INDIAN OIL CORPORATION LTD.(MARKETING DIVISION)
LPG BOTTLING PLANT ,
KESHOPUR KALAN, ETAWAH,
UTTAR PRADESH.

PROJECT REPORT FOR THE PROPOSED 2 x 900 MT CAPACITY MOUNDED LPG STORAGE VESSELS

1. INTRODUCTION

1.1 GENERAL

Oil marketing companies have projected an increase in demand of Liquefied Petroleum Gas (LPG) in future due to increase in its domestic use. The demand is likely to increase substantially over the years to come. Oil PSUs have planned enrollment of new customers to saturate the demand potential as per directive of the Ministry of Petroleum and Natural Gas, Government of India.

In line with the requirement envisaged and to ensure fulfillment of demand, MOP & NG has planned that different oil companies should increase storage for LPG. Accordingly Indian Oil Corporation Limited proposes to expand storage capacity at different locations in India to meet the demand.

1.2 PROJECT LOCATION

The proposed expansion project is located on existing 74.6 acre plot in LPG Bottling plant at Etawah, .

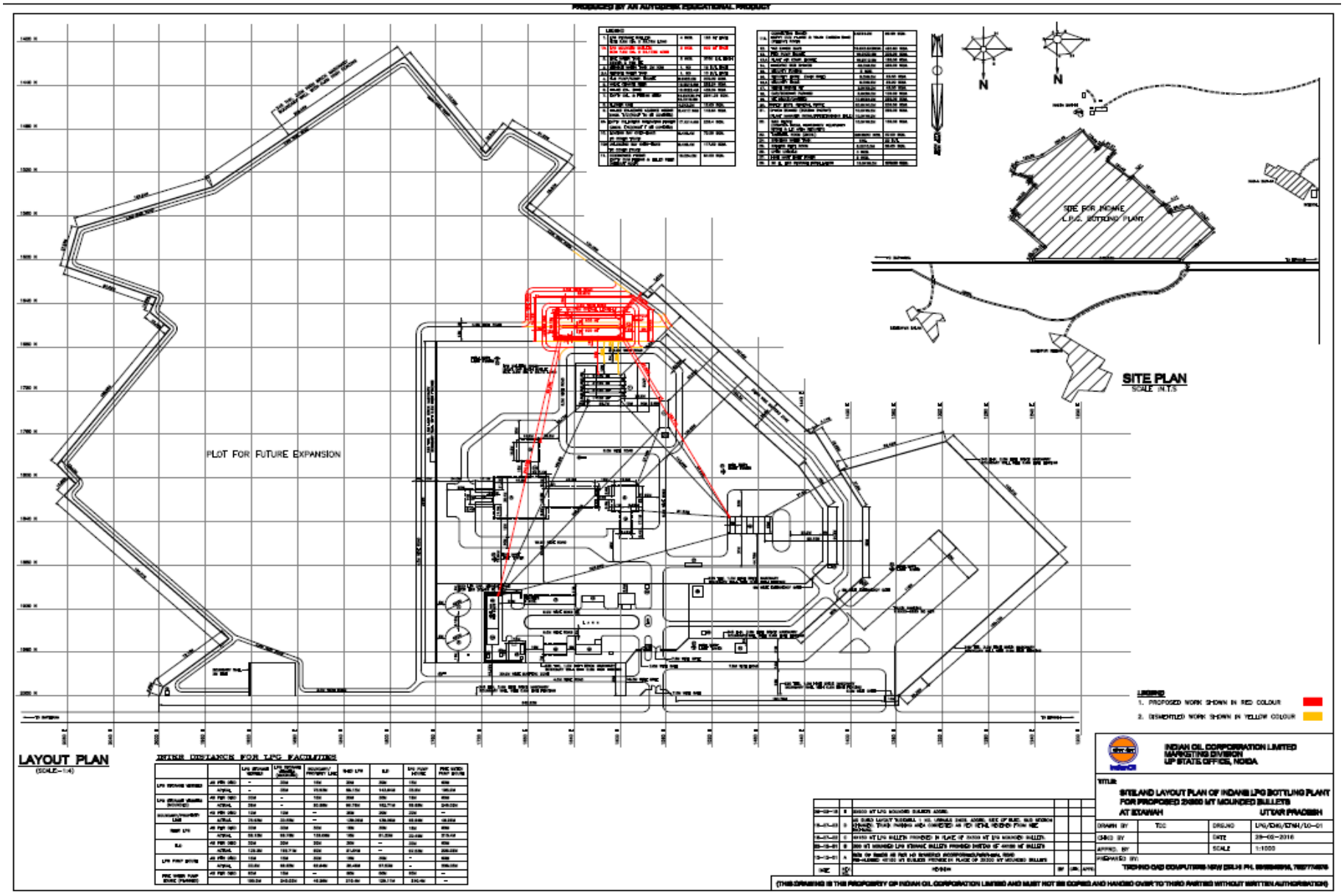


Figure: Plot Layout for proposed installation of 2 x 900 MT LPG mounded vessel at IOCL .

