RISK ASSESSMENT, DISASTER MANAGEMENT PLAN & HAZOP

M/S. HINDUSTAN PETROLEUM CORPORATION LTD
(Construction of New LPG Plant for Bottling & Storage Facilities at Haldia)

Haldia LPG Plant, Brindavan Chak (V), Durgachak Tehsil, Purba Medinipur District West Bengal

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Recognized by MoEF, and QCI – Accredited, S.No.157

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CHAPTER –I

INTRODUCTION
1.0 INTRODUCTION

1.1 Preamble

This Risk Assessment and Onsite & Offsite disaster management plan has been prepared for the Haldia LPG Plant of Hindustan Petroleum Corporation Limited. The Haldia LPG plant of Hindustan Petroleum Corporation Ltd. (HPCL) is situated at Brindavan Chak Village, Durgachak Tehsil, Purba Medinipur District, West Bengal. The plant site along with the surrounding area is shown in Site Plan. Noticing the damage potential and thus risk arising due to transportation, storage and handling of the flammable LPG HPCL, Haldia retained SV Enviro Labs & Consultants, Visakhapatnam, to undertake the Risk Analysis and Disaster Management plan for the LPG Plant.

Hindustan Petroleum Corporation Ltd, a Central Public Sector (Govt. of India Undertaking), proposes to setup a 1500MT (3 x 500MT) capacity LPG Plant, bottling capacity of 60,000 MTPA at Haldia, West Bengal, on 18 acres land taken on lease from Kolkata Port Trust. The estimated project cost is Rs. 100.0 Crores.

1.2 Background & Justification of the Project:

HPCL has only one LPG Plant in State of West Bengal at Paharpur in an industrial area located in Kolkata City. This project proposed to construct 3x500 MT Mounded Storage Vessels, Bottling Capacity of 60 TMTPA LPG Cylinders in an area of 18 Acres.

HPCL has grown only by 14 % during 2014-15 due to bottling capacity constraint. The anticipated market demand shall be 400 TMT by 2019-20.

As per Vision 2015 Document of MOP & NG, Govt. of India, the LPG penetration has to be increased so as to achieve 75% penetration of LPG. Therefore, many regular and rural distributors shall be commissioned during next 2-3 years. However, in absence of own additional bottling plants, HPCL is not getting due rural penetration, as per its market potential in the State of West Bengal, as compared to IOC & BPC.

It is proposed to attach the Distributors under East and West Midnapur, Howrah &Hoogly districts to new plant on logistic basis, which are presently being fed by Private bottlers and our hospitality arrangement with IOCL & BPCL. The total supply to these markets during 2013-14 was 41 TMT. However, potential demand was not fulfilled due to non-availability of our own plant, as supplies only to these markets gets affected in adverse situation, since priority is given to Kolkata & it’s suburban markets.
Project Benefits:

- Availability to Clean Energy for Domestic Consumption
- Employment Generation
- Socio-economic development of the area
- Educational Facilities in the area

1.3 Design Criteria:

The LPG bottling plant will be operated in two shifts/day and 300 days/year to achieve the targeted production by making use of facilities listed

Proposed Facilities of the Project:

i. 1 no. 24 head fully automatic Flexi-Speed Electronic Carousels with high speed downstream equipment.

ii. LPG Cylinder Sheds

iii. Filling and testing equipments

iv. 3 x 500 MT capacity Mounded storage facilities

v. Fire water storage tanks and allied Firefighting facilities, Gas Monitoring system and PPE as per OISD 144

vi. 1 no 8 bay Tank Truck unloading facilities

vii. 2 Nos. Manual filling scales for 35 Kg./47.5 Kg. capacity cylinders filling with QC equipment

viii. Shed & Testing equipments for Periodic Cylinder Testing Facility.

ix. Miscellaneous associated facilities / infrastructure

x. Railway siding in future, for unloading of LPG by rakes. Feasibility study included in present scope of project.

To analyze Maximum Credible Accident (MCA) Scenarios, following inventory of LPG has been considered:
Maximum permissible filling is 85% of the volume (15% is left as vapor space).

Major facilities at the LPG Bottling Plant include tank farm comprising of LPG storage, two pump houses one for fire fighting Water and another for LPG, Cylinder Filling shed, Tank Truck loading/ Unloading Gantry, DG room MCC Room, fire water pumps, jockey pumps & two water tanks of capacity 3500KL each for fire fighting.

The LPG Bottling Plant has facilities for unloading, storage and loading of LPG. LPG is class A Flammable and hence due care is taken to avoid ignition in the area.

**Table: 1.2 Work Environment Quality in LPG Bottling Plant, Haldia is given in below table**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Shift PPM</th>
<th>Time Weighted Average (TWA)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>Less than TWA</td>
<td>1000PPM (1800mg/m3)</td>
</tr>
</tbody>
</table>

TWA*= NIOSH Pocket guide to chemical hazards, US Department of Health and Human services, JUNE 1990

**Detection of LPG Leakage:**

If in case leakage of LPG occurs, it is sensed by the sensors and accordingly it will give alarm (20% of LEL: Warning & at 50%LEL: Alarm)

Senior Regional Manager/Plant Manager, who would be Site Controller/Chief Coordinator in case of any emergency, manages overall operations of the LPG Bottling...
Plant. Under his guidance, Fire Fighting Team, Rescue team & Auxiliary team would work in co-ordination during an emergency.

In order to identify the nature and extent of impact due to hazards due to the storage & handling of LPG, Risk analysis study has been carried out, which has been covered in the report. Maximum Credible Accident scenarios have been identified and damage distances have been calculated for various damage levels.

Though risk of accidents are minimized by sound design and safe operations & maintenance practices, but it has been observed that even after taking all such precautions possibility of occurrence of an accident can not be fully eliminated in such installations. There are number of accident case histories, discussed in the Risk Analysis study, which insist to formulate a functional Disaster Management Plan (DMP). Therefore planning for mitigating the effects of an accident is essential.

Mitigation of sufferings due to an accident is achieved by implementing the DMP at the time of emergency. A DMP is prepared by incorporating the results of Risk Analysis study/Maximum Credible Accident (MCA) Analysis/Consequence Analysis, which includes identification of the credible accident scenarios and assessment of the consequences of such accidents. Accordingly the emergency operations that would be implemented in the event of an emergency are decided. The requisites for response to an emergency are that the response should be quick, adequate, well devised and properly supervised.

Disaster Management Plan for HPCL LPG Plant, Haldia has been prepared in such a way so that loss minimization, hazard control in the quickest possible time and mitigation of the sufferings of the people during a major accident could be achieved. However it is to be noted that Disaster Management Plan is just one aspect of achieving higher levels of safety, which cannot be considered in isolation. In particular, it is not a substitute for maintaining good safety standards in plant operations.

CHAPTER –II

RISK ANALYSIS
2.0 OBJECTIVES & SCOPE OF THE ASSIGNMENT

Study Objectives

The purpose of carrying out Risk Analysis is to study the nature & impact of hazards due to the handling & storage of LPG and also to analyze the nature of injury & extent of the consequences Off-site the plant so as to facilitate On-site & Off-site Emergency Preparedness Plan. The analysis aims at qualitative & quantitative evaluation of the consequence involved due to location and operation of the LPG bottling plant and also to identify suitable measures to minimize the consequences. The findings result into recommendations for minimization of the existing levels of risk, and provide guidelines for increasing effectiveness of On-site & Off-site Emergency Preparedness Plan.

2.1 IDENTIFICATION OF HAZARDS & ASSESSMENT OF THE CONSEQUENCES

LPG are highly inflammable due to low flash point, high volatility, low ignition energy requirement, high burning velocity, higher vapor density than air (due to which the vapor spreads on the ground & thus more susceptible to catch a ignition source), high heat of combustion & concentration in air being within the flammability limits in empty pipelines & tanks. In addition to such intrinsic properties, extrinsic factors like operating conditions & large inventory are considered in the study.

(A) Hazard Identification (HAZID) & visualization of MCA Scenarios:

1. Study of ongoing LPG handling & bottling process and engineering information, Piping and Instrumentation (P&I) diagrams, plot and layout plans of the plant

2. Identification of fire & explosion hazards

3. Analysis of inventories in storage units with recourse to manufacture, storage & Import of Hazardous Chemical Rules, 2000 and Fire - Explosion & Toxicity Index (FEI & TI)

4. What- if analysis for all foreseeable deviations in LPG Bullets, LPG Pump & compressor, Bulk Loading/Unloading process, LPG bottling units and various
LPG handling processes like LPG unloading from truck tankers, Defective cylinder evacuation, Cylinder filling & Loading of LPG in truck tanker.

5. Identification of accident sequences and consequences with recourse to Event Tree Analysis (ETA) and to evaluate propensity of occurrence of the top event through Fault Tree Analysis (FTA)

6. Past accident data/information analysis in similar installations to develop the credibility of worst come worst accident scenarios

7. Visualization of Maximum Credible Accident (MCA) scenarios

(B) Analysis of MCA Scenarios:

1. Analysis of identified MCA scenarios and quantification of primary effects and to evaluate the domino effects with recourse to computerized mathematical models program “EFFECTS “ (Internationally recognized software developed by TNO) pertaining to cases of

   - LPG Outflow and its release
   - Dispersion
   - Heat Radiation
   - Explosion {(Vapor Cloud Explosion, Boiling Liquid Expanding Vapor Explosion (BLEVE))}

2. Application of damage criteria for heat radiation & pressure wave levels with recourse to health criteria, dose-response relations and vulnerability models

(C) Consequence Analysis:

1. Study of on-site and off-site population and land usage characteristics.
2. Characterization of Consequence/hazard levels through study of nature of exposure, pathway & consequences of MCA scenarios
3. To provide recommendations to minimize the Consequence and guidelines for On-site & Off-site Disaster Management Plan (DMP).
2.2 METHODOLOGY ADOPTED

After identifying the study objectives and collection of the data, the team identified the major consequences that are possible due to deviations from design and engineering intentions. The collection of data and information provided familiarity with the facilities to the team carrying out the Risk Analysis study. The Risk Analysis calculations based on the collected data have been carried out by using PHAST LITE 7.11 software. Finally, risk reduction measure has been suggested.
4. Risk presentation
5. Recommendation

Introduction to the study

Data collection and discussion with engineers

Identification of hazards

Data input into Risk Analysis software

Processing of risk analysis
Calculations and releases
Scenarios

Risk presentation
Recommendation
2.3 Properties, Behavior and Hazards of the LPG

Properties of LPG are analyzed to identify & quantify the hazards. Material Safety Data Sheets (MSDS) for LPG is given in Table 3.

Table 2.1: Material Safety Data Sheet (MSDS) For LPG

<table>
<thead>
<tr>
<th>A. Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS No.</td>
</tr>
<tr>
<td>Formula</td>
</tr>
<tr>
<td>Description</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Physical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular weight</td>
</tr>
<tr>
<td>Vapor Pressure</td>
</tr>
<tr>
<td>Flammability Limits</td>
</tr>
<tr>
<td>Category</td>
</tr>
<tr>
<td>Reactivity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Fire/Explosion Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Hazard</td>
</tr>
<tr>
<td>Explosion Hazards</td>
</tr>
<tr>
<td>Fire Fighting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. Health Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLV/TWA</td>
</tr>
<tr>
<td>Target Organs</td>
</tr>
<tr>
<td>Pathway</td>
</tr>
<tr>
<td>Symptoms</td>
</tr>
</tbody>
</table>
E. First Aid

Eye - if this chemical contacts the eyes, immediately wash the eyes with large amount of water, occasionally lifting lower and upper lids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

Skin - if this chemical contacts the skin, promptly wash the contaminated skin with soap and water. If this chemical penetrates the clothing, promptly remove the clothing and wash the skin with soap and water. Get medical attention promptly.

Breath - If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform mouth-to-mouth resuscitation. Keep the affected person warm and at rest. Get medical attention as soon as possible.

2.4 RISK ANALYSIS

Quantitative Risk Analysis
Quantitative Risk Analysis has been carried out with the help of world renowned SOFTWARE i.e. PHAST LITE 7.11

Modes of Failure
There are various potential sources of large/small leakages, which may release LPG to the surrounding atmosphere. This leakage may be in the form of a small gasket failure in a flanged joint or snapping of hoses, a guillotine failure of a pipeline or any other source of leakage.

