation by rail and road. The advisory Committee on Environmental Planning & Co-ordination of MOP&NG has also appreciated the pipeline project in view of its environment friendly character.

The transportation through pipelines is the safest & environment friendly means of movement of large volumes of petroleum products.

POLLUTION FREE PROJECT / OIL CONSERVATION

The pumping of petchem / petroleum products through the pipeline from Mumbai Refinery to BPCL Rasayani will be done using electric motors to drive the pumps. Therefore, there will be no air or water pollution in this sector due to this project. Additionally, this project will reduce the HSD consumption, that would have been incurred in the movement of the product by rail and road and hence, it will aid the petroleum conservation efforts.

There will not be any gaseous emissions at the receiving terminals, as the storage tanks will be provided with suitable roofs to minimize the vaporization of product. These terminals will be equipped with relevant safety code and safe-operating practices will be followed thus ensuring the safety of the neighborhood.

SAFETY FEATURES

The pipeline would be protected by a combination of internal and external corrosion protection systems by 3 layer polyethylene coating, impressed current cathodic protection and by injecting corrosion inhibitor. State-of-Art Supervisory Control And Data Acquisition systems (SCADA) for

continuous monitoring of operating parameters of the pipeline coupled with leak detection system, dedicated Tele-communication system would ensure immediate response in case of contingencies.

ADVANTAGES OVER OTHERS MODES OF TRANSPORTATION:

- i. Pipeline transportation requires the least energy as compared to other modes, including rail movement. Conservation of energy is a priority activity identified by the Govt. of India.
- ii. Pipeline transportation is environment friendly vis-à-vis rail / road movement. The environmental impact of the pipeline during construction, operation and maintenance phases is negligible. The environmental impact during construction is mostly reversible since, after laying the pipeline, the land is restored to normal use. During operation and maintenance of the pipeline, only a small quantity of effluent is generated at pumping stations and at terminals for which oil water separators are provided. These separators also take care of any oil and petroleum product spillage in the installation in a safe manner.
- iii. Pipeline transportation results in enhanced safety as there is minimum handling of product. The subterranean nature of the pipelines also makes them intrinsically safer than other modes of transportation.
- iv. Petroleum products being volatile in nature, certain losses during loading / unloading operations and during transportation are unavoidable. However, it is observed that these losses can be minimized in the pipeline mode. Experience shows that whilst pipeline transportation losses range between 0.1% to 0.15% the losses in the rail / road transportation are as high as 0.32% to 0.5% especially in lighter products, which are high value products.
- v. Natural calamities like floods, breaches, etc, disturb surface transport systems. As major part of the pipeline system traverses below the ground, the pipelines are normally less affected by natural calamities.
- vi. Transportation by modes other than pipelines, especially road, has an adverse effect on the environment through exhaust emissions apart from the wear and tear caused to the infrastructure like roads, leading to high maintenance cost for the economy.
- vii. Further, in case of pipelines, the land is restored back to its normal use after construction work is completed. In case of rail transportation, the land use pattern is permanently changed. In the pipeline option, it is possible to traverse even through very difficult terrain.

4. PIPELINE ROUTE DESCRIPTION

Section 1 : From Mahul Refinery to Land Fall point (LFP-1): 6 KM (ROW on government authorities land)

The Pipeline is originating from Mumbai Refinery and travels around 3 km inside refinery, further it traverses from Refinery to MbPT for around 2 Km. and from MbPT to intertidal area of around 1 Km and enters in offshore area at LFP-1.

Section 2 : From LFP-1 to LFP-2 : 15 KM

The line will be laid submarine for appox. 15 Kms. From LFP-1 to LFP-2. The LFP-2 is after crossing Amra Marg in creek below bridge at Morava Phata.

Section 3 : From LFP-2 to Rasayani : 21 KM (around 11 Km to be acquired as per P&MP Act.)

From Morava Phata, the line will run in en-route village and further it will run up to NH 4B – “D” point at Pargaon . From here the line will run parallel to NH4 B upto Nandgaon from here it will travel through villages viz Nandgaon, Turmala, Giravle, Somatne, Dahivli, Devlol and will terminate at Rasayani.

