HAZOP / HAZID STUDY REPORT

For

INDIAN OIL CORPORATION LIMITED

INDANE BOTTLING PLANT

PATTIKALAN

REV 1

MAY 2014

CHILWORTH TECHNOLOGY (PVT.) LTD.

(ISO:9001 CERTIFIED)

B-2, Plot – 3, Muskaan Complex, Vasant Kunj

New Delhi - 110 070, India

Tel: 91 11 26136979, Fax: 91 11 26135979

Web: - www.chilworth.co.in

Email: info-in@chilworthglobal.com

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Our Ref: J0519/IOCL Pattikalan/HAZOP HAZID/L-02

Date: 22nd May, 2014

M/s. Indian Oil Corporation Limited
Marketing Division,
Indane Bottling Plant, Pattikalan
Sultanpur Patti, Rampur (UP) – 262123.

Attn: Mr. Sujeet Kumar, HSE Officer

Dear Sir,

PROJECT: HAZOP/HAZID, QUANTITATIVE RISK ANALYSIS FOR INDANE BOTTLING PLANT, PATTIKALAN

SUBJECT: HAZOP/HAZID STUDY REPORT REV 1

We are pleased to submit one softcopy of the HAZOP/ HAZID Report (Rev 1) for the above captioned project. If you have any questions or comments, please contact the undersigned. If the report is to your complete satisfaction, please sign and return a copy of the enclosed Report Approval Form.
We thank you for allowing us the opportunity to perform this study and if we can be of any further assistance to you, please contact us.

Yours faithfully,

CHILWORTH TECHNOLOGY (PVT.) LTD.

Jitendra Kumar
Director

Chilworth Technology (Pvt.) Ltd.	REPORT APPROVAL FORM	Job No.: J0519
Client:	**INDIAN OIL CORPORATION LIMITED, PATTIKALAN**	
Report Title:	**HAZOP/HAZID For IOCL BOTTLING PLANT, PATTIKALAN**	
Rev No. 1	**SIGNATURE**	**DATE**
Prepared by:	Siddhant Chhabra	20/05/2014
Checked by:	Himanshu Chichra	21/05/2014
Approved by:	Jitendra Kumar	22/05/2014

Revisions

Rev	Revision	By	Checked	Approved	Date
0	Issued for Comments	SC	HC	JK	09/05/2014

Client Approval Of Report:

Rev No.	Signature	Date
1		

ABBREVIATIONS

CTPL	Chilworth Technology (Pvt.) Ltd.
DMP	Disaster Management Plan
ESD	Emergency Shut-Down
EFCV	Excess Flow Check Valve
HAC	Hazardous Area Classification
HAZOP	Hazard & Operability
HAZID	Hazard Identification
HC	Hydro-Carbon
ICI	Imperial Chemical Industries
IEC	International Electro-technical Commission
IOCL	Indian Oil Corporation Limited
LPG	Liquefied Petroleum Gas
NFH	No Foreseen Hazard
P&ID	Piping & Instrumentation Diagram
QRA	Quantitative Risk Assessment
REV	Revision
ROV	Remote Operated Valve
SOP	Standard Operating Procedure

EXECUTIVE SUMMARY

The Indian Oil Corporation Limited, Indane Bottling Plant, Pattikalan is spread across the total area of 33 acres having the capacity of 1850 MT. The LPG is received from the tankers by road transport. The LPG is transferred by means of differential pressure mechanism with the help of a compressor and stored in the above ground bullets and Horton Spheres. LPG is then pumped and filled in cylinders using filling machines called Carousals. Bottling of LPG cylinders is carried out for different capacities such as 5.0 kg, 14.2 kg, 19.0 kg and 47.4 kg cylinders.

Chilworth Technology Pvt. Ltd. has been engaged by IOCL Indane Bottling Plant, Pattikalan for carrying out Hazard Identification study & Hazard Operability study for storage and transportation of petroleum products. The present report is the HAZOP & HAZID Study report for the facilities based on the design information and suitable conservative assumptions.

This document presents the methodology, execution and results of the HAZOP and HAZID study. The Study session was carried out at the premises of IOCL Indane Bottling Plant, Pattikalan on 23nd April, 2014, by experienced personnel from IOCL along with the Study Facilitator from Chilworth.

CONCLUSIONS

As the safety systems assessed were evaluated as adequate for the hazards identified during the workshop, no specific recommendation was proposed for HAZOP session and HAZID session.

