



BHARAT PETROLEUM CORPORATION LIMITED

DETAILED FEASIBILITY REPORT

FOR

**Kochi – Coimbatore – Erode - Salem
LPG Pipeline**



MECON LIMITED
(A Govt. of India Enterprise)
DELHI - 110092
INDIA



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

CONTENTS

CONTENTS

| Chapter No. | Description | Total Pages |
|-------------|-----------------------------------|-------------|
| 00.00 | EXECUTIVE SUMMARY | 17 |
| 01.00 | INTRODUCTION | 05 |
| 02.00 | NEED & JUSTIFICATION FOR PROJECT | 04 |
| 03.0 | OPTIMISATION STUDY | 04 |
| 04.00 | PROCESS FACILITIES | 17 |
| 05.00 | PROCESS DESIGN BASIS | 10 |
| 06.00 | PIPELINE SYSTEM | 13 |
| 07.00 | SCADA & APPS SYSTEM | 10 |
| 08.00 | TELECOMMUNICATION SYSTEM | 14 |
| 09.00 | ELECTRICAL | 09 |
| 10.00 | INSTRUMENTATION & CONTROL | 04 |
| 11.00 | CAPITAL & OPERATING COST ESTIMATE | 15 |
| 12.00 | IMPLEMENTATION METHODOLOGY | 04 |

CONTENTS

Annexures & Drawings

| S. No. | Drawing No. | Title |
|---------------------------------|---|--|
| MAINLINE & TERMINALS | | |
| 1. | - | Pipeline Simulation Sheet |
| 2. | MEC/23N8/05/28/M/001/0001, R0 (Sheet 1 of 6) | Process Flow Drawing for Import Despatch Terminal at IOCL Kochi (Mainline pumps) |
| 3. | MEC/23N8/05/28/M/001/0001, R0 (Sheet 2 of 6) | Process Flow Drawing for Receiving Terminal at IOCL BP Kochi. |
| 4. | MEC/23N8/05/28/M/001/0001, R0 (Sheet 3 of 6) | Process Flow Drawing for Despatch Terminal at Kochi refinery. |
| 5. | MEC/23N8/05/28/M/001/0001, R0 (Sheet 4 of 6) | Process Flow Drawing for Receiving terminal at Coimbatore. |
| 6. | MEC/23N8/05/28/M/001/0001, R0 (Sheet 5 of 6) | Process Flow Drawing for IP Station cum Receiving Terminal at IOCL BP Erode. |
| 7. | MEC/23N8/05/28/M/001/0001, R0 (Sheet 6 of 6) | Process Flow Drawing for Receiving Terminal at IOCL BP Salem |
| 8. | MEC/23N8/05/E9/E/000/1081, R1 | Single Line Diagram at Despatch Terminal Kochi |
| 9. | MEC/23N8/05/E9/E/001/1081, R1 | Single Line Diagram at Kochi Refinery |
| 10. | MEC/23N8/05/E9/E/002/1081, R1 | Single Line Diagram at IOCL Coimbatore |
| 11. | MEC/23N8/05/E9/E/003/1081, R1 | Single Line Diagram at BPCL Coimbatore |
| 12. | MEC/23N8/05/E9/E/004/1081, R1 | Typical Single line Diagram of Power Distribution board for SV Station |
| 13. | MEC/23N8/05/E9/E/005/1081, R1 | Typical Single line Diagram of Power Distribution board for IP Erode Station |
| 14. | MEC/23N8/05/E9/E/006/1081, R1 | Typical Single line Diagram of Power Distribution board for RT Salem Station |
| 15. | MEC/23N8/05/E9/E/007/1081, R1 | Typical Single line Diagram of Power Distribution board for IOCL Bottling Plant |
| 16. | MEC/23N8/05/15/M/001/0002, R0 | Pipeline Network Schematic Diagram |
| 17. | MEC/23N8/05/15/M/001/0003, R0 | Pipeline Route Map |

Chapter - 00
EXECUTIVE SUMMARY

00.01 Introduction

BPCL have embarked on the expansion of their Kochi Refinery from the present refining capacity of 9.5 MMTPA to 15.5 MMTPA. Under the expanded capacity, among other things, the production of LPG is slated to increase to about 1.26 MMTPA and as per information made available, 0.5 MMTPA of LPG is likely to be consumed at Kochi itself. Evacuation arrangement for the balance 0.76 MMTPA of LPG needs to be in place by the time the refinery expansion comes on stream. With the above aim in mind the present project was conceived by BPCL as a cross country underground LPG pipeline between Kochi Refinery and Coimbatore and accordingly an Expression of Interest (EOI) was submitted to the sector regulator i.e PNGRB.

Further, IOCL have proposed an Import facility for LPG at Puthuvypeen near Kochi which will handle the imported LPG cargoes. LPG from terminal is proposed to be transported through the pipeline to various LPG plants of IOCL in the region.

Based on the inputs / comments received on BPCL's EOI during the period of public consultation, PNGRB subsequently enhanced the scope of the project by extending the pipeline conceptualised earlier, on both sides to connect the IOCL's bottling plants at Kochi , Coimbatore , Erode and Salem on the downstream side and IOCL's LPG import facility at Kochi on the upstream side.

Hence, the present project entails, despatch terminal at IOCL import facility at Puthuvypeen near Kochi and transportation of the same through underground steel pipeline up to Kochi Refinery and IOCL bottling plant at Udayamperoor. The despatch at Kochi refinery will handle the LPG available at the refinery as well as that received from IOCL import terminal. The same would be transported through an underground pipeline to Coimbatore, Erode and Salem.

As a part of this exercise BPCL have assigned MECON Limited, New Delhi the task of carrying out a feasibility study and prepare a Detailed Feasibility Report (DFR) for the Kochi-Coimbatore-Erode-Salem LPG Pipeline project.

00.01 Need & Justification for the Project

The present LPG project proposal for laying the LPG pipeline is a step in the direction to meet the challenge of increased demand for transporting LPG in the most energy efficient way through underground pipeline. As against all the other means, transportation of LPG through pipeline works out to be the cheaper, safer and more convenient. The facilities being proposed to be installed under the present project will be catering to the LPG requirement of the whole region.

Presently, the LPG transportation in the region is primarily through road tankers. By executing the above project, IOCL & BPCL will be saving substantially on the tanker based transportation in terms of both cost as well as logistics and improve on safety. As mentioned earlier, the proposed pipeline would be transporting LPG to meet the requirements of five bottling plants in the region, out of these four belong to IOCL and one to BPCL. All of these bottling plants are currently depending on LPG transportation by road.

The present project therefore, would substantially benefit the region in terms of providing a network of pipelines comprising around 458 kms of underground LPG pipeline thus resulting in substantial saving on road transportation costs as also improved safety. Once the present project is commissioned, five LPG bottling plants in the region can switch from road tanker based LPG transportation to receiving it through pipelines. This would result in substantial financial and logistical savings for the oil marketing companies. In addition to the above, added economic and social benefits shall also accrue in the form of less of traffic congestion and improved ease of vehicular movement on the roads as with the proposed pipeline system coming on stream, a large number of LPG road tankers would be off the roads.

00.03 Optimisation Study

The flow capacity of any pipeline system is a function of the diameter of the pipeline and the associated pumping capacity. An economic design of the pipeline system involves establishing an optimum combination of pipeline diameter and pumping system (number of pumps and their capacity). A smaller diameter pipeline would require a higher pumping system and on the other hand a higher sized pipeline would need a

proportionately lower pumping infrastructure. Thus a lower capital investment in pipeline may turn out to be getting partly offset by higher pump system capital costs and the recurring higher pump operating costs.

Optimization study has been carried out for pipeline diameter of 8" & 12" considering appropriate wall thickness (with maximum safety margin of 40% as per OISD 141 for over crowded area). The entire system has been designed with maximum pressure rating of the main pipeline of 600# from Kochi Refinery to IOCL's Salem terminal and with 300# between IOCL's import facility to Kochi refinery and upto IOCL's bottling plant at Udayamperoor

For transportation of the required quantity of the LPG throughput, under the prevailing process conditions of the limiting available pressure at Kochi Refinery / import terminal end and the required minimum pressure of 13 kg/cm²(g) at any receipt terminal, various options have been evaluated through software simulation.

From the study it has been found that the most optimum pipeline system would be as follows :

- From IOCL's Import terminal to IOCL's Coimbatore terminal and to Udayamperoor bottling plant : Line of size 12" and total length of 288 km.
- From IOCL's Coimbatore terminal to IOCL's Salem terminal : Line size of 8" diameter and total length 170 km.

Optimisation study and analysis has further shown that requirement of 296 m³/hr flow is possible with 12" & 8" diameter pipeline combination with only one mainline pumping station at Kochi Refinery without requirement of any intermediate pumping.

The minimum throughput of the system desired by PNGRB for the pipeline is 1.28MMTPA including common carrier margin of 25%, accordingly, the present pipeline system is designed for the said throughput. However, in the event of the throughput exceeding 1.28MMTPA, it will be required to provide an additional Booster Pumping station at a suitable location in between Kochi and Coimbatore.

00.04 Process Facilities

The process facilities take into account transportation of LPG at 1.28 MMTPA. Two product sources are identified namely IOCL Import Terminal at PuthuVypeen and Kochi refinery. MLPUS at IOCL Import Terminal will cater the pumping requirements upto IOCL bottling plant Udayamperoor, Kochi as well as the suction pressure requirement for MLPUs at Kochi Refinery. 12" dia. pipeline is proposed from IOCL Import Terminal to IOC Udayamperoor and the distance is 50 km. MLPUs at Kochi Refinery will pump the product through 12" dia. x 238 km. pipeline to IOCL Bottling Plant at Coimbatore via BPCL bottling Plant at Coimbatore and thereafter through 8" dia. x170 km. pipeline to reach IOCL Bottling Plant at Salem via IOCL Bottling Plant at Erode. Pump (1w + 1s) is planned at IOCL Import Terminal. In the case of Kochi Refinery, 1 booster + 1 stand-by and 1 MLPU + 1 stand-by pump is proposed.

Proposed receipt and despatch terminals will have filtration, metering, control valve, etc. The underground pipeline shall be provided with cathodic protection system. There will be 44 nos. SV Stations and 1 no. Intermediate Pigging Station along the entire route of the pipeline.

00.04.01 IOCL Import Despatch Terminal

LPG will be supplied from the proposed LPG mounded storage at the terminal which is not a part of the pipeline system. Despatch facilities shall include installation of two nos. MLPUs (1 working + 1 spare) at dispatch terminal. The MLPs are provided to meet the required output for IOCL Kochi Import terminal flow rate and also to meet the NPSH required for mainline pumps at Kochi Refinery. The MLP will also take care of the pressure drop at filter and mass flow meter. Pumps with VFD will be used to maintain the flow rate from 0.5 to 1.28 MMTPA. Scrapper Launcher will be provided for intelligent pigging operation. Basket Filter, Flow Meter, Control Valve shall also be provided.

00.04.02 Kochi Refinery Despatch Terminal

LPG will be supplied from the existing LPG mounded storage in Kochi Refinery. Despatch facilities, including installation of two nos. booster pumps (1 working + 1 spare) and two nos. mainline pumps (1 working + 1 spare) at dispatch terminal to be located inside Kochi Refinery at

Ambalmugal, Kochi, Kerala. The Booster pumps are provided to meet the required output and also to meet the NPSH required for mainline pumps. The booster pump will also meet pressure drop required for filter and mass flow meter. Pumps with VFD will be used to maintain the flow rate from 0.5 to 1.28 MMTPA.

Scraper Launcher will be provided for intelligent pigging operation. Basket Filter, Flow Meter, Control Valve shall also be provided. Booster pumps will also take care of supply of LPG to IOCL bottling plant at Udayamperoor and mainline pumps will take care of supply of LPG upto Salem via Coimbatore and Erode BPCL/ IOCL Bottling Plants.

00.04.03 Pipeline

Mainline

Laying of 12" dia. pipeline, approx. 288 km. long from IOCL Import Terminal to IOCL Bottling Plant, Udayamperoor via Kochi Refinery and Kochi Refinery to IOCL Bottling Plant, Coimbatore via proposed BPCL Bottling Plant, and laying of 8" dia., approx. 170 km. pipeline from IOCL Coimbatore to IOCL Salem via IOCL Bottling Plant, Erode. The transportation capacity will be 1.28 MMTPA.

Simultaneous withdrawals at IOCL Bottling Plants at Coimbatore, Erode and Salem are considered for the design.

I. P. Station

Intermediate Pigging Stations (IPS) shall consist of Scraper Launcher and Scraper Receiver along with SV Station at Chainage 151 km. for 12" pipeline and another Intermediate Pigging Station (IPS) shall consist of Scraper Launcher and Scraper Receiver along with SV Station at IOCL Bottling Plant, Erode for 8" pipeline.

SV Station

Sectionalising Valve Stations at suitable locations as per OISD along the route @12 km on an average and wherever additionally required as per Safety standards and requirements of approving authorities.

00.04.04 Receipt Terminals at BPCL Bottling Plant and IOCL Bottling Plant at Coimbatore

Receipt facilities,
Including Scraper Receiver, Basket Filter, Control Valve, Flow Meter, etc.

00.04.05 Flare System

At Kochi Refinery Despatch Terminal, relief from vents, drains and TSV relief, depressurising lines from Filters, Pumps and Launcher, etc. will be hooked up to refinery flare header. Cold flaring facility has been envisaged at IOCL Bottling Plants at Coimbatore, Erode and Salem and BPCL Bottling Plant at Coimbatore.

00.04.06 Instrumentation and SCADA system

PLC -based instrumentation & control system is envisaged for terminal and pipeline facilities. For effective, reliable management, monitoring and control of terminal & pipeline, SCADA system has been envisaged.

00.04.07 Leak Detection and APPS

Suitable leak detection and APPS system are also envisaged for this pipeline.

00.04.08 Fire Protection Facilities

Depending upon the nature of the units to be protected from fire, various types of fire protection systems viz. Fire hydrant and Monitor system, Automatic Medium Velocity Water Spray System and Automatic Fire Detection-cum-Alarm System and Portable Fire Extinguishers have been envisaged. Fire fighting pumps and fire water storage and fire fighting compressors are to be extended from the respective IOCL/ BPCL installations. Only extension of Fire water network from the existing fire water ring is considered.

00.04.09 Other Facilities

Facilities like sampling, cathodic protection system, telecommunication system, CCTV system and video conferencing, etc. have also been

provided for essential & reliable operation of the pipeline. Suitable external coating shall be provided to protect the pipeline against external corrosion. Arrangement for 4 nos. mobile flares shall be made.

50 m. x 50 m. area will be used for each mainline SV Station. Each SV Station will be provided with underground Motor Operated Ball Valve of 12" / 8" size. The power supply for MOV will be met from SEB Electric Supply or DG Set. However direct power from Battery will be used for operation of SVs. Single A/C Room for SCADA and UPS will be provided at each SV Station. Other facilities include MCC room (including inert gas flooding), battery room, guard room etc.

00.05 Process Design Basis

00.05.01 Basic Parameters

| | | |
|-------|-----------------------------------|--|
| i. | Products to be transported | Liquefied Petroleum Gas (LPG) |
| ii. | Product properties/specifications | 50:50 (Propane : Butane). Properties and specification as per IS 4576. |
| iii. | Pipeline Design Throughput | 296 m ³ /hr (\approx 1.28 MMTPA) |
| iv. | Turn Down | 40% or the minimum continuous flow of mainline dispatch pumps, whichever is higher. |
| v. | Design codes | ASME B31.4 and OISD-141 Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail. |
| vi. | Design capacity of pumps | Pumps will be specified for 10% extra flow. |
| vii. | Sparing philosophy for pumps | 100% for Single pump (1W+ 1S) |
| viii. | Type of pump driver | Electric motor. |

00.05.02 Project Scope

- Despatch facilities at IOCL, Import terminal at Kochi by providing suitable LPG Pumping facilities of desired flow rate along with hooking up with proposed storage at IOCL import facility at Kochi at the battery limit.
- Despatch facility at Kochi Refinery by providing suitable pumping facilities of desired flow rate along hooking up with existing mounded storage at the battery limit
- Laying of 12" x 39 Km. LPG Pipeline from IOCL import despatch terminal to Kochi Refinery despatch terminal from where 12"x 11Km. LPG pipeline upto IOCL bottling plant at Kochi (Udayamperror), and 12"x 238 Km.LPG pipeline upto IOCL Bottling Plant at Coimbatore via proposed BPCL Bottling plant at Coimbatore and 8" x 170 Km. LPG pipeline from Coimbatore to Salem via IOCL, Bottling Plant, Erode with SCADA & TELECOM.
- Construction of Intermediate Pigging station and Sectionalising Valve station as per OISD- 214,141 etc. with all allied facilities.
- Construction of Receipt Terminal facilities at IOCL, Bottling Plant, Kochi (Udayamperror), proposed BPCL Bottling Plant, at Coimbatore, IOCL Bottling plants at Coimbatore, Erode and Salem
- Associated fire water network along with MV spray system at Despatch & Receipt facilities, as per OISD 214 , OISD 144 and all other applicable codes. Fire water requirement for the respective terminals and despatch terminals will be made available from the existing fire fighting facilities of the bottling plants /KR/Import Terminal as the case may be and only tapping from the nearest fire ring main has been considered.
- Construction of all other facilities as per various applicable codal requirement such as OISD , BIS , IE , API etc.
- BPCL would like to get the Detailed Feasibility Report of

above along with EIA, RRA done.

00.05.03 Project Battery Limits

IOCL Import Despatch Terminal

MOV's inlet flange of suction header of mainline pump located at import despatch terminal at IOCL Kochi.

Kochi Refinery Despatch Terminal

MOV's inlet flange of suction header of Booster pump located at despatch terminal at Kochi Refinery.

Receipt Terminal at IOCL Bottling Plant at Udayamperoor

ROV's outlet flange of metering skid located at IOCL bottling plant at Udayamperoor

Receipt Terminal at BPCL Bottling Plant at Coimbatore

ROV's outlet flange of metering skid located at BPCL bottling plant at Coimbatore.

Receipt Terminal at IOCL Bottling plant at Coimbatore

ROV's outlet flange of metering skid located at IOCL bottling plant at Coimbatore

Receipt Terminal at IOCL Bottling plant at Erode

ROV's outlet flange of metering skid located at IOCL bottling plant at Erode.

Receipt Terminal at IOCL Bottling plant Salem

ROV 's outlet flange of metering skid located at IOCL bottling plant at Erode.

00.06. Pipeline Route

The site of the proposed DT at Kochi Refinery lies to the east of the IOCL Import facility with thickly populated city of Ernakulam lying between them thus the route south of Kochi Refinery up-to Karimughal in-spite of being shorter and along the road is not considered due to presence of dense habitation.

The route selected for this part generally follows the National Highway route. The route takes off from the IOCL Import facility runs in a direction slightly north of east along the NH for nearly 5 kms and then turns northwards all along the NH. After traversing another 5 kms the NH takes a turn towards north-east and the pipeline route follows it. At nearly 20 kms from the start point, the route crosses NH-47 and from thereon the route goes in a south-eastern direction and then further south, finally reaching the Kochi Refinery. For reaching the IOCL bottling plant at Udayamperoor the route moves a further 11 kms towards south.

The route of the pipeline further takes off from Kochi Refinery then it runs in the North-East direction for its initial 28 km length, the pipeline traverses through North-West direction for nearly 60 kms stretch. From thereon route turns Northwards and then North-west. The route then runs along the east side of the SH-22 and subsequently runs along the SH-74, leaving it near the town of Kavassery around Ch. 208.00 the route moves East to reach NH 544. Thus after traversing 68.00 km length detour to avoid the core area of PEECHI Wild Life Sanctuary the route again follows North-East direction along NH 544 to cross the Pollachi-Coimbatore section of NH. Subsequent to the above route takes a turn towards and reaches the IOCL Bottling Plant.

From thereon the route moves in North-eastern direction mostly following the Pollachi-Avinashi-Tirrupur-Palladam Road. Near the town of Tirrupur it leaves the highway in order to circumvent the town. Beyond Tirrupur it again follows the highway route and runs along the North-east direction reaches the NH-47 and then runs along it in the same direction and reaches the termination point near Salem.

00.07 IP Based SCADA and APPS System

To ensure effective and reliable control, management and supervision of the pipeline, new pipeline **Kochi - Coimbatore - Erode - Salem LPG Pipeline** shall have dedicated SCADA & APPS system with centralized Master control station (MS) and backup Emergency Control Station (EMS). Remote work station (RWS) has to be installed at other receiving /despatch manned locations (total 05). The MS shall be inter-linked with

Remote Telemetry Unit (RTU) along the pipeline. The APPS system shall run at Master Control Station (MS).

00.07.01 IP SCADA & APPS System Requirements

- A. To ensure effective and reliable control, management and supervision of the pipeline, the pipeline is envisaged to be monitored and controlled from IP Based SCADA system consisting of Master Stations (MS) proposed at Kochi Refinery Despatch Terminal- Kochi, Kerala and Emergency Master Station (EMS) proposed at BPCL Coimbatore BP Receipt Terminal, Tamilnadu. The MS & EMS shall be connected through dedicated OFC links (proposed to be laid along the pipeline in same trench) and Leased Line as back-up (will be finalised based on the feasibility) & as per networking philosophy proposed. The MS & EMS shall be inter-linked with remote telemetry along the pipeline on dedicated LAN network. The APPS system shall run only at MS.

One RWS (Remote work station) each at all the manned locations has been proposed. These locations are:

IOCL Import Despatch Terminal

IOC, BP, Kochi (Udayamperoor)

IOCL, BP receipt terminal Coimbatore

IOCL, BP receipt terminal, Erode

IOCL, Salem

The RWS will be connected to MS & EMS by dedicated LAN on main OFC based Telecom network connectivity as proposed **Kochi - Coimbatore - Erode - Salem LPG Pipeline**

B. The following pipeline facilities shall be considered for telemetry purposes and hook-up to Centralised SCADA through Remote Terminal Units (RTUs) located at these locations for **Kochi - Coimbatore - Erode - Salem LPG Pipeline**

- | | | |
|---|---|---------|
| ➤ Despatch Terminal facilities | - | 2 Nos. |
| ➤ Intermediate Pigging Station | - | 2 Nos. |
| ➤ Receipt terminals | - | 5 Nos. |
| ➤ Sectionalizing valve stations / CP stations | - | 44 Nos. |

C. The SCADA software would need to have the following features:

- On-line configuration
- Configuration Toolbar

- Object-orientated Graphics
- Real Time and Historical Trending
- Alarming and Alarm Management
- Rational Database Support

Along with SCADA system, pipeline will have facility for APPS SYSTEM to run the following APPS modules/ functionality;

- Leak detection module based on transient modelling
- Batch Scheduling & Batch Tracking
- Inventory analysis & Stock accounting
- Survival time analysis
- Pipeline transpiration efficiency and scraper tracking module
- Contingency Analysis
- Predictive Module
- Planning Module
- Operator learning

00.08 Telecom System

The IP based telecommunication system shall provide dedicated Voice, Data, CCTV and Video communication & Video Conferencing to cover stations of pipeline facilities.