Damage Criteria
The damage effects are different for different types of failure scenarios. The physical effects of ignition of LPG vapours, e.g. blast wave, thermal radiation and BLEVE due to release of LPG from the containment are discussed below:

i) LPG vapours released accidentally will normally spread out in the direction of the wind. If it comes into contact with an ignition source before being dispersed below the lower flammability limit (LFL), a flash fire is likely to occur and the flame may travel
back to the source of leak. Any person caught in the flash fire is likely to suffer from severe burn injury. Therefore, in consequence analysis, the distance to LFL value is usually taken to indicate the area, which may be affected by flash fires. Any other combustible material within the flash fire is likely to catch fire and may cause secondary fires. In the area close to the source of leakage of LPG there is a possibility of Oxygen depletion since the LPG vapour is heavier than air. A minimum of 19.5% Oxygen in air is considered essential for human lives.

ii) Thermal radiation due to pool fire, jet flame or fire ball may cause various degrees of burn on human bodies. Also its effects on inanimate objects like equipment, piping, building and other objects need to be evaluated.
Fig: 2.1 Possible Scenario Release of LPG
Radiation vs Distance for Fireball
Catastrophic rupture

Early Explosion Overpressure vs Distance
Catastrophic rupture

Maximum Concentration Footprint
Catastrophic rupture
HPCL-HALDIA-LPG PLANT

[RISK ASSESSMENT, DISASTER MANAGEMENT PLAN & HAZOP]
Fig: 2.2 Leakage from LPG Tanker
2.5 HAZARDOUS MATERIAL STORAGE, HANDLING & TRANSPORTATION

Maximum inventory of the LPG in the Plant is given in Table 1.1. The storage tanks are fitted with vents, expansion wires, delivery/receipt lines with separate valves & earthing arrangements.

At HPCL, Haldia LPG Bottling Plant the bulk LPG will be received at the plant through Road tankers of capacity 18MT. This LPG is then stored in the plant. Bottling of Cylinder is done in the plant through carousel and distributes the filled cylinder to the end users through Dealer network system by truck.

2.6 VISUALIZATION OF MCA SCENARIOS, HAZARD QUANTIFICATION AND ASSESSMENT OF THE CONSEQUENCES

A Maximum Credible Accident (MCA) is an accident with maximum damage potential, which is believed to be credible in a hazardous installation.

In this Plant, primarily there could be fire (ignition of spilled or leaked LPG), flare (jet fire) or VCE (Vapour Cloud Explosion), BLEVE. VCE is possible at the tank farm only whereas fire, Flare & BLEVE are possible at pipeline, any pipeline containing LPG; Tank farm, Pump House and Truck Tanker. Quantification of heat radiation levels has been carried out for VCE scenarios only as other fires would have comparatively less harmful impacts.

In case fire, flare or VCE could not be controlled there is a possibility that fire may propagate from one tank to another. This may further escalate the disaster and BLEVE may occur due to LPG.

2.6.1 Assessment of the Consequences

Primarily there could be fire (ignition of spilled or leaked LPG), flare (jet fire) or VCE in the LPG Bottling Plant. VCE is possible at the Tank farm and Tank Truck whereas fire and flare are possible at any pipeline containing LPG; Tank farm; pump shed and T/T Filling. Quantification of heat radiation levels has been carried out for VCE scenarios only as other fires would have comparatively less harmful impact on the surroundings.
Depending on the inter-unit distances, it is quite likely that the fire/explosion in one unit may affect the other nearby units and thus the damage may escalate.

A fire, flare or VCE or BLEVE may produce cascading effect (prorogation of an accident) at the tank farm. In case the BLEVE takes inside the plant and could not be controlled in the Area of accident, there is a possibility that the other facility may explode if flame directly impinges on them or any bombing takes place directly on Tank.

VCE & Jet Fire will not be as violent as that of BLEVE in Tank Truck. Also, the extent of damage due to VCE or Jet Fire will not be more than that due to BLEVE in LPG Tank Truck. Therefore it could be concluded that BLEVE in a LPG Tank Truck would be worst credible accident scenario for the LPG Bottling Plant and if this accident occurs it may destroy the complete LPG Bottling Plant. However the BLEVE can occur only as secondary effect of VCE or a impinging jet fire on the tank Truck in the TT Gantry, but frequency probability is less than $8.9 \times 10^{-6}$.

### 2.6.2 Jet Fire in LPG Pipeline/Product Pump House/Tank Farm/Bulk Loading/Unloading Shed/Truck Tanker

If there is a leakage in the pipeline and if there is availability of any ignition source, jet fire may occur. In such cases the leaked LPG may travel up to the ignition source and the fire may travel back to the place of leakage or the leaked LPG may catch fire at the place of leakage itself. The flame impingement and may cause further damage.

In this case also there would be sufficient time available for the persons to come out from the affected area, unless they are not trapped due to layout of the plant at that place. In such cases isolating the affected pipeline should be given first priority than extinguishing the fire. The affected equipment (being heated by the heat) should be kept cool with flow of water from monitor/hydrant.

### 2.6.3 Vapor cloud Explosion in tank farm

Analyzing the damage distances and heat radiation intensities for VCE scenarios, it can be inferred that there will not be any fatality outside the plant as there will be sufficient time to escape. Only burn injuries may occur. If such VCE is extinguished well in time
and escalation of accident could be avoided; disaster like Boiling Liquid Expanding Vapor Explosion in Tank Truck could be avoided. Thus damage in the LPG Bottling Plant could be limited to the tank farm only. However, frequency of occurrence of such accidents has been found extremely low.

As soon as any such major release of LPG is noticed and LPG cannot be contained in the leaking tank, first efforts should be made to transfer LPG to the other tank in maximum possible quantity. The fire tender & additional fire fighting equipment should be brought to the site. If possible the leakage should be minimized/ stopped and the personnel should ascertain that there is no possibility of any ignition source in the near vicinity. Then the spilled oil should be carefully removed at the earliest. If fire takes place, apart from extinguishing the fire, cooling of nearby tanks containing pipelines & equipment by water monitor/hydrant should be given equal importance.

2.6.4 SECONDARY OR DOMINO EFFECTS

A fire or explosion in one facility may lead to another one; the effects of this nature are called Secondary or Domino effects.

The Haldia LPG plant of Hindustan Petroleum Corporation Ltd. (HPCL) is situated at Brindavanchak, Post Box No -6, P.O Durgachak, Purba Medinipur District, West Bengal. However in case of major LPG leakage in the bottling plant and the plume traveling in down wind direction may meet an ignition source and due to backfire phenomenon severe damage to the LPG bottling plant may occur.

Referring the damage distances for BLEVE/VCE; it is possible that fire or explosion in one segment of the plant may cause adverse impact to the other segments of the plant.

2.7 DETAILS OF PREVENTIVE MEASURES TO AVOID LEAKAGES & ACCIDENTS

FIRE PROTECTION SYSTEM

The following fire protection facilities are envisaged as per the requirements of OISD-117

- Portable Fire Extinguishers / Equipments to fight small / approaching fire
Fire Fighting system with Automatic Operation to fight Emergency involving major fire

Specific norms of various types of fire extinguishers and equipment to be kept at plant has been stipulated in the OISD 144.

In case of fire fighting system detailed design and operating parameters have been defined.

Provisions for firefighting facilities for plants construction as per OISD 144 is different from plant constructed as per OISD 169. Majority of plants are as per OISD 144. Details of Fire fighting facilities as per OISD 144

Components of fire water system
The main components of the system are:
- Fire Water Storage
- Fire Water Pumps
- Fire Hydrant/ Monitor distribution piping network.
- Water Sprinkler/ Deluge system.

Portable fire extinguisher
- Portable fire extinguishers shall be located at convenient locations and shall at all times be readily accessible and clearly visible.
- The maximum running distance to locate an extinguisher in working areas shall not exceed 15 meters.

2.7.1 HOSES, NOZZLES AND ACCESSOREIS
- Reinforced rubber lined hoses (63mm) conforming to IS: 636 (type A or B) shall be provided.
- The hoses shall be of 15 Meters standard length and shall be provided with Gun metal/ Aluminium alloy male & female couplings of instantaneous pattern.

The following accessories/ first aid items shall be provided in the plant:
1) Fire hoses 100% of no. of hydrant points.
2) Safety helmets as required (Min. 10 Nos.) 1 no. for each person
3) Hose Boxes Alternate hydrant point.
4) Stretcher with blankets Min. 2 Nos.
5) First aid Box Min. 2 nos.
6) Rubber hand gloves Min. 2 pairs for electrical purpose (BIS approved)
7) Low temperature 4 pairs rubber hand gloves for LPG emergency.
8) Low temp. Protective Min. 2 sets clothing for LPG emergency.
9) Explosimeter Min. 2 Nos.
10) Fire proximity suit Min. 1 No.
11) Resuscitator Min. 2 No

**Fire alarm system**

- Sufficient No. of Manual call points shall be provided in the plant.
- Electricity operated Fire Siren shall be audible to the farthest distance in the plant (1K.M. from the periphery of the plant).
- Manually operated fire sirens shall be provided at strategic places.
- For fire condition the siren shall be wailing sound for minimum 2 minutes and for all clear signals it shall be straight run siren for 2 minutes.

**2.7.2 PREVENTIVE MEASURES:**

- Interlocking shut down device (ISD) will be connected to automatic shutdown and auto operation fire hydrant network.
- Emergency shutdown will be provided in the control room to stop all dispatch operation
- Emergency push buttons to stop all loading operations are provided in the control room.
- Gas Detection system and monitoring system will be provided
CHAPTER –III

DISASTER MANAGEMENT PLAN
3.0 OBJECTIVES AND SCOPE OF DISASTER MANAGEMENT PLAN

Objectives:

The disaster management plan is formulated with the broad objective of safeguarding human life and minimizing human suffering & property loss by localizing the emergency and to eliminate it as far as possible. Elimination of impacts of a foreseeable accident requires prompt action by operators and emergency staff using, e.g., fire-fighting equipment, shut-off valves and water sprays. Minimizing the effects include rescue, first aid, evacuation, rehabilitation & giving prompt information to people in nearby area.

The Disaster Management Plan of the company is divided into two parts:

1. Onsite Emergency Plan
   In this plan, the company officers are given pre-designated responsibilities for dealing with the emergency

2. Offsite Emergency Plan
   In this, different Govt. agencies will be informed about the emergency for necessary help from them.

Scope:

1. To examine the protection measures that are already incorporated and effectiveness of measures in respect of response times, resource mobilization, dispersion etc. and suggest corrective actions to be taken.

2. To develop an effective On-site disaster Management Plan so as to ensure safety by restricting a hazard to not to manifest into an accident. If, at all, a hazard realizes into an accident; to mitigate the consequences to minimum possible level.

In order to achieve this, it is required to:

1. Identify the hazards and assess the consequences by carrying out a Risk Analysis Study or MCA Analysis;

2. Evolve guidelines for fire fighting for each perceived accident scenario and to formulate scope of activities for mock drill;

3. Formulate and allocate the actions to be taken during an emergency by every member of the emergency team;
4. Evolve procedure for reporting an emergency;
5. To ensure adequacy of proper fire fighting equipments;
6. Ensure quick and proper communication, inside as well as outside the plant during an emergency;
7. Shutdown the Plant operation & isolate storage tanks;
8. Control the situation & contain extent of damage in order to save Plant property & environment;
9. Information to local authorities & associating with them to execute the emergency services
10. Ensure safety of the personnel engaged in control measures and rescue of other plant personnel and to provide first aid & further treatment to the injured;
11. Preserve records & relevant clues to investigate the causes so as to prevent recurrence of such events.

3.1 FORMULATION OF DMP AND EMERGENCY SERVICES

In order to cope with the above-identified MCA, it is required to formulate a Disaster Management Plan so that the arised emergency situations could be managed with least possible damage. Following aspects have been considered in preparation of the on-site Disaster Management Plan:

1. Response time of equipments, machinery and fire fighting team any emergency situation
2. Liaison with outside authorities, including the emergency services
3. Procedures for raising the alarm and communications both within and outside the works
4. Appointment of key personnel and their duties and responsibilities, especially for works incident controller and works main controller
5. Emergency Control Centre, its location and infrastructure available
6. Action on-site and off-site
7. The time element is of great significance in dealing with most of the dangerous situations in all installations handling hazardous chemicals. Past accidents have shown that this factor is often overlooked.

3.2 **EMERGENCY TEAM:**

In case of any emergency each individual in the LPG Bottling Plant has to act in proper co-ordination to execute specific tasks under the designated team leader. This avoids overlapping of responsibilities & possible chaos at the time of emergency.

3.3 **DECLARATION OF EMERGENCY**

Incidents/scenarios like fires, explosions, natural calamities, sabotage, act of war or negligence may lead to an accident or disaster at the Plant.

As soon as any untoward incident is observed which has potential to lead to any emergency situation, it is the responsibility of the observer to rush to the spot of fire (depending on the amount of fire) with the nearest portable extinguisher available to him by shouting FIRE, FIRE, FIRE till he himself (or someone hears and rushes for help and arrange to) sound the siren. Actuation of siren would mean declaration of emergency. A red colored flag would be used to indicate the site of fire. First observer must make sure that Incident Controller or (Fire In-charge) Site Controller/Chief coordinator is informed about the incident and takes overall charge of the situation. Fire in-charge will issue suitable instruction after quickly assessing the situation. The emergency will continue until all fire has been extinguished with no risk of re-ignition. On ensuring normal conditions Site Controller/ Chief coordinator will declare normalcy. Emergency Control Center is the Emergency Response Center of LPG Bottling Plant.