1.3 PROJECT DESCRIPTION

IOCL proposes to provide LPG Storage in the form of 2X900 MT Mounded Storage Vessels at LPG Bottling Plant, Etawah

2.1 LPG BULK STORAGE

Each LPG storage bullet will be of mounded type and will have storage capacity of 600 MT each. There will be only one LPG liquid nozzle through which LPG shall be received and discharged from each bullet.

The following safety provisions are provided for each bullet :

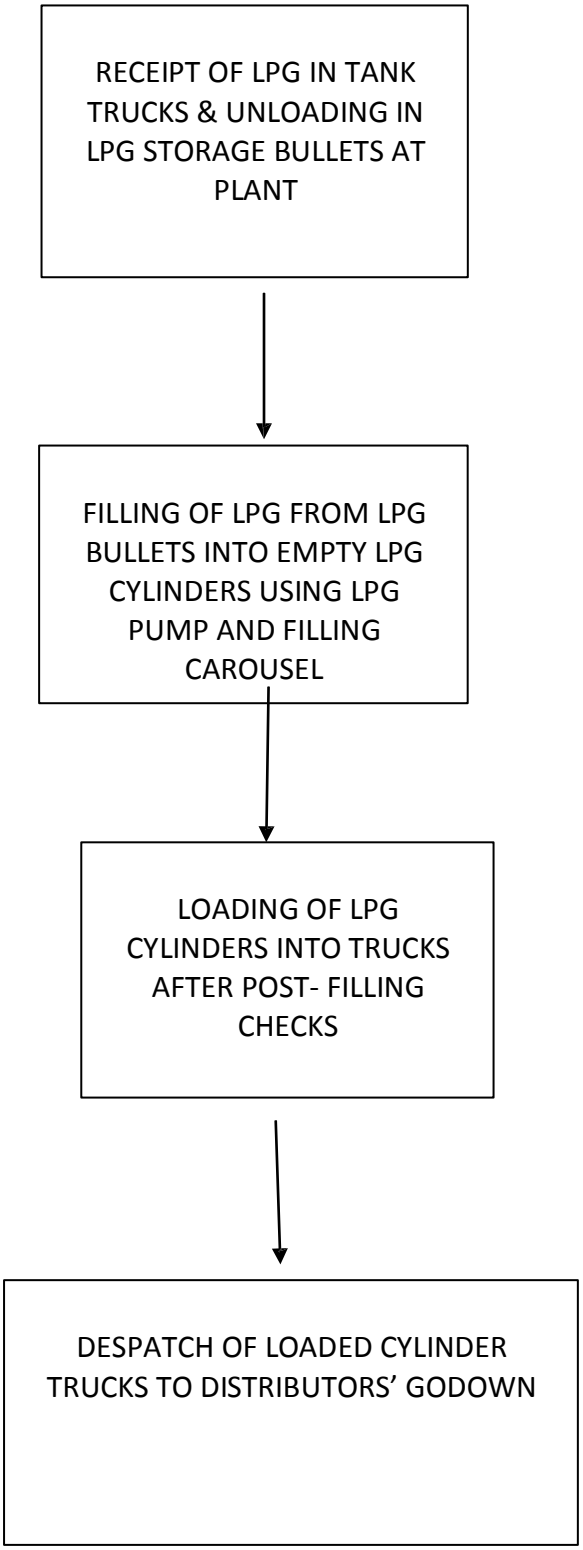
1. Independent two numbers pressure safety valves (PSVs) each connected to a vent stack , 3m high.
2. Remote Operated Valve (ROV) on the inlet LPG liquid and vapour line.
3. Two different types of Level Gauges
4. Cathodic Protection (CP) System
5. Earthing System
6. Gas Monitoring Sensors

2.2 FIRE FIGHTING FACILITIES

Plant has Automatic Fire Fighting System installed and the same will be integrated for Mounded Storage Vessels in line with OISD-144 & OISD-150. Apart from this a hydrant main ring will be provided in the surrounding of proposed mounded Storage Vessels with Fire Hydrant Points and Monitors at strategic locations as per OISD-144.