The following consideration/ assumptions are made:

- i) All Sectionalizing valves shall have remote operation.
- ii) 07 Nos. of Stations which are to be telecom attended stations. (MS & EMS and other despatch & receiving).
- iii) No. of stations (qty refer information provided elsewhere- mostly sectionalising valve stations) which are telecom unattended stations.

Overall following locations telecom equipments for telemetry purposes and hook-up to Centralised SCADA through Remote Terminal Units (RTUs) shall be considered for **Kochi - Coimbatore - Erode - Salem LPG Pipeline**

- | | | |
|--------------------------------|---|--------|
| ➤ Despatch Terminal facilities | - | 2 Nos. |
| ➤ Intermediate Pigging Station | - | 2 Nos. |
| ➤ Receipt terminals | - | 5 Nos. |

- Sectionalizing valve stations / CP stations - 44 Nos.

In line with the above, following requirements/ systems adopted:

A) IP based Optical Fiber Communication System

- i) Providing voice communication at the various through IP phones; Ordinaries (Analog), Digital, Weather proof and Explosion proof telephones with acoustic Booth and beacon (at hazardous areas).

The same shall include the following:

- Direct dialling facility between attended stations and at various unattended locations.
 - Video Conference facility connecting all the attended stations.
 - Voice communication, Pipeline Maintenance / Securities / Watchman connections all stations Attended and Unattended.
 - Hotline facility connecting attended manned stations. (All despatch / receiving stations total 07 Nos).
 - One video monitoring phone at all manned stations for station I/c.
- ii) Providing high-speed data communication (on Ethernet LAN) for SCADA.
- iii) Providing high-speed data communication for network management system for telecom (as required).
- iv) Providing facsimile communication amongst attended stations.
- v) Providing IP EPABX network connecting attended & unattended stations.
- vi) Providing video conferencing amongst all the attended manned receiving / despatch stations (total 07 locations)
- vii) Providing CCTV PTZ & Fixed type Cameras & System for station surveillance. Explosion proof PTZ cameras at all pumping stations. Client work stations to all the manned stations. (total 07 locations). One CCTV Server (1+1) with NAS at MS and EMS.

viii) Network Management System to facilitate remote monitoring & control of Telecom equipments at various stations to be installed at MS and EMS.

B) *Dedicated Leased Line*

For the back - up communication minimum 10 mbps leased line between MS Kochi & EMS Coimbatore locations shall be considered for from the external service provider. For the back - up communication between end stations minimum 2 mbps leased line with router / switch at RWS IOCL Import Despatch Terminal and IOCL, Salem stations to MS / EMS shall be considered.

00.09 Electrical

The electrical distribution system of various terminals for electrical power supply system of LPG pipeline from Kochi Despatch Terminal to Kochi Refinery to BPCL Coimbatore and IOCL Coimbatore via SV's to IP Erode and RT Salem shall be as follows:

TRANSFORMER(11kV/415V,25KVA)

Transformer with double pole structure of 11kV/415V, 25kVA shall be provided at each SV stations.

DG SET(415V, 400kVA/ 300kVA / 25kVA)

To take care of the emergency power requirements a 400 KVA DG Set shall be provided for despatch terminal at IOCL Import facility. A 300kVA DG Set each shall be provided for RT at BPCL Coimbatore and IOCL, Coimbatore. Further, for RTs at IOCL Erode, Salem and for each SVs station a 25kVA DG Set shall be provided.

HT/LT MOTOR WITH VFD PANEL

AT the Kochi Refinery despatch terminal Mainline pump motor shall be HT type and Booster Pump motor shall be of LT motor. For Despatch terminal at IOCL import facility the pump motor shall be LT type.

Uninterrupted Power supply(UPS)

30 KVA UPS shall be provided for DT at Kochi Refinery, 10 KVA UPS for RT stations and 5 KVA UPS to be provided for each SV station.

PMCC Panel, PDB and LDBs

PMCC Panel, PDB and LDB to be provided for the two DTs and PDB LDBs shall be provided for each SVs station & IP station and RT station.

XLPE Cable, Earthing Pit and Miscellaneous

All cable shall be XLPE type, Conventional Earthing pit(IS 3043) and other additional items to complete the electrical works.

00.10 Instrumentation & Control

Instrumentation and control shall be provided for safe and efficient operation of the pipeline. Dispatch Station, Pumping station & Intermediate Pigging stations, SV stations tap off points and Receipt Terminals. Control rooms shall be provided in Pipeline Dispatch terminals, Intermediate pumping stations and at each Pipeline Receipt terminals with facility to monitor and control the station from the station PLC based control system. Additionally necessary interface is envisaged in each station including SV stations and stations to connect pipe line/terminal parameters to the SCADA system for remote and tele-metering.

00.11 Capital & Operating Cost Estimates

Capital cost estimate for the project facilities envisaged for dispatch terminals at Puthuvypeen & Kochi Refinery, Five nos Receipt Terminals (at Udayamperoor, Coimbatore, Erode & Salem), 458 km long steel pipeline along with SV / IP stations and all other associated facilities works out to **Rs 997.88 Crores**. The project cost summary is presented in the Table below :

Table-00.01

CAPITAL COST SUMMARY

In Rs Lakhs

| Sl. No. | DESCRIPTION | Amount | | |
|----------|--|---------------|----------------|-----------------|
| | | FC | LC | TOTAL |
| A | Plant & Machinery | | | |
| 1 | Despatch Terminal at IOCL Import Facility Kochi | 204.8 | 1468.4 | 1673.2 |
| 2 | Pipeline from IOCL Import Facility to Kochi Refinery and IOCL Udayamperoor | 0.0 | 10812.5 | 10812.5 |
| 3 | Despatch Terminal at Kochi Refinery | 2136.8 | 2343.9 | 4480.7 |
| 4 | Receiving Terminal at IOCL BP, Udayamperoor | 0.0 | 801.8 | 801.8 |
| 5 | Pipeline from Kochi Refinery to IOCL, Udayamperoor | 0.0 | 41093.3 | 41093.3 |
| 6 | Receiving Terminal at BPCL Coimbatore | 78.8 | 871.5 | 950.3 |
| 7 | Receiving Terminal at IOCL Coimbatore | 0.0 | 1009.3 | 1009.3 |
| 8 | Pipeline from Coimbatore to Erode and Salem | 0.0 | 22827.8 | 22827.8 |
| 9 | Receiving Terminal at IOCL Erode | 0.0 | 872.6 | 872.6 |
| 10 | Receiving Terminal at IOCL Salem | 78.8 | 894.3 | 973.0 |
| 11 | SCADA & Telecom | 0.0 | 2813.2 | 2813.2 |
| | Sub-Total (A) | 2499.0 | 85808.6 | 88307.6* |
| B | Engineering Costs : PMC Fees, @6.5% (Incl Service Tax) | | | 5740.0 |
| C | Owner's management expenses @4% | | | 3532.3 |
| E | Contingency @2.5% | | | 2207.7 |
| | Total cost before IDC & MM | | | 99787.5 |
| 3 | Interest during construction period & financing charges | | | 0.0 |
| 4 | Margin money for working capital | | | 0.0 |
| | Sub-Total (E) | | | 0.0 |
| | GRAND TOTAL COST | | | 99787.5 |

* - Cost is for a total system throughput of 1.28MMTPA of LPG. In the event of the throughput exceeding 1.28 MMTPA, additional intermediate pumping station would be required which may cost approx. Rs 65 Crores for a Greenfield facility, at current prices

00.12 Operating Costs

Annual operating costs for the pipeline system works out to **Rs 39.99 Crores**, considering 8000 hour operation for Booster and Mainline pumping units at the two dispatch terminals.

00.13 Implementation Schedule

The overall project may be perceived as broadly comprising the following ;

- Despatch Terminals at IOCL Import Facility and Kochi Refinery
- 458 km long Cross Country LPG Pipeline
- Receipt Terminal at Udayamperoor, Coimbatore, Erode and Salem

The above and the other associated facilities envisaged under the project are proposed to be implemented in total in one phase by the end of the 3rd year of the project. Considering the size, length and the area / terrain to be negotiated, it would need about 36 months time for completion even if the laying work is got executed in two spreads and by independent agencies.



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

Chapter - 01

INTRODUCTION

01.00 Introduction

LPG may be defined as the hydrocarbons which are gaseous at normal atmospheric pressure, but may be condensed to the liquid state at normal temperature, by the application of moderate pressures. Although they are normally used as gases, they are stored and transported as liquids under pressure for convenience and ease of handling. Liquid LPG evaporates to produce about 250 times volume of gas. Thus, a large quantity of energy can be packed, stored, transported and used in small containers.

01.01 General

Bharat Petroleum Corporation Limited, one of the leading public sector oil refining and marketing companies in India. BPCL is engaged in refining, transport, storage and distribution of petroleum products across the country. Originally Burmah Shell Company and on 24th January 1976, the Burmah Shell Group of Companies was taken over by the Government of India to form Bharat Refineries Limited. On 1st August 1977, it was renamed Bharat Petroleum Corporation Limited. It was also the first refinery to process newly found indigenous crude (Bombay High), in the country. It figures among the Fortune 500 listing also.

Kochi Refinery, a unit of Bharat Petroleum Corporation Limited, formerly known as Cochin Refineries Limited, was originally established in collaboration with Phillips Petroleum Corporation, USA. Today it is a frontline entity as the unit of BPCL. Numaligarh Refinery Limited is a public sector oil company set up in the year 1993, with its 3 MMT refinery situated in Numaligarh, Assam. The Refinery is one of the most technologically advanced and environment friendly refineries in the country. Bharat Oman Refineries Limited (BORL), a company promoted by Bharat Petroleum Corporation Limited (BPCL) and Oman Oil Company Limited (OOCL), are operating a recently commissioned 6 MMTPA grass root refinery at Bina, district – Sagar, Madhya Pradesh along with crude supply system consisting of a Single Point Mooring system (SPM), Crude Oil Storage Terminal (COT) at Vadinar, District – Jamnagar, Gujarat and 935 Km long cross country crude pipeline from Vadinar to Bina.

01.02 Background

BPCL have embarked on the expansion of their Kochi Refinery from the present refining capacity of 9.5 MMTPA to 15.5 MMTPA. Under the expanded capacity, among other things, the production of LPG is slated to increase to about 1.26 MMTPA and as per the formation made available by Kochi Refinery officials, out of the total incremental LPG production, an amount of around 0.5 MMTPA is expected to get consumed at Kochi only. Evacuation arrangement for the balance approximately 0.76 MMTPA of LPG need to be in place, by the time the refinery expansion comes on stream. With the above aim in mind the present project was conceived by BPCL as a cross country underground LPG pipeline between Kochi Refinery and Coimbatore and accordingly an Expression of Interest (EOI) was submitted to the sector regulator i.e PNGRB.

Further, IOCL have proposed an Import facility for LPG at Puthuvypeen near Kochi which will handle the imported LPG cargoes. LPG from terminal is proposed to be transported through the pipeline to various LPG plants of IOCL in the region.

Based on the inputs / comments received on BPCL's EOI during the period of public consultation, PNGRB subsequently enhanced the scope of the project by extending the pipeline conceptualised earlier, on both sides to connect the IOCL's bottling plants at Kochi , Coimbatore , Erode and Salem on the downstream side and IOCL's LPG import facility at Kochi on the upstream side. Thus, under the changed scheme the pipeline system commences from IOCL's LPG import facility at Puthuvypeen near Kochi and proceeds via Kochi Refinery, IOCL bottling plants at Udayamperoor, Coimbatore and Erode and terminates at IOCL Bottling Plant at Salem.

Hence, the present project entails, despatch terminal at IOCL import facility at Puthuvypeen near Kochi and transportation of the same through underground steel pipeline up to Kochi Refinery and IOCL bottling plant at Udayamperoor. The despatch terminal at Kochi refinery will handle the LPG available at the refinery as well as that received from IOCL import terminal. The

same would be transported through an underground pipeline to Coimbatore, Erode and Salem.

As a part of this exercise BPCL have assigned MECON Limited, New Delhi the task of carrying out a feasibility study and prepare a Detailed Feasibility Report (DFR) for the Kochi-Coimbatore-Erode-Salem LPG Pipeline project.

01.03 Brief Scope of Work

As mentioned earlier, the present project is being conceived with the aim of providing an outlet for the additional LPG which will be produced after expansion of BPCL's Kochi Refinery and for providing pipeline connectivity for the LPG import facility of IOCL at Kochi. Over and above the evacuation requirement of Kochi Refinery, the system shall have additional carrying capacity to take into account the requirement of the existing bottling plants en-route to Salem and possibility of additional LPG transportation as also marine movement of LPG in future.

The project has been conceived with LPG despatch terminals at IOCL's LPG Import facility at Puthuvypeen and BPCL's Kochi Refinery along with receiving terminals at Udayamperoor, Coimbatore, Erode and Salem with an underground steel pipeline connecting them.

Brief Scope of Work for DFR shall cover :

- Despatch facilities at IOCL Import facility and at Kochi Refinery by providing suitable LPG Pumping facilities of desired flow rate along with hooking up with existing storages.
- Underground LPG Pipeline from IOCL Import facility to Kochi Refinery & IOCL bottling plant at Udayamperoor and from Kochi Refinery to Coimbatore, Erode & Salem. Total length of the pipeline coming to approx 458 km long along with SCADA & TELECOM.
- Construction of Intermediate Sectionalising Valve station and Pigging stations as per OISD 214,141 etc. with all allied facilities.

- Construction of Pipeline Receipt stations at the five indicated locations at Udayenpeoror, Coimbatore (2 nos), Erode and Salem.
- Associated fire water network along with MV spray system at Despatch & Receipt facilities as per OISD 214 , OISD 144 , and all other applicable codes.
- Construction of all other allied facilities as per various applicable codal requirement such as OISD , BIS , IE , API etc.

The DFR contains information under following chapters to meet with the requirement of the work order:

- Executive Summary
- Introduction
- Process Facilities
- Pipeline System
- SCADA & APPS System
- Telecommunication System
- Electrical
- Instrumentation and Control
- Capital and Operating Cost Estimates
- Implementation Schedule

- Annexures & Drawings
 - P&IDs
 - Schematic Arrangement of Pipeline Facilities
 - Key Single line diagram
 - Pipeline Route Map

01.04 Visits and Data Collection

MECON team visited Kochi Refinery and the proposed site at Coimbatore where LPG receipt and storage terminal is to come up and also travelled along the proposed pipeline route to study critical route points and major crossings. Preliminary discussions were held at Kochi Refinery. In addition to the primary field data collection during the field survey, some more information and secondary data was collected for the purpose of DFR preparation.

01.05 Acknowledgement

MECON would take this opportunity to thankfully acknowledge the cooperation extended by BPCL, IOCL and Kochi Refinery officials and for the data / information and other inputs provided by them for preparation of this report

Chapter - 02

NEED AND JUSTIFICATION

02.00 NEED AND JUSTIFICATION FOR THE PROJECT

02.01 General

As mentioned in the preceding chapter, BPCL is going in for a major capacity enhancement of Kochi Refinery from the existing 9.5 MT to 15.5 MT and the present project was conceived with the aim of providing an outlet for the additional LPG which will be produced after expansion of the Kochi Refinery. Over and above the evacuation requirement of Kochi Refinery, the pipeline system envisages to provide pipeline connectivity for the IOCL's LPG import facility at Puthuvypeen near Kochi and shall also have additional carrying capacity to cater to the requirement of the existing bottling plants falling en-route to Salem and keep provision for additional LPG transportation in future. The project has been conceived with despatch terminals at Puthuvypeen and Kochi Refinery and receipt terminals at Udayenperoor, Coimbatore, Erode & Salem and an underground steel pipeline between them.

The despatch terminals at IOCL Import facility & Kochi Refinery would have facilities for hooking up with the existing LPG storage facilities followed by booster and mainline pumping infrastructure of desired flow rate. There shall be an approximately 458 km long steel pipeline for transportation of LPG up to Salem. The pipeline would terminate at the proposed receipt station at IOCL bottling plant at Salem.

02.02 Need and Justification

02.02.01 Importance for the Region

The present LPG project proposal for laying the LPG pipeline is a step in the direction to meet the challenge of increased demand for transporting LPG in the most energy efficient way through underground pipeline. As against all the other means, transportation of LPG through pipeline works out to be the cheaper, safer and more convenient. The present pipeline will be transporting the LPG being received at IOCL's Import facility at Puthuvypeen near Kochi and a substantial quantity of the LPG produced at Kochi Refinery to the bottling plants at Udayenperoor in the state of Kerala and to

Coimbatore, Erode and Salem in the state of Tamilnadu. The facilities being proposed to be installed under the present project will be catering to the LPG requirement of the whole region.

Presently, the LPG transportation in the region is primarily through road tankers. By executing the above project, IOCL & BPCL will be saving substantially on the tanker based transportation in terms of both cost as well as logistics and improve on safety. As mentioned earlier, the proposed pipeline would be transporting LPG to meet the requirements of five bottling plants in the region, out of these four belong to IOCL and one to BPCL. All of these bottling plants are currently depending on LPG transportation by road.

The present project therefore, would substantially benefit the region in terms of providing a network of pipelines comprising around 458 kms of underground LPG pipeline thus resulting in substantial saving on road transportation costs as also improved safety.

02.02.02 Economic and Social Benefits

As stated in preceding chapter that the basic need for present project stems from the increased LPG production on account of the ongoing capacity expansion work of the Kochi Refinery. With the increased production, augmented evacuation facilities have to be in place by the time refinery expansion comes on stream. The financial benefits accruing from the increased output of the refinery will come about only if adequate arrangements are made for the off-take for the products from the refinery to the consumer ends.

Presently LPG transportation in the region is taking place primarily through LPG road tankers. Once the present project is commissioned, six LPG bottling plants in the region can switch from road tanker based LPG transportation to receiving it through pipelines. This would result in substantial financial and logistical savings for the oil marketing companies. As has been mentioned earlier that transportation through pipeline is cheaper and more convenient means of transportation of any fluid in comparison to the other available alternatives and in the specific context of LPG transportation benefits also be there in the form of substantially improved safety.

In addition to the above, added economic and social benefits shall also accrue in the form of less of traffic congestion and improved ease of vehicular movement on the roads as with the proposed pipeline system coming on stream, a large number of LPG road tankers would be off the roads.

02.03 Conclusion

- The project proposal for underground pipeline based transportation of LPG is a step in the direction to meet challenges of increased demand of LPG, which is basic necessity of society. By above study and analysis, we find that it would be possible to transport LPG from Kochi to southern eastern parts of Tamilnadu at a substantially lower cost
- Socially, use of LPG in domestic and commercial sector, is basic necessity of life, and therefore it requires to be meet reliably. Making it available is beneficial to the society.
- By substituting road transport of LPG in the present situation to transportation by LPG Pipelines, it is a step towards improving safety, reducing pollution and traffic load on Highways, is beneficial to local population, apart from saving on the consumption of the subsidised Diesel fuel.
- By using existing land, power and water of IOCL Import facility and Kochi Refinery for the dispatch terminals and other bottling terminals for receipt facilities, it is a step in conservation of resources.
- The project is very environmentally friendly and does not contribute any waste.
- It will be beneficial to society by increasing employment opportunities and social infrastructure will improve in presence of entity's corporate social responsibility plans
- The present project would positively impact and greatly improve the availability / reliability of supplies of the essential commodity i.e. LPG, in the region

- It would improve reliability of LPG supplies in the far flung areas of the states of Kerela and Tamilnadu.

Therefore, proposed project is economically and socially justified for immediate approval



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

Chapter - 03

OPTIMISATION STUDY

03.00 OPTIMISATION STUDY

03.01 General

The flow capacity of any pipeline system is function of the diameter of the pipeline and the associated pumping capacity. An economic design of the pipeline system involves establishing an optimum combination of pipeline diameter and pumping system (number of pumps and their capacity). A smaller diameter pipeline would require a higher pumping system and on the other hand a higher sized pipeline would need a proportionately lower pumping infrastructure. Thus a lower capital investment in pipeline may turn out to be getting offset by higher pump system capital costs and the recurring higher pump operating costs.

03.02 Basis for Analysis

Analysis has been carried out on the following basis:

- Dispatch of LPG from IOCL Import terminal at Puthuvypeen near Kochi to Booster Station located at Kochi Refinery Dispatch Station located at approximately 39 km upstream of it. The maximum capacity as 1.28 MMTPA (equivalent to 296 m³/hr @ 8000 hours of operation per annum).
- Dispatch of LPG from Kochi Refinery storage vessels to the boosting station located at Kochi Refinery with a maximum flow of 1.28 MMTPA (equivalent to 296 m³/h @ 8000 hours of operation per annum).
- The supply of 1.28 MMTPA of LPG can be taken either entirely out of the flow from IOCL Import Facility at Puthuvypeen or entirely from Kochi Refinery's storage system. The system also considers combined supply of LPG from IOCL Import facility and also from Kochi Refinery to maintain the maximum flow of 1.28 MMTPA.
- The 39 km pipeline from IOCL import terminal to Kochi Refinery terminal to be extended by another 11 km to connect

with and meet the LPG demand of IOCL's bottling plant located at Udayamperoor.

- Total length of the main pipeline from IOCL Import facility to IOCL's bottling plant at Salem is 447 km (incl. 39 km of the first section). However the major with drawl of LPG will be at change 272 km at BPCL's Coimbatore Receipt Station.
- System design with or without intermediate pumping station.
- Receipt facilities at BPCL's Coimbatore terminal, IOCL's Coimbatore terminal, IOCL's Erode terminal and also at IOCL's Salem terminal. With a minimum pressure of 13 kg/cm² (g).
- The pipeline throughput 1.28 MMTPA with a flow rate of 296 M³/hr operating for 8000 hours per annum.

Optimization study has been carried out for pipeline diameter of 8" & 12" considering appropriate wall thickness (with maximum safety margin of 40% as per OISD 141 for over crowded area). The entire system has been designed with maximum pressure rating of the main pipeline of 600# from Kochi Refinery to IOCL's Salem terminal and with 300# between IOCL's import facility to Kochi refinery and upto IOCL's bottling plant at Udayamperoor.

03.03 Pipeline Parameters for Optimisation Study

Pipeline parameters considered for the optimization are as under :

AA. Pipeline Parameters :

| | | |
|------------------------------------|---|---|
| Design Code | : | ANSI B31.8 & OISD 141 |
| Design factor | : | 0.72 (for normal area) type-A 0.40 (populated area) type-B |
| Corrosion allowance | : | 0.5 mm. |
| Pipeline Material (API 5L Gr65) | : | 12" X 8.7 mm (for 600# with type B) 12" X 6.4 mm (for 600# with type A) 12" X 6.4 mm (for 300# with type A) 8" X 6.4 mm (for 600# with type A) |

BB. Pumping Parameters

- Booster pumps at IOCL Import facility despatch terminal with a maximum discharge pressure of 33 kg/cm² (g).
- Booster pumps at BPCL's Kochi Refinery despatch terminal with a outlet pressure of 18 kg/cm² (g).
- Mainline pumps at BPCL's Kochi Refinery despatch terminal with a maximum outlet pressure of 98 kg/cm² (g) (900#).