3.4 **ACTIONS TO BE TAKEN DURING AN EMERGENCY:**

The actions that are required to be taken during an emergency in the LPG Bottling Plant have been analyzed and listed below. This includes various information to be made available to Site Controller/ Chief coordinator and the decisions to be taken according to the situation at the time of emergency.
<table>
<thead>
<tr>
<th>Sr.</th>
<th>Actions</th>
<th>To be Performed by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Emergency alarm is to be raised immediately on observing any type of emergency. In Case of total electricity failure fire bell is to be used</td>
<td>First Observer</td>
</tr>
<tr>
<td>2.</td>
<td>What is the exact location of fire/LPG leak in the plant and extent/size of LPG leak?</td>
<td>First observer/ Incident Controller</td>
</tr>
<tr>
<td>3.</td>
<td>Which flammable material is involved?</td>
<td>First observer/ Incident Controller</td>
</tr>
<tr>
<td>4.</td>
<td>What is the nature of emergency? Whether Tank overflow / Bund Over-flow / Truck with filled cylinders on fire / LPG Tanker on fire / Fire in pump house / generator room, dry grass etc., a natural calamity.</td>
<td>First observer/ Incident Controller/ Site Controller/ Chief Controller</td>
</tr>
<tr>
<td>5.</td>
<td>The Control Systems are to be put into service</td>
<td>Incident Controller</td>
</tr>
<tr>
<td>6.</td>
<td>Fire combating team is to reach to the spot with the equipments</td>
<td>Fire Combating Team</td>
</tr>
<tr>
<td>7.</td>
<td>Fire pump is to be put on &amp; to ensure correct water pressure in the hydrant line</td>
<td>Fire Combating team</td>
</tr>
<tr>
<td>8.</td>
<td>All the LPG transfer pumps are to be stopped &amp; the valves are to be closed</td>
<td>Auxiliary Team</td>
</tr>
<tr>
<td>9.</td>
<td>Fire extinguishers are to be put into operation immediately</td>
<td>Fire Combating team</td>
</tr>
<tr>
<td>10.</td>
<td>Whether the extinguishers are available in sufficient Nos. at the site of fire?</td>
<td>Auxiliary Team</td>
</tr>
<tr>
<td>11.</td>
<td>On Bulk LPG Unloading Shed, unloading operations are to be terminated. Valves in the Bulk Unloading Shed are to be closed and the unloading hoses to be removed from the Tankers under unloading</td>
<td>Truck Loading/Unloading In-charge otherwise Auxiliary Team</td>
</tr>
<tr>
<td>12.</td>
<td>To ensure that all the Tankers are taken out of the premises</td>
<td>Auxiliary Team</td>
</tr>
<tr>
<td>13.</td>
<td>Cash box is to be closed and kept into the safe. Important documents to be kept in safe.</td>
<td>Rescue Team</td>
</tr>
<tr>
<td>14.</td>
<td>Traffic at main gate is to be kept clear</td>
<td>Security Staff</td>
</tr>
<tr>
<td>15.</td>
<td>Whether evacuation of personnel required? If so, then to arrange the evacuation</td>
<td>Site Controller/ Chief Controller &amp; Rescue Team</td>
</tr>
<tr>
<td>16.</td>
<td>Entry of unauthorized persons is to be restricted.</td>
<td>Security Guard</td>
</tr>
<tr>
<td>17.</td>
<td>External agencies like fire brigade, Police, Ambulance, etc. are to be informed depending on the need and necessary help is to be asked.</td>
<td>Rescue team on instructions from Site Controller/Chief Controller</td>
</tr>
<tr>
<td>18.</td>
<td>Contractors and visitors are to be taken out of the premises</td>
<td>Rescue Team</td>
</tr>
<tr>
<td>19.</td>
<td>How many vehicles are available?</td>
<td>Security</td>
</tr>
<tr>
<td>20.</td>
<td>To ensure power supply &amp; operation of the generator</td>
<td>Auxiliary team</td>
</tr>
<tr>
<td>21.</td>
<td>Risk to the emergency control center from the incident</td>
<td>Fire In-charge (Site Controller/Chief Controller)</td>
</tr>
</tbody>
</table>
Every individual worker as well as Fire Incharge, Fire Combating team Incharge and other personnel are expected to use their presence of mind in spite of the duties allotted to them and take prompt action to safe guard lives and minimize the damage to the plant property and environment. Specific duties of the emergency team are as follows.

### 3.5 APPOINTMENT OF PERSONNEL AND THEIR DUTIES

In order to performed the actions listed in item 3.3, duties of all the numbers of the emergency team have been identified and listed below:

**Table: 3.1 List of Key Personnel**

<table>
<thead>
<tr>
<th>Sr no.</th>
<th>DESIGNATION OF KEY PERSONNEL</th>
<th>NAME OF KEY PERSONNEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>SITE CONTROLLER/CHIEF COORDINATOR</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>INCIDENT CONTROLLER</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>ADMINISTRATIVE COORDINATOR</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>FIRE &amp; SAFETY COORDINATOR</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>COMMUNICATION &amp;MAINTAINENCE COORDINATOR</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>SECURITY CONTROLLER</td>
<td></td>
</tr>
</tbody>
</table>

**Table: 3.2 Details of Manpower**

Details of Official Staff at Haldia LPG Plant *(also to be used as Roll Call List)*

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Designation/Grade</th>
<th>Name of Employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Sr. Regional Manager</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Sr. Manager Projects</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Plant Manager</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Sr Operations Officer</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Sr Operations Officer</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Sr Operations Officer</td>
<td></td>
</tr>
</tbody>
</table>
### Table: 3.3 Details of Clerical Staff at Haldia LPG Plant
Details of Clerical Staff at Haldia LPG Plant (also to be used as Roll Call List)

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Designation/Grade</th>
<th>Name of Employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sr. Comp. Clerk M-10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Clerk M-10</td>
<td></td>
</tr>
</tbody>
</table>

### Table: 3.4 Details of Workmen at Haldia LPG Plant
Details of Workmen Staff at Haldia LPG Plant (also to be used as Roll Call List)

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Designation/Grade</th>
<th>Name of Employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LPG Pump Operator M-07</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>LPG Operator M-05</td>
<td></td>
</tr>
</tbody>
</table>

#### 3.5.1 Fire Incharge (Site Controller/Chief Coordinator):

Senior Regional Manager/ Plant Manager will act as Site Controller (Fire Fighting - Chief Co-Ordinator) in the event of an emergency. As soon as emergency is reported, he will rush to the spot & take overall charge of the emergency operations from incident controller.

**Main duties of Site Controller/Chief Coordinator are:**

1. Analyze and review the situation and its possible impacts
2. Clarify and declares emergency
3. Assess the magnitude of the situation and decides whether the staff needs to be evacuated from the assembly points

4. Establish contract with District emergency authorities like Police, Fire Brigade, Ambulance, Inspector of factories and mutual Aid partners and alert them for any assistance, if needed

5. Contact with zonal office and HQO and maintain continuous review of possible development in consultation with incident controller and other key personnel to shut down the plant

6. Monitors and review the events and also the possible development in consultation with incident controller, Administrative controller, Safety & Maintenance coordinator

7. Ensure the record of all events, decisions taken, any government directives etc. and are well kept for future reviews & analysis

8. Assess the damage after emergency is over

3.5.2 **Incident Controller:**

Senior Operation Officer/ Operation Officer, will act as Incident Controller in the event of emergency. On hearing of an emergency, Incident Controller will rush to the scene of the occurrence and take overall charges and report Site Controller/Chief Coordinator. His other duties include:

1. Direct all operation within the affected area so as to ensure that safety of personnel gets priority over stocks/priority

2. Take assistance from Fire Brigade & mutual Aid Partners in controlling the situation as and when they arrive

3. Collect information regarding the origin and nature of fire

4. Maintain record of all information collected and report all significant development to communication coordinator

5. Ensure that all non essential workers/staff of the areas affected are evacuated to the appropriate assembly points, and the areas are searched for causalities

6. Pending arrival of Site Controller/Chief Coordinator, assume the duties of his post

7. Direct closure and evacuation of plant areas likely to be affected by the emergency

8. Ensure that all key personnel and outside help are called in
3.5.3 Administrative Coordinator

Account Officer (JN) will act as a Administrative Controller in the event of emergency. His duties include:

1. Safeguard all document, cash etc
2. Handle under the direction of site Controller, Police, Press and other enquiries
3. Receive report from assembly point and pass on the information to the communication coordinator
4. Ensure stoppage of movement on the highway, inform the railway authorities to stop the rail movement in case of need and ensure that alternate transportation is available when need arises
5. Ensure that causalities receive adequate attention, and arrange additional help, if required and inform the victims relatives
6. Make arrangement for relief of personnel and organize refreshment/catering facility
7. Provide hourly situation reports to the emergency control center indicating men, equipments, materials involved at each area under the influence of emergency

3.5.4 Communication & Maintenance Coordinator

Senior Operation Officer will act as Communication and maintenance Officer in the event of emergency. His duties include:

1. On hearing the alarm proceed to control center and maintain communication with Incident controller
2. Advice Site Controller/ Chief Coordinator of the situation recommending, if necessary evacuation of staff from Assembly point
3. Recruit suitable staff to act as a runner between Incident Controller and itself (If the telephone and other mode of communication fails)
4. Maintain log of all the incidents, communication etc.
5. In case of prolonged emergency involving risk to the outside areas, contact police & Fire Brigade for warning & if necessary, evacuating the nearby localities
3.5.5 **Fire and Safety Coordinator:**

Safety Officer will act as Fire and Safety Coordinator in the event of emergency. His duties include:

1. On hearing the alarm, rush to the emergency spot and report the Site Controller/Chief Coordinator
2. Organize, plan and give necessary instructions to the plant staff to fight emergency
3. Take care of fire fighting pumps and to get feedback from fire engine shed about, fuel and any other requirement
4. Ensure adequate material and manpower to handle the emergency
5. Review the situation periodically and inform Site Controller/Chief Coordinator

3.5.6 **Security Controller:**

Security Supervisor will act as Security Controller in the event of emergency. His duties include:

1. Ensure protection to all corporation personnel and their property
2. Close public traffic on corporation roads as advised by Site Controller/Chief Coordinator
3. Assist in evacuation personnel from affected areas
4. Control law and order in law premises.

3.5.7 **Fire Combating Team:**

This team is lead by Executive operations officer. In his absence Executive Operation Officer will act as a leader. This team will rush to the sight of fire with the fire fighting equipments and put off the fire as early as possible before it could spread to other areas. Responsibilities of this team are:
**On declaration of emergency/occurrence of fire:**

1. The employees will immediately reach the accident place along with the nearest available fire extinguishers. They will immediately be in action under the guidance of chief officer (In charge). In the absence of the chief officer, his representative will look after the emergency operations.

2. The fire fighting team will start fire fighting immediately.

3. The staff will operate sprinkler and release air pressure of the deluge valves.

4. Operate fire hydrant and jet monitor

**3.5.8 Auxiliary Team:**

This team is lead by Fire and Safety Coordinator, assisted by LPG Pump Operator, LPG Operator, Security and Electrician. Depending on the nature of emergency Fire Combating Team & Auxiliary Team would merge together or co-ordinate with each other to carry out emergency operations. Functions of this team are as follows:

**On declaration of emergency/occurrence of fire:**

1. The team will put indicator on right place of fire zone indicator.

2. The staff will operate fire siren, break glass of emergency switch. If power fails then operate hand fire siren. The “all OK” siren will be given on the instruction of the leader.

3. If the fire engine does not start in auto mode then the team will operate it from the Panel.

4. The team will disconnect LPG Unloading hoses from the tankers and move LPG tankers to safe place.

5. All the normal operational activities will be stopped immediately and put-off the valves of storage tank. The main switch of electric supply will be switched-off, so that the electricity distribution to the Plant will be interrupted.

6. All tankers, trucks and other vehicles will be taken to safe zones away from the Loading/Unloading Platform.

7. The team will ensure water supply from bore well to water reservoir.
8. All the valves, except that of fire extinguishing networks of pipelines and other appliances, are to be switched-off immediately.

9. The team will arrange for firewater hose pipes nozzles and fire extinguishers.

10. The team will close store and ware house.

11. The free flow of fire extinguishing materials and the appliances is assured. The necessary assistance and help be accorded to the fire fighting team

12. Replace if necessary all equipment used in fire fighting.

Specific responsibilities of the team members of auxiliary team are:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Duties During Emergency</th>
<th>Operating Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fire Clock Setting</td>
<td>➢ Security-A.S.O</td>
</tr>
<tr>
<td>2.</td>
<td>Operate Electrical Siren/Fire Fighting Engines</td>
<td>➢ LPG Pump operator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Electrician</td>
</tr>
<tr>
<td>3.</td>
<td>Removal of Bulk T/T and packed Truck trough emergency gate</td>
<td>➢ LPG Operator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>➢ Security-ULA</td>
</tr>
<tr>
<td>4.</td>
<td>MCB Shutdown and closing of all valves as instructed by fire chief</td>
<td>➢ LPG Pump operator, Electrician will act in absence of LPG Pump Operator</td>
</tr>
<tr>
<td>5.</td>
<td>Control Shutdown</td>
<td>LPG Operator</td>
</tr>
<tr>
<td>6.</td>
<td>Closing of Store and Ware Houses</td>
<td>Security-TPR</td>
</tr>
</tbody>
</table>

* Note: All team members will also report to their team in-charge for further instructions.