GENERAL RECOMMENDATIONS

A list of general recommendations have been proposed for the Indane LPG Bottling plant:

- Consequence calculations for rupture of LPG Storage in QRA to confirm requirement of mounded storage.
- Scheduled inspection and testing of Pressure Gauge, Safety Relief Valve (SRV) of compressor, Horton Sphere and Bullets to be carried out.
- Inspection and maintenance schedule for EFCVs and ROVs to be strictly followed
- Periodic maintenance of Rotogauge to be carried out.

1 INTRODUCTION

1.1 GENERAL

Chilworth Technology Pvt. Ltd. (CTPL) has been engaged by IOCL Indane Bottling Plant, Pattikalan for carrying out HAZOP/HAZID and QRA study for storage and transportation of LPG. The present report is the HAZOP and the HAZID Study report for the Indane Bottling Plant, Pattikalan based on the design information and suitable conservative assumptions.

1.2 FACIILITY DESCRIPTION

The Bottling plant has no manufacturing activities. The facility receives LPG via tankers and stores in Horton Spheres & Bullets using differential pressure mechanism (through compressors). The LPG is pumped to the bottling plant, where cylinders of varying capacities are dispatched to various consumers.

The Bottling plant has following facilities:

- Receipt of LPG Tankers (24 tankers per day having various capacities such as 11MT, 17MT, etc.);
- Unloading of LPG from road tankers, one gantry with eight bays.
- Storage of LPG in Horton Spheres (1400 MT);
- Storage of LPG in Bullets (3×150 MT);
- LPG Pump House (3 Bottling Pumps)
- LPG Compressors (total four compressors; three of them having a flow rate of 36 m^3/hr and one with a flow rate of 170 m^3/hr)
- The Bottling Plant has two Carousal with 24 filing points each and associated facilities;
- Associated facilities for carrying out above tasks / operating above facilities including fire fighting facilities.

2 OBJECTIVES

The objectives of this study are as follows:

- To identify deviations from the design intent;
- To identify potential hazards and operability problems associated with the deviations;
- To identify and review the adequacy of the existing safeguards, mitigations or preventive measures for the identified hazard event;
- To recommend ways to mitigate the identified problems or to identify areas that need to be further investigated.

3 SCOPE OF WORK

The scope of work is to carry out HAZOP Study and HAZID Study of IOCL Indane Bottling Plant, Pattikalan.

The Hazard and Operability (HAZOP) study is carried out to identify the Hazard and operability problems. In addition, recommendations in the process facilities to reduce the probability and consequences of an incident are to be provided.

The Hazard Identification (HAZID) study is carried out to identify potential hazards from a facility. Hazards, which can harm personnel, environment or property, are identified.

3.1 DRAWINGS USED

The HAZOP/ HAZID facilitator did the following:

- Review of design drawings prior to the HAZOP/ HAZID session;
- Lead and documented the HAZOP/ HAZID sessions; and
- Developed a comprehensive HAZOP/ HAZID report and action items list.