CC. Construction period : 3 years.

DD. Pipeline operational life : 25 years

03.04 Optimisation Study

For transportation of the required quantity of the LPG throughput, under the prevailing process conditions of the limiting available pressure at Kochi Refinery end and the required minimum pressure of 13 kg/cm²(g) at any receipt terminal, various options have been evaluated through software simulation.

From the study it has been found that the most optimum pipeline system would be as follows :

- From IOCL's Import terminal to IOCL's Coimbatore terminal and to Udayamperoor bottling plant : Line of size 12" and total length of 288 km.
- From IOCL's Coimbatore terminal to IOCL's Salem terminal : Line size of 8" diameter and total length 170 km.

Optimisation study and analysis has further shown that requirement of 296 m³/hr flow is possible with 12" & 8" diameter pipeline combination with only one mainline pumping station at Kochi Refinery without requirement of any intermediate pumping.

The minimum throughput of the system desired by PNGRB for the pipeline is 1.28MMTPA including common carrier margin of 25%, accordingly, the present pipeline system is designed for the said throughput. However, in the event of the throughput exceeding

1.28MMTPA, it will be required to provide an additional Booster Pumping station at a suitable location in between Kochi and Coimbatore.

03.05 Pipeline and Main Pumping Units

The despatch terminal for the project is proposed to be located inside the Kochi Refinery premises and land required for the same along with all the necessary utilities at the project battery limits, is to be provided by Kochi Refinery. Any intermediate pumping, if to be provided, would have to be at a green field site to be separately acquired along with the provision of the necessary utilities and other associated facilities.

03.06 Conclusion

Based on the above study and considering throughput of 1.28 MMTPA for designing the pipeline system under the mentioned process conditions, optimisation study carried out and it has been found that 12" dia pipeline from IOCL Import facility at Puthuvypen to IOCL Coimbatore and an 8" diameter pipeline from theron upto IOCL Salem works out to be the most optimum.



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

Chapter - 04

PROCESS FACILITIES

04.00 PROCESS FACILITIES

04.01 General

The process facilities take into account transportation of LPG at 1.28 MMTPA. Two product sources are identified namely IOCL Import Terminal at PuthuVypeen and Kochi refinery. MLPUS at IOCL Import Terminal will cater the pumping requirements upto IOCL bottling plant Udayamperoor, Kochi as well as the suction pressure requirement for MLPUs at Kochi Refinery. 12" dia. pipeline is proposed from IOCL Import Terminal to IOC Udayamperoor and the distance is 50 km. MLPUs at Kochi Refinery will pump the product through 12" dia. x 238 km. pipeline to IOCL Bottling Plant at Coimbatore via BPCL bottling Plant at Coimbatore and thereafter through 8" dia. x 170 km. pipeline to reach IOCL Bottling Plant at Salem via IOCL Bottling Plant at Erode. Pump (1w + 1s) is planned at IOCL Import Terminal. In the case of Kochi Refinery, 1 booster + 1 stand-by and 1 MLPU + 1 stand-by pump is proposed.

Proposed receipt and despatch terminals will have filtration, metering, control valve, etc. The underground pipeline shall be provided with cathodic protection system. There will be 42 nos. SV Stations and 2 nos. Intermediate Pigging Station along the entire route of the pipeline.

The proposed pipeline transportation of LPG shall include the following facilities :-

04.02 IOCL Import Despatch Terminal

LPG will be supplied from the proposed LPG mounded storage at the terminal which is not a part of the pipeline system. Despatch facilities shall include installation of two nos. MLPUs (1 working + 1 spare) at dispatch terminal. The MLPs are provided to meet the required output for IOCL Kochi Import terminal flow rate and also to meet the NPSH required for mainline pumps at Kochi Refinery. The MLP will also take care of the pressure drop at filter and mass flow meter. Pumps with VFD will be used to maintain the flow rate from 0.5 to 1.28 MMTPA. Scrapper Launcher will be provided for intelligent pigging operation. Basket Filter, Flow Meter, Control Valve shall also be provided.

04.03 Kochi Refinery Despatch Terminal

LPG will be supplied from the existing LPG mounded storage in Kochi Refinery. Despatch facilities, including installation of two nos. booster pumps (1 working + 1 spare) and two nos. mainline pumps (1 working + 1 spare) at despatch terminal to be located inside Kochi Refinery at Ambalmugal, Kochi, Kerala. The Booster pumps are provided to meet the required output and also to meet the NPSH required for mainline pumps. The booster pump will also meet pressure drop required for filter and mass flow meter. Pumps with VFD will be used to maintain the flow rate from 0.5 to 1.28 MMTPA.

Scraper Launcher will be provided for intelligent pigging operation. Basket Filter, Flow Meter, Control Valve shall also be provided. Booster pumps will also take care of supply of LPG to IOCL bottling plant at Udayamperoor and mainline pumps will take care of supply of LPG upto Salem via Coimbatore and Erode BPCL/ IOCL Bottling Plants.

04.03 Pipeline

04.03.01 Mainline

Laying of 12" dia. pipeline, approx. 288 km. long from IOCL Import Terminal to IOCL Bottling Plant, Udayamperoor via Kochi Refinery and Kochi Refinery to IOCL Bottling Plant, Coimbatore via proposed BPCL Bottling Plant, and laying of 8" dia., approx. 170 km. pipeline from IOCL Coimbatore to IOCL Salem via IOCL Bottling Plant, Erode. The transportation capacity will be 1.28 MMTPA.

Simultaneous withdrawals at IOCL Bottling Plants at Coimbatore, Erode and Salem are considered for the design.

04.03.02 I. P. Station

One number of Intermediate Pigging Station (IPS) shall consist of Scraper Launcher and Scraper Receiver along with SV Station at Chainage 151 km. for 12" pipeline and another Intermediate Pigging Station (IPS) shall consist of Scraper Launcher and Scraper Receiver along with SV Station at IOCL Bottling Plant, Erode for 8" pipeline.

04.03.03 SV Station

Sectionalising Valve Stations at suitable locations as per OISD along the route @12 km. and wherever additionally required as per Safety standards and requirements of approving authorities.

04.04 Receipt Terminals at BPCL Bottling Plant and IOCL Bottling Plant at Coimbatore

04.04.01 Receipt facilities,
Including Scrapper Receiver, Basket Filter, Control Valve, Flow Meter,
etc.

04.05 Flare System

At Kochi Refinery Despatch Terminal, relief from vents, drains and TSV relief, depressurising lines from Filters, Pumps and Launcher, etc. will be hooked up to refinery flare header. Cold flaring facility has been envisaged at IOCL Bottling Plants at Coimbatore, Erode and Salem and BPCL Bottling Plant at Coimbatore.

04.06 Instrumentation and SCADA system

PLC -based instrumentation & control system is envisaged for terminal and pipeline facilities. For effective, reliable management, monitoring and control of terminal & pipeline, SCADA system has been envisaged.

04.07 Leak Detection and APPS

Suitable leak detection and APPS system are also envisaged for this pipeline.

04.08 Fire Protection Facilities

Depending upon the nature of the units to be protected from fire, various types of fire protection systems viz. Fire hydrant and Monitor system, Automatic Medium Velocity Water Spray System and

Automatic Fire Detection-cum-Alarm System and Portable Fire Extinguishers have been envisaged. Fire fighting pumps and fire water storage and fire fighting compressors are to be extended from the respective IOCL/ BPCL installations. Only extension of Fire water network from the existing fire water ring is considered.

04.09 Other Facilities

Facilities like sampling, cathodic protection system, telecommunication system, CCTV system and video conferencing, etc. have also been provided for essential & reliable operation of the pipeline. Suitable external coating shall be provided to protect the pipeline against external corrosion. Arrangement for 4 nos. mobile flares shall be made.

50 m. x 50 m. area will be used for each mainline SV Station. Each SV Station will be provided with underground Motor Operated Ball Valve of 12" size. The power supply for MOV will be met from SEB Electric Supply or DG Set. However direct power from Battery will be used for operation of SVs. Single A/C Room for SCADA and UPS will be provided at each SV Station. Other facilities include MCC room (including Inert Gas flooding), battery room, guard room etc.

04.10 Broad Equipment Specifications

04.10.01 Mainline and Terminals

Specifications of Process equipment for 12" pipeline system (mainline) are as listed below:

| 1. PIPELINE | |
|-------------------------|----------------------------------|
| Tag No. | 12"-P-0X-XXX |
| Design Code | ANSI B31.4 |
| Service | LPG |
| Origin | IOCL Import Despatch Terminal |
| Destination | BPCL Coimbatore Receipt Terminal |
| Grade | API 5L Grade X 65 |
| Diameter, Inches, NB | 12 |
| Pipe Roughness, microns | 45 |

| | |
|---------------------------------------|----------------------------------|
| Length & Thickness | 144 km (8.7 mm) , 94 km (6.4 mm) |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 0.5 |

2. PIG LAUNCHER

IOCL Import Despatch Terminal

| | |
|---------------------------------------|--|
| Tag No. | SL (16"X12") with QOEC |
| Service | LPG |
| Performance specification | Suitable for launching intelligent pig |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

BPCL Kochi Refinery Despatch Terminal

| | |
|---------------------------------------|--|
| Tag No. | SL (16"X12") with QOEC |
| Service | LPG |
| Performance specification | Suitable for launching intelligent pig |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

Intermediate Pigging Station (Ch. 151 km)

| | |
|---------------------------------------|--|
| Tag No. | SL (16"X12") with QOEC |
| Service | LPG |
| Performance specification | Suitable for launching intelligent pig |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

3. PIG RECEIVER

IOCL Bottling Plant, Kochi

| | |
|---------------------------------------|--|
| Tag No. | SR (18"X12") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |

| | |
|--|--|
| Corrosion allowance, mm | 3.0 |
| IOCL Coimbatore Receipt Terminal | |
| Tag No. | SR (18"X12") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |
| Intermediate Pigging Station (Ch. 151 km) | |
| Tag No. | SR (18"X12") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

4. BASKET FILTER

| | |
|---|-------------------------------|
| IOCL Import Despatch Terminal | |
| Tag No. | BF (1+1) |
| Service | LPG |
| Type | Basket |
| Size | 12" NB |
| Max. flow rate, m ³ /hr | 296 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 (Max for Dirty Condition) |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |
| Kochi Refinery Despatch Terminal | |
| Tag No. | BF (1+1) |
| Service | LPG |
| Type | Basket |
| Size | 12" NB |
| Max. flow rate, m ³ /hr | 296 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 (Max for Dirty Condition) |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |
| IOCL Bottling Plant, Kochi | |
| Tag No. | BF (1+1) |
| Service | LPG |

| | |
|--|-------------------------------|
| Type | Basket |
| Size | 10" NB |
| Max. Flow rate, m ³ /hr | 110 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 (Max for Dirty Condition) |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |
| BPCL Coimbatore Bottling Plant Receipt Terminal | |
| Tag No. | BF (1+1) |
| Service | LPG |
| Type | Basket |
| Size | 10" NB |
| Max. Flow rate, m ³ /hr | 296 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 (Max for Dirty Condition) |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |

| | |
|---|---|
| 5. MAIN LINE PUMP | |
| IOCL Import Despatch Terminal | |
| <u>(a) Condition - I</u> | |
| Tag No. | P-XXXX A/ P-XXXX B (1+1) |
| Service | LPG |
| Type | Centrifugal (Horizontal, BB5) (API-610, 11 th Edn.) |
| Drive | Electric Motor (VFD) |
| Rated flow rate, m ³ /hr | 110 (Minimum) |
| Suction pressure, kg/cm ² g | 12 |
| Discharge pressure, kg/cm ² g | 18 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Density at operating condition, kg/m ³ | 540 |
| <u>(b) Condition - II</u> | |
| Tag No. | P-XXXX A/ P-XXXX B (1+1) |
| Service | LPG |
| Type | Centrifugal (Horizontal, BB5) (API-610, 11 th Edn.) |
| Drive | Electric Motor (VFD) |
| Rated flow rate, m ³ /hr | 230 (Normal) |
| Suction pressure, kg/cm ² g | 12 |
| Discharge pressure, kg/cm ² g | 25 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Density at operating condition, kg/m ³ | 540 |

| <u>(c) Condition - III</u> | |
|---|---|
| Tag No. | P-XXXX A/ P-XXXX B (1+1) |
| Service | LPG |
| Type | Centrifugal (Horizontal, BB5) (API-610, 11 th Edn.) |
| Drive | Electric Motor (VFD) |
| Rated flow rate, m ³ /hr | 296 (Maximum) |
| Suction pressure, kg/cm ² g | 12 |
| Discharge pressure, kg/cm ² g | 28 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Density at operating condition, kg/m ³ | 540 |

BPCL Kochi Despatch Terminal

| <u>(a) Condition - I</u> | |
|---|---|
| Tag No. | P-XXXX A/ P-XXXX B (1+1) |
| Service | LPG |
| Type | Centrifugal (Vertical, VS6) (API-610, 11 th Edn.) |
| Drive | Electric Motor (VFD) |
| Rated flow rate, m ³ /hr | 110 (Minimum) |
| Suction pressure, kg/cm ² g | 8 |
| Discharge pressure, kg/cm ² g | 18 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Density at operating condition, kg/m ³ | 540 |
| <u>(b) Condition - II</u> | |
| Tag No. | P-XXXX A/ P-XXXX B (1+1) |
| Service | LPG |
| Type | Centrifugal (Vertical, VS6) (API-610, 11 th Edn.) |
| Drive | Electric Motor (VFD) |
| Rated flow rate, m ³ /hr | 176 (Normal) |
| Suction pressure, kg/cm ² g | 8 |
| Discharge pressure, kg/cm ² g | 18 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Density at operating condition, kg/m ³ | 540 |
| <u>(c) Condition - III</u> | |
| Tag No. | P-XXXX A/ P-XXXX B (1+1) |
| Service | LPG |
| Type | Centrifugal (Vertical, VS6) (API-610, 11 th Edn.) |

| | |
|---|----------------------|
| Drive | Electric Motor (VFD) |
| Rated flow rate, m ³ /hr | 296 (Maximum) |
| Suction pressure, kg/cm ² g | 8 |
| Discharge pressure, kg/cm ² g | 18 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Density at operating condition, kg/m ³ | 540 |

6. MAINLINE PUMP

Kochi Refinery Despatch Terminal

| | |
|---|---|
| Tag No. | P-XXXX A/ P-XXXX B (1+1) |
| Service | LPG |
| Type | Centrifugal (Horizontal, BB5) (API-610, 11 th Edn.) |
| Drive | Electric Motor (VFD) |
| Rated flow rate, m ³ /hr | 296 |
| Suction pressure, kg/cm ² g | 18 |
| Discharge pressure, kg/cm ² g | 95 |
| Design pressure, kg/cm ² g | 98 (600#) |
| Density at operating condition, kg/m ³ | 540 |

7. MASS FLOW METER

IOCL Import Despatch Terminal

| | |
|---|-----------------------------------|
| Tag No. | FT-XX01/ FT-XX02 (1+1) |
| Service | LPG |
| Type | Mass Flow Meter (Line size : 12") |
| Max. flow rate, m ³ /hr | 296 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

Kochi Refinery Despatch Terminal

| | |
|---|-----------------------------------|
| Tag No. | FT-XX01/ FT-XX02 (1+1) |
| Service | LPG |
| Type | Mass Flow Meter (Line size : 12") |
| Max. flow rate, m ³ /hr | 296 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

| BPCL Coimbatore Receipt Terminal | |
|---|-----------------------------------|
| Tag No. | FT-XX01/ FT-XX02 (1+1) |
| Service | LPG |
| Type | Mass Flow Meter (Line size : 10") |
| Max. flow rate, m ³ /hr | 296 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

| 8. PRESSURE CONTROL VALVE | |
|---|-------------------|
| Kochi Refinery Despatch Terminal | |
| Tag No. | PV-XX01 |
| Service | LPG |
| Type | Electro-pneumatic |
| Size, inches | XX" |
| Max. flow rate, m ³ /hr | 296 |
| Allowable pressure drop, kg/cm ² | 1 (at max. flow) |
| Diff. Pressure, Shut-off, kg/cm ² | 98 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| BPCL Coimbatore Receipt Terminal | |
| Tag No. | PV-0701 |
| Service | LPG |
| Type | Electro-pneumatic |
| Size, inches | XX" |
| Max. flow rate, m ³ /hr | 296 |
| Allowable pressure drop, kg/cm ² | 1 (at max. flow) |
| Diff. Pressure, Shut-off, kg/cm ² | 98 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |

04.10.02 IOCL, Kochi

Specifications of Process equipment for 12" x 11 km. pipeline to IOCL's bottling plant at Kochi are as listed below :-

| 1. PIPELINE | |
|---------------------------------------|-----------------------------------|
| Tag No. | 12"-P-0X-XXX |
| Service | LPG |
| Origin | IOCL Kochi Despatch Terminal |
| Destination | IOCL bottling plant, Udayamperoor |
| Grade | API 5L Grade X-65 |
| Diameter, Inches, NB | 12 |
| Length & Thickness | 11 km. (6.4 mm) |
| Flow rate, m ³ /hr | 110 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 0.5 |

| 2. PIG RECEIVER | |
|--|--|
| IOCL Bottling Plant, Kochi (Udayamperoor) | |
| Tag No. | SR (18"X12") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

| 3. BASKET FILTER | |
|---|-------------------------------|
| IOCL Bottling Plant, Kochi (Udayamperoor) | |
| Tag No. | BF (1+1) |
| Service | LPG |
| Type | Basket |
| Size | 10" NB |
| Max. flow rate, m ³ /hr | 110 x 1.25 |
| Allowable pr. drop, kg/cm ² | 0.5 (Max for Dirty Condition) |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

| 4. MASS FLOW METER | |
|--|-----------------------------------|
| IOCL Bottling Plant, Kochi (Udayamperoor) | |
| Tag No. | FT-XX01/ FT-XX02 (1+1) |
| Service | LPG |
| Type | Mass Flow Meter (Line size : 10") |

| | |
|---|------------|
| Max. flow rate, m ³ /hr | 110 x 1.25 |
| Allowable press. drop, kg/cm ² | 0.5 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

| | |
|--|-------------------|
| 5. PRESSURE CONTROL VALVE | |
| IOCL Bottling Plant, Kochi (Udayamperoor) | |
| Tag No. | PV-XXXX |
| Service | LPG |
| Type | Electro-pneumatic |
| Size, inches | XX" |
| Max. flow rate, m ³ /hr | 100 |
| Allowable pressure drop, kg/cm ² | 1 (at max. flow) |
| Diff. Pressure, Shut-off, kg/cm ² | 49 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

04.10.03 IOCL Bottling Plant Receipt Terminal, Coimbatore

Specifications of Process equipment for IOCL's bottling plant at Coimbatore are as listed below :-

| | |
|--|--|
| 1. PIG RECEIVER | |
| IOCL Bottling Plant, Coimbatore | |
| Tag No. | SR (18"X12") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

| | |
|--|------------------------|
| 2. BASKET FILTER | |
| IOCL Bottling Plant, Coimbatore | |
| Tag No. | BF-XX01/ BF-XX02 (1+1) |
| Service | LPG |

| | |
|---|-------------------------------|
| Type | Basket |
| Size | 8" NB |
| Max. flow rate, m ³ /hr | 40 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 (Max for Dirty Condition) |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |

3. MASS FLOW METER

IOCL Bottling Plant, Coimbatore

| | |
|---|----------------------------------|
| Tag No. | FT-XX01/ FT-XX02 (1+1) |
| Service | LPG |
| Type | Mass Flow Meter (Line size : 8") |
| Max. flow rate, m ³ /hr | 40 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

4. PRESSURE CONTROL VALVE

IOCL Bottling Plant, Coimbatore

| | |
|---|-------------------|
| Tag No. | PV-XX01 |
| Service | LPG |
| Type | Electro-pneumatic |
| Size, inches | XX" |
| Max. flow rate, m ³ /hr | 40 |
| Allowable pressure drop, kg/cm ² | 1 (at max. flow) |
| Diff. Pressure, Shut-off, kg/cm ² | 98 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |

04.10.04 IOCL Bottling Plant Receipt Terminal, Erode

Specifications of Process equipment for 8" x 77 km. pipeline to IOCL Bottling Plant at Erode are as listed below :-

| 1. PIPELINE | |
|---------------------------------------|------------------------------------|
| Tag No. | 8"-P-0X-XXX |
| Service | LPG |
| Origin | IOCL Despatch Terminal, Coimbatore |
| Destination | IOCL bottling plant, Erode |
| Grade | API 5L Grade X-65 |
| Diameter, Inches, NB | 8 |
| Length & Thickness | 77 km (6.4 mm) |
| Flow rate, m ³ /hr | 40 |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 0.5 |

| 2. PIG LAUNCHER | |
|---|--|
| IOCL Despatch Terminal, Coimbatore | |
| Tag No. | SR (12"X8") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

| 3. PIG RECEIVER | |
|-------------------------------------|--|
| I. P. Station, Erode | |
| Tag No. | SR (14"X8") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

| 4. BASKET FILTER | |
|-----------------------------------|------------------------|
| IOCL Bottling Plant, Erode | |
| Tag No. | BF-XX01/ BF-XX02 (1+1) |

| | |
|---|-------------------------------|
| Service | LPG |
| Type | Basket |
| Size | 8" NB |
| Max. flow rate, m ³ /hr | 40 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 (Max for Dirty Condition) |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |

| | |
|---|----------------------------------|
| 5. MASS FLOW METER | |
| IOCL Bottling Plant, Erode | |
| Tag No. | FT-XX01/ FT-XX02 (1+1) |
| Service | LPG |
| Type | Mass Flow Meter (Line size : 8") |
| Max. flow rate, m ³ /hr | 40 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

| | |
|---|-------------------|
| PRESSURE CONTROL VALVE | |
| IOCL Bottling Plant, Coimbatore | |
| Tag No. | PV-XX01 |
| Service | LPG |
| Type | Electro-pneumatic |
| Size, inches | XX" |
| Max. flow rate, m ³ /hr | 40 |
| Allowable pressure drop, kg/cm ² | 1 (at max. flow) |
| Diff. Pressure, Shut-off, kg/cm ² | 98 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |

D. IOCL, Salem

Specifications of Process equipment for 8" x 93 km. pipeline to IOCL bottling plant at Salem are as listed below :-

| | |
|--------------------|-------------|
| 1. PIPELINE | |
| Tag No. | 8"-P-0X-XXX |

| | |
|---------------------------------------|----------------------------|
| Service | LPG |
| Origin | I.P. Station, Erode |
| Destination | IOCL bottling plant, Salem |
| Grade | API 5L Grade X-65 |
| Diameter, Inches, NB | 8 |
| Length & Thickness | 93 km (6.4 mm) |
| Flow rate, m ³ /hr | 40 |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 0.5 |

2. PIG LAUNCHER

| | |
|---------------------------------------|--|
| I.P. Station, Erode | |
| Tag No. | SR (12"X8") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

3. PIG RECEIVER

| | |
|---------------------------------------|--|
| IOCL Bottling Plant, Salem | |
| Tag No. | SR (14"X8") with QOEC |
| Service | LPG |
| Performance specification | Suitable for receiving intelligent pig |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |
| Material of construction | Carbon Steel |
| Corrosion allowance, mm | 3.0 |

4. BASKET FILTER

| | |
|------------------------------------|------------------------|
| IOCL Bottling Plant, Salem | |
| Tag No. | BF-XX01/ BF-XX02 (1+1) |
| Service | LPG |
| Type | Basket |
| Size | 8" NB |
| Max. flow rate, m ³ /hr | 40 x 1.25 |

| | |
|---|-------------------------------|
| Allowable pressure drop, kg/cm ² | 0.5 (Max for Dirty Condition) |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |

| | |
|---|----------------------------------|
| 5. MASS FLOW METER | |
| IOCL Bottling Plant, Salem | |
| Tag No. | FT-XX01/ FT-XX02 (1+1) |
| Service | LPG |
| Type | Mass Flow Meter (Line size : 8") |
| Max. flow rate, m ³ /hr | 40 x 1.25 |
| Allowable pressure drop, kg/cm ² | 0.5 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 49 (300#) |
| Design temperature, °C | 65 |

| | |
|---|-------------------|
| 6. PRESSURE CONTROL VALVE | |
| IOCL Bottling Plant, Salem | |
| Tag No. | PV-XX01 |
| Service | LPG |
| Type | Electro-pneumatic |
| Size, inches | XX" |
| Max. flow rate, m ³ /hr | 40 |
| Allowable pressure drop, kg/cm ² | 1 (at max. flow) |
| Diff. Pressure, Shut-off, kg/cm ² | 98 |
| Density at inlet condition, kg/m ³ | 540 |
| Design pressure, kg/cm ² g | 98 (600#) |
| Design temperature, °C | 65 |



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

Chapter - 05

PROCESS DESIGN BASIS

05.00 PROCESS DESIGN BASIS

05.01 General

Bharat Petroleum Corporation Limited (BPCL) has planned to expand their Kochi Refinery (KRL) from the present refining capacity of 9.5 MMTPA to 15.5 MMTPA. Under the expanded capacity, among other things, the production of LPG is slated to increase to about 1.28 MMTPA. Evacuation arrangement for the incremental production of LPG need to be in place, by the time the refinery expansion comes on stream.

