Cross Country Pipelines
An - Overview

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GM (Operations) IOCL- PL- HO
Demand Projections for Petroleum Products

(MMT)

Year

Source: Report of Working Group on P&NG Sector for the XI Plan
Refining Scenario - India

Source: Report of Working Group on P&NG Sector for the XI Plan
Supply Chain

Crude evaluation & Procurement?

What and How to Feed?

What & Where To Make?

Demand Forecast?

Distribution Planning?

What & where to Store and from where?
Modes of Product Transportation

- Pipelines
- Railways
- Water Ways
- Road
Typical Mode-wise Transportation of Petroleum Products

**INDIA**
- Rail: 30%
- Road/Coastal: 31%
- Pipelines: 39%

**USA**
- Coastal: 25%
- Rail: 3%
- Road: 4%
- Pipelines: 68%

* Source: PPAC
** Source: Association of Oil Pipelines, 2006
Pipeline System

- Pipeline systems are the safest and the most environment friendly mode of transportation of crude petroleum, refined products and natural gas.

- Being a closed system, minimal handling and transit losses as compared to other means of transportation, hence most efficient.

- Safety & Reliability – minimum disruptions.
# Modes for Transportation of Petroleum – A Comparison

<table>
<thead>
<tr>
<th>Head</th>
<th>Road</th>
<th>Rail</th>
<th>Pipeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy cost</td>
<td>Very High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Operating cost</td>
<td>Very High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Pollution</td>
<td>High</td>
<td>Low</td>
<td>Nil</td>
</tr>
<tr>
<td>Movement congestion</td>
<td>High</td>
<td>Low</td>
<td>Nil</td>
</tr>
<tr>
<td>Handling loss</td>
<td>High</td>
<td>Low</td>
<td>Negligible</td>
</tr>
<tr>
<td>Safety Hazards</td>
<td>High</td>
<td>Low</td>
<td>Negligible</td>
</tr>
<tr>
<td>Reliability</td>
<td>Low</td>
<td>Low</td>
<td>100%</td>
</tr>
</tbody>
</table>
Introduction of Pipelines in Oil Transportation

- The first cross country oil pipeline was laid in Pennsylvania (USA) in 1879 from Bradford to Allen town, about 109 miles long and 6” in diameter.

- In India after 1960, most of the refineries were installed in land-locked locations and then crude / product pipelines were laid.

- During 1960-63, Oil India Limited laid the first trunk crude oil pipeline, 1156 km long from Naharkatiya and Moran oil fields to the refineries at Guwahati and Barauni.

- The first cross country product pipeline was laid by IOCL during 1962-64 to transport products from Guwahati refinery to Siliguri.

- Pipeline industry has grown in parallel with the development of oil industry.
## Liquid Petroleum Pipeline Network – Industry

(Length in km)

<table>
<thead>
<tr>
<th>Company</th>
<th>Crude</th>
<th>Product</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOCL</td>
<td>4,366</td>
<td>6,286</td>
<td>10,652</td>
</tr>
<tr>
<td>HPCL</td>
<td>11</td>
<td>2,134</td>
<td>2,145</td>
</tr>
<tr>
<td>BPCL</td>
<td>-</td>
<td>1,389</td>
<td>1,389</td>
</tr>
<tr>
<td>GAIL</td>
<td>-</td>
<td>1,850</td>
<td>1,850</td>
</tr>
<tr>
<td>PIL</td>
<td>-</td>
<td>946</td>
<td>946</td>
</tr>
<tr>
<td>OIL</td>
<td>1193</td>
<td>-</td>
<td>1193</td>
</tr>
<tr>
<td>ONGC</td>
<td>6106</td>
<td>-</td>
<td>6106</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11,676</td>
<td>12,605</td>
<td>24,281</td>
</tr>
</tbody>
</table>

Figs as on 01.4.2010

Source: Petroleum & Planning Analysis Cell
Network of Gas Pipelines in India

**LNG**
- **Existing**
- **Upcoming**

**Transmission Pipelines**
- **Existing**
- **GAIL’s Planned Pipeline**
- **RIL’s East West Pipeline**
- **RIL’s Planned Pipeline**
- **GSPC’s Planned Pipeline**

**City Gas/ CNG**
- **Existing**
- **Planned**
- **LNG Terminal**

**Total Length = 11360 (Approx.)**

**Network Details**
- **DAHEJ**
  - 10 mmtpa
- **HAZIRA**
  - 2.5 mmtpa
- **DABHOL**
  - 5 mmtpa
- **KOCHI**
  - 5 mmtpa
- **MUNDRA**
  - 6.5 mmtpa
High Grade Steel Pipes (conforming to International Code API 5L) are used for constructing cross country Pipelines.