2.3 POWER SUPPLY SYSTEM

The requirements of power supply will be met with the existing power supplied by Uttar Pradesh Power Corporation Ltd. (UPPCL) and two nos. of DG Sets of capacities 400 KVA & 160 KVA and 250 kva have been provided to supply power during power failure. The Basic Flow Diagram for activities in the existing LPG Bottling plant is as furnished below :



2.4 PROPERTIES OF LPG

LPG has been identified as 'hazardous chemical' as per Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989/1994.

LPG marketed in India is governed by IS 4576 and test methods by IS 1448. IS 4576 defines LPG as a mixture of light hydrocarbons derived from petroleum which are gaseous at ambient temperature and atmospheric pressure but may be condensed to the liquid state at normal ambient temperature by the application of moderate pressure.

LPG to be handled at the facility under study will be Propane - Butane mixture, with small quantities of unsaturated hydrocarbons. LPG is highly flammable, capable of producing fire and explosion hazards under certain conditions.LPG at atmospheric pressure and temperature is a gas which is 1.5 to 2.0 times heavier than air. It is easily liquefied under moderate pressure, Since LPG vapour is heavier than air, it normally settles down at ground level/low lying areas. This accumulation of LPG vapour gives rise to potential fire and explosion.

LPG has an explosive limit range of 1.8% to 9.5% by volume of the gas in air. This is considerably narrower than other common gaseous fuel. Combustion of LPG increases the volume of products in addition to generation of heat. LPG requires about 24 to 30 times its own volume of air for complete combustion and yields 3-4 times its own volume of CO_2. The heat of combustion is about 10,900 Kcal/kg.

LPG is colourless both in liquid and vapour phase. During leakage, vapourisation of LPG cools the atmosphere and condenses the water vapour contained in it forming a white fog. This makes possible to see an escape of LPG.

LPG has a low viscosity (around 0.3 C.S. at 45°C) and can leak when other petroleum products can not. This property demands a high degree of integrity in the pressurised systems handling LPG to avoid leakage.

LPG has a very faint smell and as such for detecting leakage of LPG, ethyl mercaptan is generally added in the ratio approx. 1 kg of mercaptan per 100 cubic ft. of liquid LPG (20 ppm).

LPG is slightly toxic. Although it is not poisonous in vapour phase, it suffocates when present in large concentrations due to displacement of oxygen. Immediately Dangerous to Life & Health (IDLH) value of LPG is generally taken as 19000 ppm.

Highly inflammable pyrophoric iron sulphide is formed due to reaction of loose iron/iron oxide with sulphur or its compounds. Formation of pyrophoric iron sulphide is prevented by totally eliminating H2S, limiting the total volatile sulphur to 0.2% by mass and reducing loose iron oxide by thoroughly cleaning the storage vessels internally during outage.

However, pyrophoric iron sulphide will not spontaneously ignite in a Mounded Vessel or a cylinder due to high concentration of LPG which is much above the upper flammable limit. When these vessels are aired (during opening to atmosphere or air entrapped condition) to within or below the range, it will ignite spontaneously unless steam/water is used to cut the sulphur iron reaction. Similar type of precaution is needed while opening the strainers of LPG pumps or any other location where loose iron oxide is expected.

Some of the important physical and chemical properties bearing on risk assessment are presented in Table 2.2. The pertinent information and data on LPG with Material Safety Data Sheet is presented in Annexure 1.

2.5 HAZARDS OF LPG

When LPG is released from a storage vessel or a pipeline, a fraction of LPG vapourises immediately and the other portion forms a pool if the released liquid quantity is more. LPG from the pool vapourises rapidly entrapping some liquid as droplets as well as considerable amount-of air, forming a gas cloud. The gas cloud is relatively heavier than air and forms a thin layer on the ground. The cloud flows into trenches and depressions and in this way travels a considerable distance.

As the cloud formed in the area of spill moves-downwind under influence of wind, it gets diluted. A small spark within the flammability limit can cause flash fire, explosion and if the liquid pool still exists and remains in touch of cloud under fire it can ignite the whole mass of liquid. However, in case of non existence of any source of fire there will be no occurrence of hazardous event and the cloud may get diluted to such a level that the mixture is no longer explosive.