3.5.9 **Rescue Team:**

This team is lead by Accounts Officer (JN). The Team also consists of Clerk, LPG Operator. Responsibilities of this team are:

On declaration of emergency/occurrence of fire:

1. Under the instructions of the Chief Officer, they will seek necessary help from external agencies Police, Fire Brigade etc. on telephone.

2. Remove all the important documents, Computer floppies to safe place.

3. The team will stop entry of all the unauthorized persons into the Plant.

4. The team will insist all the persons other then the employees of HPCL to vacate the Plant.
5. The team will control the traffic and keep the route open to facilitate external help.

6. The team will provide first aid to the injured persons.

7. Opening of emergency gate.

On instruction from the Chief Officer, the team will arrange vehicle to move seriously injured persons to hospital

Specific responsibilities of the team members of rescue team are:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Duties During Emergency</th>
<th>Operating Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Communication with outside agencies like Fire Brigade, Police, Ambulance, Hospital, Other agencies in consultation with chief</td>
<td>Accounts Officer (JN) &amp; LPG Operator</td>
</tr>
<tr>
<td>2.</td>
<td>Bring Stretcher &amp; First Aid</td>
<td>Security L/A</td>
</tr>
<tr>
<td>4.</td>
<td>Removal of important document, cash to safe place</td>
<td>Accounts Officer (JN) &amp; LPG Operator</td>
</tr>
<tr>
<td>5.</td>
<td>Shifting of PPF</td>
<td>LPG Operator</td>
</tr>
<tr>
<td>6.</td>
<td>Use of Personnel Protective Equipment</td>
<td>LPG Operators</td>
</tr>
</tbody>
</table>

There are instructions that whoever detects fire will give a fire alarm and rush to the spot with the Fire Extinguisher and try to extinguish the fire. Fire Hydrant System is operated & water is sprayed to keep the exposed tanks, pipe lines & pumps cool.

3.5.10 **Fire Fighting Organization For The Off-Shift (Night):**

Only security staff exists during night shift and there are no plant operations. The security people perform all the responsibilities. They are trained to handle the situation of emergency. The security will perform the duty of all the three teams. The security people will rush to the place with the nearest fire extinguisher and try to combat fire. They will operate the siren and operate the fire hydrant and fire monitors. The security will switch off the power supply to all equipments. They will provide first aid to the people injured in the accident and inform the plant manager and safety officer immediately.
Specific responsibilities of the team members of night shift and holidays are:

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Duties During Emergency</th>
<th>Operating Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>To inform the plant manager / other officers at residence &amp; contact fire Brigade, Police etc.</td>
<td>Security A.S.O</td>
</tr>
<tr>
<td>2.</td>
<td>To blow fire alarm and start fire engines if required.</td>
<td>Security UL A</td>
</tr>
<tr>
<td>3.</td>
<td>Controlling traffic at main gate</td>
<td>Security Guard Main Gate</td>
</tr>
</tbody>
</table>

3.6 Emergency Equipment & Facilities at the LPG Bottling Plant

3.6.1 Emergency Control Center:

In the event of an accident Emergency Response Center will be utilized as emergency control center. It is located close to the main exit/entrance of the LPG Bottling Plant and has telephone & the first aid facilities. In the event of an accident all the fire fighting activities and rescue and relief activities will be controlled from this center only. The control center has:

1. Site Plan
2. Telephone nos. of Fire brigade, Police and other organizations at Haldia
3. Chemical Fact Sheet
4. Explosive meter

3.6.2 Emergency Assembly Points:

People those who are not assigned any work during the period of incident like contractors, workers, and visitors will be taken to assembly point. Care will be taken that it does not hamper the movement of traffic or any other help from outside parties. Following Areas are identified as Assembly Points:

1. Place in front of Administrative Office (Administrative & workers amenity building)
2. Open area opposite to fire fighting Pump house
Place in front of the Administrative and worker amenity building is for the Assembly of all outside persons/casual labour/contract worker. At this place, Security incharge in coordination will take stock of all the persons assembled.

Open area opposite to fire fighting Pump house will be Assembly point for any group decision during emergency with plant personnel. If Fire is totally control then information is can be passed to this point to declare ALL CLEAR by giving a continuous long alarm and resetting the zone indicator.

### 3.6.3 Escape Routes:
Following are the escape routes provided for evacuation in case of emergencies:
1. Emergency Gate-I
2. Emergency Gate-II
3. Main Gate

### 3.6.4 Emergency Lighting in critical areas:
As the plant operates in one shift there is no need of any emergency lighting. But in case if it is required, the plant have portable emergency lights at MCC room, Office and Main Gate Security Cabin.

### 3.6.5 Medical facilities provided at the plant in case of Emergency:
Name of the Hospital: -
Doctor’s Name:
Distance from plant:
Bed Capacity:
Antidotes available: As required
First aiders available:
Ambulance:
  - Equipments available in ambulance: Respiratory Equipment
  - Place of availability: In Hospital & Ambulance
  - Capacity: As Required
  - Facilities available e.g. safety equipment Immobilization emergency, medicines etc. in the Ambulance: Available
3.6.6 Special Equipment Including Fire Fighting Materials, Damage Control and Repair Items

The following are the various fire fighting facilities available in the plant:

Water for Fire Fighting (Source & Capacity):
Fire Water requirement for Haldia LPG Plant as per OISD-144 is 6660 KL whereas LPG Bottling Plant, Haldia has total Capacity of water available is 7000KL. Hence there is sufficient water storage in Haldia LPG Plant for firefighting purpose.
Fire fighting water requirement is 10.2 LPM/m$^2$ (as per OISD-144 Amended Edition September 2001) and water storage should suffice for 4 hrs.

Fire Water Pump House:
In Haldia LPG Bottling Plant, Fire Pumps are used for pumping fire water in case of emergency. All pumps is capable of delivering 410 KL/ hour. Also 2 jockey pumps will be available in the LPG Bottling Plant. The availability of fire fighting pumps will be as per OISD 144.

In regular surveys, it is assured that the pressure of 7 Kg/Cm$^2$ is maintained at farthest point.

Fire Hydrant/Monitor System:
The system is operated manually.

Sprinkler System:
The system automatically starts as the quartzoid bulb fuse due to heat (at 79$^\circ$C), which releases the air pressure and thus actuates the deluge valve, which opens the water flow through the sprinklers. It can also be started manually. As the pressure drops in the system, the fire fighting pumps will automatically start one by one. The sprinkler system will be provided in the following areas:
1. TT Loading/Unloading Gantry (TT Gantry)
2. LPG pump & compressor house
3. LPG bulk storage area
4. Filled cylinder shed
5. Empty cylinder cum filling shed
6. Cylinder testing & repairing shed

**Dry Chemical Powder & CO₂ Type Fire Extinguishers**

Fire Extinguishers are posted at all places inside the plant. The instructions are about the use of the fire extinguishers is given to all employees. Proper care of the fire extinguishers is taken and the employees are informed about the use of the FE regularly.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Area</th>
<th>Portable fire Extinguisher (F.E.)</th>
<th>Required as per OISD-144</th>
<th>Future availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>LPG Storage Vessel (Each) – 3 Bullets</td>
<td>10 Kg DCP FE 2 in number</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>LPG Cylinder filling shed – 3000m²</td>
<td>10 Kg DCP FE 2 in number per 200 m²</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>3.</td>
<td>Cylinder Loading / Unloading Shed – 600 m²</td>
<td>10 Kg DCP FE 2 in number per 200 m²</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>4.</td>
<td>Filling Cylinder Storage Shed -1500 m²</td>
<td>10 Kg DCP FE 2 in number per 200 m²</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>5.</td>
<td>Valve Changing Shed - 1000 m²</td>
<td>10 Kg DCP FE 2 in number per 200 m²</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>6.</td>
<td>LPG pump House – 350 m²</td>
<td>10 Kg DCP FE 2 in number per 50 m²</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>7.</td>
<td>T/T loading / unloading (8 Bays) 2 nos</td>
<td>10 Kg DCP FE 2 in number in each bay</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>8.</td>
<td>Other Pump Houses (Fire H₂O)</td>
<td>10 Kg DCP FE 2 in number</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td>9.</td>
<td>Office/Canteen/stores</td>
<td>10 Kg DCP FE 2 in number in each building</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td>10.</td>
<td>MCC/DG Room</td>
<td>4.5 Kg CO₂ 2 in numbers in each room or for 100 m²</td>
<td>02</td>
<td>02</td>
</tr>
</tbody>
</table>

**Personal Protective Equipments**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>PPE Equipment</th>
<th>Required as per OISD</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Safety Helmets</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>Stretcher with Blankets</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td>3.</td>
<td>First Aid Box</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td>4.</td>
<td>Rubber Hand Gloves for Electrical purpose</td>
<td>02 Sets</td>
<td>&gt; 2 Sets</td>
</tr>
<tr>
<td>5.</td>
<td>Fire Proximity Suit</td>
<td>01</td>
<td>01</td>
</tr>
<tr>
<td>6.</td>
<td>Red / Green Flags</td>
<td>As Required</td>
<td>3 Red &amp; 3 Green</td>
</tr>
<tr>
<td>7.</td>
<td>Breathing Apparatus</td>
<td>01</td>
<td>01</td>
</tr>
<tr>
<td>8.</td>
<td>Safety Goggles</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>9.</td>
<td>Safety Belts</td>
<td>-</td>
<td>4</td>
</tr>
</tbody>
</table>
First Aid & Rescue:
Injuries/Casualties if any have to be attend simultaneously. First aid facilities are available in the LPG Bottling Plant. For carrying injured man to hospital, Ambulance services will be called immediately on phone by the Rescue Team.

3.6.7 Communication system:

Internal:
I. Paging System
II. Warning Alarm: LPG sensors, Hand Siren & Electric Siren
III. Walkie-Talkie:

External:
I. P&T Telephone lines
II. Fax
III. Email

Communication Links Including Telephones, Radios and Standby Methods:

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>PPE Equipment</th>
<th>Required as per OISD</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Explosive Meter Hand Held</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Resuscitator</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>Water Jet Blanket</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>13</td>
<td>Hose Boxes</td>
<td>Alternate Hydrant Points</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>Low Temperature rubber hand gloves for LPG Emergency</td>
<td>4 Pairs</td>
<td>4 Pairs</td>
</tr>
<tr>
<td>15</td>
<td>Low Temperature clothing for LPG Emergency</td>
<td>2 Sets</td>
<td>2 Sets</td>
</tr>
<tr>
<td>16</td>
<td>Unitized Gas Detector</td>
<td>2</td>
<td>&gt;2</td>
</tr>
<tr>
<td>17</td>
<td>Hand Operated Siren</td>
<td>1) ½ Km range</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) ¾ Km range</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>Motor Driven Electric Siren</td>
<td>1) 220 V A.C Supply – 3.2 Km range</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2) 220 V A.C Supply – 2 Km range</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3) 24 V D.C Supply – 2 Km range</td>
<td>-</td>
</tr>
</tbody>
</table>

External Communication:
There are P&T lines at the LPG Bottling Plant, which will be used to communicate external bodies. These numbers should be available with Plant Persons

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Mutual aid members</th>
<th>Location</th>
<th>Phone Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fire Brigade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Primary Health Center Hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>District Collector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Superintendent Police</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>LPG Plant Safety Officer</td>
<td>Residence</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Govt. Ambulance,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Police Control Room</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Police Station City</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Railways</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Chief Inspector of Factory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Dy. Chief Controller of Explosives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Pollution Control Board</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>LPG Regional Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>LPG Plant Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Plant Manager, LPG Bottling Plant, HPCL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Number of Mutual Aid Members</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notify the Public:**

An Electrical and hand operated siren is being installed inside the LPG Bottling Plant to warn public in case of any fire/emergency due to LPG inside the Plant. For different types of emergency different types of Alarm/Siren are practiced in the plant.

**Procedure for notifying families of injured persons:**

HPCL, LPG Bottling Plant, Haldia maintains up-to-date record of their employees/workers including their home addresses, telephone numbers, telephone numbers of relatives, if any. So, in case of emergency, if any of the employees get injured, contact can be made with his family by phone or by sending the message or letter.
Safety Training of Personnel and Mock Drill / Rehearsing Emergency Procedures:
On appointment of every personnel it is essential to provide training to cope with all types of perceived emergencies. Training is to be provided for:

- Properties and hazards of LPG as given in the report
- Knowledge, location and use of fire fighting and protective equipments
- Emergency actions for various emergency scenarios as discussed in Onsite.

