Chapter - 7

Marketing Terminals/ Depots

7.1 Introduction

The biggest challenge in the complete supply chain of Petroleum Products is to reach out to almost-37000 retail outlets all over the country. Every element in this value chain has to have unfailing reliability in all circumstances. Building this reliability in the logistics is a marvel of supply chain management.

The products from refinery are transported to the secondary points called Depots and Terminals through pipelines / wagons / tank trucks. The basic jobs undertaken at these depots / terminals is warehousing, wherein receipt, storage and dispatch of various products is accomplished. These secondary supply points are responsible for maintaining supply lines to Retail Outlets and numerous Institutional Customers.

Terminals/Depots mainly undertake pumping operations. Any energy conservation initiative in Depots/Terminals should aim at improving energy efficiency in pumping operations. PCRA has found energy conservation potential of upto 30% in Depots/Terminals operation.

A Depot/Terminal uses the following energy intensive machinery for accomplishing its operations:-

1. Pumps
2. DG Sets
3. Lighting
4. Air Conditioners
5. Miscellaneous Machinery

7.2 Energy Conservation Opportunities

The major energy conservation opportunities, identified by PCRA, during its various energy audit studies are as per the following details:

7.2.1 Pumping System

From Energy Conservation point of view, the area of concern in a terminal / depot operation is over sizing. The typical protocols for handling the problem of over sizing in pumping operation needs to be customized to the terminal operation, as the flow requirement here may vary over a wide range.

At the terminal, the number of bays operating at any particular instance is changing as a result of the change of flow requirement. Recirculation is the method of Capacity Control on Pumps being employed at present. In this method, a part of the product being pumped is recirculated back to the suction of the pump, to regulate the flow of the loading terminals/ bays. This type of control is the most energy inefficient, since only a part of the actual energy being consumed is useful and the rest is lost in re-circulation.

The average working hours of the pumps observed at one of the terminals is as follows:

SKO Pump- 5 hrs per day with 1 to 3 bays operating at a time (1500 hrs/annum)
MS Pump - 3 hrs per day with 1 to 2 bays operating at a time (900 hrs/annum)
HSD Pump- 5 hrs per day with 1 to 3 bays operating at a time (1500 hrs/annum)
From each bay, one tank lorry is filled

Case Study 1 : Installation of Variable Frequency Drive (VFD) on HSD Pump

Brief

In order to eliminate / minimize the continuous Power losses in these systems, it is suggested to install a variable frequency drive (VFD) on the Pumps. This would enable the plant to control the flow through a feedback signal to the pump and vary the RPM to exactly match the requirement.

With the installation of a Variable Frequency Drive, energy savings could be achieved by reducing the RPM of the pump and the subsequent reduction in the power consumption per litre of material actually delivered.

Energy Savings

(i) Variable Frequency Drive (VFD) for HSD Pump of rated flow 2400 LPM

Material	Operation	Effective Flow after bypass – LPM	Power Drawn in kW (measured values)		Net reduction in the power drawn in kW	Estimated working hours of the Pumps per annum	Estimated energy savings kWh
			At present (with by pass open)	After installing VFD			
HSD	If 1 bay in use	825 (34.3% of 2400)	11.6	3.6	8.0	1500	12000
HSD	If 2 bays are in use	1250 (52.08% of 2400)	14	4.0	10.0	1500	**15000**
						Avg	**13500**

Energy Savings

- *Energy Savings per annum* *13500/0.93 = 14516 kVAh*
- *Monetary Savings per annum* *Rs 0.486Lacs (@Rs 3.35 per kVAh)*
- *Estimated Investments* *Rs 1.3 Lacs*
- *Payback period* *33 months*

(ii) Variable Frequency Drive (VFD) for SKO Pump

In case of SKO (40 HP motor), the savings shall be on the same lines

- *Total Energy Saving per annum* *14000/0.93=15053 kVAh*
- *Annual Savings* *Rs 0.504 Lakhs (@Rs 3.35 per kVAh)*
- *Estimated Investments* *Rs 1.5 Lakhs*
- *Payback period* *36 months*

Energy Savings

(iii) Operation by closing the bypass valve : *By simply closing the return valve on the recirculation line, savings can be achieved.*