The typical sizes of the Pipes are as under:
- Diameter - 4 inch – 56 inch
- Pipe thickness - 0.219 inch – 1 inch

Pipes are welded and inspected as per the most stringent international standards.
The flow in the pipeline is achieved using high capacity pumps (liquid lines) & compressors (gas lines).

The normal flow in product pipeline is around 300-1000 KL/hr & for Crude Pipeline is around 1500-3400 KL/hr

The cross country pipelines are designed to operate at very high pressures (upto 120 kg/cm²) to achieve throughput.
Pipeline System

- To safeguard the Pipeline from external corrosion, the pipes are coated from the following type of materials:
  - 3LPE - Three Layer Polyethylene
  - 3LPP - Three Layer Polypropylene
  - DFBE - Dual Layer Fusion Bonded Epoxy
  - Coal Tar Enamel

- In addition to the anti-corrosion coating, the pipelines are also provided with custom designed Cathodic Protection systems.
PIPELINE CONSTRUCTION

ROW Grading/Leveling

Trenching
Transportation of Pre-coated Pipes to Site

String of Pipes in ROW
Welding of Pipes in Progress

Joint after Welding
Coating of the Welded Joint
PIPELINE CONSTRUCTION

Lowering of the Pipeline
PIPELINE OPERATIONS
CRUDE TRANSPORTATION

- CRUDE OIL IN SHIPS
  - JETTY/SPM SYSTEM
    - UNDER BUOY HOSES
      - PIPELINE END MANIFOLD
        - DOCKLINES / OFFSHORE / ONSHORE PIPELINE
  - OFFSHORE LINE
  - GATHERING STATION

- OIL FIELDS
  - STORAGE TANKS
    - PUMPING UNITS
      - CROSS COUNTRY PIPELINE
        - CRUDE OIL IN SHIPS
        - REFINERY TANKAGE
PUMPING STATION CUM TANK FARM
PRODUCT TRANSPORTATION

REFINED PRODUCT FROM UNIT OF REFINERIES

REFINERY’s PRODUCT TANKAGE

IMPORTED / OTHER PRODUCT IN SHIP/OIL JETTY

TANKAGES

PUMPING STATION

CROSS COUNTRY PIPELINE

PUMPING CUM DELIVERY STATIONS

DELIVERY TERMINAL
Product Pipeline Pump cum Delivery Station
Mainline pumping units
Typical – Terminal Station
In multi-product pipelines, different products are pumped one after the other in a particular sequence. This leads to generation of a mixture where two products meet. This mixture is called interface.

Interface generation is dependent on factors like Pipeline diameter, velocity of the flow, topography of the land, turbulent flow conditions and the type of products.
LENGTH OF INTERFACE

- The pipeline can not be operated precisely unless the length or the volume of the interface and its location can be known at any given time, once the length of interface is determined, it is easy to calculate its volume from line fill.

- The length of interface is given by the following formula.

  \[ C = 11.75(D)^{0.5} (L)^{0.5} (Re)^{-0.1} \]

  where,
  
  - \( C \) = length of interface (ft.)
  - \( D \) = Inside diameter (ft.)
  - \( L \) = distance of travel (ft.)
  - \( Re \) = Reynolds number of 50 : 50 mixture

- The interface has to be absorbed by one of the products without affecting its quality. This necessitates product sequencing and batch lengths based on product characteristics.
Meeting Product demand in market

To match /balance production at Refinery and supply demand at ToPs including tankages capacity

Avoiding/Minimizing Tanker demurrage

Optimizing Pipeline Operating Cost (-Less consumption of power & fuel)

How much --- Where ----- When
Earlier pipelines were operated under Administered Price Mechanism (APM) and were re-imbursed based on cost plus formula.

Presently pipeline tariff is fixed at 75% of railway freight.

In future Petroleum & Natural Gas Regulatory Board (PNGRB) will fix tariff of individual pipeline based on common carrier principle.
THANK YOU