As stated earlier, the present project entails despatch facilities for the LPG received from IOCL import despatch terminal at Puthuvypeen, Kochi and Kochi Refinery and transportation of the same through 12" NB underground steel pipeline up to IOCL, bottling plant at Coimbatore and thereafter through an 8" NB underground steel pipeline from Coimbatore to Salem via IOCL, Bottling Pant Erode. The project also envisages connectivity with IOC Bottling Plant, Kochi (Udayamperoor) with IOCL import despatch terminal through Kochi Refinery despatch terminal.

The present chapter provides a process design basis covering the basic parameters necessary for the design of the facilities coming under this project.

05.02 Basic Parameters

- | | | |
|------|-----------------------------------|---|
| i. | Products to be transported | Liquefied Petroleum Gas (LPG) |
| ii. | Product properties/specifications | 50:50 (Propane : Butane). Properties and specification as per IS 4576. |
| iii. | Pipeline Design Throughput | 296 m ³ /hr (≈1.28MMTPA) |
| iv. | Turn Down | 40% or the minimum continuous flow of mainline dispatch pumps, |

whichever is higher.

- | | | |
|-------|------------------------------|--|
| v. | Design codes | ASME B31.4 and OISD-141 Guidelines will be followed as applicable. However, in case of contradictory stipulations, the more stringent conditions will prevail. |
| vi. | Design capacity of pumps | Pumps will be specified for 10% extra flow. |
| vii. | Sparing philosophy for pumps | 100% for Single pump (1W+ 1S) |
| viii. | Type of pump driver | Electric motor. |

05.03 Project Scope and Battery Limits

05.03.01 Project Scope

- Despatch facilities at IOCL, Import despatch terminal, at Kochi by providing suitable LPG Pumping facilities of desired flow rate along with hooking up with proposed storage at IOCL import facility at Kochi at the battery limit.
- Despatch facility at Kochi Refinery by providing suitable pumping facilities of desired flow rate along hooking up with existing mounded storage at the battery limit
- Laying of 12" x 39 Km. LPG Pipeline from IOCL import despatch terminal to Kochi Refinery despatch terminal from where 12"x 11Km. LPG pipeline upto IOCL bottling plant at Kochi (Udayamperror), and 12"x 238 Km.LPG pipeline upto IOCL Bottling Plant at Coimbatore via proposed BPCL Bottling plant at Coimbatore and 8" x 170 Km. LPG pipeline from Coimbatore to Salem via IOCL, Bottling Plant, Erode with SCADA & TELECOM.

- Construction of Intermediate Pigging station and Sectionalising Valve station as per OISD- 214,141 etc. with all allied facilities.
- Construction of Receipt Terminal facilities at IOCL, Bottling Plant, Kochi (Udayamperoor), proposed BPCL Bottling Plant, at Coimbatore, IOCL Bottling plants at Coimbatore, Erode and Salem
- Associated fire water network along with MV spray system at Despatch & Receipt facilities, as per OISD 214 , OISD 144 , and all other applicable codes. Fire water requirement for the respective terminals and despatch terminals will be made available from the existing fire fighting facilities of the bottling plants /KR/Import Terminal as the case may be and only tapping from the nearest fire ring main has been considered.
- Construction of all other facilities as per various applicable codal requirement such as OISD , BIS , IE , API etc.
- BPCL would like to get the Detailed Feasibility Report of above along with EIA, RRA done.

05.03.02 Battery Limits

IOCL Import Despatch Terminal

MOVs' inlet flange of suction header of mainline pump located at import despatch terminal at IOCL Kochi.

Kochi Refinery Despatch Terminal

MOVs' inlet flange of suction header of Booster pump located at despatch terminal at Kochi Refinery.

Receipt Terminal at IOCL Bottling Plant at Udayamperoor

ROV's outlet flange of metering skid located at IOCL bottling plant at Udayamperoor

Receipt Terminal at BPCL Bottling Plant at Coimbatore

ROV's outlet flange of metering skid located at BPCL bottling plant at Coimbatore.

Receipt Terminal at IOCL Bottling plant at Coimbatore

ROV's outlet flange of metering skid located at IOCL bottling plant at Coimbatore

Receipt Terminal at IOCL Bottling plant at Erode

ROV's outlet flange of metering skid located at IOCL bottling plant at Erode.

Receipt Terminal at IOCL Bottling plant Salem

ROV 's outlet flange of metering skid located at IOCL bottling plant at Erode.

05.04 Pipeline Parameters

| | | |
|-----|-------------------------|-------------------------------|
| i. | Pipeline Operating Life | Liquefied Petroleum Gas (LPG) |
| ii. | Pipeline Length | 12"x 288 km.& 8"x 170 Km. |

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline

| | | |
|-------|---------------------------------------|---|
| iii. | Basis for Hydraulic Calculation | Hydraulic calculations will be based on LPG supply temperature (i) maximum 40°C (ii) minimum 12°C and subsoil temperature of 25°C whichever is the controlling case |
| iv. | Main Pipeline Diameter | 12" NB and 8" NB. |
| v. | Pipeline Roughness | 45 microns |
| | Material of Construction for Pipeline | Carbon Steel |
| vi. | Pipeline Corrosion Allowance | 0.5 mm |
| vii. | Pigging Facilities | Permanent pigging facilities suitable for "Intelligent Pigging" shall be provided. |
| viii. | Subsoil Temperature (1m below ground) | 25°C |
| ix. | Pipeline Rating | 300#/600# ANSI |
| x. | Design Temperature | 65°C |
| xi. | Pipeline Laying | On shore - Buried Refinery premises- above ground |
| xii. | Pipeline Corrosion Protection System | Pipeline shall be protected from external corrosion by suitable external coating. Cathodic protection shall also be provided. |
| xiii. | Elevation Profile of Pipeline | As per Fig – 05.01 |

| | | |
|------|-----------------------|---|
| xiv. | Sectionalizing valves | Sectionalizing valves will be provided as per ASME B 31.4. & OISD-141 and as per elevation profile requirement. |
|------|-----------------------|---|

05.05 Despatch Station Parameters

05.05.01 Design Parameters at IOC Import despatch Terminal Kochi

| | | |
|------|--|--|
| i. | Location | IOCL Import despatch Terminal (Puthuvypeen) Kochi |
| ii. | Source of LPG | Import storage |
| iii. | Supply Flow, m ³ /h (max) | 296 |
| iv. | Suction pressure of mainline pump | Pressure : 8 kg/cm ² g, Temperature: 55°C / (-) 34°C |
| v. | Supply temperature, °C (min/nor/max) | 12/ 40/ 40* |
| vi. | Supply Pressure, kg/cm ² g (min/nor/max) | 18/25/28 |
| vii. | Elevation difference between storage bottom and Main Line pumping Units. | 1 m |

* The maximum operating pressure and temperature conditions are related to the corresponding design conditions for LPG storage bullets keeping into consideration standard design margins.

05.05.02 Design Parameters at despatch terminal, Kochi Refinery

| a) Booster Pump | | |
|-------------------------|--|--|
| i. | Location | Kochi Refinery |
| ii. | Source of LPG | LPG mounted bullets |
| iii. | Supply flow rate m ³ /h (max) | 296 |
| iv. | Suction pressure of Booster pump | Pressure : 8 kg/cm ² g, Temperature: 55°C / (-) 34°C |
| v. | Supply temperature, °C (min/nor/max) | 12/ 40/ 40* |
| vi. | Supply Pressure, kg/cm ² g | 19 |
| vii. | Elevation difference between storage bottom and booster pumps. | 1 m |
| b) Mainline Pump | | |
| i. | Location | Kochi Refinery |
| ii. | Source of LPG | Discharge header of booster Pump. |
| iii. | Supply flow rate m ³ /h (Max.) | 296 |
| iv. | Suction pressure of mainline pump | Pressure : 18 kg/cm ² g, Temperature: 55°C / (-) 34°C |
| v. | Supply temperature, °C (min/nor/max) | 12/ 40/ 40* |

| | | |
|------|---|-------|
| vi. | Supply Pressure, kg/cm ² g | 98 |
| vii. | Elevation difference between discharge header of booster pumps and suction line of mainline pump.(max.) | 0.5 m |

* The maximum operating pressure and temperature conditions relate to the corresponding design conditions for LPG storage bullets keeping into consideration standard design margins.

05.06 Instrumentation

| | | |
|------|-----------------------|--|
| i. | General | Adequate instrumentation and control system will be provided for safe and efficient operation. PLC based control system shall be provided at dispatch and receipt terminal. Supervisory Control and Data Acquisition (SCADA) system shall be designed for Remote monitoring and control. |
| ii. | Type of Control | Electronic Pneumatic |
| iii. | Final control element | Pneumatic |

05.07 Metering System

| | | |
|----|-------------|---|
| i. | Flow meters | Coriolis type mass flow meters with one spare run shall be provided at despatch and receipt terminals for custody transfer as well as leak detection purpose. |
|----|-------------|---|

05.08 SCADA & TELECOMMUNICATION SYSTEM

SCADA and Telecommunication systems for the entire pipeline will be provided to ensure effective and reliable control, management and supervision of the pipeline from a centralized location using Remote Telemetry Units (RTU) along the pipeline route at the proposed SV stations and Intermediate Pigging Stations.

SCADA Monitoring and Control: The SCADA master control station (SMCS) shall be located at Kochi Refinery.

05.09 Leak Detection and Other Apps System

Real time leak detection system integrated with SCADA network will be provided.

05.10 General Project Specifications

05.10.01 Numbering System to be followed:

| | | |
|------|------------------|-------------|
| i. | Equipment | As per BPCL |
| ii. | Instrument | As per BPCL |
| iii. | Drawing/Document | As per BPCL |

05.10.02 Units of Measurements: Metric, unless otherwise specified LPG flow rate shall be in Tonnes/hr.

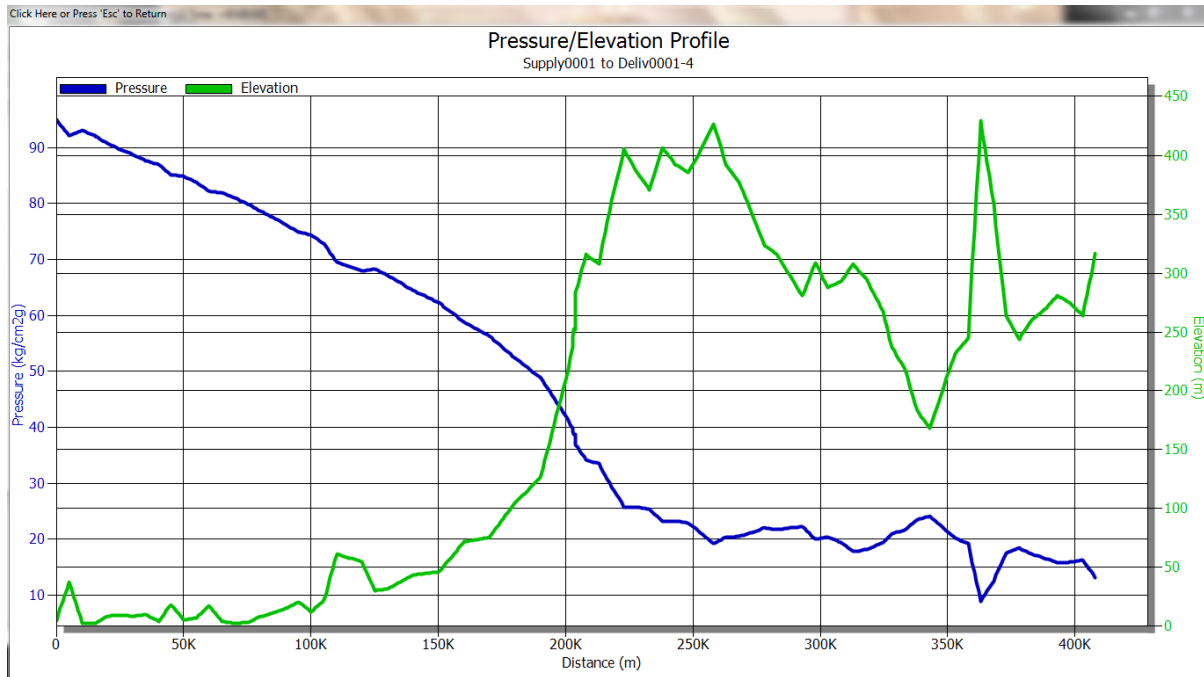


Fig 05.01



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

Chapter - 06

PIPELINE SYSTEM

06.00 PIPELINE SYSTEM

06.01 Design Documents

Following codes and standards referred for the designing of pipeline system:

Codes and Standards:

a) American Society of Mechanical Engineers (ASME)

- ASME B31.4 : Pipeline Transportation System for Liquid Hydrocarbons and others
- ASME B16.5 : Pipe Flanges and Flanged Fittings
- ASME B16.10 : Face to Face and End to End – Dimensions of Valves
- ASME B16.20 : Metallic Gaskets for Pipe Flanges – Ring Joint, Spiral Wound and Jacketed.
- ASME B16.21 : Non-Metallic Flat Gaskets for Pipe Flanges
- ASME B16.34 : Valves – Flanged, Threaded & Welding Ends

b) American Petroleum Institute (API)

- API Spec 5L : Specification for Line Pipe
- API RP 1102 : Recommended Practice for Liquid Petroleum Pipelines Crossing Railroads and Highways
- API Std 1104 : Standard for Welding Pipeline and Related Facilities
- API RP 1110 : Recommended Practice for the Pressure Testing of Liquid Petroleum Pipelines
- API Std 607 : Fire Test for Soft Seated Quarter Turn Valves

c) British Standard Institute

- BS1868 : Steel Check Valve (Flanged and Butt-Welding Ends) for Petroleum, Petro-Chemical and Allied Industries
- BS1873 : Steel Globe, Globe Stop and Check Valves (Flanged and Butt Welding Ends) for the Petroleum, Petrochemical and Allied Industries
- BS5351 : Steel Ball Valves for Petroleum, Petrochemical and Allied Industries

| | | |
|------------------|---|--|
| BS5352 | : | Steel Wedge Gate, Globe and Check Valves 50mm and Smaller for Petroleum, Petro-Chemical and Allied Industries |
| BS6755 Part-I | : | Testing of Valves Part-1 : Production Pressure Testing Requirements |
| BS6755 Part-2 | : | Testing of Valves Part-2 : Specification for Fire Type Testing Requirements. |
| DIN 30672 | : | Coatings of corrosion protection tapes and heat-shrinking products for pipelines for operational temperatures up to 50°C |
| DIN 20670 | : | Polyethylene coatings for steel pipes and fittings |
| DIN 2413 Part-II | : | Design of steel bends used in pressure pipelines |

d) American Society for Testing and Materials (ASTM)

| | | |
|-----------|---|---|
| ASTM E92 | : | Standard Test Method for Vickers Hardness Testing of Metallic Materials |
| ASTM E94 | : | Standard Practice for Radiographic Testing |
| ASTM E165 | : | Standard Practice for Liquid Penetrant Inspection Method |
| ASTM E709 | : | Standard Guide for Magnetic Particle Examinations. |

e) Oil Industry Safety Directorate

| | | |
|-------------------|---|--|
| OISD-GDN-115 | : | Guidelines on Fire Fighting, Equipment and Appliances in Petroleum Industry |
| OISD-Standard-141 | : | Design and construction requirements for cross country hydrocarbon pipelines |
| OISD-Standard-118 | : | Layouts for oil and gas installations |

06.02 Selection Criteria of Proposed Site and Pipeline Route

06.02.01 Start Point

Since the pipeline is to take first of its two feeds from IOCL import facility at Puthuvypeen, the start point of the pipeline has to be suitably located near the LPG IOCL import facility area in Puthuvypeen. The start point is thus considered at the IOCL import facility.

06.02.02 Pipeline Route Selection Criteria

- Avoidance of heavily populated/ built-up areas.
- Minimum route length through protected areas.
- Minimum route length through marshy and water logged area.
- Minimum number of crossings (road, rail and water courses).
- Safety of public and private properties.
- Minimum impact on environment.
- Major/Minor crossings en-route.
- Suitable locations for terminals and stations.
- Safety of people and property as far as possible.
- Minimum number of bends as far as possible.
- Favourable ground profile for Pipeline.
- Accessibility to Pipeline route during construction, maintenance and operation as far as possible.
- Location of Pipeline facilities and access thereto.
- Avoidance of Mines protected and reserved forest, archaeological and other sensitive areas including flora and fauna as far as possible.
- Avoidance of unstable ground feature as far as possible.
- Minimising road, canal, river and flood prone and tidally affected areas.
- Avoidance of Rocky stretches as far as possible.
- Avoidance of Areas reserved for planned and future development as far as possible.
- Flexibility for future expansion.

For the Pipeline alignment, two options have been examined.

06.02.03 Terminal Point

The pipeline is to be terminated at the IOCL Bottling plant at Salem, hence the terminal point of the pipeline is already identified and selected.

06.03 Pipeline Route

The site of the proposed DT at Kochi Refinery lies to the east of the IOCL Import facility with thickly populated city of Ernakulam lying

between them thus the route south of Kochi Refinery up-to Karimughal in-spite of being shorter and along the road is not considered due to presence of dense habitation.

The route selected for this part generally follows the National Highway route. The route takes off from the IOCL Import facility runs in a direction slightly north of east along the NH for nearly 5 kms and then turns northwards all along the NH. After traversing another 5 kms the NH takes a turn towards north-east and the pipeline route follows it. At nearly 20 kms from the start point, the route crosses NH-47 and from thereon the route goes in a south-eastern direction and then further south, finally reaching the Kochi Refinery. For reaching the IOCL bottling plant at Udayamperoor the route moves a further 11 kms towards south.

The route of the pipeline further takes off from Kochi Refinery then it runs in the North-East direction for its initial 28 km length, the pipeline traverses through North-West direction for nearly 60 kms stretch. From thereon route turns Northwards and then North-west. The route then runs along the east side of the SH-22 and subsequently runs along the SH-74, leaving it near the town of Kavassery around Ch. 208.00 the route moves East to reach NH 544. Thus after traversing 68.00 km length detour to avoid the core area of PEECHI Wild Life Sanctuary the route again follows North-East direction along NH 544 to cross the Pollachi-Coimbatore section of NH. Subsequent to the above route takes a turn towards and reaches the IOCL Bottling Plant.

From thereon the route moves in North-eastern direction mostly following the Pollachi-Avinashi-Tirrupur-Palladam Road. Near the town of Tirrupur it leaves the highway in order to circumvent the town. Beyond Tirrupur it again follows the highway route and runs along the North-east direction reaches the NH-47 and then runs along it in the same direction and reaches the termination point near Salem.

Forest Involvement:

The proposed pipeline passes through Reserved Forest (Fairly Dense Mixed Jungle) in Attur Section for 1.47 km stretch.

| SR No. | DESCRIPTION | CHAINAGE (m) | | Length (m) |
|--------|---|--------------|-------------------------|----------------|
| | | START | END | |
| 1 | Reserved Forest (Fairly Dense Mixed Jungle) (Attur Section) | 111405.03 | 112875.40 | 1470.37 |
| | | | Total Length (m) | 1470.37 |

Though, the total length of the route in this alternative is about 29 km more than the Alternative-I on account of this detour but the advantage of this route over the others is that this route completely avoids the core area of Peechi Wild Life Sanctuary. However, it does not avoid the buffer zones of Peechi and Chulanar sanctuaries.

06.03 Size of operation (Throughput)

The system considers transportation of max. 1.280 MMTPA LPG from IOCL Import despatch terminal at Kochi to Salem via Kochi Refinery, IOCL BP Coimbatore, IOCL BP Erode. The flow-rate of LPG will be 296 m³/h.

The size of the pipeline will be 12" NB with a total length of 288 km. from IOCL Import despatch terminal at Kochi to IOCL BP at Coimbatore via Kochi refinery and 8" NB with a total length of 170Km. from IOCL BP at Coimbatore to Salem via IOCL BP at Erode.

06.04 Location of Pipeline Facilities

06.04.01 IOCL Import despatch terminal at Kochi

The proposed facilities at Kochi shall consist of scraper launcher, Mainline pumps (1w+1S), filtering, metering and pressure controlling facilities. The proposed facilities shall be accommodated in the area near the existing LPG import facility and additional area may also be required for ease of operation and maintenance of the proposed facilities. On-line Sulphur analyser and moisture analyser will be installed.

06.04.02 Kochi Refinery Dispatch Terminal

The proposed facilities at Kochi shall consist of scraper launcher, booster pumps (1w+1S), mainline pumps (1w+1s), filtering, and metering and pressure control valve. The proposed facilities shall be accommodated in the area provided by BPCL near the existing LPG storage area. An additional area may also be required for ease of operation and maintenance of the proposed facilities. On-line Sulphur analyser and moisture analyser will be installed.

06.04.02 Intermediate Pigging Station

One number of Intermediate pigging(IP) station shall be located in CH. 151 Km. for 12" NB pipeline and one number IP station shall be located in Ch. 354Km. at Erode for 8" pipeline. The proposed facilities at intermediate pigging station shall consist of scraper launcher and scraper receiver.

06.04.03 Receipt Terminal at IOCL Bottling Plant at Kochi

Receipt terminal for the proposed pipeline shall also be considered at IOCL's Bottling in Ch. 50 km. at Kochi. Pipeline facilities at shall consist of Scraper Receiver, Basket Filter, Pressure Control Valve, and Flow Meter.