Average kW saving observed in HSD, MS & SKO Pumps = 3 kW each
Expected annual running hrs of HSD and SKO Pumps = 1500 x2 =3000hrs
Average annual energy saving in HSD and SKO Pumps = 9000 kWh
Expected annual running hrs of MS Pump = 900hrs
Average annual energy saving in MS Pump = 2700 kWh
Total annual energy saving in HSD, MS & SKO Pumps = 11700 kWh

- *Total Energy Savings per annum* *11700/0.93=12581 kVAh*
- *Annual Savings* *Rs 42146 (@Rs 3.35 per kVAh)*
- *Estimated Investments* *Nil*
- *Payback period* *Immediate*

When, no receipt of the product is taking place at TLF area and the pump is run with bypass closed, only churning of the product takes place; the pump being centrifugal shall be able to bear the backpressure. In spite of this, the operator should take care to avoid prolonged idle running of the pump

7.2.2 Illumination

Illumination in Depot / Terminal is basically required for safety reasons. Receipt operation is conducted during the night in locations receiving supply through Railway Wagons / Pipelines. However, illumination in the tank lorry filling Area, tank farm area and the buffer area is provided through flame proof lighting fixtures. The lighting is predominantly through high mast towers.

The following case study has been taken from the actual study taken up by PCRA.

Case study 2 : Replacement of 40W Tubelights having electromagnetic chokes by 36W T/L with Electronic chokes, assuming 0.8 as load factor

Energy Savings

Total energy consumption by 131 nos. 40 Watt Tubelights with electromagnetic chokes, taking working hours (12 hrs daily in 300 days).	=	(40+15)x 131 x 0.8 /1000
	=	5.76 kW
	=	3600 hrs
	=	20736 kWh/year
Total energy consumption by 131 nos. 36 Watt tubelights with electronic chokes, taking working hours (12 hrs daily in 300 days).	=	(36 + 2) x 131x 0.8 x 3600
	=	14337 kWh/year
So, total energy saving	=	6399 kWh/year
taking pf as 0.82	=	7804 kVAh /year
monetary saving potential	=	Rs 27, 860.00/year (@ Rs 3.57/kVAh)
Total investment @ Rs.400/- per choke	=	400 x 131 = Rs.52400.00
Payback period	=	23 months

Case Study 3 : Replacement of 40W tubelights with electromagnetic chokes by 28W T/L (T5), assuming 0.8 as load factor:

Energy Savings

Total energy consumption by 131 nos. 40 Watt tubelights with electromagnetic chokes, taking working hours (12 hrs daily in 300 days).
= (40+15)x 131 x 0.8
= 5.76 kW
= 3600 hrs
= 20736 kWh/year

Total energy consumption by 131 nos. 28 Watt tubelights (T5), taking working hours (12 hrs daily in 300 days).
= (28) x 131x 0.8 x 3600
= 10564 kWh/year

So, total energy saving = 10172 kWh/year
taking pf as 0.82 = 12405 kVAh /year
monetary saving potential = Rs 44,286.00/year (@ Rs 3.57/kVAh)

Total investment @ Rs.700/- per retrofit = Rs.91700.00

Payback period = 25 months

Case Study 4 : Replacement of 100W Incandescent lamps by 15W Compact Florescent lamps (CFL), assuming 0.8 as load factor:

Energy Savings

Total energy consumption by 77 nos. 100 Watt incandescent lamps, taking working hours (12 hrs daily in 300 days).
= (100)x 77 x 0.8
= 6.16 kW
= 3600 hrs
= 22176 kWh/year

Total energy consumption by 77 nos. 15 Watt CFL lamps, taking working hours (12 hrs daily in 300 days).
= (15) x 77x 0.8 x 3600
= 3326 kWh/year

So, total energy saving = 18850 kWh/year
taking pf as 1.0 = 18850 kVAh /year
monetary saving potential = Rs 67294.00/year (@ Rs 3.57/kVAh
Total investment = Rs 11,000
Payback period = 2 months

Case study 5 : Installing daylight sensor for controlling street lights and out side lights, thereby saving 1hour of daily running, assuming 0.8 as load factor

Energy Savings

Total energy consumption by 43 nos 250W sodium vapour lamps, 54 no 400W Sodium vapour lamp, 10 no 250W Mercury Vap lamp and 42 no 160W Mercury Vap Lamp , taking working hours (1 hrs daily in 365 days).
= (43x250 + 54x400 + 10x250 + 42x160) x 0.8
= 33.26 kW
= 365 hrs
= 12138 kWh/year

So, total energy saving, taking pf as 0.82 = 14802 kVAh/year
Monetary saving potential = Rs 52843.00/year (@ Rs 3.57/kVAh

Total investment = Rs 5,000

Payback period = 2 months

7.2.3 Energy Saving Opportunity in DG Sets

The loading of the DG set as shown in the Figure- 7.1, significantly influences the fuel efficiency of a DG set. The associated losses due to operation of the DG set below the optimum limit is reflected by significant increase in the specific fuel consumption. As can be seen from the curve, the generator should be loaded between 65% to 85%. The loading beyond 85% does not give any extra efficiency, but it decreases engine life.