Many organizations use table-top exercises to test their emergency plans. These are very cost-effective because they do not interrupt the day-to-day running of the plant and because the organizer of the exercise can "arrange" for a variety of difficulties to be taken. Full-scale exercises, providing a realistic rehearsal setting, will still be needed to complement the tabletop exercises.

In LPG Bottling plant Haldia, Mock Drill will be carried out twice in a month. The Strengths and weakness of Mock Drill in LPG Bottling Plant Haldia are as follows:

**Strength:**
1. LPG Bottling Plant Haldia, have an excellent, well trained manpower to act in case of emergencies.
2. Continuous training on fire fighting is a part of regular routine jobs.
3. Having well developed fire-fighting facilities, which can be operated in manual as well as in auto.
4. Regular rehearsal of fire drills on different type of emergency scenarios.
5. Excellent co-ordination with mutual aid members.
6. All employees are trained in First-Aid.

**Weakness:**
As such nothing major whatever minor weaknesses are there, those are corrected through regular rehearsals

**3.7 Emergency Actions for Various Accident Scenarios**
There are instructions that whoever detects fire will give a fire alarm and rush to the spot with the Fire Extinguisher and try to extinguish the fire. Fire Hydrant System is operated
& water is sprayed to keep the exposed tanks, pipelines & pumps cool. Suggested Emergency Actions, which are to be taken in case of occurrence of following Incidents:

3.7.1 **Accident Scenario: leak from flanges, valves, tail-ends or during transfer from/to main tank:**

*Emergency Action*

1. Detect the source of leakage. If the leakage is found significant then isolate that branch of line & stop the flow.
2. Stop unloading of LPG at the Bulk Unloading Shed.
3. Direct the Tankers to go out of the premises.
4. Bring the portable fire extinguishers near to the area of leakage.
5. Ensure operation of the fire pump

3.7.2 **Accident Scenario: LPG is ignited at the source of leak:**

*Emergency Action*

1. See that the flame does not impinge on other Pipelines or tanks or any other adjacent installation or control instrument.
2. Give priority to closure of valve and stop the LPG leakage. Post trained personnel to prevent further spread of fire. Watch flame diminishing.
3. If problem seems to be out of control, call fire brigade and police. Report to District Magistrate, Factory Inspector etc.

3.7.3 **Accident Scenario: Fire Near Tank Farm:**

*Emergency Action*

1. If fire is beyond main isolation valve of the tank, follow procedure as in item 3.6.2.
2. If the fire is near tank farm area than use water hydrant and DCP type fire extinguisher.
3. Never allow fire to spread to the area below the tank, Start cooling the tank by the emergency water spray. Call fire brigade and police. Report to District Magistrate, Factory Inspector etc.
3.7.4 **Accident Scenario: If there is Vapour Cloud Explosion near the tank:**

**Emergency Action**

1. If fire is around the tank or surrounding the LPG lines, valves etc. and if the same does not come under control within half an hour then evacuate all the workers from the LPG Bottling Plant.

2. Open tank cooling at full flow, call fire brigade & police. Report to District Magistrate, Factory Inspector etc.

3.7.5 **Accident Scenario: Tank Truck on Fire at TLF Bay or Pump House catches Fire:**

**Emergency Action**

1. Whoever detects fire will give a fire alarm and rush to the spot with the Fire Extinguisher.

2. Fire fighting team will rush to the spot and will extinguish the fire with the help of a fire extinguisher. Main Switch of electricity supply is to be switched off. All filling valves are to be closed. Other Tankers on bay to move out immediately and close the main door. Fire Hydrant System is to be operated and the hydrant points to be used to keep the bay cool. The auxiliary team will also come to help the fire combat team, if needed.

3. External agencies like fire brigade, police & hospital are to be called for necessary help.

4. First aid box to be taken to the bay/pump house.

5. When the fire is extinguished site controller will give signals for clearance.

3.7.6 **Accident Scenario: Dry Grass Fire**

**Emergency Action**

- Dry grass is normally avoided in the LPG Bottling Plant premises and it is ensured that there is no grass (dry) at any point of time by ensuring better house keeping. In the event of fire, Fire Fighting Team will rush to the spot. Closing of main switch, closure of all the valves and activation of Fire Hydrant System for putting off the fire and also to keep the tanks cool, if being affected; will be carried out.
• Tanker if are being unloaded, will be disconnected and taken out of the LPG Bottling Plant premises.

3.8 EXTERNAL EXIGENCIES
Extrinsic factors like possibilities of lightening/storm, floods, missile attack during war, sabotage & bomb threats have been considered in the DMP as follows:

3.8.1 Possibilities of Lightening:
Lightening may affect in two ways. One is electrocution of personnel and the other is causing an ignition source for LPG. Proper lightening protection shall take care of the LPG Bottling Plant from both of these hazards.

Emergency Action
1. All pipeline and tank valves should be closed and all the operations inside the LPG Bottling Plant should be stopped. The intensity of operations should be reduced or stopped depending on weather conditions.
2. All the filled tank trucks should be evacuated to safer places.
3. In case of fire, LPG Bottling Plant personnel should contact Fire Brigade and district authorities: Collectorate & Police immediately for necessary help.

3.8.2 Floods &/or Storm:
The consequences will totally depend on the intensity of the floods & storm. The following can be the worst after effects of severe storm:
1. Release & spread of LPG due to damage to the tanks/pipelines. The released LPG can spread beyond the plant premise, catch fire and can cause large destruction to the plant and nearby area.
2. Loss of product and property.
**Emergency Action**

1. All pipeline and tank valves should be closed and all the operations inside the LPG Bottling Plant should be stopped. The intensity of operations should be reduced or stopped; once the weather department announces possibility of storm or cyclone.

2. All the filled tank trucks should be evacuated to safer places.

3. LPG Bottling Plant personnel should contact district authorities: Collectorate and Police immediately for necessary help.

4. Persons inside the Plant should be evacuated as soon as possible.

5. In case of fire, city fire brigade should be called.

### 3.8.3 Missile/Air Attack During War:

In case of war if the bombing takes place on the HPCL, LPG Bottling Plant, Haldia, then the after effects might be the total destruction of the Plant.

The magnitude of destruction will be in millions of Rupee. The loss of Product, Property and Human beings can be huge. The bombing will result in to complete destruction of the plant.

**Emergency Action**

1. Plant personnel should contact district authorities like collector, police immediately.

2. All pipeline and tank valves should be closed and all the operations inside the Plant should be stopped.

3. All the tank trucks should be evacuated to safer places.

4. The LPG Bottling Plant lighting should be switched off during nighttime.

5. Persons inside the LPG Bottling Plant should be evacuated as soon as possible.

6. In case of fire, city fire brigade should be called.

### 3.8.4 Earthquakes:

Earthquakes can cause large damage to the plants. Earthquakes result in cracks in the foundation, which in turn result into vessel damage. This may result into release of the stored product. There is a danger of VCE around the tank, which could finally result into BLEVE. If the earthquake is not severe, it could result into leaks and cracks in the
pipeline, storage vessels, etc. The scene could be as dangerous, if not properly managed might cause vast destruction to the Plant.

**Emergency Action**

1. Raise the alarm to inform everyone to be alert in the plant
2. Inform the fire brigade, nearest hospital and police control
3. Rush to check out cracks and leakages in the plant immediately
4. Switch off the main switch of electricity supply, so that electricity distribution to the LPG Bottling Plant will be interrupted
5. Take all truck, tankers and other vehicles to the safe zone outside the Bulk Unloading Shed premises.
6. The site controller will give signal when the situation is under control

3.8.5 Sabotage & Bomb Threats:

With increase in terrorist activities towards the end of 20th century and LPG installations having, significant role in national economy sabotage & bomb threats should also be considered in the disaster management plan. In any such situation, city police/administration should be informed immediately and their help should be sought.

**Emergency Action**

1. The persons inside the Plant should be evacuated as soon as possible.
2. All the tank trucks should be evacuated to safer places.
3. Plant personnel should contact district authorities like collector, police immediately.
4. Any new or doubtful thing should not be touched.
5. All pipeline and tank valves should be closed and all the operations inside the LPG Bottling Plant should be stopped.
6. In case of fire, city fire brigade should be called.

**Bomb Threat-Guidelines**

**Action By Operators On Receipt Of Bombs Threat Call**

- Put on tape.
- Alert colleague.
• Sound alarm as per the standard operating procedures.

• Note:  
  a) Time at which the call came.  
  b) Time at which the call was disconnected.  
  c) Information given by the caller  
  d) Remember the information given

• Try to be calm & obtain following information:
  a) WHO is calling?  
  b) WHERE is the bomb placed?  
  c) WHEN is it set to go off?  
  d) WHAT does it look like?  
  e) WHAT kind of a bomb is it?  
  f) WHY have you kept the bomb?  
  g) DO you know that it can kill?

Hear Properly and Try To Figure Out:

<table>
<thead>
<tr>
<th>Caller's Voice</th>
<th>Background Noises</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Accent</td>
<td>1. Airport</td>
</tr>
<tr>
<td>2. Broken</td>
<td>2. Booth</td>
</tr>
<tr>
<td>3. Crying</td>
<td>3. Factory</td>
</tr>
<tr>
<td>5. Distinct</td>
<td>5. Office</td>
</tr>
<tr>
<td>6. Deliberate</td>
<td>6. Petrol pump</td>
</tr>
<tr>
<td>7. Disguised</td>
<td>7. Poultry</td>
</tr>
<tr>
<td>8. Drunken</td>
<td>8. P. A. System</td>
</tr>
<tr>
<td>9. Excited</td>
<td>9. Recorded</td>
</tr>
<tr>
<td>10. Familiar</td>
<td>10. Railways Station</td>
</tr>
<tr>
<td>11. Heavy</td>
<td>11. Street Noises</td>
</tr>
<tr>
<td>12. Irritating</td>
<td>12. School</td>
</tr>
<tr>
<td>13. Laughing</td>
<td>13. Any other</td>
</tr>
<tr>
<td>14. Rapid</td>
<td></td>
</tr>
<tr>
<td>15. Sincere</td>
<td></td>
</tr>
<tr>
<td>16. Slow</td>
<td></td>
</tr>
<tr>
<td>17. Any other</td>
<td></td>
</tr>
</tbody>
</table>

Things to Look For While Searching

1. Anything out of place
2. Any thing foreign to the place
3. Things which does not belong there
4. Thing out of a place
5. Recently disturbed area
6. Saw dust, brick dust or wooden chips
7. Chemicals which need not be there
8. Gresoey papers wrappings
9. Disturbed carpets
10. Tin foils silver papers
11. Dry battery or parts
12. Electrical wires pieces
13. Loose electrical fittings
14. Loose or taut electrical wires across the room
15. Adhesive tape point
16. Scratched new paint
17. Disturbed vegetation
18. Fresh cement plaster
19. Partly and hurriedly opened doors/windows
20. Any thing suspicious

**Things To Do On Location Of Suspected Device**

1. Warn employees not to panic
2. Inform them to first search their areas
3. Warn them to take their belongings
4. Open all doors and windows
5. Put off electricity and lifts
6. Put off cooking gas
7. Evacuate in orderly fashion as rehearsed
8. Collect employees at a safe distance
9. Barricade and mark article
Action On Location Of Suspected Device

Inform the following:

1. Command Post
2. Security
3. Chief of location
4. Police control
5. Local police station
6. Bomb squad
7. Dog squad
8. Nearest hospital, fire brigade
9. Ambulance services
10. Blood bank
11. Telephone exchange
12. Neighboring offices and buildings
13. Decide for evacuation
14. Use bomb blanket

DO NOTs

1. Do not touch
2. Do not move
3. Do not try to remove
4. Do not try to pick up
5. Do not try to wet or pour water
6. Do not pull
7. Do not put pressure
8. Do not cut tight wires
9. Do not cut strings or loose wires
10. Do not take marking on face value
11. Do not let someone enter with suspected article
12. Do not cut, pierce, or puncture
13. Do not be a dead hero
LETTER BOMBS-RECOGNITION FACTORS

1. More than the required postage stamps used for safe delivery.
2. Sender’s name missing.
3. Sender’s address missing.
4. Senders name and address may be wrong, incorrectly spelt or may not be known to the receiver.
5. Name of the addressee may be miss-spelt or wrong.
6. Holes may exist in the envelope.
7. View with suspicion and caution – foreign/air mail.
8. Suspect an attractive cover with beautiful lettering.
9. Envelope may have ‘confidential’ or ‘personal’ mark.
11. Check for incorrect titles.
12. Check for miss-spelt common words.
14. Oil stains or discoloration on the package.
15. Look for uneven or lopsided envelope.
16. Be suspicious of protruding wires or tin foils.
17. Beware of visual distraction.
18. Excessive security may be indicated.