Schematic diagram / P&ID is attached as Annexure/

06.04.04 Receipt Terminal at BPCL Bottling Plant at Coimbatore

Receipt terminal for the proposed pipeline shall be at BPCL's upcoming LPG complex in Ch. 272 km. at Coimbatore. Pipeline facilities at Coimbatore shall consist of Basket Filter, Pressure Control Valve, and Flow Meter.

06.04.05 Receipt Terminal at IOCL Bottling Plant at Coimbatore

Receipt terminal for the proposed pipeline shall also be considered at IOCL's Bottling in Ch. 277 km. at Coimbatore. Pipeline facilities at Coimbatore shall consist of Scraper Receiver, Basket Filter, Pressure Control Valve, and Flow Meter and 8"X12" Scraper launcher.

06.04.06 Receipt Terminal at IOCL Bottling Plant at Erode

Receipt terminal for the proposed pipeline shall also be considered at IOCL's bottling plant in Ch. 354 km. at Erode. Pipeline facilities at Erode shall consist of Scrapper launcher, Scrapper Receiver, Basket Filter, Pressure Control Valve, and Flow Meter

06.04.07 Receipt Terminal at IOCL Bottling Plant at Salem

Receipt terminal for the proposed pipeline shall be considered in Ch. 447 Km. at IOCL Bottling Plant, Salem. Pipeline facilities at IOCL bottling plant, Salem shall consist of Scrapper Receiver, Basket Filter, Pressure Control Valve and Flow Meter.

06.05 Pipeline Design Parameters

The following design parameters have been considered for the study:

Mainline

| | | |
|---------------------------------------|---|---|
| A) Section | : | IOCL Import despatch terminal at of M/s IOCL at Kochi to LPG Bottling plant of M/s IOCL at Udayamparoor with a tap-off at KRL-Kochi |
| Total length of Pipeline | : | 50 km. (approx.) |
| Product handled | : | LPG |
| Composition | : | 50:50 (Propane: Butane) |
| Fluid Temperature | : | 15-30°C |
| Flow Rate | : | 1.28 MTPA (~ 296 m ³ / hr) |
| Operating Time | : | 8000 hr / year |
| Pipeline Material of Construction: | | Carbon Steel |
| Pipeline Corrosion Allowance | : | 0.5 mm |
| Diameter of Pipeline to be considered | : | 12" NB |
| External Coating | : | 3 layer PE |

| | | |
|---------------------------------------|---|---|
| Pipeline Rating | : | 300# ANSI |
| Design Temperature | : | 60°C (Buried) |
| | : | 65°C (Above Ground) |
| Pipeline Laying | : | Buried |
| B). Section | : | BPCL-KRL Despatch Terminal to IOCL-Coimbatore |
| Total length of Pipeline | : | 233 km. (approx.) |
| Product handled | : | LPG |
| Composition | : | 50:50 (Propane : Butane) |
| Fluid Temperature | : | 15-30°C |
| Flow Rate | : | 1.280 MMTPA (~ 296 m ³ / hr) |
| Operating Time | : | 8000 hr / year |
| Pipeline Material of Construction: | | Carbon Steel |
| Pipeline Corrosion Allowance | : | 0.5 mm |
| Diameter of Pipeline to be considered | : | 12" NB |
| External Coating | : | 3 layer PE |
| Pipeline Rating | : | 600# ANSI |
| Design Temperature | : | 60°C (Buried) |
| | : | 65°C (Above Ground) |
| Pipeline Laying | : | Buried |

| | | |
|---|---|---|
| C).Section | : | IOCL Coimbatore to IOCL Salem. |
| Total length of Pipeline | : | 170 km. (approx.) |
| Product handled | : | LPG |
| Composition | : | 50:50 (Propane: Butane) |
| Fluid Temperature | : | 15-30°C |
| Flow Rate | : | 1.28MMTPA (\simeq 296 m ³ / hr) |
| Operating Time | : | 8000 hr / year |
| Pipeline Material of Construction: | | Carbon Steel |
| Pipeline Corrosion Allowance | : | 0.5 mm |
| Diameter of Pipeline to be considered : | | 8" NB |
| External Coating | : | 3 layer PE |
| Pipeline Rating | : | 600# ANSI |
| Design Temperature | : | 60°C (Buried) 65°C (Above Ground) |
| Pipeline Laying | : | Buried |

06.06 Pipeline Materials

Pipeline & its appurtenances shall be provided with carbon steel material suitable for the intended service, as indicated below:

a) Line Pipe

Line pipe shall conform to API Specification 5L Grade-65. The process of manufacturing of line pipe shall be electric welded/ seamless construction. Pipe wall thickness shall conform to ASME B 31.4 and shall also meet requirement of OISD 141. Design Factor has been considered as 0.4 for Highly Populated area and balance 0.72 for other areas for pipeline design.

b) Pipeline fittings and flanges

All pipeline materials downstream of the pumps, such as valves, flanges and fittings, etc. shall be of Class 300#/600# rating.

c) Mainline Valves

All mainline valves are full bore type and designed as per API 6D and API 6FA/ API 607 fire safe design requirements.

All mainline valves shall be double block & bleed type. First isolation valve in mainline shall be butt welded type. All mainline valves including launcher & receiver valves full bore, butt welded type motorised type. All valves at SV Station and Intermediate Pigging Station is of welded type full bore valves.

d) Flanges, Terminal Pipes & Fittings

All aboveground piping system shall be of seamless pipes of equivalent grade to match 300#/600# pressure and temperature rating. All fittings shall conform to ANSI 300#/600# application.

e) Flow Tees

All branch connection on the main line, which are greater than 40% of mainline diameter, shall be provided with flow tees to allow smooth passage of pigs. The material of flow tees shall be compatible with line pipe material.

B) Insulating Joints

Insulating joints shall be provided at transition point of aboveground & underground section of pipeline for electrical isolation. These will be mono-block type suitable for both above/ underground installations.

C) Ball Valves

All ball valves for terminals shall be full bore/ reduced bore type. TMBV underground ball valve shall have welded configuration and aboveground station valves shall be a bolted configuration.

D) Scrapper Traps

Scrapper Traps (Launcher/Receiver) shall be provided at the Despatch Terminal, Intermediate Pigging Station and Receiving Terminal for facilitating cleaning pigging. Scrapper traps shall be designed as per

ASME B31.4, ASME SEC VIII, and Div.-1 latest edition. The material of scraper traps shall be compatible with line pipe material.

E) LR Bends

Cold field bends shall be in accordance with codes but in no case with a radius below 40 times diameters. Induction bend shall only be used where ever space constraint is there. However at stations it can be used. 6D bends shall be acceptable only in mainline stations.

06.07 Corrosion Coating

The selected corrosion coating shall be suitable for the temperature range specified in the Process Design Basis. In addition, it should have the following properties:

- High integrity
- Resistant to aging and degradation Resistant to attack by micro-organisms
- Resistant to soil stresses
- Ease of application
- Resistant to impact and mechanical damage during transportation

It is proposed to provide corrosion protection of the buried pipeline in onshore section using 3 layer side extruded Poly Ethylene (PE) coating.

The total thickness of the coating shall be minimum 2.0 mm. The sequence of application of the coating shall be as follows:

- Epoxy
- Co-polymer layer applied by extrusion
- Polyethylene layer applied by extrusion

In addition to the corrosion coating, the entire buried portion of the pipeline system shall be provided with cathodic protection system.

06.08 Pipeline Construction

Pipeline and associated facilities shall be constructed in accordance with ASME B 31.4 and other applicable API standards. The pipeline

shall be laid underground with minimum 1.0m cover. Additional cover, wherever required, shall be provided in accordance with OISD 141.

Welding shall be carried out as per API 1104. All welds shall be 100% radiographed. After the installation is completed, the entire pipeline shall be hydrostatically tested as per ASME B31.4. The hydrostatic test pressure at any test section shall be 1.4 times the design pressure. The maximum hydrostatic test pressure at any location in the pipeline during testing shall not exceed the pressure required to produce hoop stress equal to 95% of SMYS of pipe material. The test duration shall be minimum 24 hours for pipeline. Despatch/Receipt terminals as well as other intermediate facilities shall also be tested at 1.4 times the design pressure. The test duration shall be minimum 4 hours.

06.09 CONSTRUCTION METHODOLOGY

06.09.01 Main Pipeline

In case of soft soil, conventional trenching and backfilling can be considered for laying of pipeline.

In case of sub surface encountered being weathered rock, a minimum of 300mm thick layer of soft back-fill material shall be provided all around the pipeline prior to back-filling the trench with excavated material. Where blasting cannot be carried out due to close proximity of existing facilities, mechanical equipment for rock excavation can be used. Conventional trenching and back-filling using trenching machine has been considered for laying of the pipeline in the soft soil areas other than described above.

The type of corrosion coating selected (PE) for the pipeline has adequate mechanical properties to withstand the hard surface features. A typical cover of one (1) meter over the top of pipeline is considered

06.09.02 Pipeline Crossings

a) Rail

Railway lines shall be crossed by boring method. Approval of designs and construction methodology shall be obtained from concerned railway authorities. Pipeline at railway crossing shall

be provided with casing pipe. The carrier pipe shall be installed inside casing pipe. The casing pipe shall be three nominal sizes larger than carrier pipe. The minimum clear cover at the crossing above top of pipeline shall be 1.7 m. The crossing angle shall be as close to 90° as possible. The railway crossing shall comply with the requirement of API 1102 and Indian Railway authorities.

Casing insulator and seals shall be provided to isolate carrier and casing pipes.

b) Road & Canal

Road crossing shall comply with the requirement of API 1102 and requirements of the concerned road authorities. Pipeline at National Highways and State Highways Crossing (wherever required) shall be provided with the casing pipe. Metalled roads other than the national highways and state highways shall be crossed by open cut method. However at locations where it is not possible to cross the road by open cut method boring/ jacking method shall be used. No casing pipe shall be considered at such locations. All the cart tracks crossings shall be carried out by open cut method. The road crossing shall be provided with minimum cover of 1.2 m measured from top of the carrier pipe.

Irrigation land canals shall be crossed by boring method wherever required by the statutory authorities. All other minor canals and nulls crossings shall be carried out with conventional open cut method unless directed other-wise by concerned authorities. The canal crossings and other water crossing shall be provided with a minimum clear cover of 1.5m.

c) River Crossing:

Pipeline route crosses Periyar, Chalakudi, Manali, Mangalam, Gayatri, Kannadi, Koraiyar, Valayar & Kummattipatti Rivers. Rivers are proposed to be crossed by HDD or by open cut methods depending on the river. Pipeline shall be installed approx. 2.5 m below the lowest bed level. Lowest bed level shall be calculated after giving due consideration to scour depth.



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

Chapter - 07

SCADA & APPS SYSTEM

07.00 IP BASED SCADA and APPS System

07.01 Introduction

It is common in complex natural cross-country Oil & Gas infrastructure projects to have a Supervisory Control and Data Acquisition (SCADA) system. The SCADA system envisaged to ensuring effective and reliable control management and supervision of the pipeline from centralized location using Remote Terminal Units (RTUs) at various pipeline facilities & Exchange of critical parameters with respect to Marketing Terminal Automation System & Other operating pipeline SCADA Systems. The SCADA system can typically either control the infrastructure, by way of adjusting set points and opening/ closing valves, or monitoring the system by way of data acquisition. Where a SCADA system only monitors, the system control functions will need to be performed by field operations staff.

In a distribution system, a monitoring SCADA system can typically be expected to report on Cathodic Protection levels (for steel systems), inlet and outlet pressures of the pressure reduction stations, flow, gas temperature through the stations and fringe point pressure (gas pressures at the extremity of the distribution grid). A monitoring system can also be utilized to monitor system pressures and assist in identifying system leaks. A monitoring system comprising of one Remote Terminal Unit (RTU) at each Terminal and one RTU at each associated fringe point/ SV stations are recommended. The fringe point RTU would only monitor inlet and outlet gas pressure, station flow, status of the associated plants & equipments, slam shut status, electrical, CP & fire system etc.

The present pipeline proposed by M/s BPCL, Laying of 12" dia pipeline, approx. 288 km. long from IOCL Import Terminal to IOC BP, Kochi via KR and KR to Coimbatore IOC BP via proposed BPCL BP, Coimbatore and laying of 8" dia., approx 170 km. Pipeline from IOCL Coimbatore to IOCL Salem via IOC, Erode BP. The transportation capacity will be 1.28 MMTPA. Simultaneous withdrawals at IOC BP Coimbatore, Erode and Salem are considered for the design.

To ensure effective and reliable control, management and supervision of the pipeline, new pipeline **Kochi - Coimbatore - Erode - Salem LPG Pipeline** shall have dedicated SCADA & APPS system with centralized Master control station (MS) and backup Emergency Control

Station (EMS). Remote work station (RWS) has to be installed at other receiving /despatch manned locations (total 05). The MS shall be inter-linked with Remote Telemetry Unit (RTU) along the pipeline. The APPS system shall run at Master Control Station (MS).

07.02 IP SCADA & APPS System Requirements

- A. To ensure effective and reliable control, management and supervision of the pipeline, the pipeline is envisaged to be monitored and controlled from IP Based SCADA system consisting of Master Stations (MS) proposed at Kochi Refinery Despatch Terminal- Kochi, Kerala and Emergency Master Station (EMS) proposed at BPCL Coimbatore BP Receipt Terminal, Tamilnadu. The MS & EMS shall be connected through dedicated OFC links (proposed to be laid along the pipeline in same trench) and Leased Line as back-up (will be finalised based on the feasibility) & as per networking philosophy proposed. The MS & EMS shall be inter-linked with remote telemetry along the pipeline on dedicated LAN network. The APPS system shall run only at MS.

One RWS (Remote work station) each at all the manned locations has been proposed. These locations are:

IOCL Import Despatch Terminal

IOC, BP, Kochi (Udayamperror)

IOCL, BP receipt terminal Coimbatore

IOCL, BP receipt terminal, Erode

IOCL, Salem

The RWS will be connected to MS & EMS by dedicated LAN on main OFC based Telecom network connectivity as proposed **Kochi - Coimbatore - Erode - Salem LPG Pipeline**

- B. The following pipeline facilities shall be considered for telemetry purposes and hook-up to Centralised SCADA through Remote Terminal Units (RTUs) located at these locations for **Kochi - Coimbatore - Erode - Salem LPG Pipeline**

| | | | |
|---|---|---|---------|
| ➤ | Despatch Terminal facilities | - | 2 Nos. |
| ➤ | Intermediate Pigging Station | - | 2 Nos. |
| ➤ | Receipt terminals | - | 5 Nos. |
| ➤ | Sectionalizing valve stations / CP stations | - | 44 Nos. |

C. The SCADA software would need to have the following features:

- On-line configuration
- Configuration Toolbar
- Object-orientated Graphics
- Real Time and Historical Trending
- Alarming and Alarm Management
- Rational Database Support

Along with SCADA system, pipeline will have facility for APPS SYSTEM to run the following APPS modules/ functionality;

- Leak detection module based on transient modeling
- Batch Scheduling & Batch Tracking
- Inventory analysis & Stock accounting
- Survival time analysis
- Pipeline transpiration efficiency and scraper tracking module
- Contingency Analysis
- Predictive Module
- Planning Module
- Operator learning

07.03 Design Criteria

A. The IP based SCADA & APPS system shall meet the requirements of open architecture in the following manner:

- 1) The IP based SCADA shall meet the requirements of interoperability, portability and scalability as per the following international standards, with their latest version:
 - (i) The SCADA software with main SCADA data base shall be SCADA server resident and the OS shall support real-time operation.
 - (ii) The SCADA HMI (MS, EMS & RWS) and web server shall be microprocessor window based.
 - (iii) The networking shall support OSI/TCP/IP network connectivity.
 - (iv) The LAN shall meet IEEE 802.3 standards.

- (v) The SCADA database management system shall support database access through SQL.
 - (vi) The server (MS / EMS) shall be both ODBC & OPC compliance. Both Primary and Secondary Server of MS and EMS shall be loaded with OPC software (both OPC client and OPC server interface.)
- 2) The interface between SCADA and APPS system will be OPC and shall be based on generic modular architecture to support multi-vendor system integration.
- B. The SCADA and APPS system shall be adequate (without adding any hardware to the already installed system at MS, EMS) to accommodate 50% feature expansion (w.r.t. additional RTUs and consequent pipeline length and facilities, communication channels, additional remote workstations etc.) without any limitations and without affecting the various system performance parameters and keeping average CPU, memory and disk utilization within 50%.
- C. The communication protocol with RTUs shall confirm to IEC 870-5-101 or DNP3.0 (TCP/IP).
- D. The polling time of RTU shall be completed within 5 seconds.
- E. The poll time considering 50% parameter changes every poll of all RTUs including time for scanning, polling, processing and complete updating on SCADA & APPS database & MMI shall not exceed 30 seconds.
- F. SCADA/ APPS interface data interchange, APPS modules execution including updating on SCADA/ APPS database/ displays shall be completed every 30 sec or better.
- G. In normal operation, the Kochi Master Station (MS) shall poll all the RTUs. However, if the OFC link/low speed data channels fail then the EMS, Coimbatore shall start polling the affected RTUs accessible to EMS and to update the database at MS over WAN links / backup link. In this case the control commands from Kochi MS meant for the affected RTUs shall be routed through EMS to the corresponding RTUs. On recovery of OFC link/high speed data channel, the Kochi MS shall resume the polling of all RTUs. The philosophy will be modified if

required based on the operational requirements of the BPCL during execution.

07.04 System Configuration & Networking Philosophy

07.04.01 System Configuration at MS, Kochi

The system at MS shall be configured as real time computing environment consisting of Two Computer Servers (CWS #1, #2), One Web Server, Two MMI workstations (MMI #1, MMI #2), APPS Servers (hot redundant) with predictive model workstation (PMWS) or SQL client, One GPS Server, dual CCUs, Line Switching Unit, One WAN router and printers (1 No. color Laser Printer, 2 Nos. Color Inkjet Printer) distributed over a dual redundant Local Area Network (LAN) of 100 Base-T Ethernet switches.

Two SCADA Servers i.e. CWS #1 and CWS #2 shall be configured as SCADA servers. CWS #1 and CWS #2 shall be configured in dual hot standby mode such that in case of any failure of fault in the active machine due to CPUs failure / disc failure/ both LAN interface failure/ software failure etc. smooth changeover to standby machine shall be completed within 30 sec automatically and without causing any loss of data and without any effect on SCADA & APPS functionality.

The standby server CWS#2 along with APPS Server shall be used for running complete application software (APPS) package in conjunction with real time data from active SCADA workstation through dual redundant LAN, High resolution rear projection type Mimic Screen shall also be provided at MS.

07.04.02 System Configuration at EMS, Coimbatore:

The system at EMS will be similar to MS in all respect.

Servers i.e. CWS #1 and CWS #2 shall be configured as SCADA standby servers at EMS. CWS #1 and CWS #2 shall be configured in dual hot standby mode such that in case of any failure of fault in the active machine due to CPUs failure / disc failure/ both LAN interface failure/ software failure etc. smooth changeover to standby machine shall be

completed within 30 sec automatically and without causing any loss of data and without any effect on SCADA & APPS functionality.

In case of total failure of MS, EMS will poll all the RTU via Server 1 or in case of failure of Server- 1 through Server – 2. When MS is available, then EMS will again act as standby and update the both the Server of MS via backup link for the failure period.

07.05 System Hardware: Master Station & Emergency Master Station

The system at MS / EMS shall consist of following hardware's :

- a) Two SCADA servers Primary & Secondary with hard disks & backup, main memory, 21" color TFT LCD screen monitor, Window based HMI/MMI workstations functionality, alphanumeric & functional Keyboards, mouse, Power supply units etc.
- b) Dual Redundant LAN
- c) Two nos. of 24 channels Ethernet Switch (In Dual LAN setup).
- d) One no. of color laser jet printer with Ethernet Port and to be connected to SCADA LAN.
- e) Comm. Interfaces including all types of cables, Glands, connectors etc.
- f) One no. of WAN router providing of G.703 ports. (Dual hot standby) The routers shall have LAN ports, and 1 configuration port. The Router shall have provisions for the backup telecom connectivity network.
- g) SCADA Cabinets (for hosting the SCADA equipments)
- h) Auxiliary equipments including cabling, connectors, converters, tap offs, interfaces, Furniture etc.

GPS TIME SERVER / Time synchronization:

GPS time server along with Network Time Protocol shall be provided at MS to synchronize the clocks of the entire machine on the DUAL LAN

and to synchronize all the RTUs time with MS / EMS. GPS time server shall have Ethernet port, which shall be connected to Dual LAN.

07.05.01 Communication Controller Units

Dual Communication Controller Units at MS and EMS shall manage the data acquisition function, SCADA scan tasks, communication control, polling of RTUs etc. and can be implemented in any of the following two CCU configuration:

- CCU implemented at Software level in the Computer Server along with Terminal Server **(CCU #A)**
- CCU implemented in dedicated hardware & software level as a separate sub-system **(CCU #B)**

07.05.02 WAN Router

Wan Router shall be provided to manage the high-speed data connectivity between the MS & EMS. If required same will be provided at all the RWS locations (finalised based on the backup philosophy to be decided during detailed engineering).

Each computer servers shall be based on multiprocessor architecture with two 64 bits RISC based processors installed as a minimum

The MMI workstations, web server and remote workstations shall be based in machines with multi processor architecture (with two processor installed as a minimum). Necessary ports for Ethernet Interface or G.703 interface on switch shall be considered as per the requirements.

07.06 Remote Workstations (RWS)

Presently, RWS have been envisaged at 05 receiving / despatch manned locations as define above, RWS can be provided as per requirements. The remote workstations shall have dual 21" flat screen industrial grade color VDUs with keyboard & mouse along with one Laser Printer & one WAN router. Each remote workstation (RWS) shall

access alarms/ events, real time database from active SCADA CWS at MS in normal operation and provide the MMI functionality. The RWS communicate to Telecom equipments on Ethernet. Dedicated LAN will be provided to connect MS/EMS to RWS over OFC.

07.07 Remote Terminal Units (RTUs)

The RTU shall be microprocessor based programmable units with both ROM & RAM memory.

The RTUs shall have own processor, memory, power supply unit & communication modules, serial interface modules and I/O cards complete in all respects. All RTU shall be modular and from same model product line with identical capacities.

Each card shall perform dedicated functionality w.r.t. Analog input, analog output, digital input and digital output functions.

The RTUs shall intelligent and shall provide the following functions:

- Time Tagging
- Self Diagnostic
- Check before execute and time out feature to be supported in RTUs in conjunction with the SCADA package at host level.
- Serial interfacing with flow computers, gas chromatographs etc on Modbus protocol. For serial interfacing facility shall exist for development/ incorporation of user written driver programs in the language/ script support by the RTUs.
- The PLC of Pump & Pipeline operations and Marketing terminal shall be communicated on serial Modbus communications. Modbus will be the standard protocol for communications however any conversion if required shall be done at the equipment level.
- RTU will be communicated to telecom equipments on Ethernet (two ports) on LAN network over OFC.