Co-ordinates:

Mumbai Refinery	: 19°01'39.08" N	72°53'33.67" E
Rasayani Petrochemical Complex	: 18°53'46.62" N	73°09'42.10" E

5. DESIGN BASIS

1. PIPELINE DESIGN PARAMETERS / CONDITIONS:

- a. **On-stream Hours** : 8000 Hours/year (Multi Product Pipeline)
5330 Hours/year (Propylene, Lube Oil , UCO Pipeline)
- b. **Economic Design Life** : 25 Years
- c. **Pipeline Length** : 42 Km
- d. **Basis for hydraulic** : All pipeline Hydraulics calculation will be based on standard product specification such as Density and Viscosity.
- e. **Pipeline grade/wall thickness:** As per design
- f. **Corrosion Allowance (min)** : 0.5mm onshore portion
3mm offshore portion
- g. **Pipeline internal roughness** : 45 microns
- h. **MAOP** : 90% of Design pressure
- i. **Max. Operating Temperature:** Above Ground 5 to 45°C
Subsoil 10 to 40°C
- j. **Design Pressure** : As per hydraulics.
- k. **Design Temperature (Max / Min):** Above ground (Station) 65°C / 0°C
Subsoil / Cross Country 50 °C / 0°C
- l. **Design Codes** : ANSI / ASME B31.4, OISD 141, OISD 214, DNV 101 & PNGRB T4S etc. Standard will be followed as applicable. However in case of contradictory stipulations the stringent condition will prevail.

- m. **Surge Control** : Suitable surge control measure like SRV Skid facility with connection to slop tanks at Rasayani considered. In addition, station piping up to pipeline receipt manifold and beyond receipt manifold up to tank inlet shall be tested at 21Kg/Cm².
- Surge analysis shall be carried out for the entire pipeline for all possible operating scenarios and pipeline thickness and SV / SBV opening / closing time to be established accordingly.
- n. **Pipeline laying** :Buried (Depth as per applicable Standard)
- o. **Pipeline Design factor** : 0.72 to 0.4 (as per applicable standard)
- p. **Corrosion protection system** : Corrosion inhibitor injection system at
(Internal) Mumbai
- q. **Corrosion protection system** : a) 3 LPE Coating
(External) b) TCP during Construction stage
c) Permanent Cathodic protection by impressed current (onshore portion) and sacrificial embedded anode (offshore portion). CP station to be provided at SV station as per design requirement.
- r. **Corrosion Monitoring System** : ER Probes with real-time display in C/R at Mumbai and Rasayani. In addition, corrosion coupons to be provide at MDT and Rasayani
- s. **Sectionalizing Valves** : Sectionalizing Valves (SV's) will be provided as per ANSI/ASME B 31.4, OISD 141, and PNGRB T4S standard. Total 2 nos. of SVs will be provided
- t. **Booster Pumps** : Booster Pump of suitable capacity shall be installed at BPCL Refinery for All four Pipelines
- u. **Mainline pumps** : Mainline Pumps of suitable capacity shall be installed at BPCL Refinery for all four pipelines

- v. Pipeline Overpressure : Protection Philosophy** : The Main Line Pump discharge piping upto shall be designed as per shut off pressure of the pump. Pipeline after the PCV is protected by High High pressure trip High Integrity Pressure Protection System (HIPPS) / two out of three voting logic of Pressure switch. High High Set pressure is 5% above MAOP to allow fluctuation in pressure control.

2. INSTRUMENTATION:

- a. General** : Adequate Instrumentation and control system will be provided for safe and efficient operation. The pipeline shall be monitored and controlled through panel based instruments. Both Mumbai and Rasayani station shall be monitored and controlled through dedicated PLC system. In addition supervisory control and data acquisition (SCADA) system shall be designed for remote monitoring and control.
- b. Instrument Mounting** : Various instruments like indicators, alarm annunciators, push buttons and lamps will be mounted on the control panels in the respective control rooms. Transmitters like pressure, temperature, differential etc. shall be remotely mounted on 2" stanchion. Impulse connection between primary process taps and these instruments shall generally be of ¾" MS pipe.
- c. Type of Control** : Electronic
- d. Final control of element:** Electrohydraulic
- e. Safety valve isolation :** Safety valve isolation will be provided Wherever required. These isolation valves shall be locked open and full bore.
- f. Density Meters** : Density meters will be provided as per process requirement.

3. SCADA & APPS:

- a. **General** : To ensure effective and reliable control, Management and supervision of this pipeline is envisaged to be monitored and controlled by SCADA system using Remote Telemetry Units along pipeline at SV stations & controlled centrally from SCADA Master Control Station (SMCS) located at Mumbai.
- b. **Span** : The SMCS will be linked through optical fibre with RTU's located along the pipeline. The following pipeline facilities will be considered in the tele supervisory span:
- a) Mumbai dispatch terminal including storage tanks signals interface
 - b) Sectionalizing valve stations
 - c) Rasayani receiving terminal including storage tanks signals interface
- c. **APPS (LDS)** : A suitable RTTM based and negative Pressure wave based leak detection system (APPS) will be provided with SCADA system. A dedicated LDS server at Mumbai dispatch station shall be considered.
- d. **Telecomm System** : Optical Fiber based telecom system shall be provided including SDH equipment's at all locations, which shall be a backbone system for carrying voice (EPABX), data (SCADA) and video (CCTV, VCS) information for the pipeline system. Common Telecomm system shall be provided for all four pipelines.

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