PLANNING & SCHEDULING OF CRUDE/PRODUCT PIPELINES

BD Yadav GM(O) PL-HO

08-09-10
Presentation Plan

Planning and Scheduling of Product and Crude Oil in Cross Country Pipelines

- Objective
- Supply plan procedures
- Pipelines operation
- Schematic flow diagram for Pipelines system
- Interface generation and diffusion
- Batch length
- Sample product pipeline scheduling for a month
- Crude Oil Scheduling
- Pipeline economics
How to have efficient planning and scheduling of Pipeline Operations in order to optimise the supply chain
Modes of Product Transportation

- Pipelines
- Railways
- Water
- Road
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>
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<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>
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<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>
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<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>Very High</td>
</tr>
</tbody>
</table>
What is Batching

It means transportation of different products in a sequence down the same pipeline. The goal is to schedule the volumes of each product transported by pipelines and to ensure delivery to the customer--------?
Batching

- **Right Quality**
- **Right Quantity**
- **Right Time**
- **Right Place**
- **Right Cost**
PRODUCT TRANSPORTATION

1. Refined Product from Unit of Refineries
   - Refinery Product Tankage

2. Imported / Other Product in Ship/Oil Jetty
   - Tankages

3. Pumping Station

4. Cross Country Pipeline

5. Pumping Cum Delivery Stations

6. Delivery Terminal
Mathura - Jalandhar Pipeline

Delhi Pump cum delivery Station

Sonepat T-Point

Ambala PS/DS

Panipat PS/DS

Meerut Terminal

Jalandhar Terminal

Mathura Pump station
Schematic of a Pumping cum Delivery station
In a product pipeline, multiple products are transported through a common pipeline. Various products are pumped inside the pipeline one after another.

- Since all the products packed inside the pipeline moves at very high velocity there bound to have some intermixing of products.

- These intermixing of two adjoining product inside a pipeline is called **INTERFACE**

- To maintain the product quality the interface is normally blended in the inferior product

- Interface generation is dependent on the factors like Pipeline diameter, velocity of the flow, topography of the land, turbulent flow conditions and the type of products.
### PUMPING SEQUENCES IN A PIPELINE

<table>
<thead>
<tr>
<th>Sequence of Pumping</th>
<th>I/F between</th>
<th>Base product in which I/F is taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>SK-MS-SK</td>
<td>SK &amp; MS</td>
<td>MS</td>
</tr>
<tr>
<td>SK-HSD-SK</td>
<td>SK &amp; HSD</td>
<td>HSD</td>
</tr>
<tr>
<td>SK - ATF - SK</td>
<td>SK &amp; ATF</td>
<td>SK</td>
</tr>
</tbody>
</table>
1. For batch operations a specific volume of petroleum products is accepted for shipment.

2. The interface of adjacent product batches during any transportation can sometimes be mixed into one or both of the adjacent batches.

3. For interface from adjacent batches of different grades of the same product, such as regular gasoline, the mixture is typically blended into the lower grade.

4. This “downgrading” reduces the volume of the higher quality product.

5. Kerosene is maintained pure w.r.t. HSD and MS. SKO can be blended with MS and HSD.

6. No contamination of any product is allowed in ATF.
**CALCULATION OF BATCH LENGTH**

**Depends on**
- Type of product
- Destination of product
- Expected qty of I/F
- Tolerance limit of intermixing in mother product
- These batches are able to absorb the I/F at delivery end without affecting quality

**Example**
- MS/ SKO I/F generation say 100 KL => 50 SKO+50 MS
- Tolerance limit of SKO in to MS= 1% (say)
- Minimum batch length of MS say ‘x’
- 1% SKO means x*1/100=50 so, x=5000 KL.
- If MS to be delivered at intermediate TOPs with I/F absorption at end stn, then batch length of MS at source to be= 5000 KL+ qty of MS to be delivered to TOPs
Supply Chain Present

Crude evaluation & Procurement?

What and How to Feed?

What & Where To Make?

Corporate

Demand Forecast?

Distribution Planning?

What & where to Store and from where?
Operations Targets

- Annual Targets (MOU/Internal)
  - Annual pumping plan

- Monthly Targets
  - Monthly pumping plan

- Daily Targets
  - Daily pumping plan
Demand Distribution

- Company demand data from field
- Production data from Refineries.
- Product inventories from field.
- Finalized data for product imports.
- Optimize product distribution
Supply Plan Procedure

Review

- Current month’s refinery production & consumption pattern.

Estimation

- Opening inventory of next month.
- Production numbers of indigenous refineries for next month.
- Demand through demand forecasting model for next month.
- Total import / Export of finished products for next month (Demand - Availability).