07.08 Communication Channels Requirements :

- 07.08.01 Ethernet connectivity of the RTU with telecom equipments on dual ports shall be considered for connectivity to Master SCADA.
- 07.08.02 24 Nos of channels as part of MS & EMS connectivity shall be provided as per the network designed finalised during detailed engineering. The interface may be on Ethernet or on serial at RS 485 / RS 232 with IEDs and on Ethernet for Telecom equipments.
- 07.08.03 The OFC high-speed data channels shall support connectivity between the MS & EMS and any Remote Workstations (RWS) at 2 Mbps (Minimum).

07.09 Mandatory spares

The mandatory spares shall include the following:

- a) 2 No. CCU/terminal switch.
- b) 10 % of all installed cards/ modules (including I/O cards of each type) with pre-fab cables, connectors.
- c) Any other items found necessary based on the criticality of the system requirements shall be considered while designing.

07.10 Test Equipment

Test equipment shall include the following as a minimum one each for Kochi & Coimbatore stations:

- a) 2 Nos. of Portable diagnostic Test Unit (PDT).
- b) 2 Nos. of Portable Plant Simulator and Power 4-20 mA/1-5 V current/voltage sources cum meters with carrying case.

- c) 2 Nos. of Digital Multimeter (4½ digit) with built-in signal level meters and with carrying case.
- d) 1 No. Protocol analyzer software covering various Protocol used in SCADA communications for Coimbatore.
- e) Line Testers for testing RS 485 link which check, transmit and receive functions for Coimbatore.
- f) Any other items found necessary based on the criticality of the system requirements shall be considered while designing.



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

Chapter - 08

TELECOMMUNICATION SYSTEM

08.00 IP based Telecommunication System

08.01 Introduction

The present pipeline proposed by M/s BPCL, Laying of 12" dia pipeline, approx. 288 km. long from IOCL Import Terminal to IOC BP, Kochi via KR and KR to Coimbatore IOC BP via proposed BPCL BP, Coimbatore and laying of 8" dia., approx 170 km. Pipeline from IOCL Coimbatore to IOCL Salem via IOC, Erode BP. The transportation capacity will be 1.28 MTPA. Simultaneous withdrawals at IOC BP Coimbatore, Erode and Salem are considered for the design.

Since the pipeline is to pass through the cross-country area not adequately covered by the public telecommunication system, a dedicated telecommunication system is proposed to be implemented to meet the operation and maintenance requirements of this pipeline and for future telecom requirements.

Considering the implementation schedule, comparative economics of various communication media and availability of the right-of-way along the pipeline route, Internet Protocol (IP) based an optical fiber communication system is proposed for **Kochi - Coimbatore - Erode - Salem LPG Pipeline** project as the main communication system for the pipeline operation and for future requirements and for back up communications on dedicated leased line from other service provider after reviewing the suitability may be considered.

08.02 Telecommunication Requirements

The IP based telecommunication system shall provide dedicated Voice, Data, CCTV and Video communication & Video Conferencing to cover stations of pipeline facilities.

The following consideration/ assumptions are made:

- i) All Sectionalizing valves shall have remote operation.
- ii) 07 Nos. of Stations which are to be telecom attended stations. (MS & EMS and other despatch & receiving).

- iii) No. of stations (qty refer information provided elsewhere- mostly sectionalising valve stations) which are telecom unattended stations.

Overall following locations telecom equipments for telemetry purposes and hook-up to Centralised SCADA through Remote Terminal Units (RTUs) shall be considered for **Kochi - Coimbatore - Erode - Salem LPG Pipeline**

- Despatch Terminal facilities - 2 Nos.
- Intermediate Pigging Station - 2 Nos.
- Receipt terminals - 5 Nos.
- Sectionalizing valve stations / CP stations - 44 Nos.

In line with the above, following requirements/ systems adopted:

A) ***IP based Optical Fiber Communication System***

- i) Providing voice communication at the various through IP phones; Ordinaries (Analog), Digital, Weather proof and Explosion proof telephones with acoustic Booth and beacon (at hazardous areas).

The same shall include the following:

- Direct dialling facility between attended stations and at various unattended locations.
 - Video Conference facility connecting all the attended stations.
 - Voice communication, Pipeline Maintenance / Securities / Watchman connections all stations Attended and Unattended.
 - Hotline facility connecting attended manned stations. (All despatch / receiving stations total 07 Nos).
 - One video monitoring phone at all manned stations for station I/c.
- ii) Providing high-speed data communication (on Ethernet LAN) for SCADA.
- iii) Providing high-speed data communication for network management system for telecom (as required).
- iv) Providing facsimile communication amongst attended stations.
- v) Providing IP EPABX network connecting attended & unattended stations.

- vi) Providing video conferencing amongst all the attended manned receiving / despatch stations (total 07 locations)
- vii) Providing CCTV PTZ & Fixed type Cameras & System for station surveillance. Explosion proof PTZ cameras at all pumping stations. Client work stations to all the manned stations. (total 07 locations). One CCTV Server (1+1) with NAS at MS and EMS.
- viii) Network Management System to facilitate remote monitoring & control of Telecom equipments at various stations to be installed at MS and EMS.

B) *Dedicated Leased Line*

For the back – up communication minimum 10 mbps leased line between MS Kochi & EMS Coimbatore locations shall be considered for from the external service provider. For the back – up communication between end stations minimum 2 mbps leased line with router / switch at RWS IOCL Import Despatch Terminal and IOCL, Salem stations to MS / EMS shall be consider.

08.03 System Engineering Considerations:

Overall end-to-end system availability of better than 99.99% at $1 * 10^{-10}$ BER for optical fibre communication system & 99.96% at 10^{-6} BER for satellite system shall be considered.

The mean time to repair of a faulty module is taken as 1 hours.

The optical fibre communication system shall meet the current requirements & shall provide for future expansion in voice and data traffic as well as leasing out requirement if any in future.

The network shall have built-in self-diagnostic and network management capabilities to continuously check the communication network the network management centers with dedicated Network Management System proposed at Kochi MS and Coimbatore EMS.

In case of an optical fibre cable cut/station failure, data upto the fibre break/station failure shall be available at MS and from the fibre break/station failure shall be available at EMS. Each NMC in that case shall also control and monitor the various stations upto the fibre break/station failure.

Considering the above it is therefore envisaged to provide for the following :

- a) A dedicated IP based SDH on optical fibre communication system implemented as the main system for effective operation and maintenance of the pipeline.
- b) Leased line from other service provider shall also be considered as back-up communication.
- c) To meet the present as well as future expansion for Voice & Data requirements, IP based Synchronous Digital Hierarchy (SDH) which is future proof technology as per International Telecommunication Union (ITU-T) shall be considered. Concepts like ring protection shall achieved higher system reliability required (the same shall be achieved by providing by duplicating the signals and sending them through two parallel optical fibres).
- d) The proposed system shall have minimum STM16 (1+1) equipments based on the bandwidth requirements.
- e) IP EPABX system with IP phones shall be considered at MS Kochi & EMS Coimbatore with Manageability from either side. Telephones of unattended station shall be extended over SDH as per requirements.
- f) CCTV System with PTZ Cameras & Fixed Cameras shall be considered with Viewing Server at MS & EMS and client work stations at all manned despatch / receiving stations. (Rest 05 locations).
- g) Video Conferencing Equipments at manned locations (07 locations).

08.04 System Implementation Plan

- a) Considering the present requirements & the possibility of future expansion / requirements and leasing out capacity to other users, a

160 Mbps digital optical fibre communication link as the main communication system is considered adequate to meet the telecommunication requirements.

- The scope of the telecom works through optical system shall cover attended and unattended stations along the pipeline.
- Air conditioning shall be considered at Dispatch & Receiving terminals, however at SV's equipments can be work without Air conditioning environments.
- Minimum 72 hrs back-up shall be considered for Telecom equipments.

08.05 Broad Specification of Major Equipment / Sub-System

a) *Optical Fibre Cable*

The optical fibre cable shall be corrugated steel tape armored comprising of 24 nos Single Mode fibers as per ITU-T 652 suitable for working in 1550 nm/1310 nm wave length region & suitable for direct underground burial including laying in wet and swamp areas. The cable shall be fire retardant, chemical resistant, termite & rodent proof and moisture proof.

b) *Optical Fibre Cable Laying*

The optical fibre cable shall in general follow the pipeline route. The cable shall be laid shall be laid by blowing technique in ϕ 40 mm PLB HDPE Telecom duct to be laid along in same pipeline trench (same ROW). The cable shall be laid appx 450 mm away from the pipeline edge. An additional PLB HDPE duct shall be laid along the major crossing / HDD / rivers and shall be laid in cased pipe.

c) *Optical Transmission Equipment*

STM 16 system (1+1) configuration with SNCP protection on the main line (1st Tier) connecting to MS, RWS and EMS and other stations as required based on link calculations and future connectivity.

The present STM-16 equipment shall have interface for STM- 4 / 1 equipments for any future / present installations.

Ethernet interface 10/1000 Base – T shall be used for LAN/WAN applications at each stations.

The above equipment shall include interface (optical / electrical) and tributary cards.

Primary reference clock (cesium) at (MS) and secondary reference clock at (EMS) shall be used for synchronization of transmission equipment.

d) ***IP based Network Management System***

A network management system (internet Protocol based) for SDH shall be considered.

IP based Network Management System shall enable remote monitoring and control of the selected equipment parameters (These equipment parameters shall be finalized with the successful vendor and shall include the alarms fault data originated in the various telecommunication equipment and system.

(MS) & (EMS) shall act as Communication Control Centers (CCCs) with built-in supervisory facility for monitoring the health of the remote stations.

e) ***IP EPABX***

ISDN Native IP EPABX's with voice mails system & Operator/Maintenance console are proposed to be installed at all the attended stations.

100 lines expandable to 200 lines IP EPABX shall be provided at Kochi MS.

200 lines expandable to 400 Lines IP EPABX shall be provided EMS Coimbatore.

A PC based network management system along with all necessary hardware/ software shall be provided connecting all the IP EPABXs. Both the IP EPABX shall be manageable from either location.

f) IP Telephones

- **Power requirement:** AC: 240VAC, DC: -48 VDC (+ve grounded)
- **Ethernet:** 2 port switch VLAN IEEE 802.11p, Power over Ethernet support
- **User Interface:**
 - 2 x 24 character display
 - At least 4 Soft keys
 - Last calls (At least 100 entries)
 - Speed dialling, hands free dialling
 - Missed calls, taken calls
 - Call waiting indication
 - Clock
 - Caller-ID
 - Call blocking
 - At least 4 Programmable function keys
 - Option to increase programmable keys by just adding one module to the phone
 - Menu driven user interface
 - Selectable ringing melodies
 - Log in/Log out
 - Do not disturb
 - Speakerphone
 - Should support SIP protocol
 - Call features (Hold, Blind transfer, Attended transfer, Music on hold support, Divert, Call intrusion, Call completion, etc.)
 - Web server (Embedded web server, Easy configuration of the phone, remote configuration, Password protection, Diagnostics (tracing, logging), Static IP provisioning, DHCP, etc.)

g) Telephone Instruments (Analog)

The Telephone instruments (analog) shall be compatible with the offered IP EPABX and shall have the following features:

- Rugged
- Tabletop
- Dialing of push button multi-frequency type, frequency range of 300-3400 Hz.
- Lamp for Message wait Indication
- Pulse tone switchable
- Electronic ringer with adjustable volume and melodious ring.
- Flash, pause, redial, mute functions
- Housing & Handset of ABS or HIP with Glossy finish.

h) **Digital Telephone**

These telephones shall have the following features:

- LCD Display
- Dialed number and caller identification
- Hands free operations through single key press.
- Volume control function
- Ringing tone and music control, memory, voice mail, indicator, data interface port.
- Programmable keys for feature operation.

i) **Weather Proof Telephone**

These telephones shall be rugged; wall mounted & shall be weatherproof confirming to IP-66 specification.

j) ***Explosion proof Telephone for Hazardous Areas and Acoustic Booths***

The telephone instrument shall conform to IEC standards. It shall be explosion proof type. It shall be coated to ensure proper-corrosion protection.

Acoustic booths shall have polyester powder coating. The acoustic booth shall be mounted on a floor mounting type steel pole and shall house the explosion proof phone set. Equipment shall be provided howlers.

k) ***Facsimile Equipment***

The equipment shall confirm to CCITI recommendation T-30, v.27 ter G32 mode. It shall be connected to electronic telephone exchange to provide dialing facility. It shall be designed to transmit charts/message of upto A4 size.

l) ***Video-Conferencing System***

Studio type (with industrial grade LED / plasma screen) 3 party video conferencing system shall be provided at all manned despatch /receiving stations and Tabletop with LCD display based single party video conferencing system shall be provided at rest of the attended system if required.

m) ***FXO & FXS VoIP Gateways***

For extension of analog telephones to the remote locations via Ethernet / IP network, FXO type VoIP gateways shall be consider at EPABX side and FXS type VoIP gateway shall be provided at remote location to which analog phone shall be connected.

n) ***CCTV VIDEO SURVEILLANCE SYSTEM:***

An IP based CCTV system is envisaged for this project. Closed circuit televisions cameras, cables, power supply converters, switches, etc as required shall be provided.

One fixed type and one PTZ cameras along with IR illuminators shall be provided at all SVs, IPs and Two fixed type and Two PTZ cameras along with IR illuminators at dispatch stations, all receiving stations. Client work stations to be provided at Kochi, and Coimbatore. The system shall provide User activity log (audit trail) with user id, time stamp, and action performed, etc.

NVR (Camera Server) with open architecture shall be considered.

Licence for 200 cameras shall be considered alongwith NVR server.

Client work stations shall be extended to all the despatch / receiving stations other than MS /EMS.

o) CAMERA SPECIFICATION

i. PTZ type

Camera shall be IP network based color day/night camera suitable for indoor & outdoor application with IR Illuminators shall be provided.

- Networked dome camera for remote pan/tilt/zoom control
- Motion MPEG-4 and H.264 based hardware compression
- Direct IP based (without external converters, cards, etc)
- Compression: H.264, 4CIF@25 frame/sec
- Interlace scan
- Wide dynamic range
- Network interface: IEEE802.3, 10/100 BaseT Ethernet networks (RJ45) for LAN/WAN, TCP, UDP, IGMP, SNMP, HTTP, RJ45
- Lens: CCD, Zoom: min 24 x optical +min 12x digital
- IR sensitive black/white video at night
- IR Illuminator
- Suitable for Outdoor with temperature range upto 50 °C. Outdoor housing and mounts to be provided with IP-66 rated protection.

ii. FIXED TYPE

Camera shall be IP based network color camera suitable for indoor & outdoor application shall be provided.

- Motion JPEG or MPEG-4 based hardware compression with built-in web server
- Direct IP based (without external converters, cards, etc)
- Zoom and auto focus
- Local Storage
- Power over Ethernet
- HDTV quality
- Intelligent video capabilities
- Network interface - 10BaseT/100BaseTX Ethernet networks (RJ-45) for LAN/WAN
- IR Illuminator with sensitive black/white video at night
- Frame: 25fps or better
- Built-in video motion detection

08.06 Mandatory spares

The mandatory spares shall include the following:

- a) 2 No. Routers and Switches
- b) 10 % or minimum 2 nos. of all installed cards/ modules (including I/O cards of each type) with pre-fab cables, connectors.
- c) Any other items found necessary based on the criticality of the system requirements shall be considered while designing.

Consumables & commissioning spare as required.

08.07 TEST INSTRUMENTS:

a) DIGITAL MULTIMETER

- Measurement of AC voltage (+/-0.7% accuracy), DC voltage (+/-0.05% accuracy), resistance, AC current (+/-1.0% accuracy), DC current (+/-0.2% accuracy), temperature.
- 4-1/2 digit LCD display.

b) OTDR (OPTICAL TIME DOMAIN REFLECTOMETER)

Base Unit Requirements:

- Test Equipment Configuration
- The mainframe shall accept at least two modules simultaneously.
- The Test Equipment shall be field upgradeable
- The modules shall be field interchangeable
- The Test Equipment shall be battery operated in any configurations.

OTDR Measurement Capabilities

- Wavelengths: 1310 +/-20nm, 1550 +/-20nm & 1625 nm
- Laser Safety: Class 1
- Distance accuracy: +/- 1m +/-10⁻⁵x distance +/- sampling resolution (excluding group index uncertainties).
- Vertical linearity: +/- 0.05dB/dB
- Distance sampling: minimum 4cm
- Number of data points: minimum 65000 acquisition points
- Real time sweep: 0.1 s

c) LASER SOURCE & POWER METER (HAND HELD)

i) Optical Laser Source:

The optical source will be applied for loss/attenuation measurements during installation, operation and maintenance of fiber optic networks. It will be operating in conjunction with an appropriate power meter.

The source has to simulate the system parameters, so laser sources are preferred operating at 1310 and 1550 nm, coupling the output power into a SM-fiber 9/125 μ m.

(ii) Optical power meter

The power meter shall be an easy operatable, lightweight, rugged and water resistant handheld instrument withstanding all practical environmental conditions like temperature, shock, bumps etc. The instruments shall use standard AA batteries –dry cells.

The instrument must cover the whole wavelength range between 800 and 1700 nm. The operation wavelength could be set to every value between 800 and 1700 nm in 1 nm increments. Automatic wavelength detection must be there.

The instrument must have no warm up time and it must use auto zeroing with no need for manual zeroing.

d) SDH ANALYSER

The multi-rate PDH/SDH Analyzer is required for installation, maintenance, commissioning and verification of SDH and PDH networks.

e) ETHERNET TESTER

- a. The instrument should be battery operated handheld field instrument having USB interface for printers. It should have enough memory for storing results and additional interface device like PC interface/USB interface for storage/ transfer of files. The graphical user interface must have on-line help functions.
- b. The test instrument shall support dual port with Tx and Rx function for 10/100/1000 MB interfaces in one module:
 - 1 10/100 Base T via RJ-45 interface (Electrical interface)
 - 2 1000Base SX or LX with standard GBIC (Optical interface)

f) AUTOMATIC FUSION SPLICER :

The Automatic Fusion Splicer :

- Should be able to splice single-mode, multi-mode, NZ dispersion-shifted and erbium-doped fibers. Should have in-built program to clean the electrodes automatically.

- Should have Auto power off to save the battery life.
 - Should be capable of storing data of min. 1000 splices.
 - In addition to the built-in ± 5 inch color display LCD monitor, should have in-built heater, RS232 output port for connecting an external monitor. Average splice loss 0.02 dB or better for single mode and 0.04 or better for NZDS fibres, : 11 sec splice time, display of splicing process and splice loss. Should have heat-shrinking arrangement, fiber holder system.
- g) Any other items found necessary based on the criticality of the system requirements shall be considered while designing.

Chapter – 09
ELECTRICAL

09.00 ELECTRICAL SYSTEM

09.01 Electrical Distribution (Power Supply) System

The electrical distribution system of various terminals for electrical power supply system of LPG pipeline from Kochi Despatch Terminal to Kochi Refinery to BPCL Coimbatore and IOCL Coimbatore via SV's to IP Erode and RT Salem shall be as follows:

09.01.01 Despatch Terminal at IOCL Import Facility

The power system envisaged for the despatch terminal at IOCL import facility has been indicated in the Single Line Diagram (No. MEC/23N8/05/E9/E/000/1081). The following has been considered :

- Power supply at 415Volt shall be made available from existing system by Two Nos. Feeder which shall feed to procured LT PMCC-1 with two nos incomer which will further feed the LT loads of various new facilities by underground LT XLPE cable.
- Motors below 200kW shall be fed from contactor-controlled starter feeders of PMCC-1 through Variable Speed Drive.
- 110 V DC Lead Acid Sealed Maintenance Free battery bank of 200 Ah capacity along with battery charger shall be provided for substation equipment with DCDB and critical DC lighting.
- 10 KVA, 230 V Single Phase, 50HZ, dual redundant industrial type UPS system with solid state voltage stabilizer for bypass supply, ACDB and 6 hrs. Battery(Ni-Cd /VRLA type) back shall be provided for meeting SCADA/Telecom/Instrumentation requirements. For meeting DC requirement of Telecom/SCADA 3.5KW, 230V to (-)48V Dual redundant Rectifier system and DCDB are considered.
- Auxiliary loads viz. MOV Distribution Boards, Lighting Distribution Boards, UPS, Battery Chargers etc. Shall be fed from 415V LT PMCC-1.

- PMCC Panel, Dual redundant UPS, DG set (400KVA, 415V), PDB, LDBs, MOV DB, FLP/Non FLP Lighting Fixtures, XLPE Power/PVC control Cables etc. for DT terminals.
- 1 No. 400KVA DG Set shall be provided with AMF facility for catering to the emergency power requirement for SCADA, Telecom, Instrumentation, Fire Alarm, CP System, Emergency Lighting and other 415V emergency process loads including LT motors.
- All Power cables shall be FRLS XLPE type and control cable PVC type.
- Break glass fire alarm points shall be provided at strategic locations along the escape route and smoke detectors in the substation and control room. The fire alarm system shall be controlled by the main fire alarm panel, which shall be located in the control room.

09.01.02 Kochi Refinery Terminal

The power system envisaged for the despatch terminal at Kochi Refinery has been indicated in the Single Line Diagram (No. MEC/23N8/05/E9/E/001/1081, REV2). The following has been considered :

- Power supply at 6.6 kV shall be made available from refinery by two nos. Feeder which shall feed to HT VCB Panel and HT VCB board by under ground HT XLPE cable.
- 6.6 KV, 26.3 KA indoor VCB Panel shall be provided to feed VCB Panel Board which will further feed the motors above 200kW (particularly Mainline Pumps) through Variable Frequency Drive .
- Power supply at 415V shall be made available from existing system by Two Nos. Feeder which shall feed to procured LT PMCC-1 with two nos incomer which will further feed the LT loads of various new facilities by underground LT XLPE cable.
- Motors below 200kW shall be fed from contactor-controlled starter feeders of PMCC-1 through Variable Speed Drive.

- 110 V DC Lead Acid Sealed Maintenance Free battery bank of 200 Ah capacity along with battery charger shall be provided for substation equipment with DCDB and critical DC lighting.
- 30 KVA, 230 V Single Phase, 50HZ, dual redundant industrial type UPS system with solid state voltage stabilizer for bypass supply, ACDB and 2 hrs. battery back shall be provided for meeting SCADA/Telecom/Instrumentation requirements. For meeting DC requirement of Telecom/SCADA 3.5KW, 230V to (-)48V Dual redundant Rectifier system and DCDB are considered.
- PMCC Panel, Dual redundant UPS,PDB, LDBs, MOV DB , FLP/Non FLP Indoor/Outdoor Lighting Fixtures, CP systems, XLPE Power/PVC control Cables etc. for all Terminals.
- Auxiliary loads viz. MOV Distribution Boards, Lighting Distribution Boards, UPS, Battery Chargers etc. Shall be fed from 415V LT PMCC-1.
- All HT/LT Power cables shall be FRLS XLPE type and control cable PVC type.
- Break glass fire alarm points shall be provided at strategic locations along the escape route and smoke detectors in the substation and control room. The fire alarm system shall be controlled by the main fire alarm panel, which shall be located in the control room.