Safety Precautions-Letter Bombs

1. Do not open the letter by hand.
2. Do not touch further if in doubt, call bomb squad.
3. Do not submerge in water.
4. Do not cut strings, tape or untie the package.
5. Do not smoke or place the letter near heat/fire.
6. Do not cut or puncture the letter.
7. Do not pull any wire if prodding out.
8. Do not handle roughly or throw the letter.
9. Do not pass metal objects from near the letter.
10. Do not keep in steel cupboard, safe or drawer.
11. Do not cover with heavy object or sand bag.
12. Do not turn, tilt or turn up side down a letter or a parcel delivered with instructions:

‘NOT TO BE TURNED UPSIDE DOWN’ or ‘HANDEL WITH CARE’.

1. Do-evacuate all personnel if in doubt.
2. Do-stop further entry in to the room
3. Do-open all the doors and windows.
4. Do-use bomb basket.

3.9 LONGER TERM CLEAN UP/POST EMERGENCY PLAN:
1. Regular cleaning and housekeeping is practiced in the Plant.
2. Find out the causes for an accident/disaster.
3. Calculate economical as well as material losses.
4. Provide the necessary facilities to the causalities.
5. Recruitment of other labors in place of injured labors or employees to continue the work in the plant.
6. Repairing of the machines and equipments if any.
7. Based on specific requirements generated due to particular nature of emergency, all the post emergency activities will be carried out.
3.10 OFF-SITE EMERGENCY PLAN:

Type of emergency facilities/ actions required from outside bodies:

- Fire fighting facilities required: The proposed project will have its own fire fighting facilities but during emergency, assistance of local fire department may be taken.
- Police help required during emergency for evacuation of the people, traffic control security arrangements etc. shall be available.
- Medical help required: seriously injured personnel may be referred to the Hospital/Primary Health Centre depending upon the gravity and type of injuries.

**List of Key persons of Offsite Emergency Plan**

<table>
<thead>
<tr>
<th>No.</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Collector of District</td>
</tr>
<tr>
<td>02</td>
<td>Asst. Director I &amp; II</td>
</tr>
<tr>
<td>03</td>
<td>Fire office</td>
</tr>
<tr>
<td>04</td>
<td>Controller of Explosive</td>
</tr>
<tr>
<td>05</td>
<td>District Informatics Officer</td>
</tr>
<tr>
<td>06</td>
<td>Superintendent of Police</td>
</tr>
<tr>
<td>07</td>
<td>District Health Officer</td>
</tr>
<tr>
<td>08</td>
<td>Assistant Labor Commissioner</td>
</tr>
<tr>
<td>09</td>
<td>SDO</td>
</tr>
</tbody>
</table>
CHAPTER –IV
HAZARD & OPERABILITY STUDIES (HAZOP)
4.0 HAZOP: A STUDY FOR HAZARD IDENTIFICATION

In petro-chemical industry there is a great awareness of the necessity to apply more systematic approach to safety and ease of operation, particularly in design. Addition, there is an increasing pressure from government & society for improve standards of safety and for the protection of the environment. The major hazard identification tools include checklists, Hazard indices (FEI & TI), what – if analysis and HAZOP. Combinations of all these techniques have been used in this study.

Early detection of hazards and visualization of disastrous situation helps to impart safely in a systematic way. The existing plants can continue to operate for many years and can be modified several times in its life span, so due care must be given to avoid any compromise on the safety concept included in the original plant design and operating conditions. Hazard & Operability studies on existing plants improve operating methods, operational safety, deficiencies in available systems and can show potholes responsible for accidents or even a disaster.

HAZOP is structured methodology, which allows its user to employ imaginative thinking in the identification of hazards and operational problems. It involves a systematic, methodical examination of design document that describe the facility. A multidisciplinary team to identify hazards or operability problems that could result in an accident performs the study. Deviations from the design value of key parameters are studies, using guide words to direct the process of evaluation. This technique presumes that the design values of flows, temperatures and other process variable are inherently safe and operable.

This HAZOP guideword approach was originally developed by imperial chemical industries Ltd, (ICI); which was further modified and made user friendly by the American Institute of Chemical Engineers – Center for Chemical Process Safety.
The Hazard & Operability Study results in:

- Assisting the management with information of where the potential hazard may exist and facilitate recommendations towards improved safety.
- Providing the safety – related documentation of every line and piece of equipment in the plant, which is very useful when modifications are carried out.
- Furnishing a prioritized basis for subsequent risk analysis work.

If HAZOP is performed and if findings are subsequently implemented to mitigate the risk, then it can be said that the plant is operating at comparatively lower risk that before the study. HAZOP helps to find the “Weak link” in a plant and to provide a basis for developing procedural or engineering controls to remove or lessen the risks from the identified problem area.

Definition of HAZOP terminology:

Hazard: Anything (Chemical reaction, equipment malfunction, or operator error) that can lead to an unwanted event.

Operability: Anything that causes the operator to improvise in his actions.

These definitions are an important part of the basic HAZOP premise that the process does not have inherent hazards or operating problems when the unit is operating as designed, and as defined by the basic documents such as the process flow diagrams, equipment specifications, and operating procedures. In other words, if there are no deviations from the norm, there are no problems.

HAZOP is a recommended tool when making plant extension, modifications or revamps, since the changes introduce opportunities for error that might not be obvious unless reviewed as part of a “system” instead of a localized change. HAZOP is also very useful for existing facilities, where they can be used for evaluating hazards and operations from an unbiased view point, to identify possible process improvements or as a quality – assurance effort.
4.1 HAZOP PROCEDURE, SIGNIFICANCE OF GUIDEWORDS & DATA/DOCUMENTS REQUIRED:

Hazard & Operability study systematically analyses all foreseeable deviations from normal operating conditions, which includes description of deviations, the causes of these deviations, the possible consequences and the necessary preventive measures to be taken.

HAZOP study involves a set of standardized GUIDE WORDS, which are used to initiate the discussion in the team. All possible deviations in process parameters in a reactor or a pipeline are considered to determine their causes and consequences. If a hazard is identified, first the existing protective measures are analyzed with respect to the intensity of the hazard. If the protective measures are not adequate, recommendations are given to mitigate the hazard.

Table: 4.1 HAZOP GUIDE WORDS & POSSIBLE DEVIATIONS

<table>
<thead>
<tr>
<th>Guide Word</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>No forward flow when there should be, i.e. no flow or reverse flow.</td>
</tr>
<tr>
<td>More of</td>
<td>More of any relevant physical property than there should be, e.g. flow (rate or total quantity), higher temperature, higher pressure, higher viscosity, etc.</td>
</tr>
<tr>
<td>More than</td>
<td>More components present in the system than there should be, e.g. extra phase present (vapor, solid), impurities (air, water, acids, corrosion products), etc.</td>
</tr>
<tr>
<td>Less of</td>
<td>Less of any relevant physical property than there should be e.g. lower (rate or total quantity), lower temperature, lower pressure, etc.</td>
</tr>
<tr>
<td>Part of</td>
<td>Composition of system different from what it should be, e.g. change in rate of components, component missing, etc.</td>
</tr>
<tr>
<td>Other than</td>
<td>what else can happen apart from normal operation, e.g. start-up, shutdown, up rating, low rate running, alternative operation mode, failure of plant services, maintenance, catalyst change, etc.</td>
</tr>
</tbody>
</table>

Hazard & Operability Study require prior understanding of the behavior and hazards of the hazardous chemicals being used in the plant, which mainly includes:

- Physical & Chemical Properties
- Fire & Explosion Characteristics
- Toxicological Properties, if any
First HAZOP sheets are prepared and then the team discusses on possibilities of occurrence of various deviations from the intended operating conditions by employing the guidewords; thereafter responses of the control equipments for these deviations are analyzed. Then, consequences of the deviations are examined for vulnerability towards occurrence of unsafe situations and suggestions are made to improve system reliability, if required.

HAZOP team, mix of interdisciplinary participants, usually includes the following:

- HAZOP Expert
- Fire & Safety Officer
- Process Engineer
- Instrumentation engineer
- Electrical engineer
- Maintenance personnel

Inputs Required for HAZOP Study are as follows:

- Plot plan
- Process Manuals & Process flows Diagrams
- P&I diagrams

4.2 TYPES OF HAZARD CONSIDERED IN THE HAZOP STUDY

Following types of hazard have been considered in the study:

1. Hazard to plant personnel working in the study
2. Damage to plant equipments
3. Hazard to and from product specification
4. Hazard to outside public
5. Hazard to Environment

Listing of LPG Handling Processes Followed in HPCL, LPG Bottling Plant, Haldia

The various LPG Handling processes followed in the plat are listed below:

**Receipt of LPG from Haldia through Road tankers**

It includes receipt of LPG through Truck & LPG pipeline. Storage of received LPG in respective bullets.

**Bottling of Cylinders in Filling Shed & their dispatch to end users**

The stored LPG is filled in cylinders in filling shed through LPG pumps and after filing, it load into Road Trucks and Dispatched to end users through tank trucks.

All these processes are for Existing facility and will remain same for proposed activity.
Selection of Process/storage units and processes for HAZOP

The LPG handling processes/storage units have been selected for HAZOP evaluations which are listed below.

1. Receipt of LPG to Bullets: Road Tankers, Pipeline, Compressors
2. Filling of Cylinders: Bullets, LPG pumps, Pipeline
3. Fire Pump House Operations: Static water tanks, Fire pumps, Ring Main system, Water Hydrant/Monitor
4. Electrical Sub-station: Diesel from Diesel Tank to Generator, Generation of power and Distribution of power.

Hazard & Operability studies for various sections:

Hazard & Operability studies has been carried out for the HPCL, LPG Bottling Plant, Haldia for proposed activity by applying the significant guide words and adequacy of safety systems are evaluated; and suggestions have been made accordingly in worksheets.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action/Corrective Measures Required</th>
</tr>
</thead>
</table>
| Flow of LPG | No                      | 1. No LPG in truck tanker  
2. T/T unloading arms closed.  
3. Air compressor stopped so that ROV does not open.  
4. Differential pressure not created in Mounded Bullet to T/Ts  
5. Valves provided in the line T/T and Mounded Bullet may get choked/closed | 1. No flow of LPG from truck tanker  
2. Operability problem  
3. Pressure inside T/Ts increases  
4. Pressure rise, compressor delivery SRV may blow.  
5. EFCV (Excess Flow Check Valve) spring broken & choked the flow.  
6. Increase in pressure in the line will take place | 1. POP action valve provided to release pressure built up (18 Kg/cm²).  
2. Liquid level indicator provided in the Knockout drum.  
3. Pressure gauges are provided in T/Ts  
4. SRV provided at compressor delivery line.  
5. Pressure gauge on Mounded Bullet  
6. Pressure indicator will indicate no flow.  
7. Regular preventive maintenance schedule of valve.  
8. Close supervision of the operation.  
9. Operators are trained & instructed about | 1. Valve positioning must be ensured before starting bulk unloading operation.  
2. Start of smooth LPG flow during unloading should be ascertained |
# Table 4.2: HAZOP STUDY WORKSHEET

| Facility: | Tank Lorry Decanting Shed, LPG Compressors & Mounded Bullet |
| Process: | Unloading of LPG from T/T to Mounded Bullet by differential pressure method |

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
<th>Possible causes</th>
<th>Possible consequences</th>
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</tr>
</thead>
</table>
|           |                         | 6. EFCV closed  
   ● Vapor line of unloading mounded Bullet.  
   ● Liquid line of the T/Ts corresponding.  
7. Liquid LPG accumulated in knockout drum.  
8. Wrong connection of liquid/vapor hose | 7. Overload, over voltage, single phasing & earth fault protection provided to the compressor motor. | operation. 10. Gas detection systems provided. 11. Sight flow indicator provided 12. Knock out drum high level alarm provided which then trips the compressor. 13. Compressor will trip | Immediately after starting unloading operation. |
## HAZOP Study Worksheet