TABLE 2.2

IMPORTANT PROPERTIES OF LIQUIFIED PETROLEUM GAS (LPG)

Sr. No.	Property	Remark
1.	Appearance and Odour	Colourless and odourless gas
		when pure. Normally marketed with mercaptan odouring agent.
2.	Composition	Mixture of commercial propane, butane and unsaturated hydrocarbons.
3.	Liquid Density	500 to 580 kg/m^3 at 15 deg. C depending on composition
4.	Vapour Density	1.5 to 2.0 times heavier than air.
5.	Boiling Point	- 50 to -0.5 deg. C.
6.	Flammability Limits in Air	LFL - 1.9% V/V. UFL - 9.5% V/V.
7.	Permissible Exposure Limit- OSHA Standard	1000 ppm (1800 mg/m^3)

Different types of combustion reactions associated in case of release of LPG from the containment are listed in the following sections.

Escaping jet of LPG from pressure vessels / piping, if ignited, causes a Jet flame. The jet flame direction and tilt depend on prevailing wind direction and velocity. Damage, in case of such type of jet fires, is restricted within plant boundary. However, the ignited jet can impinge on other vessels and equipment carrying LPG and can cause domino effect.

The liquid pool, if ignited, causes a 'Pool Fire'. In the pool fire, LPG burns with long smoky flame throughout the pool diameter radiating intense heat which creates severe damage to the adjoining buildings, structures, other vessels and equipment causing secondary fires. The flame may tilt under influence of wind and may get propagated /

blown several pool diameters down wind. Damage, in case of such fires, is restricted within the plant area and near the source of generation except causing a phenomena, called Boiling Liquid Expanding Vapour Explosion (BLEVE), which is discussed and detailed below.

However, in case of plants having a good layout maintaining safe separation distances and other precautionary measures, the damage is minimum.

Clouds of LPG vapour mixed with air (within flammability limit) may cause propagating flames when ignited. In certain cases flame may take place within seconds. The thermal radiation intensity is severe depending on the total mass of LPG in the cloud and may cause secondary fires. When the flame travels very fast it explodes causing high overpressures or blast effects causing heavy damage at considerable distance from the release point. Such explosions are called unconfined vapour cloud explosions and are most common cause of such industrial accidents.

BLEVE occurs when pressure inside a storage vessel increases above the design pressure due to a fire in the adjacent area. Due to impingement of flame or due to radiant heat, temperature in the vapour portion of the storage vessel increases rapidly compared to the portion filled with liquid. Increase in temperature weakens the shell and the shell can burst open spilling the whole mass. The released liquid splashes and atomizes immediately often resulting in a fireball in contact with an ignition source. The fireball lasts only a few seconds.

The effect of BLEVE can extend beyond the plant boundary in case of catastrophic failure of large pressurized storage vessels but occurrence of such phenomena is very rare.

The storage in IOCL's context will be 'Mounded' type and hence will be protected from direct flame impingement caused by any eventual fire in the surroundings. Due to this there won't be any initialization of sequence of events that lead to occurrence of BLEVE and subsequent BLEVE will not occur.

3. SAFETY PHILOSOPHY

LPG is a common material used extensively in households as well as industry. If its characteristics are understood well and proper precautions as stipulated in

various codes and standards are followed, it is an easy and safe material to handle. Accordingly, in most of the developed / developing countries, where LPG is consumed in million tons / year, specific codes and standards are available for storing and handling of LPG.

3.1 MOUNDED STORAGE FOR LPG

LPG is normally stored in above ground storage mainly spheres and cylindrical tanks, namely, bullets & Horton spheres, the advantage being their accessibility for regular inspection and maintenance which is important for such storage for hazardous service. **But these storages are susceptible to fire impingement and can give rise to Boiling Liquid Expanding Vapour Explosions (BLEVE).**

The reason for selecting mounded or buried bullets for LPG storage is to protect them from direct flame impingement caused by any eventual fire in the surroundings and thus prevent initiation of the sequence of events leading to an occurrence of BLEVE.