Monthly distribution planning

- Company wise, Location wise, product wise, mode wise on minimum transportation cost basis so as to meet full demand of industry.
Projection of sales by Sales group at Marketing HO/ State Offices/ Field Offices

Processing and Distribution plan by Optimisation group at CO

Crude Indenting plan by Technical Service group at Refineries HQ

Crude procurement plan by IT group at CO

Crude shipment plan by Shipping group at Refineries HQ

Pumping plan by Crude oil pipelines

Pumping plan by Product pipelines

Planning forums - BPO, IDCM, CO(OPT), CMC, MOU/ S TGT, Monthly meeting
Meeting Product demand of 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
Elements of Batch Scheduling

- Periodicity of review - daily - Ever dynamic
- Type of Crudes/Products - Requirement vis-a-vis availability / Mkt demand
- Ref/Mktg safety stock/ minimum inventory norms
- Refinery Process rate & process cycle
- ETAs of Tankers & Type of crude
- Line fill content/ batch sizes
- Rate of Pumping
- Product/Crude Stock & Ullage - Tank wise at all locations- Refinery, T-points, Mother station
Elements of Batch Scheduling

- Pumping Capacity/ Engine availability & any shutdown requirement
- M/L allowable op. pressure de-rating if required on M/L health ground/ M/L maintenance
- Minimizing T-Point booster running
- Maximizing batch length to min. no of interfaces
- Minimize line shutdown by varying flow rate from min. to max.
- Delivering On Spec - Products / Crude
- Any requirement of trial run by Ref for establishing crude assy with new crude
- Conveying crude mix to Refinery before delivery
## Sample : Scheduling for a month

### PLAN -September '10 - CTMPL

<table>
<thead>
<tr>
<th>Station</th>
<th>MDP Demand in TKL</th>
<th>PLAN in TKL</th>
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<tbody>
<tr>
<td></td>
<td>MS</td>
<td>SKO</td>
</tr>
<tr>
<td>Trichy</td>
<td>11.4</td>
<td>4.9</td>
</tr>
<tr>
<td>Madurai</td>
<td>14.1</td>
<td>10.0</td>
</tr>
<tr>
<td>Sankari</td>
<td>18.2</td>
<td>6.1</td>
</tr>
<tr>
<td>Total</td>
<td>43.7</td>
<td>21.0</td>
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</table>
# Sample Scheduling Daywise for a month

**Pumping in TKL Deliveries in TKL**

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<tr>
<th>Date</th>
<th>Chennai Batch</th>
<th>Chennai Qty in TKL</th>
<th>Chennai Total in TKL</th>
<th>Trichy Batch</th>
<th>Trichy Qty in TKL</th>
<th>Trichy Total in TKL</th>
<th>Madurai Batch</th>
<th>Madurai Qty in TKL</th>
<th>Madurai Total in TKL</th>
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<tr>
<td>01-Sep-10 (from 00:00 hrs to 07:00 hrs)</td>
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<td>53</td>
<td>7.4</td>
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<tr>
<td>(Upto 24:00 Hrs)</td>
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<td>2.3</td>
<td>2.3</td>
<td>59</td>
<td>1.1</td>
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</table>
1. Expected tanker arrival, quantity and type of crude as intimated by IOC shipping department.

2. Monthly process Nos. of each Refinery grade wise decide the flow rate in each section of pipeline.

3. Refinery gives parcel sizes of crude in accordance to process cycle. Keeping in view the monthly product distribution as decided by Corporate optimisation group.

4. Crude stock at all pipeline location and Refinery as of 1st of the month taken along with the line fill of various section of pipeline.

5. Minimum batch of various type of crude required at each refinery which is based on available tankages.
PUMPING STATION CUM TANK FARM
## 6. Refinery processing plan for a month

<table>
<thead>
<tr>
<th></th>
<th>Koyali</th>
<th>Mathura</th>
<th>Panipat</th>
<th>Total</th>
<th>Vadinar Allocation</th>
<th>Vadinar Pumpable Stk as on 1st Day of the month</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH</td>
<td>100</td>
<td>160</td>
<td>0</td>
<td>260</td>
<td>205</td>
<td>51</td>
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<td>LS</td>
<td>300</td>
<td>265</td>
<td>200</td>
<td>765</td>
<td>800</td>
<td>96</td>
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<tr>
<td>HS</td>
<td>165</td>
<td>325</td>
<td>280</td>
<td>770</td>
<td>783</td>
<td>296</td>
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<tr>
<td>TOTAL</td>
<td>565</td>
<td>750</td>
<td>480</td>
<td>1795</td>
<td>1788</td>
<td>443</td>
</tr>
</tbody>
</table>
Crude Scheduling in SMPL

- Obtain processing plan (ILP-Industrial Logistics Plan) of refineries for the month from RHQ.

- Obtain crude tankers schedule for the month.

- Total crude wise (HS, LS & BH) Monthly plan of MR & PR are split into batches as per refineries’ process cycle and capability.

- These batches are scheduled in CM & CP sections based on the daily avg. throughput.

- The batch requirement of CM, CP along with Chaksu stock / ullage availability are projected on to VC section.
These projected requirement of batches are scheduled in VC section.

In the same way as in the CM & CP section, the JR plan is split and schedule into batches in VK section also.

As done at the Chaksu node, the batch requirement of VC, VK along with Viramgam stock / ullage availability are projected on to SV section.

These crude batches are scheduled in SV and see the availability of crude as per tankers arrival dates at Vadinar.

The above back-ward scheduling is viable when the crude requirement projected at Vadinar is matched with tankers arrival.
Due to Volatile suppliers market of crude, the procurements of crude happen not only as per our requirement, but also as per the availability of crude in the market.

Often this mismatch of our requirement and tanker schedule exists in the system, hence we have to make forward scheduling as well as per the tankers schedule.

An optimum batch plan is obtained with this back-forth scheduling.

These schedules get reviewed & updated on daily/ weekly basis as per the actual operations and constraints at Refineries/ Pipelines.
Earlier pipelines were operated under Administrated Price Mechanism (APM) and were reimbursed 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.
OPEN FORUM........
THANK YOU