The drawings / documents utilised for the sessions are listed in Table 3.1

Table 1.1: Documents and Drawings Used

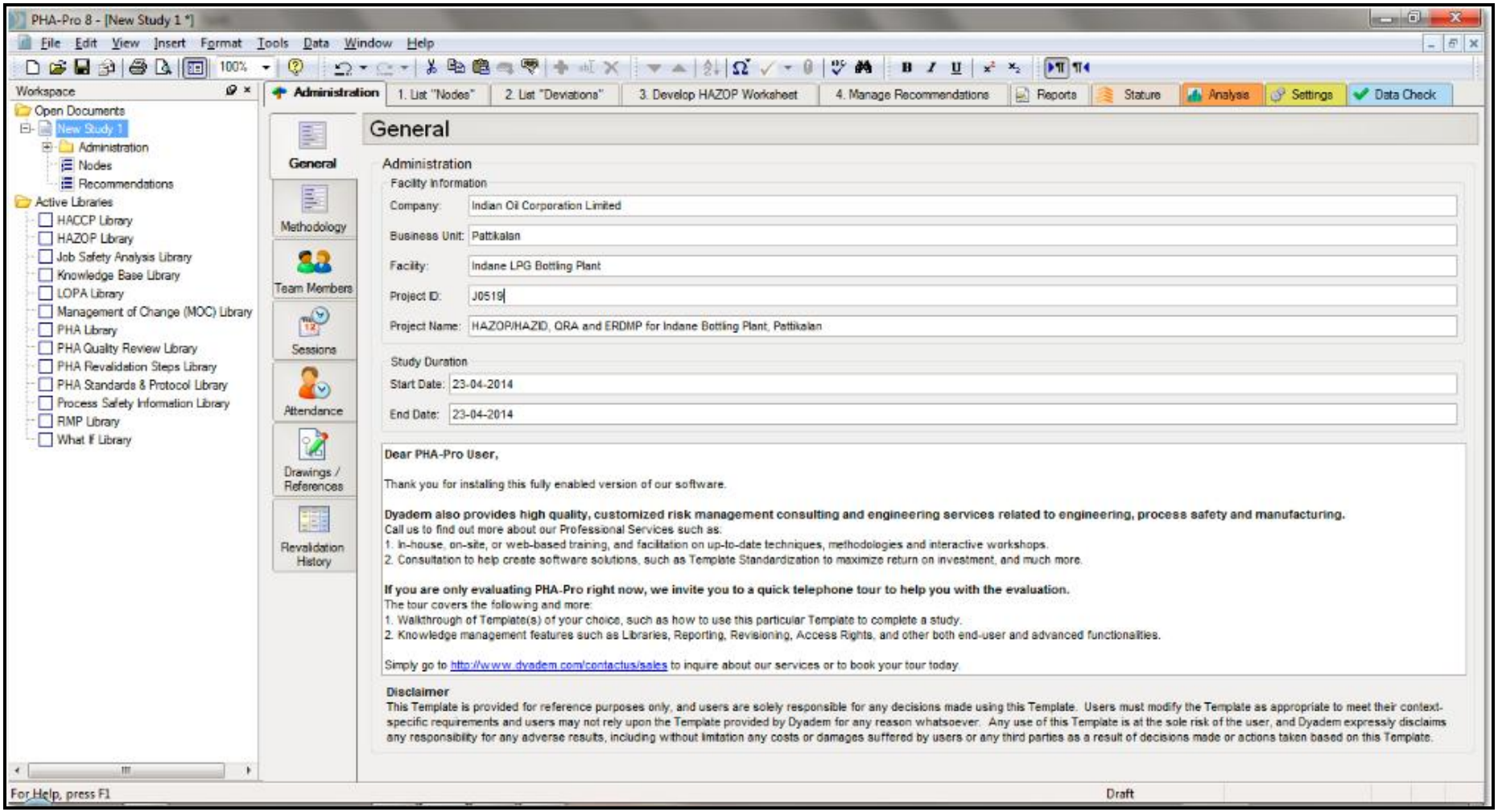
S. No.	Document / Drawing Title	Document / Drawing No.	Rev.
1.	LPG storage & handling	MIA-01	1
2.	LPG storage & handling	MIA-02	1
3.	LPG Bottling Plant, Pattikalan, Kashipur	LPG/ENG/KSP/LO-31	D

3.2 HAZOP/HAZID STUDY TEAM MEMBERS

The HAZOP/HAZID sessions were carried out at the premises of IOCL Indane Bottling Plant, Pattikalan on 23nd April, 2014 by experienced personnel from IOCL along with the Facilitator from Chilworth. The attendance of the members who participated in the sessions is presented in Appendix C.

3.3 ABOUT THE SOFTWARE

PHA PRO by Dyadem International Limited, the most comprehensive and innovative software tool for conducting a Process Hazards Analysis, has been used to conduct HAZOP/HAZID study. Following screenshot has been attached below:


PHA-Pro 8 - [New Study 1 *]
File Edit View Insert Format Tools Data Window Help
Workspace
Open Documents
New Study 1
Administration
Nodes
Recommendations
Active Libraries
HACCP Library
HAZOP Library
Job Safety Analysis Library
Knowledge Base Library
LOPA Library
Management of Change (MOC) Library
PHA Library
PHA Quality Review Library
PHA Revalidation Steps Library
PHA Standards & Protocol Library
Process Safety Information Library
RMP Library
What If Library
Administration
1. List "Nodes"
2. List "Deviations"
3. Develop HAZOP Worksheet
4. Manage Recommendations
Reports
Stature
Analysis
Settings
Data Check
General
Methodology
Team Members
Sessions
Attendance
Drawings / References
Revalidation History
General
Administration
Facility Information
Company: Indian Oil Corporation Limited
Business Unit: Pattikalan
Facility: Indane LPG Bottling Plant
Project ID: J0519
Project Name: HAZOP/HAZID, QRA and ERDMP for Indane Bottling Plant, Pattikalan
Study Duration
Start Date: 23-04-2014
End Date: 23-04-2014
Dear PHA-Pro User,
Thank you for installing this fully enabled version of our software.
Dyadem also provides high quality, customized risk management consulting and engineering services related to engineering, process safety and manufacturing.
Call us to find out more about our Professional Services such as:
1. In-house, on-site, or web-based training, and facilitation on up-to-date techniques, methodologies and interactive workshops.
2. Consultation to help create software solutions, such as Template Standardization to maximize return on investment, and much more.
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The tour covers the following and more:
1. Walkthrough of Template(s) of your choice, such as how to use this particular Template to complete a study.
2. Knowledge management features such as Libraries, Reporting, Revisioning, Access Rights, and other both end-user and advanced functionalities.
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4 BASIS OF HAZOP STUDY