09.01.03 Receipt Terminal at IOCL Coimbatore

The power system envisaged for **Receipt Terminal at Coimbatore** been indicated in the Single Line Diagram (No. MEC/23N8/05 /E9 /E/002/1081). The following has been considered :

- Power supply at 415Volt shall be made available from existing system by Two Nos. Feeder which shall feed to procured LT PMCC-1/PDB with two nos incomer which will further feed the

LT loads of various new facilities by underground LT XLPE cable.

- 1 No. 300Kva DG Set shall be provided with AMF facility for catering to the emergency power requirement for SCADA, Telecom, Instrumentation, Fire Alarm, CP System, Emergency Lighting and other 415V emergency process lads.
- 110 V DC Lead Acid Sealed Maintenance Free battery bank of 200 Ah capacity along with battery charger shall be provided for substation equipment with DCDB and critical DC lighting.
- 10 KVA, 230 V Single Phase, 50HZ, dual redundant industrial type UPS system with solid state voltage stabilizer for bypass supply, ACDB and 2 hrs. Battery(Ni-Cd/VRLA) back shall be provided for meeting SCADA/Telecom/Instrumentation requirements. For meeting DC requirement of Telecom/SCADA 3.5KW, 230V to (-)48V Dual redundant Rectifier system and DCDB are considered.
- Auxiliary loads viz. Lighting Distribution Boards, UPS, Battery Chargers etc. Shall be fed from 415V LT PDB.
- All Power cables shall be FRLS XLPE type and control cable PVC type.
- Break glass fire alarm points shall be provided at strategic locations along the escape route and smoke detectors in the substation/Electrical and control room. The fire alarm system shall be controlled by the main fire alarm panel, which shall be located in the control room.

09.01.04 Receipt Terminal at BPCL Coimbatore

The power system envisaged for **Receipt Terminal at Coimbatore** been indicated in the Single Line Diagram (No. MEC/23N8/05 /E9 /E/003/1081). The following has been considered :

- Power supply at 415Volt shall be made available from existing system by Two Nos. Feeder which shall feed to procured LT PMCC-1/PDB with two nos incomer which will further feed the

LT loads of various new facilities by underground LT XLPE cable.

- 1 No. 300Kva DG Set shall be provided with AMF facility for catering to the emergency power requirement for SCADA, Telecom, Instrumentation, Fire Alarm, CP System, Emergency Lighting, ESD MOV's/PCV and other 415V emergency process loads.
- 110 V DC Lead Acid Sealed Maintenance Free battery bank of 200 Ah capacity along with battery charger shall be provided for substation equipment with DCDB and critical DC lighting.
- 10 KVA, 230 V Single Phase, 50HZ, dual redundant industrial type UPS system with solid state voltage stabilizer for bypass supply, ACDB and 2 hrs. Battery(Ni-Cd/VRLA) back shall be provided for meeting SCADA/Telecom/Instrumentation requirements. For meeting DC requirement of Telecom/SCADA/CP system 3.5KW, 230V to (-)48V Dual redundant Rectifier system and DCDB are considered.
- Auxiliary loads viz. MOV Distribution Boards, Lighting Distribution Boards, UPS, Battery Chargers etc. Shall be fed from 415V LT PDB.
- All Power cables shall be FRLS XLPE type and control cable PVC type.
- Break glass fire alarm points shall be provided at strategic locations along the escape route and smoke detectors in the substation/Electrical and control room. The fire alarm system shall be controlled by the main fire alarm panel, which shall be located in the control room.

09.01.05 SV Station

The power system envisaged for SVs at various location been indicated in the Single Line Diagram (No. MEC/23N8/05 /E9 /E/004/1081). The following has been considered :

- It has been considered that power supply at 11kV shall be available from SEB by 1 No. Feeder. This shall feed new double pole over head structure which shall feed the Isolator.
- 25kVA, 11/0.433 kV Outdoor Type Distribution Transformer shall be provided to feed 415V LT PDB which will further feed the LT loads of other facilities.
- 1 No. 25Kva DG Set shall be provided with AMF facility for catering to the emergency power requirement for SCADA, Telecom, Instrumentation, Fire Alarm, CP System, Emergency Lighting and other 415V emergency process lads.
- Lead Acid Sealed Maintenance Free battery of 150 Ah capacity along with Invertor shall be provided for critical lighting.
- Ni-Cd/VRLA battery for with 2 hrs backup shall be provided along with battery charger for meeting SCADA/Telecom/Instrumentation requirements. For meeting DC requirement of Telecom/SCADA/CP system, 3.5KW, 230V to (-)48V Dual redundant Rectifier system and DCDB are considered for all SVs.
- Auxiliary loads viz., Lighting Distribution Boards, UPS, Battery Chargers etc. Shall be fed from 415V LT PDB.
- MOVs shall be single phase motor for all SVs.
- All Power cables shall be FRLS XLPE type and control cable PVC type.
- Break glass fire alarm points shall be provided at strategic locations along the escape route and smoke detectors in the Electrical and control room. The fire alarm system shall be controlled by the main fire alarm panel, which shall be located in the control room.

09.01.06 IP Erode and RT Salem Station

The power system envisaged for IP Erode and RT Salem Terminals been indicated in the Single Line Diagram (No. MEC/23N8/05 /E9

/E/005/1081 & MEC/23N8/06 /E9 /E/006/1081). The following has been considered :

- Power supply at 415Volt shall be made available from existing system by Two Nos. Feeder which shall feed to procured LT PMCC-1/PDB with two nos incomer which will further feed the LT loads of various new facilities by underground LT XLPE cable.
- 1 No. 40Kva DG Set shall be provided with AMF facility for catering to the emergency power requirement for SCADA, Telecom, Instrumentation, Fire Alarm, CP System, Emergency Lighting and other 415V emergency process lads for IP Erode and RT Salem.
- Lead Acid Sealed Maintenance Free battery of 150 Ah capacity along with Invertor shall be provided for critical lighting.
- 5 KVA, 230 V Single Phase, 50HZ, dual redundant industrial type UPS system with solid state voltage stabilizer for bypass supply, ACDB and 2 hrs. Battery(Ni-Cd/VRLA) back shall be provided for meeting SCADA/Telecom/Instrumentation requirements. For meeting DC requirement of Telecom/SCADA 3.5KW, 230V to (-)48V Dual redundant Rectifier system and DCDB are considered for both the location.
- Auxiliary loads viz. MOV Distribution Boards, Lighting Distribution Boards, UPS, etc. Shall be fed from 415V LT PDB.
- All Power cables shall be FRLS XLPE type and control cable PVC type.

09.01.07 IOCL BOTTLING PLANTS

The power system envisaged for IP cum RT Erode and RT Salem Terminals has been indicated in the Single Line Diagram (No. MEC/23N8/05 /E9 /E/005/1081 & MEC/23N8/06 /E9 /E/006/1081). The following has been considered :

- Power supply at 415Volt shall be made available from existing system by Two Nos. Feeder which shall feed to procured LT PMCC-1/PDB with two nos incomer which will further feed the LT loads of various new facilities by underground LT XLPE cable.
- 1 No. 40Kva DG Set shall be provided with AMF facility for catering to the emergency power requirement for SCADA, Telecom, Instrumentation, Fire Alarm, CP System, Emergency Lighting and other 415V emergency process lads for IP Erode and RT Salem.
- Lead Acid Sealed Maintenance Free battery of 150 Ah capacity along with Invertor shall be provided for critical lighting.
- 5 KVA, 230 V Single Phase, 50HZ, dual redundant industrial type UPS system with solid state voltage stabilizer for bypass supply, ACDB and 2 hrs. Battery(Ni-Cd/VRLA) back shall be provided for meeting SCADA/Telecom/Instrumentation requirements. For meeting DC requirement of Telecom/SCADA 3.5KW, 230V to (-)48V Dual redundant Rectifier system and DCDB are considered for both the location.
- Auxiliary loads viz. MOV Distribution Boards, Lighting Distribution Boards, UPS, etc. Shall be fed from 415V LT PDB.
- All Power cables shall be FRLS XLPE type and control cable PVC type.

09.02 Broad Specification of Major Equipments

| | |
|----------------|---|
| Transformer | 3 phase, double wound, oil immersed ONAN cooled, outdoor type power and distribution transformer as per SLD. |
| HV Switchboard | 6.6kV Indoor Type, Metal-Clad Switchboard consisting of incomers, bus-couplers and outgoing feeders provided with Vacuum Circuit Breaker. |

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline

| | |
|------------------|--|
| MV Switchboard | 415V free standing, metal-clad, dust and vermin proof in drawout/fixed execution in single front or double front configuration. |
| Motor | TEFC, IP-55, Squirrel Cage Induction Motors with space heaters for motors rated above 30kW. For both LT & HT area classification, Hazardous, Flameproof/Explosion Proof, Gas group II C shall be considered. |
| DC System | 2 x 100% 110 V DC battery charger with Lead Acid Sealed Maintenance Free of 200 Ah capacity battery bank. |
| UPS | 230 V Single Phase, 50HZ, dual redundant industrial type, UPS system suitable for input Power supply voltage of 415 V, TPN, +/-10%, output 230 V +/-1% AC with solid state voltage stabilizer for bypass supply, ACDB and 2 hrs. Battery(Ni-Cd/VRLA)back-up. |
| Diesel Generator | 415V Diesel Generator to feed the emergency load in the event of power failure of Grid. |



B P C L

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline



MECON

Chapter 10

INSTRUMENTATION & CONTROL

10.00 INSTRUMENTATION & CONTROL SYSTEM

10.01 General

Instrumentation and control shall be provided for safe and efficient operation of the pipeline. Dispatch Station, Pumping station & Intermediate Pigging stations, SV stations tap off points and Receipt Terminals. Control rooms shall be provided in Pipeline Dispatch terminals, Intermediate pumping stations and at each Pipeline Receipt terminals with facility to monitor and control the station from the station PLC based control system. Additionally necessary interface is envisaged in each station including SV stations and stations to connect pipe line/terminal parameters to the SCADA system for remote and tele-metering.

10.02 Local Control Rooms

Air-conditioned control room in safe area is required at each of the Dispatch terminal, Intermediate Pumping/pigging stations, Receipt terminals for station PLC equipments, Station Operator console, RTU, SCADA Remote work station etc. At remote operated SV stations a telemetry room to installed RTU/ Telecom eqpt, Instrument panel/TIC shall be considered. Separate Pipeline control room shall be provided at Dispatch terminal, Receipt terminals. Marketing Terminal control room shall be considered separate from the Pipeline Control room.

10.03 Metering System

Liquid Mass Flow Meter metering system (1+1) with upstream/downstream meter runs are envisaged at Dispatch Terminal and Receipt Terminals. Flow Computers shall be provided for each meter for computing flows at standard conditions and will provide corrected Volumetric and mass flow rates/ totalized flow. Flow computers will be interfaced station PLC to RTUs for telemetry/SCADA for central monitoring. There shall be provision of automatic "K" factor or meter factor correction based on product density in the Flow computers.

10.03.01 Online Sulphur Analyser:

Online Sulphur analyzer shall be considered at Despatch stations.

10.03.02 Online Moisture analyser:

Online Moisture Analysers shall be considered at all dispatch stations.

10.04 Control Valves (for flow control and Pressure control):

Control valves shall be Globe type with electro-hydraulic and actuator control system integrally mounted on valve actuator.

10.05 Miscellaneous instruments

Miscellaneous field instruments such as pressure switches, Pressure gauge, Temperature elements & thermowell, thermal relief valves level gauges, level transmitters and any other instruments as per the process and operation requirement will be provided.

10.06 Field Instrumentation

All transmitters for pressure & differential pressure and temperature shall be Smart type with HART Protocol with 4-20 ma output. Pressure & DP transmitters shall have accuracy of +/- 0.075% and temperature shall have an accuracy of +/- 0.1%. All transmitters shall be intrinsically safe certified. Isolating barriers shall be used in safe areas.

10.07 Control Room Instrumentation

10.07.01 Dispatch and Receipt Terminals

A PC PLC based Control system is envisaged at Dispatch Terminals and receipt Terminals for station level operation, control and monitoring requirements. The panels and PLC control system equipments will be located in an air-conditioned control room. The

PLC shall be with dual redundant with redundant processor, Power supply and I/O. The station PLC shall be used for interlocks, control, monitoring of all the station parameters. Two nos. of PC based Operator cum Engineering console shall be provided at each station. All storage bullets / spheres of LPG & station control MOVs signals will be repeated from terminal control room and will be interfaced to Station PLC and repeated to SCADA from station PLC. Similarly outlet MOV control signals will be repeated from Station PLC in pipeline control room to other control room.

10.08.02 Remote SV and IP Station

One telemetry interface cabinet for housing banners & 24V DC power supply distribution for barriers and terminals for all the signals to RTU is considered at each remote operated SV. For CCTV surveillance system converter will be provided.

10.09 Hazardous area protection for instruments

All field mounted instrumentation items shall be suitable for continuous working in outdoor installations, considering temperature, humidity etc. Ingress protection for all field instruments and enclosures/ junction boxes/ cable glands etc. shall be IP-55 /NEMA 4 as minimum. Instruments mounted on the skid shall be suitable for installation in tropical hot and humid climate to be consider:

- a) All field transmitters and I/P convertes shall be certified weather proof to minimum IP 55 and intrinsically safe suitable for hazardous area classification IEC zone 1, Gr. IIA, IIB, T3.
- b) All limit switches, Junction boxes, cable glands and accessories shall be certified weather proof to minimum IP55 and Flame proof suitable for hazardous area classification !EC Zone I, Gr. IIA, IIB, T3.

10.10 Operation and control philosophy for pumps:

Station PLC shall have necessary Operation & control and logic of pumps and its auxiliaries for each pump. Station PLC shall be located in respective control rooms. Pump auxiliaries controls, Vibration & temperature monitoring required for Pump and its motors will be

provided separately on wall mounted panel. Pumps shall be operated from Station PLC operator console or SCADA. There shall be mode selection PLC station level operation mode / SCADA Operation mode. Pump start up, stop & tripping interlock shall be implemented in PLC

10.11 Interface with storage Spheres / Bullets and Its Isolation Valves status & control signals at Dispatch Terminals and at Receipt Terminals.

It is envisaged that the signals of storage Spheres / Bullets product outlet isolation valves (at Dispatch terminals Tanks) and product inlet isolation valves (Receipt marketing terminal tanks), the data and marketing terminal connected to Pipeline System shall be extended to Pipeline control room for Remote monitoring in Pipeline SCADA system and locally at respective Pipeline control rooms.

Utilities

a) Power Supplies:

- 230 V AC, I Phase UPS (Redundant) and 24 V DC, 48 V DC uninterrupted supplies for instrumentation, SCADA & Telecom at Dispatch and Intermediate Pumping stations Receipt Terminals.
- For Remote operated SVs and IP stations 24 VDC, 48 V DC supply would be required from Electrical System. For CCTV necessary convert at all locations.

b) Instrument Air

Instrument air for all flow control valves and ROV at all stations however for PCV dispatch & receiving locations control with electro-hydraulic type actuators shall be considered.

Chapter - 11

CAPITAL & OPERATING COSTS

11.00 CAPITAL COSTS

11.01 General

Capital cost based on the facilities envisaged for despatch terminals, receiving terminals, IP Stations, Trunk Pipelines and all other associated facilities for the entire route has been estimated as Rs.997.88 Crores. The total cost of the project is summarised in Table 11.01 below.

Table-11.01

CAPITAL COST SUMMARY

In Rs Lakhs

| Sl. No. | DESCRIPTION | Amount | | |
|----------|--|---------------|----------------|-----------------|
| | | FC | LC | TOTAL |
| A | Plant & Machinery | | | |
| 1 | Despatch Terminal at IOCL Import Facility Kochi | 204.8 | 1468.4 | 1673.2 |
| 2 | Pipeline from IOCL Import Facility to Kochi Refinery and IOCL Udayenperoor | 0.0 | 10812.5 | 10812.5 |
| 3 | Despatch Terminal at Kochi Refinery | 2136.8 | 2343.9 | 4480.7 |
| 4 | Receiving Terminal at IOCL BP, Udayenperoor | 0.0 | 801.8 | 801.8 |
| 5 | Pipeline from Kochi Refinery to IOCL, Udayenperoor | 0.0 | 41093.3 | 41093.3 |
| 6 | Receiving Terminal at BPCL Coimbatore | 78.8 | 871.5 | 950.3 |
| 7 | Receiving Terminal at IOCL Coimbatore | 0.0 | 1009.3 | 1009.3 |
| 8 | Pipeline from Coimbatore to Erode and Salem | 0.0 | 22827.8 | 22827.8 |
| 9 | Receiving Terminal at IOCL Erode | 0.0 | 872.6 | 872.6 |
| 10 | Receiving Terminal at IOCL Salem | 78.8 | 894.3 | 973.0 |
| 11 | SCADA & Telecom | 0.0 | 2813.2 | 2813.2 |
| | Sub-Total (A) | 2499.0 | 85808.6 | 88307.6* |
| B | Engineering Costs : PMC Fees, @6.5% (Incl Service Tax) | | | 5740.0 |
| C | Owner's management expenses @4% | | | 3532.3 |
| E | Contingency @2.5% | | | 2207.7 |
| | Total cost before IDC & MM | | | 99787.5 |
| 3 | Interest during construction period & financing charges | | | 0.0 |
| 4 | Margin money for working capital | | | 0.0 |
| | Sub-Total (E) | | | 0.0 |
| | GRAND TOTAL COST | | | 99787.5 |

- * - *Cost is for a total system throughput of 1.28MMTPA of LPG. In the event of the throughput exceeding 1.28 MMTPA, additional intermediate pumping station would be required which may cost approx. Rs 65 Crores, for a Greenfield facility at current prices.*

11.02 Major Facilities

Major facilities included in the capital cost estimates are given below:

- LPG Despatch Terminal at IOCL Import Facility with including Booster LPG Pumps
- LPG Despatch Terminal at Kochi Refinery including Booster & Mainline LPG Pumps
- LPG Receipt Terminals at
 - IOCL, Udyenperoor
 - BPCL Coimbatore
 - IOCL, Coimbatore
 - IOCL, Erode
 - IOCL, Salem
- 458km Long Steel Pipeline from Puthuvypeen near Kochi to Salem in Tamilnadu

Further details have already been elaborated in preceding Chapters.

Costs toward technological equipment, associated electrics, spares, erection, civil engineering works, land and ROU are included in the estimate. The estimates are based on the prices for different cost elements prevailing during 3rd quarter of 2013 and do not include any provision for future escalation.

The break up of capital costs under major heads such as plant & equipment, spares, civil engineering works, erection, duties & taxes, transportation and engineering, supervision, project management etc., for despatch terminals, receiving terminals, IP Stations, Trunk Pipelines and all other associated facilities have been furnished in Tables - 11.02 to 11.11.

11.03 Assumptions

Following assumptions have been made for working out the capital costs.

11.03.01 Land and ROW/ ROU Compensation

The cost of land for setting up the SV stations has been considered at a rate of Rs. 4500 per sqm. The cost towards Right of Use has been considered as Rs. 50.6 lakhs per km for new and Rs.21.78 lakhs / Km for existing routes falling in the state of Kerela. For the pipeline portion falling in the state of Tamilnadu, which primarily runs along the NH, ROU costs have been considered as Rs 24 Lakhs per km for required width and length of the pipeline.

11.03.02 Pipeline and other Associated Equipment

The costs of equipment and facilities, in some areas, are based on recent LOAs/ budgetary offers. However, generally, in house information for equipment installed in other projects has been used. The cost of equipment under this head is on ex-works basis.

11.03.03 Spares

Provision for spares required for 2 years normal operation has been deemed as included in the basic cost of the equipment and facilities considered.

11.03.04 Civil engineering works

Cost estimates for civil engineering works have been worked out based on preliminary layout and design of grid line and route survey and rates generally prevailing for similar work in the area.

11.03.05 Erection

Provision towards erection of equipment has been made on the basis of erection rates as prevailing in the region.

11.03.06 Freight, insurance, duties and taxes

For imported equipment, provision for ocean freight & marine insurance @ 5%, Port handling @1%, Customs duty @ 26.267% and for indigenous equipment excise duty @12.36%, Central sales tax @10%, inland freight & transit insurance @2% has been made. Service tax @12.36% & 4.944% has also been considered on erection and civil costs.

11.03.07 Engineering, Supervision and Project Management

A provision has been made towards engineering, supervision and project management services etc., at the rate of 6.5% including service tax. This includes detailed engineering including preparation of drawings, technical specifications, preparation of tender documents & assistance for award of contracts, designer's supervision, project management services, etc.

11.03.08 Owner's Management Expenses

Provision towards owner's management expenses have been kept at the rate of 4%. This includes preliminary and pre-operative expenses.

11.03.09 Contingencies

A provision of 2.5% of the project cost has been made towards contingencies to take care of the unforeseen aspects of the estimate.

11.03.10 Time Schedule

The time schedule for construction of various facilities for the proposed project would be as per implementation schedule given in earlier chapter.

11.03.11 Financing

It has been assumed that the project cost would be financed through internal generations, therefore no provision has been made towards interest during construction.