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>2. Partial choking of T/T unloading arms.</td>
<td>2. Delayed unloading procedure</td>
<td>4. Pressure gauges are provided at T/Ts</td>
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<tr>
<td></td>
<td></td>
<td>3. Leakage from T/T unloading arms or joints.</td>
<td>3. Fire may occur in the presence of ignition source.</td>
<td>5. Roto gauge provided to know percentage of liquid in TT</td>
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<tr>
<td></td>
<td></td>
<td>4. Any of the valves in filling line may be partially closed or choked.</td>
<td>4. Pressure built-up in pipeline, so chances of flashover or fire hazard.</td>
<td>6. Gas monitoring system are provided</td>
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<tr>
<td></td>
<td></td>
<td>5. Vapor is less, so low suction pressure.</td>
<td>5. Low suction pressure trip provided will trip the compressor</td>
<td>7. PRV provided</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Vapor compressor bypass line is open.</td>
<td>6. Low lube oil pressure trip provided will trip the compressor</td>
<td></td>
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<td></td>
<td></td>
<td>7. Vapor compressor fails to develop required pressure.</td>
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<td></td>
<td></td>
<td>• Due to motor fault</td>
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<tr>
<td></td>
<td></td>
<td>• Due to low suction pressure</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Due to low lube oil</td>
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<td></td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>Flow of LPG</td>
<td>Reverse</td>
<td>1. Due to opposite (than intended) differential pressure between T/T &amp; Mounded Bullet.</td>
<td>1. Operability problem 2. T/T may over fill</td>
<td>1. NRV provided in the line will not permit reverse flow.</td>
<td>No additional action required.</td>
</tr>
<tr>
<td>Flow of LPG</td>
<td>Other flow</td>
<td>1. Leakage of LPG from T/T or Mounded Bullet or LPG pipelines</td>
<td>1. Massive Release of LPG 2. Air Pollution due to excess concentration of LPG in atmosphere 3. Vapor Cloud Explosion 4. BLEVE/Flash fire/fire ball</td>
<td>1. Gas Monitoring system are provided 2. Warning alarm are provided 3. Isolating the leaked portion and safe release of LPG and emergency repair by plant personnel</td>
<td></td>
</tr>
<tr>
<td>Flow of high concentration of Water</td>
<td>Part-off</td>
<td>1. Higher water level in Mounded Bullet. 2. Higher level of water in T/T.</td>
<td>1. Mounded Bullet fills up more quickly with water. 2. Cylinders may have significant water quantity resulting in hazard at customer end.</td>
<td>1. Water draining line provided in all the Mounded Bullet. 2. Frequent checking by plant personnel for extent of water level.</td>
<td>No additional action required.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Guide Words (deviation)</td>
<td>Possible causes</td>
<td>Possible consequences</td>
<td>Measures/Existing facilities safeguard</td>
<td>Action/Corrective Measures Required</td>
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<td>--------------------------------------------------------------------------------------------------------</td>
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</tr>
</tbody>
</table>
| Pressure of LPG | Less                    | 1. LPG compressor fails (Mechanical problem, electrical problem)                | 1. Less flow                   | 1. Pressure Indicator will indicate low pressure.  
2. Corrective actions by plant personnel.  
3. Corrective actions by plant personnel. | No additional action required.  
No additional action required. |
|                 |                         | 1. Due to less vapor pressure in Mounded Bullet (either due to Mounded bullet being almost full or almost empty) | 2. Possibility of reverse flow. |                                                                                                        |                                     |
| Pressure of LPG | More                    | 1. LPG Compressor high-pressure discharge switch fails.  
2. Any valve in the line fails close or clogged. | 1. More flow due to more pressure differential  
2. Pressure rise, but less flow. | 1. PI indicates.  
2. SRV in compressor delivery line.  
3. EFCV functions.  
4. High temperature trip functions, if temperature also goes up.  
5. Operator’s corrective actions.  
6. Pressure gauge provided. | No additional action required. |

Facility: Tank Lorry Decanting Shed, LPG Compressors & Mounded Bullet
Process: Unloading of LPG from T/T to Mounded Bullet by differential pressure method
### HAZOP STUDY WORKSHEET

**Facility:** Tank Lorry Decanting Shed, LPG Compressors & Mounded Bullet  
**Process:** Unloading of LPG from T/T to Mounded Bullet by differential pressure method

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</tr>
</thead>
</table>
| Flow of liquid as well as vapor LPG | As well as | 1. Very less LPG in T/T  
2. Generation of static electricity | 1. Vapor locking  
2. T/Ts are earthed during unloading. | Static electricity audit to be carried out. |
| Others | Maintenance of valve/sight flow indicator/PI/TI/roto gauge/testing of mounded bullet/pumps/compressor | Maintenance of valve/sight flow indicator/PI/TI/roto gauge/testing of mounded bullet/pumps/compressor | LPG liquid/vapor may come out and causes fire/explosion if proper purging/water flushing is not carried out before maintenance. | • Proper purging/water flushing.  
• Permit to work system.  
• Strict supervision. | No additional measure is required. |
| Others | Utility failure | Operational Problem | No hazard | 1. DG set to generate power. | No additional measure is required. |
| Others | Start up | 1. Leakage from flange joints at the time of connection  
2. Dry run of LPG compressors | LPG leakage resulting in terms of fire/explosion | 1. Strict supervision is followed at the time of start up of operation  
2. Pump ammeter is provided which show high current | No additional measure is required. |
## HAZOP STUDY WORKSHEET

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</thead>
<tbody>
<tr>
<td><strong>Others</strong></td>
<td>Shut down</td>
<td>1. Leakage from flange joints at the time of disconnection</td>
<td>1. LPG leakage resulting in terms of fire/explosion</td>
<td>1. Strict supervision is followed at the time of shut down of operation. 2. Explosive meter for Leakage of LPG 3. T/T Drivers are instructed &amp; trained to vent out LPG vapor through cold flare line.</td>
<td>No additional measure is required.</td>
</tr>
</tbody>
</table>
Table 4.3: HAZOP Study Worksheet For Bottling of LPG Cylinder (LPG from Mounded Bullet to Cylinder through Pump & Carousel)

<table>
<thead>
<tr>
<th>Facility:</th>
<th>LPG Mounded Bullet, LPG Pumps &amp; Cylinder Filling Shed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process:</td>
<td>Bottling of LPG Cylinder (LPG from Mounded Bullet to Cylinder through Pump &amp; Carousel)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
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</tr>
</thead>
</table>
Table 4.4: HAZOP STUDY WORKSHEET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4. Air compressor fails due to</td>
<td>4. ROV may close due which pressure in</td>
<td>7. High pressure discharge switch provided in the vapor</td>
<td>7. High pressure discharge switch provided in the vapor compressor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>i. Mechanical/Electrical failure</td>
<td>pipeline will increase</td>
<td>compressor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. ROV closed due to insufficient air pressure</td>
<td>5. Vapour compressor overheating may lead to fire hazard</td>
<td>8. High discharge temperature switch provided in LPG compressor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. EFCV closed</td>
<td>6. Air compressor overheating may lead to fire hazard</td>
<td>9. Interlocking of cooling pump with Vapor Compressor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. One or more than one valves closed (Valves provided in between Mounded Bullets &amp; pump)</td>
<td>7. There is high pressure in the Mounded Bullets, if pump fails &amp; vapor compressor running, SRV may blow</td>
<td>10. By pass line provided in the Air Compressor, Vapor Compressor &amp; LPG pump</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>8. Pump by-pass line open</td>
<td>8. In the pump there is a possibility of leakage from interstage due to failure of the flange gasket rings so ultimately there is no pressure</td>
<td>11. Temperature &amp; pressure indicator provided</td>
<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Guide Words (deviation)</td>
<td>Possible causes</td>
<td>Possible consequences</td>
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</tr>
<tr>
<td>10.</td>
<td>Due to wrong pneumatic connection in cut off valve / filling gun there is no flow</td>
<td>9. Due to high pressure EFCV gives frequent problem</td>
<td>13. Water draining facilities provided in the Mounded Bullets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Due to defective or jammed valve there are chances of no flow in the LPG cylinder</td>
<td>10. If water in the product is in sufficient quantity it may cause rusting/corrosion to the vessel, which might not otherwise be affected by product in any way</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Improper fixing of the gun</td>
<td>11. Undesirable quality of product to the customers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Pin travel is too less</td>
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<tr>
<td>14.</td>
<td>LPG filling gun hose choked</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Parameter</td>
<td>Guide Words (deviation)</td>
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</tr>
</tbody>
</table>
| Flow of LPG     | Less                    | 1. Any of the valves provided before pump suction valve is choked.  
2. Low pressure in the Mounded Bullet  
3. Low pump ratio. (Suction/Delivery)  
4. By pass line open in the LPG pump.  
5. Cold flare line opens in delivery line of LPG pump.  
6. Insufficient vapor pressure develops due to faulty vapor compressor.  
7. Insufficient air pressure due to faulty air compressor. | 1. Operability problem  
2. Due to choking of the line, pipeline may burst |                          | 1. Regular preventive/predictive maintenance practice sustained.  
2. TRV provided in the line. |
## HAZOP STUDY WORKSHEET

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Flow of LPG</td>
<td>More</td>
<td>1. Mounded Bullet may be overfilled.</td>
<td>1. Due to high flow rate, generations of static electricity will be more.</td>
<td>1. Ball/Gate Valve provided in the line.</td>
<td>1. Constant supervision of the job.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Suction pressure high.</td>
<td>2. High power consumption.</td>
<td>2. Earthing is provided.</td>
<td>2. Sustained routine maintenance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Due to high discharge rate EFCV spring may fail.</td>
<td>3. Cut off valve may get closed resulting production loss.</td>
<td>3. High Level alarm provided on Mounded Bullet.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Carousel bypass line closed.</td>
<td>4. Valve problem.</td>
<td>4. SRV provided.</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>5. POP action valve provided in the line.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>6. High discharge pressure trip provided.</td>
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<tr>
<td></td>
<td></td>
<td>8. Leakage in the flange or valve</td>
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<tr>
<td></td>
<td></td>
<td>9. Liquid/vapor mixture in liquid delivery line</td>
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<tr>
<td></td>
<td></td>
<td>10. Cut off valve partially closed/choked</td>
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<tr>
<td></td>
<td></td>
<td>11. Filling gunnies partially closed/choked</td>
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<td>12. Less flow from gun to cylinder due to i) Less pin travel ii) Improper gun fixing</td>
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</tbody>
</table>
2. Due to fewer vapors in the Mounded Bullet because the Mounded Bullet is either almost full or almost empty.  
3. Vapor compressor bypass line is open causing low discharge pressure.  
4. Pump bypass line is in open condition. | 1. Less flow | 1. Preventive maintenance schedule followed of Vapor Compressor, pump & valve. | 1. No extra measures are required. |
| Pressure of LPG | No | Not credible | None | None | No action required. |
### HAZOP STUDY WORKSHEET

<table>
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<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
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<th>Action/Corrective Measures Required</th>
</tr>
</thead>
</table>
| **Pressure of LPG** | More                    | 1. Due to high pressure in filling Mounded Bullet.  
2. Pump suction pressure indicator & discharge pressure indicator faulty; & vapor compressor running causing high pressure in the line.  
3. Any valve fails close (fails in closed position) | 1. More flow                                                                  | 1. High pressure discharge Trip in the delivery line Of the Vapor Compressor Provided.  
2. Pressure indicator provided in the Suction/delivery line Of the pump. | 1. Sustained routine Maintenance of the Equipments to be Strictly followed. |
| **Others**     | Maintenance             | 1. Maintenance of valve/sight flow indicator/PI/TI/Rotogauge/Testing of Mounded Bullets / Pumps /Compressors etc. | 1. LPG liquid/vapor may come out leads to fire hazard or explosion if proper purging is not carried out. | 1. Proper purging.  
2. Permit to work system.  
3. Strict supervision at the time of maintenance. | 1. Constant & close supervision of the job. |
| **Others**     | Utility failure, electricity failure | 1. Operational problem                                                          | No hazard                              |                                        | No action required                 |

Facility: LPG Mounded Bullets, LPG Pumps & Cylinder Filling Shed

Process: Bottling of LPG Cylinder (LPG from Mounded Bullet to Cylinder through Pump & Carousel)
<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Others</td>
<td>Start up</td>
<td>1. Dry run of LPG Pumps, 2. Leakage from flange joints at the time of connection 3. Dry run of vapor compressors &amp; water Pump 4. Due to accidental removal/fixing of filling gun or any other device, the valve automatically gets shut off thus preventing any likely accident that may otherwise take place due to leakage of LPG from cylinder 5. Dry run of carousals 6. Leakage from any of the valves</td>
<td>1. LPG leakage resulting in terms of fire hazard/explosion 2. Operability problem.</td>
<td>1. Strict supervision is followed at the time of start up of operation</td>
<td>No Action</td>
</tr>
<tr>
<td>Others</td>
<td>Shut down</td>
<td>1. Leakage from flange, valves during closing &amp; at the time of disconnection.</td>
<td>1. LPG leaks out from the flange joints/valves.</td>
<td>1. Strict supervision is followed at the time of shutdown of operation.</td>
<td>No additional action required.</td>
</tr>
</tbody>
</table>
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</thead>
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<td></td>
<td></td>
<td>2. Cylinders may be filled up with water, resulting safety hazard at customer end.</td>
<td>2. After every receipt of LPG water draining procedure followed.</td>
<td>2. After every receipt of LPG water draining procedure followed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Freezing of water may cause problems in valves functioning.</td>
<td>3. Before shift operation, water is drained from the Mounded Bullets.</td>
<td>3. Before shift operation, water is drained from the Mounded Bullets.</td>
<td></td>
</tr>
<tr>
<td>Flow of liquid as well as vapor LPG</td>
<td>As well as</td>
<td>1. Very less LPG in Mounded Bullets.</td>
<td>1. Vapor locking (Cavitation) in LPG pump.</td>
<td>1. Double earthing provided in the LPG pumps.</td>
<td>Static electricity audit is to be carried out.</td>
</tr>
</tbody>
</table>