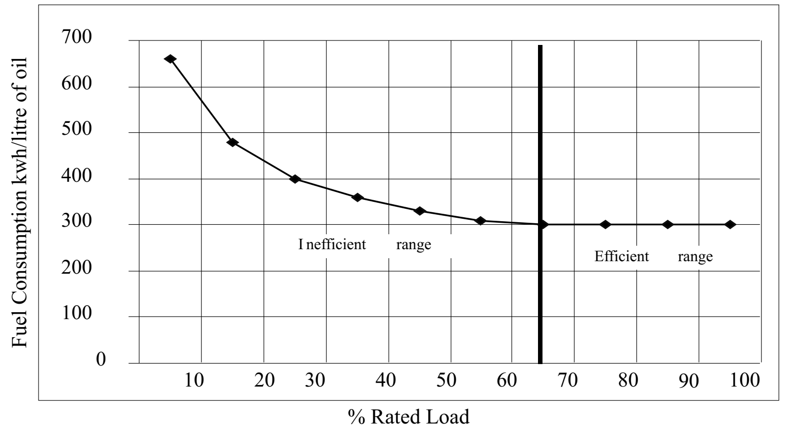

Figure - 7.1 Load Characteristics of DG Set

It is generally observed, that keeping the security lights on during nights is a security requirement. To keep the lights on, DG set is operated in case of power failure. It is further observed that if only lighting load is served by the DG set, the DG set becomes under loaded and hence the specific generation ratio of the DG set goes down drastically.

It is suggested to have a smaller DG set to take care of lighting load only during nights.

Case Study 6 : Improving the efficiency by overhauling of DG Sets

The specific power generation of two no. DG sets available in a terminal was assessed as per the following details :

Equipment	***Specific Power Generation (kWh/liter of fuel oil)***	***Remarks***
DG Set. - 1 (200 kVA)	*2.9*	*At 41% of rated load*
DG Set. - 2 (75 kVA)	*2.5*	*At 51% of rated load*

The specific power generation of both the DG sets is very low, normally it should be > 3.8 units per litre of HSD. As can be seen from the table, the performance of 200 kVA DG set as compared with 75 kVA DG set is better.

Corrective measure in the form of major overhauling was undertaken. This resulted in improvement of specific power generation. The yearly consumption could be reduced from 17 kl per year to 11.75 kl per year resulting in savings of 5.25 kl HSD worth Rs. 17,0000/- per year.

Monitoring of specific power generation and early detection of deviation would help decide when to conduct major overhaul.

Major overhaul may include :

(I) Calibration of fuel injection system
(ii) Setting of fuel discharge pattern
(iii) Removal of hot spots
(iv) Reduction of blow-by
(v) Replacement of cylinder liner/piston rings etc.

DG sets - Other recommendations:

(i) The DG set should be maintained properly and loading should be monitored so as to achieve specific power generation of 3.80 units per litre,

(ii) Energy meters may be installed in the DG panels, to enable the plant to monitor specific power generation of each of the DG set on regular basis.

(iii) It should be ensured that the single phase loads on the DG set should be distributed appropriately so that the unbalance between the 3 phases is not more than 10% of the total DG set capacity.

(iv) The lube oil consumption should not exceed 1% of fuel consumption.

(v) DG room should be properly ventilated to achieve best results. The allowable temperature of inlet air is ambient ±5 ^{0}C. Arrangements should be made to maintain required inlet air temperature, because for every 3 ^{0}C rise in inlet air temperature, there is 1% loss of fuel.

7.2.4 Optimization of Power Supply System Billing and Demand Side Management

The Energy conservation opportunities mentioned above in the Bottling Plant section under the following heads hold good for terminal / depots as well:

a) Transformers
b) Demand Side Management
c) Maximum Demand Control / PF Control
d) Voltage Optimization

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Section 4
Energy Conservation
in
other Industry sectors