SAFETY DATA SHEET

1. **CHEMICAL IDENTITY**

Chemical Name	:	Liquefied Petroleum Gas
Chemical Classification	:	Aromatic Mixture
Synonyms	:	LPG, Propane, Butane, Propylene, Purotax, Bottled Gas
Formula	:	C3H4-C3H6-C4H10 (Mixture)
C.A.S. No.	:	68476-85-7
U.N. No.	:	1075

Regulated Identification

Shipping Name	:	Liquified Petroleum Gas
Codes/Label	:	Flammable Class 2.
Hazardous Waste	:	ID No. 5

Hazchem Code : 2 W E

HAZARDOUS INGREDIENTS

1. Liquified petroleum Gas (CAS NO. 68476-85-7)
2. Propane (CAS NO. 74-98-6
3. Butane (CAS NO. 106-97-8)
4. Propylene (CAS NO. 115-07-1)

2. **PHYSICAL/CHEMICAL DATA**

Boiling Pt./Range	:	> -40°
Physical State	:	Gas
Appearance	:	Colourless
Odour	:	Mercaptan added for odour warning.
Melting/Freezing Pt.	:	Not Pertinent
Vapour Pressure @ 35º	:	Not Available
Vapour Density Air=1	:	1.5
Solubility in water at 30º	:	Floats
Others	:	Soluble in Organic Sovents, Alcohol
Specific Gravity (water = 1)	:	0.51-0.58
pH	:	Not Pertinent

3. **FIRE/EXPLOSION DATA**

Flammability	:	Yes
LEL	:	1.9%
UEL	:	9.5%
Flash Point Deg C Open Cup	:	104.4 Propane, 60 Butane
Autoignition Temperature Deg C	:	466 Propane, 405 Butane
Explosion Sensitivity to impact	:	Explodes
Explosion Sensitivity to static Electricity	:	Explodes
Hazardous Combustion Products	:	Emits CO, CO2
Hazardous Polymerisation	:	Will not occur

Combustible Liquid : Yes

Flammable Material	:	Yes
Pyrophoric Material	:	No
Explosive Material	:	Yes
Oxidiser	:	No
Organic Peroxide	:	No
Corrosive Material	:	No

4. **REACTIVITY DATA**

Chemical Stability	:	Stable
Incompatibility with other material	:	Strong Oxidisers

5. **HEALTH HAZARD DATA**

Routes of entry	:	Inhalation, Skin
Effects of Exposure/Symptoms	:	Concentration in air greater than 10% causes dizziness in few minutes. 1% conc. Gives the same symptoms in 10 minutes. High concentration causes asphyxiation. Liquid on skin causes frostbite.
Emergency Treatment	:	If inhaled, remove the victim to fresh air area. Provide artificial resuscitation. Skin : Remove the wetted clothes and wash the affected area with plenty of water. Eyes: Flush with plenty of water for 15 minutes. Seek medical aid.

LD50 (Oral-Rat)	:	Not listed
Permissible Exposure Limit	:	Not listed
TLV (ACGIH)	:	1000 ppm (1800 mg/cu.m.) STEL
: Not listed		
Odour threshold	:	5000 to 20000 ppm

NFPA Hazard :	Health	Flammability		Reactivity	Special
	1	4	0		

6. PREVENTIVE MEASURES

Personnel	:	Avoid contact with liquid or gas.

Protective Equipment	:	Provide hand gloves, safety goggles, gas mask, protective overclothing and shoes.
Handling & Storage Precautions	:	Keep in tightly closed cylinders in a cool well ventilated area, away from heat, flame and sparks.

7. **EMERGENCY/FIRST AID MEASURES**

FIRE

Fire Extinguishing Media	:	CO_2, Dry chemical powder, water spray
Special Procedure	:	Keep the containers cool by spraying water, if exposed to fire or heat.
Unusual Hazards	:	Containers will explode in fire.

EXPOSURE

First Aid Measures	:	If inhaled, remove the victim to open air area and artificial resuscitation may be provided, if required. If skin is affected with the liquid, remove the clothing and wash the affected area with plenty of water. Seek immediate medical aid.
Antidotes/Dosages	:	Not available

SPILLS

Steps to be taken	:	Shut off leaks if without risk. Warn everybody that it is explosive.
Waste Disposal Method	:	Allow to evaporate under control and protect the area.

8. **ADDITIONAL INFORMATION/REFERENCES**

Avoid contact with oxidizers. Olefinic impurities may lead to narcotic effect or it may act as a simple asphyxiant. A very dangerous hazard when exposed to heat or flame. If fire is big, keep surrounding areas cool by spraying water. Allow gas to burn under control.