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**Facility:** LPG Mounded Bullets, LPG Pumps & Cylinder Filling Shed  
**Process:** Bottling of LPG Cylinder (LPG from Mounded Bullets to Cylinder through Pump & Carousel)
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required</th>
</tr>
</thead>
</table>
| Flow of water in fire hydrant network | No | 1. Static water storage tank empty  
2. Pump fails to start due to Mechanical problem/Diesel engine problem  
3. Diesel engine failure due to i) No fuel in fuel tank  
ii) Fuel line choked  
iii) Battery failure  
iv) Self starter failure  
v) Fuel injector choked  
vi) Panel contact problem  
vii) Non availability of lube oil in the engine  
4. Suction valve & hydrant pump suction valve and delivery line valve closed.  
5. Engine is running ideally due to stoppage of fuel-cut-off valve.  
6. Pump suction strainer fully choked | 1. Unavailability of water in ring main system for fire fighting purpose  
2. Engine heated if running with stoppage of suction valve  
3. Impeller damaged  
4. Engine seized | 1. Pumps are provided with static water tank with common suction line  
2. Water is made available at pump suction with positive suction head (due to level of water in the storage tanks)  
3. Daily checks of the pump/fire engine is strictly followed  
4. Battery panel charger provided |
### Table 4.6: HAZOP STUDY WORKSHEET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required</th>
</tr>
</thead>
</table>
| Flow of fire hydrant water | Less | 1. Any one suction valve in suction line or all of them are partially closed/choked  
2. Pump delivery line valve is partially closed or choked.  
3. Pump is running in low RPM position  
4. Under ground hydrant pipe line partially choked or under ground gate valve partially closed/choked  
5. Hydrant monitor valve partially closed/choked | 1. Cooling system works improperly or even failed  
2. Safety hazards | | |
| Flow of fire hydrant water | More | 1. Fuel pump failure  
2. Increase in RPM | 1. Pipeline may burst.  
2. Fire pump/engine may damage.  
3. Bearing damaged.  
4. Gland leakage in suction/ delivery line | | |
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>No</td>
<td>1. No water in the above ground tank  &lt;br&gt;2. Strainer may be choked  &lt;br&gt;3. Suction valve in the line is closed.  &lt;br&gt;4. Delivery line in the line may be closed.  &lt;br&gt;5. Diesel engine failure due to i) No fuel in fuel tank ii) Fuel line choked iii) Battery failure iv) Self starter problem v) Fuel injector choked vi) Panel contact problem</td>
<td>1. No flow of fire fighting water in the hydrant/monitor  &lt;br&gt;2. Cooling system failure and engine damaged due to excessive heat.</td>
<td>1. Pressure Indicator provided in the delivery line of hydrant pump  &lt;br&gt;2. Water temp indicator provided in the engine  &lt;br&gt;3. Lube oil indicator provided in the engine  &lt;br&gt;4. Lube oil pressure indicator provided  &lt;br&gt;5. Lube oil temp indicator provided</td>
<td></td>
</tr>
<tr>
<td>Pressure</td>
<td>Less</td>
<td>1. Pressure drop due to leakage in valve/or leakage in flange joints or pipe line.  &lt;br&gt;2. One or all of the valves partially choked/closed in the suction line as well as in the delivery line.  &lt;br&gt;3. Throttle control is not working properly.</td>
<td>1. Cooling system failure and engine damaged due to excessive heat  &lt;br&gt;2. Safety hazards</td>
<td>1. The pumps start automatically; one by one; as the pressure drops in the ring main system so as to maintain the pressure requirement of 7 Kg/Cm² at farthest point from the pump house.</td>
<td></td>
</tr>
</tbody>
</table>
## HAZOP STUDY WORKSHEET

<table>
<thead>
<tr>
<th>Unit/Facility</th>
<th>Fire Pump House (old &amp; new)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>Fire Hydrant Network</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required</th>
</tr>
</thead>
</table>
| Pressure  | More                  | 1. Governor failure  
2. Throttle control failure  
3. Fuel pump failure | 1. Cylinder head may burst  
2. Fuel injector damaged  
3. Lube/diesel mixed up | | |
Table 4.7: HAZOP Worksheet For Fire Sprinkler System

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required &amp; Action to be Taken By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow of Water</td>
<td>No</td>
<td>1. Static water storage tank empty</td>
<td>1. No flow of fire fighting water to deluge valve/open sprinkler head.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Pump fails to start due to mechanical problem/diesel engine problem</td>
<td>2. Engine heated if running with stoppage of suction valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Diesel engine failure due to</td>
<td>3. Pump bearing head</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>i) No fuel in fuel tank</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>ii) Fuel line choked</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii) Battery failure</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>iv) Self starter failure</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>v) Fuel injector choked</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>vi) Panel contact problem</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>vii) None availability of Lube oil in the engine</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Pumps are provided to static water storage tank with common suction line.
2. Level indicator provided in the water storage tank.
3. Daily checks of pump/fire engine is strictly followed.
### Table 4.8: HAZOP WORKSHEET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required &amp; Action to be Taken By</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4. Pump suction sprinkler valves are closed.</td>
<td>4. Impeller damaged</td>
<td>5. Fuel level indicator provided in the fuel tank.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Delivery valves are closed</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>6. Deluge valves are closed</td>
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<tr>
<td></td>
<td></td>
<td>7. Air pressure not released in the deluge valve due to faulty spring.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>8. Air pressure not released from deluge valve due air valve in closed position.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>9. Engine is running ideally due to stoppage of fuel-cut-off valve.</td>
<td>5. Engine seized</td>
<td>6. Battery panel charger provided</td>
<td></td>
</tr>
</tbody>
</table>
# HAZOP WORKSHEET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required &amp; Action to be Taken By</th>
</tr>
</thead>
</table>
| **Flow**  | Less                  | 1. Any one suction valve in suction line or all of them are practically closed/choked.  
2. Pump delivery line valve is partially closed or choked  
3. Pump is running in ideal RPM position | 1. Cooling system works improperly or even failed  
2. Safety hazards | | | |
| **Flow**  | More                  | 1. Fuel pump failure  
2. Increase in RPM | 1. Pipe line may burst  
2. Fire pump/engine may damaged  
3. Bearing damaged  
4. Gland leakage in suction/delivery line | | | |
| **Pressure** | No | 1. No water in the static water tank.  
2. Strainer may be choked.  
3. Suction valves in the line are closed. | 1. No flow of fire fighting water in the hydrant/monitor  
2. Cooling system failure resulted engineer heated up & it may seized also | 1. Pressure Indicator provided in the delivery line of hydrant pump  
2. Water temp indicator provided in the engine | |
## HAZOP WORKSHEET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required &amp; Action to be Taken By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>Less</td>
<td>1. Pressure drop from leakage from valve/or leakage from flange joints or leakage from pipe</td>
<td>1. Cooling system failure and engine damaged due to excessive heat</td>
<td>1. The pumps start automatically; one by one; as the pressure drops in the ring main system so as to maintain the pressure</td>
<td></td>
</tr>
</tbody>
</table>

4. Delivery line in the line may be closed.
5. Engine is running ideally due to stoppage of fuel cut off valve.
6. Diesel engine failure due to
   i) No fuel in fuel tank
   ii) Fuel line choked
   iii) Battery failure
   iv) Self starter problem
   v) Fuel injector choked
   vi) Panel contact problem

3. Lube oil indicator provided in the engine
4. Lube oil pressure indicator provided
5. Lube oil temp indicator provided.
## HAZOP WORKSHEET

<table>
<thead>
<tr>
<th>Unit/Facility</th>
<th>Fire Pump House</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process</td>
<td>Fire Sprinkler System</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words deviation</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required &amp; Action to be Taken By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gui Word deviation</td>
<td>line</td>
<td>2. One or all of the valves are partially choked/closed in the suction line as well as in the delivery line 3. Throttle control is not working properly or in fault condition. 4. NRV of the delivery line is faulty.</td>
<td>2. Safety hazards</td>
<td>requirement of 7 Kg/Cm² at farthest point from the pump house.</td>
<td></td>
</tr>
</tbody>
</table>
Table 4.9: HAZOP Study Worksheet For Power Generation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required</th>
</tr>
</thead>
</table>
| Voltage Generation | No                      | 1. Self starter problem  
2. Valve near tank and near generator are choked /closed.  
3. Battery failure  
4. Governor locked/choked  
5. Field circuit open/reverse  
6. No fuel (HSD) in Reserve Fuel Tank  
7. Fuel filter jammed  
8. Ring/Gear problem  
9. Fuel injector jammed/defective  
10. Line totally clogged with sludge  
11. Residual magnetism lost  
12. High Carbon in the alternator  
13. Carbon Bush Problem  
14. Coupling of generator is detached  
15. Starter and rotor to be short circuited  
16. Wrong calibration of voltage meter | 1. No generation of voltage  
## Table 4.10: HAZOP STUDY WORKSHEET

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Generation</td>
<td>Less</td>
<td>1. Unequal distribution of the fuel (HSD) in all the fuel injector</td>
<td>1. Due to less voltage line, current will be high and if the line current is high than the rated current - Insulation failure may occur resulting in terms of accident manpower loss</td>
<td>1. No additional action required.</td>
<td>No additional action required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Partial clogging of the fuel (HSD) filter</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>3. Wrong calibration of the fuel pump</td>
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<tr>
<td></td>
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<td>4. Water temperature high due to clogging of the radiator</td>
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<td></td>
<td>5. Due to defective governor</td>
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<td>6. Exhaust pipe jammed due to clogging of carbon</td>
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<td></td>
<td></td>
<td>7. Rectifier defective</td>
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<td></td>
<td></td>
<td>8. Field circuit open</td>
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<td></td>
<td></td>
<td>9. Voltmeter defective</td>
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<td></td>
<td></td>
<td>10. Air gap between rotor and starter is increased</td>
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<td>11. Due to bad insulation quality</td>
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<td></td>
<td>12. Fan belt tension is low for cooling pump</td>
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<td></td>
<td></td>
<td>1. Partial clogging of the fuel (HSD) filter</td>
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<td>2. Partial clogging of the fuel (HSD) filter</td>
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<td>3. Wrong calibration of the fuel pump</td>
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<td>4. Water temperature high due to clogging of the radiator</td>
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<td>5. Due to defective governor</td>
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<td>6. Exhaust pipe jammed due to clogging of carbon</td>
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<td></td>
<td></td>
<td>12. Fan belt tension is low for cooling pump</td>
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</tbody>
</table>
# HAZOP STUDY WORKSHEET

**Facility:** DG Set  
**Process:** Power generation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Guide Words (deviation)</th>
<th>Possible causes</th>
<th>Possible consequences</th>
<th>Measures/Existing facilities safeguard</th>
<th>Action Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage generation</td>
<td>More</td>
<td>1. Fuel supply (HSD) of fuel indicator increase due to malfunctioning of fuel pump 2. RPM throttle / governor failure 3. Magnetic field tapping increase</td>
<td>1. Load of power will be affected 2. Engine malfunctioning 3. Insulation failure of winding or any feeder line/motor resulting - Short circuit - Accident if any person contact with feeder line 4. Temperature will be high. 5. Bearing problem of the DG Set.</td>
<td>1. High voltage relay provided 2. Over current relay provided 3. Thermostat / Devices provided for controlling high temperature. 4. High temperature alarm provided. 5. Sustained routine maintenance followed.</td>
<td>No additional action required</td>
</tr>
<tr>
<td>Others</td>
<td>2. Shut down</td>
<td>1. Mechanical lock failure</td>
<td>1. Problem arises in the feeder line.</td>
<td>1. Additional electrical interlocking provided.</td>
<td>No-action required</td>
</tr>
</tbody>
</table>
RECOMMENDATIONS

Based on worksheets of Haldia LPG Bottling Plant, recommendations are as follows

1. Strict supervision and required action of plant personnel during LPG receipt operation should be carried out.
2. Maintenance of pumps & compressors must be done as per OISD-STD 119& OISD-STD 120.
3. Periodic inspection and maintenance of all the valves, joints, compressors and pumps should be done.
4. Mechanical seal of LPG Pump should be regularly monitored to prevent leakage.
5. Visual inspection of pipeline must be done regularly to locate leaks.
6. Earthing must be provided on the pipeline, TT Gantry & storage tanks.
7. All the hydrant points should be easily accessible.
8. Attention should be given to pipe connection, joints of valves and expansion joints.
9. Inspection of pipes for internal & external corrosion shall be carried out with special attention.
10. Back washing of all strainers should be done in regular interval in order to avoid chocking.
11. All proposed installation & maintenance of LPG cylinder filling shed should be done as per OISD.
12. During bottling operation one personnel should present at each stage of operation.
13. All Electrical Equipment & their installation should be as per OISD standard.