Table- 11.02

Capital Cost of Despatch Terminal at IOCL Import Facility, Kochi

(Rs. In lakh)

| SL. NO. | DESCRIPTION | FC | LC | TOTAL |
|----------|-----------------------------------|---------------|----------------|----------------|
| A | MAJOR ITEMS | | | |
| 1 | Scrapper traps and PIG signallers | | 13.00 | 13.00 |
| 2 | LPG Pumps | | 150.00 | 150.00 |
| 3 | Mass Flowmeter | | 40.00 | 40.00 |
| 4 | Basket Filters | | 20.00 | 20.00 |
| 5 | Fire Protection System | | 70.00 | 70.00 |
| 5 | Power Supply Arrangements | | | 0.00 |
| 6 | Others | | | 0.00 |
| 6 | Analysers | 120.00 | | 120.00 |
| 7 | Mobile Flare | 75.00 | | 75.00 |
| | Sub-total | 195.00 | 293.00 | 488.00 |
| B | BULK MATERIAL | | | |
| 1 | Piping & Valves | | 220.00 | 220.00 |
| 2 | Electrical | | 110.00 | 110.00 |
| 3 | Instrumentation | | 120.00 | 120.00 |
| 4 | Others | | | |
| | Sub-total | 0.00 | 450.00 | 450.00 |
| C | SPARES | Incl. | Incl. | - |
| D | ERECTION | | | |
| 1 | Mechanical | | 45.50 | 45.50 |
| 2 | Electrical | | 20.00 | 20.00 |
| 3 | Instrumentation | | 30.00 | 30.00 |
| 4 | Civil works | | 317.50 | 317.50 |
| 5 | Land | | - | - |
| 6 | Others | | 10.00 | 10.00 |
| | Sub-total | 0.00 | 423.00 | 423.00 |
| E | TAXES & DUTIES | | | |
| 1 | Ocean Freight | 9.75 | | 9.75 |
| 2 | Port handling | | 1.95 | 1.95 |
| 3 | Custom duty | | 54.29 | 54.3 |
| 4 | Inland Freight | | 14.86 | 14.9 |
| 5 | Excise Duty | | 91.8 | 91.8 |
| 6 | Sales tax | | 83.5 | 83.5 |
| 8 | Insurance | | 3.7 | 3.7 |
| 9 | Service tax | | 52.3 | 52.3 |
| | Sub-total | 9.75 | 302.4 | 312.2 |
| | Total (A to E) | 204.75 | 1468.42 | 1673.17 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

Table- 11.03

Capital Cost of Pipeline from IOCL, Kochi to Kochi Refinery

(Rs. In lakh)

| SL. NO. | DESCRIPTION | FC | LC | TOTAL |
|----------|---------------------------------|-------------|----------------|----------------|
| A | MAJOR ITEMS | | | |
| 1 | Survey and Field Engineering | | 20.0 | 20.0 |
| 2 | Land, ROU and area compensation | | 2872.5 | 2872.5 |
| 3 | Line pipes | | 1716.2 | 1716.2 |
| 4 | Line Materials | | 99.0 | 99.0 |
| 5 | Coating and Transportation | | 367.8 | 367.8 |
| 6 | Pipeline laying | | 1522.2 | 1522.2 |
| 7 | Cathodic protection | | 74.4 | 74.4 |
| 8 | Crossings | | 2385.0 | 2385.0 |
| 10 | SV Stations | | 621.8 | 621.8 |
| 11 | IP Station | | 0.0 | 0.0 |
| | Sub-total | 0.00 | 9678.8 | 9678.8 |
| B | TAXES & DUTIES | | | |
| 1 | Ocean Freight | 0.00 | | 0.0 |
| 2 | Custom duty | | 0.0 | 0.0 |
| 3 | Port handling | | 0.0 | 0.0 |
| 4 | Inland Freight | | 11.3 | 11.3 |
| 5 | Excise Duty | | 314.8 | 314.8 |
| 6 | Sales tax | | 286.2 | 286.2 |
| 8 | Insurance | | 2.8 | 2.8 |
| 9 | Service tax | | 518.5 | 518.5 |
| | Sub-total | 0.00 | 1133.6 | 1133.6 |
| | Total (A to B) | 0.00 | 10812.5 | 10812.5 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

Table- 11.04

Capital Cost of Receipt Terminal at IOCL BP, Udayenperoor

(Rs. In lakh)

| SL. NO. | DESCRIPTION | FC | LC | TOTAL |
|----------|-----------------------------------|-------------|--------------|--------------|
| A | MAJOR ITEMS | | | |
| 1 | Scrapper traps and PIG signallers | | 13.0 | 13.0 |
| 2 | Pumps | - | - | - |
| 3 | Mass Flowmeter | | 32.0 | 32.0 |
| 4 | Basket Filters | | 20.0 | 20.0 |
| 5 | Fire Protection System | | 40.0 | 40.0 |
| | Sub-total | 0.00 | 105.0 | 105.0 |
| B | BULK MATERIAL | | | |
| 1 | Piping | | 137.0 | 137.0 |
| 2 | Electrical | | 80.0 | 80.0 |
| 3 | Instrumentation | | 100.0 | 100.0 |
| 4 | Others | | | 0.0 |
| | Sub-total | 0.0 | 317.0 | 317.0 |
| C | SPARES | | | |
| D | ERECTION | | | |
| 1 | Mechanical | | 25.0 | 25.0 |
| 2 | Electrical | | 10.0 | 10.0 |
| 3 | Instrumentation | | 20.0 | 20.0 |
| 4 | Civil works | | 175.0 | 175.0 |
| 5 | Land | | - | - |
| 6 | Others | | 10.0 | 10.0 |
| | Sub-total | 0.00 | 240.0 | 240.0 |
| E | TAXES & DUTIES | | | |
| 1 | Ocean Freight | 0.00 | | 0.00 |
| 2 | Port handling | | 0.00 | 0.00 |
| 3 | Custom duty | | 0.00 | 0.0 |
| 4 | Inland Freight | | 8.44 | 8.4 |
| 5 | Excise Duty | | 52.2 | 52.2 |
| 6 | Sales tax | | 47.4 | 47.4 |
| 8 | Insurance | | 2.1 | 2.1 |
| 9 | Service tax | | 29.7 | 29.7 |
| | Sub-total | 0.00 | 139.8 | 139.8 |
| | Total (A to E) | 0.00 | 801.8 | 801.8 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

Table- 11.05

Capital Cost of Despatch Terminal at Kochi Refinery

| SL. NO. | DESCRIPTION | (Rs. In lakh) | | TOTAL |
|----------|-----------------------------------|----------------|---------------|---------------|
| | | FC | LC | |
| A | MAJOR ITEMS | | | |
| 1 | Scrapper traps and PIG signallers | | 13.0 | 13.0 |
| 2 | LPG Pumps | 1840.00 | 120.0 | 1960.0 |
| 3 | Mass Flowmeter | | 40.0 | 40.0 |
| 4 | Basket Filters | | 24.0 | 24.0 |
| 5 | Fire Protection System | | 85.0 | 85.0 |
| 5 | Power Supply Arrangements | | | 0.0 |
| 6 | Others | | | 0.0 |
| 6 | Analysers | 120.00 | | 120.0 |
| 7 | Mobile Flare | 75.00 | | 75.0 |
| | Sub-total | 2035.00 | 282.0 | 2317.0 |
| B | BULK MATERIAL | | | |
| 1 | Piping | | 275.0 | 275.0 |
| 2 | Electrical | | 160.0 | 160.0 |
| 3 | Instrumentation | | 125.0 | 125.0 |
| 4 | Others | | | |
| | Sub-total | 0.0 | 560.0 | 560.0 |
| C | SPARES | | | |
| D | ERECTION | | | |
| 1 | Mechanical | | 45.0 | 45.0 |
| 2 | Electrical | | 30.0 | 30.0 |
| 3 | Instrumentation | | 35.0 | 35.0 |
| 4 | Civil works | | 493.8 | 493.8 |
| 5 | Land | | | 0.0 |
| 6 | Others | | 15.0 | 15.0 |
| | Sub-total | 0.00 | 618.8 | 618.8 |
| E | TAXES & DUTIES | | | |
| 1 | Ocean Freight | 101.75 | | 101.75 |
| 2 | Port handling | | 20.35 | 20.35 |
| 3 | Custom duty | | 566.61 | 566.6 |
| 4 | Inland Freight | | 16.84 | 16.8 |
| 5 | Excise Duty | | 104.1 | 104.1 |
| 6 | Sales tax | | 94.6 | 94.6 |
| 8 | Insurance | | 4.2 | 4.2 |
| 9 | Service tax | | 76.5 | 76.5 |
| | Sub-total | 101.75 | 883.2 | 984.9 |
| | Total (A to E) | 2136.75 | 2343.9 | 4480.7 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

DETAILED FEASIBILITY REPORT

Kochi-Coimbatore-Erode-Salem LPG Pipeline

Table- 11.06

Capital Cost of Pipeline from Kochi Refinery to Coimbatore

(Rs. In lakh)

| SL. NO. | DESCRIPTION | FC | LC | TOTAL |
|----------|---------------------------------|-------------|----------------|----------------|
| A | MAJOR ITEMS | | | |
| 1 | Survey and Field Engineering | | 50.0 | 50.0 |
| 2 | Land, ROU and area compensation | | 11243.0 | 11243.0 |
| 3 | Line pipes | | 9748.6 | 9748.6 |
| 4 | Line Materials | | 580.2 | 580.2 |
| 5 | Coating and Transportation | | 1955.1 | 1955.1 |
| 6 | Pipeline laying | | 6796.2 | 6796.2 |
| 7 | Cathodic protection | | 357.8 | 357.8 |
| 8 | Crossings | | 1440.0 | 1440.0 |
| 10 | SV Stations | | 3878.5 | 3878.5 |
| 11 | IP Station | | 269.0 | 269.0 |
| | Sub-total | 0.00 | 36318.4 | 36318.4 |
| B | TAXES & DUTIES | | | |
| 1 | Ocean Freight | 0.00 | | 0.0 |
| 2 | Port handling | | 0.0 | 0.0 |
| 3 | Custom duty | | 0.0 | 0.0 |
| 4 | Inland Freight | | 58.9 | 58.9 |
| 5 | Excise Duty | | 1798.2 | 1798.2 |
| 6 | Sales tax | | 1634.7 | 1634.7 |
| 8 | Insurance | | 14.7 | 14.7 |
| 9 | Service tax | | 1268.4 | 1268.4 |
| | Sub-total | 0.00 | 4774.9 | 4774.9 |
| | Total (A to B) | 0.00 | 41093.3 | 41093.3 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

Table- 11.07

Capital Cost of Receipt Terminal at BPCL, Coimbatore

(Rs. In
lakh)

| SL. NO. | DESCRIPTION | FC | LC | TOTAL |
|----------|-----------------------------------|--------------|--------------|--------------|
| A | MAJOR ITEMS | | | |
| 1 | Scrapper traps and PIG signallers | | 0.0 | 0.0 |
| 2 | LPG Pumps | | 0.0 | 0.0 |
| 3 | Mass Flowmeter | | 40.0 | 40.0 |
| 4 | Basket Filters | | 24.0 | 24.0 |
| 6 | Fire Protection System | | 60.0 | 60.0 |
| 7 | Mobile Flare | 75.00 | 0.0 | 75.0 |
| | Sub-total | 75.00 | 124.0 | 199.0 |
| B | BULK MATERIAL | | | |
| 1 | Piping & Mechanical | | 126.0 | 126.0 |
| 2 | Electrical | | 65.0 | 65.0 |
| 3 | Instrumentation | | 130.0 | 130.0 |
| 4 | Others | | | |
| | Sub-total | 0.0 | 321.0 | 321.0 |
| C | SPARES | | | |
| D | ERECTION | | | |
| 1 | Mechanical | | 25.0 | 25.0 |
| 2 | Electrical | | 15.0 | 15.0 |
| 3 | Instrumentation | | 30.0 | 30.0 |
| 4 | Civil works | | 175.0 | 175.0 |
| 5 | Land | | | 0.0 |
| 6 | Others | | 12.0 | 12.0 |
| | Sub-total | 0.00 | 257.0 | 257.0 |
| E | TAXES & DUTIES | | | |
| 1 | Ocean Freight | 3.75 | | 3.75 |
| 2 | Port handling | | 0.75 | 0.75 |
| 3 | Custom duty | | 20.88 | 20.9 |
| 4 | Inland Freight | | 8.90 | 8.9 |
| 5 | Excise Duty | | 55.0 | 55.0 |
| 6 | Sales tax | | 50.0 | 50.0 |
| 8 | Insurance | | 2.2 | 2.2 |
| 9 | Service tax | | 31.8 | 31.8 |
| | Sub-total | 3.75 | 169.5 | 173.3 |
| | Total (A to E) | 78.75 | 871.5 | 950.3 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

Table- 11.08

Capital Cost of Receipt Terminal at IOCL, Coimbatore

(Rs. In
lakh)

| SL. NO. | DESCRIPTION | FC | LC | TOTAL |
|-----------------------------|-----------------------------------|-------------|---------------|---------------|
| A MAJOR ITEMS | | | | |
| 1 | Scrapper traps and PIG signallers | | 13.0 | 13.0 |
| 2 | LPG Pumps | | 0.0 | 0.0 |
| 3 | Mass Flowmeter | | 32.0 | 32.0 |
| 4 | Basket Filters | | 24.0 | 24.0 |
| 6 | Fire Protection System | | 50.0 | 50.0 |
| 7 | Mobile Flare | 0.00 | 0.0 | 0.0 |
| | Sub-total | 0.00 | 119.0 | 119.0 |
| B BULK MATERIAL | | | | |
| 1 | Piping & Mechanical | | 183.0 | 183.0 |
| 2 | Electrical | | 80.0 | 80.0 |
| 3 | Instrumentation | | 168.0 | 168.0 |
| 4 | Others | | | |
| | Sub-total | 0.0 | 431.0 | 431.0 |
| C SPARES | | | | |
| D ERECTION | | | | |
| 1 | Mechanical | | 40.0 | 40.0 |
| 2 | Electrical | | 20.0 | 20.0 |
| 3 | Instrumentation | | 36.0 | 36.0 |
| 4 | Civil works | | 175.0 | 175.0 |
| 5 | Land | | | 0.0 |
| 6 | Others | | 10.0 | 10.0 |
| | Sub-total | 0.00 | 281.0 | 281.0 |
| E TAXES & DUTIES | | | | |
| 1 | Ocean Freight | 0.00 | | 0.00 |
| 2 | Port handling | | 0.0 | 0.00 |
| 3 | Custom duty | | 0.0 | 0.0 |
| 4 | Inland Freight | | 11.00 | 11.0 |
| 5 | Excise Duty | | 68.0 | 68.0 |
| 6 | Sales tax | | 61.8 | 61.8 |
| 8 | Insurance | | 2.8 | 2.8 |
| 9 | Service tax | | 34.7 | 34.7 |
| | Sub-total | 0.00 | 178.3 | 178.3 |
| | Total (A to E) | 0.00 | 1009.3 | 1009.3 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

Table- 11.09

Capital Cost of Pipeline from Coimbatore to Erode and Salem

| SL. NO. | DESCRIPTION | FC | LC | (Rs. In lakh) TOTAL |
|-----------------------------|---------------------------------|-------------|----------------|------------------------|
| A MAJOR ITEMS | | | | |
| 1 | Survey and soil investigation | | 30.0 | 30.0 |
| 2 | Land, ROU and area compensation | | 6805.5 | 6805.5 |
| 3 | Line pipes | | 4374.5 | 4374.5 |
| 4 | Line Materials | | 381.6 | 381.6 |
| 5 | Coating and Transportation | | 813.5 | 813.5 |
| 6 | Pipeline laying | | 3344.0 | 3344.0 |
| 7 | Cathodic protection | | 146.2 | 146.2 |
| 8 | Crossings | | 1410.0 | 1410.0 |
| 10 | SV Stations | | 2755.5 | 2755.5 |
| 11 | IP Station | | 241.5 | 241.5 |
| | Sub-total | 0.00 | 20302.2 | 20302.2 |
| B TAXES & DUTIES | | | | |
| 1 | Ocean Freight | 0.00 | | 0.0 |
| 2 | Custom duty | | 0.0 | 0.0 |
| 3 | Port handling | | 0.0 | 0.0 |
| 4 | Inland Freight | | 43.7 | 43.7 |
| 5 | Excise Duty | | 899.0 | 899.0 |
| 6 | Sales tax | | 817.3 | 817.3 |
| 8 | Insurance | | 10.9 | 10.9 |
| 9 | Service tax | | 754.6 | 754.6 |
| | Sub-total | 0.00 | 2525.6 | 2525.6 |
| | Total (A to B) | 0.00 | 22827.8 | 22827.8 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

Table- 11.10

Capital Cost of Receipt Terminal at IOCL, Erode

(Rs. In lakh)

| SL. NO. | DESCRIPTION | FC | LC | TOTAL |
|----------|-----------------------------------|-------------|--------------|--------------|
| A | MAJOR ITEMS | | | |
| 1 | Scrapper traps and PIG signallers | | 13.0 | 13.0 |
| 2 | LPG Pumps | | 0.0 | 0.0 |
| 3 | Mass Flowmeter | | 32.0 | 32.0 |
| 4 | Basket Filters | | 24.0 | 24.0 |
| 6 | Fire Protection System | | 50.0 | 50.0 |
| 7 | Mobile Flare | 0.00 | 0.0 | 0.0 |
| | Sub-total | 0.00 | 119.0 | 119.0 |
| B | BULK MATERIAL | | | |
| 1 | Piping & Mechanical | | 140.5 | 140.5 |
| 2 | Electrical | | 60.0 | 60.0 |
| 3 | Instrumentation | | 148.0 | 148.0 |
| 4 | Others | | | |
| | Sub-total | 0.0 | 348.5 | 348.5 |
| C | SPARES | | | |
| D | ERECTION | | | |
| 1 | Mechanical | | 35.0 | 35.0 |
| 2 | Electrical | | 12.0 | 12.0 |
| 3 | Instrumentation | | 20.0 | 20.0 |
| 4 | Civil works | | 175.0 | 175.0 |
| 5 | Land | | | 0.0 |
| 6 | Others | | 10.0 | 10.0 |
| | Sub-total | 0.00 | 252.0 | 252.0 |
| E | TAXES & DUTIES | | | |
| 1 | Ocean Freight | 0.00 | | 0.00 |
| 2 | Port handling | | 0.00 | 0.00 |
| 3 | Custom duty | | 0.00 | 0.0 |
| 4 | Inland Freight | | 9.35 | 9.4 |
| 5 | Excise Duty | | 57.8 | 57.8 |
| 6 | Sales tax | | 52.5 | 52.5 |
| 8 | Insurance | | 2.3 | 2.3 |
| 9 | Service tax | | 31.1 | 31.1 |
| | Sub-total | 0.00 | 153.1 | 153.1 |
| | Total (A to E) | 0.00 | 872.6 | 872.6 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

Table- 11.11

Capital Cost of Receipt Terminal at IOCL, Salem

| | | (Rs. In lakh) | | |
|-----------------------------|-----------------------------------|---------------|--------------|--------------|
| SL. NO. | DESCRIPTION | FC | LC | TOTAL |
| A MAJOR ITEMS | | | | |
| 1 | Scrapper traps and PIG signallers | | 13.0 | 13.0 |
| 2 | LPG Pumps | | 0.0 | 0.0 |
| 3 | Mass Flowmeter | | 32.0 | 32.0 |
| 4 | Basket Filters | | 24.0 | 24.0 |
| 6 | Fire Protection System | | 50.0 | 50.0 |
| 7 | Mobile Flare | 75.00 | 0.0 | 75.0 |
| | Sub-total | 75.00 | 119.0 | 194.0 |
| B BULK MATERIAL | | | | |
| 1 | Piping & Mechanical | | 140.5 | 140.5 |
| 2 | Electrical | | 60.0 | 60.0 |
| 3 | Instrumentation | | 148.0 | 148.0 |
| 4 | Others | | | |
| | Sub-total | 0.0 | 348.5 | 348.5 |
| C SPARES | | | | |
| D ERECTION | | | | |
| 1 | Mechanical | | 35.0 | 35.0 |
| 2 | Electrical | | 12.0 | 12.0 |
| 3 | Instrumentation | | 20.0 | 20.0 |
| 4 | Civil works | | 175.0 | 175.0 |
| 5 | Land | | 0.0 | 0.0 |
| 6 | Others | | 10.0 | 10.0 |
| | Sub-total | 0.00 | 252.0 | 252.0 |
| E TAXES & DUTIES | | | | |
| 1 | Ocean Freight | 3.75 | | 3.75 |
| 2 | Port handling | | 0.75 | 0.75 |
| 3 | Custom duty | | 20.88 | 20.9 |
| 4 | Inland Freight | | 9.35 | 9.4 |
| 5 | Excise Duty | | 57.8 | 57.8 |
| 6 | Sales tax | | 52.5 | 52.5 |
| 8 | Insurance | | 2.3 | 2.3 |
| 9 | Service tax | | 31.1 | 31.1 |
| | Sub-total | 3.75 | 174.8 | 178.5 |
| | Total (A to E) | 78.75 | 894.3 | 973.0 |

FC- Foreign currency in Rupees; **LC-** Local currency in Rupees

11.05 Operating Costs

Annual Operating costs for the pipeline system have been worked out considering 8000 hour operation of the Booster and Mainline pumps and are presented in the table below :

| S. No. | Description | Unit | Qty. | Rate, Rs | (Rs. Lakhs) |
|----------|---|------|---------|----------|-------------|
| A | VARIABLE COST | | | | |
| 1 | Power Cost (Pumping + other loads) | Kwh | 76 Lakh | 7 | 532 |
| 2 | Miscellaneous cost includes the cost of DG set running, rental/ Statutory/ property tax payment/ cost of Govt. land for SV/IP, insurance, admin, training etc | LS | | | 400 |
| B | FIXED COST | | | | |
| 1 | Plant Security & ROU surveillance | LS | | | 299 |
| 2 | Salary and allowances of operating staff | Nos | 70 | 20 Lakhs | 1400 |
| 3 | Salary and allowances of Non Management staff | No | 14 | 12 Lakhs | 168 |
| 4 | Repairs & maintenance of Rotating , Electrical, Pipeline SCADA , Telecom , Instrumentation, Civil Buildings Etc | LS | | | 1000 |
| C | LEASE RENTALS | | | | |
| | ROU Charges | LS | | | 100 |
| | Land for Terminals | LS | | | 100 |
| | Total Cost A + B + C | | | | 3999 |

Chapter - 12

IMPLEMENTATION SCHEDULE

12.01 IMPLEMENTATION SCHEDULE

12.01 General

The overall project may be perceived as broadly comprising the following ;

- Despatch Terminals at IOCL Import Facility and Kochi Refinery
- 458 km long Cross Country LPG Pipeline
- Receipt Terminal at Udayenperoor, Coimbatore, Erode and Salem

The above and the other associated facilities envisaged under the project are proposed to be implemented in total in one phase by the end of the 3rd year of the project. Considering the size, length and the area / terrain to be negotiated, it would need about 36 months time for completion even if the laying work is got executed in two spreads and by independent agencies.

12.02 Project Implementation

The implementation activities shall commence with the appointment of Engineering and Project Management Consultant by BPCL who shall carry out :

- Design and Basic Engineering
- Detailed Engineering
- Procurement Activities
- Construction Management

The construction of pipeline from KRL to Coimbatore shall include the following:

- ROU acquisition
- Basic & detailed engineering
- Procurement of free issue items for pipeline
- Award of works contract for pipeline
- Construction of pipeline
- Commissioning of pipeline

Concurrent with the detailed engineering, approvals from the statutory authorities shall be obtained

Indicative implementation schedules as proposed for different activities have been given in Figure 12.01 for first year which shall be repeated for the facilities to be installed in subsequent years. Activities for all the above areas shall commence from zero date after appointment of project consultant.

12.03 Major activities during Implementation

Following are the set of major activities involved in development of pipeline and terminal facilities:

- i) Route Survey and Survey of Plots for terminals
- ii) Design of facilities at Despatch and Receiving terminal
- iii) Design of Pipeline Facilities
- iv) Basic & detailed engineering
- v) Procurement of free issue items for steel line and terminals
- vi) Award of works contract for Steel Pipeline and Terminals
- vii) Award of contract for construction of Mounded Storage vessels
- viii) Construction of Steel line and terminal facilities
- ix) Commissioning of Steel line and terminal facilities

12.04 Assumptions

- a) It is assumed that ROU acquisition work for pipeline and land for terminal shall be completed as per given schedule.
- b) Finalization of engineering consultant shall be considered as the 'ZERO' date.
- c) It is assumed that all the required statutory approvals shall be obtained as per schedule.

12.05 Recommendations

The proposed project shall be implemented under the overall responsibility of the owner who shall obtain necessary technical services from an engineering consultant in the areas of basic design, detailed engineering, procurement of major equipment and materials, selection of suitable vendors and contractors, construction supervision, commissioning assistance and project management.

The construction work along with erection of major equipment, pertaining to Despatch Terminal, Pipeline, Receipt Terminal shall be given to competent contractors, who shall complete the works as per project schedule. All major/ critical equipment and materials will be procured by the owners directly, as this shall ensure the quality of equipment / material as well as their availability in time.

ANNEXURES & DRAWINGS