4.1 HAZOP TECHNIQUE

Safety in the design of Refinery process, petrochemical and offshore plants primarily relies on the application of various codes of practice or design, which are based upon the wide experience and knowledge of professional experts and specialists in the industry. Such application is backed up by the experience of local plant managers, engineers and operators who have direct experience in the relevant plant operation.

All new projects, and in some cases modifications to existing plants, embody some element of change and the degree of change is often considerable. It is important to recognize that experience expressed in codes, etc. is limited by the extent of existing knowledge. It has become increasingly evident in recent years that it is important to supplement these codes with an imaginative anticipation of the hazards that could arise.

One technique developed to study the possibility and consequences of hazardous situations arising is the Hazard and Operability Study (HAZOP) defined as:

“The application of a formal systematic critical examination to the process and engineering intentions of new or modified facilities to assess the hazard potential or mal-operation or mal-function of individual items of equipment and the consequential effects on the facility as a whole”.

The technique aims to stimulate the imagination of designers, engineers and operators in a systematic way so that they can identify the potential hazards in a new design or modification works.

HAZOP studies are not an end in them but are part of an overall procedure for the initiation, design, construction, commissioning and operation of the facilities.

The distinguishing feature of HAZOP studies is the “Examination Session” during which a multi-disciplinary team using a structured approach systematically examines all relevant parts of a design.

Essentially the examination procedure takes a full description of the process, systematically questions every part of it to discover how deviations from the design intent can occur and decides whether these deviations can give rise to hazards or operational/maintenance problems.

The questioning is focused in turn on every part of the design. Each part is subjected to a number of questions formulated around a number of guidewords/deviations. In effect,

the guidewords/deviations are used to ensure that the questions will explore ways in which the process could deviate from the design intent.

Some of the causes of a deviation may be unrealistic and derived consequences insignificant, and would therefore not be considered further. However, there may be a deviation with both conceivable causes and potentially hazardous consequences. Essentially the HAZOP study identifies problem areas and does not seek engineering solutions although recommendations of an obvious nature can be made. In some cases it will be necessary to obtain further information and/or carry out detailed studies/analysis.

4.2 METHODOLOGY

This study was conducted through a node by node review, i.e. the system was divided into discrete nodes and each node was numbered accordingly.

The method involved several repetitive steps:

i) Identify a node of the process on the P&IDs.

ii) Define the design intent and normal operating conditions of the node.

iii) Identify a deviation from the intent or operating condition by applying guidewords based on the BS - IEC 61882 lists of guidewords.

iv) Identify possible causes and consequences of the deviation. A deviation can be considered "meaningful" if it has a credible cause and can result in harmful consequences.

v) Identify safeguards, if any.

vi) Identify recommendations and action parties if no safeguard is provided or safeguards are insufficient.

In practice the guidewords/deviations are set down in a standard list of questions relevant to the systems under review. The following guidewords/deviations were used in this study:

Table 2.1: Guidewords/Deviations Used for HAZOP

Guide-word Code	No.
More Flow	01
Less / No Flow	02

Guide-word Code	No.
Reverse Flow	03
Other Than Flow	04
High Pressure	05
Low Pressure	06
High Temperature	07
Low Temperature	08
High Level	09
Low Level	10
Composition	11
Start-up / Shut-down	12
Maintenance	13
Leakage / Rupture	14
Sampling	15
Corrosion / Erosion	16
Drawing Error	17

4.3 HAZOP PRE-CONCESSIONS

Throughout the HAZOP session, the following rules were adopted:

i) In principle, only single failure results in hazard – no double jeopardy.

ii) All equipment are well designed, manufactured and properly inspected.

iii) Plant is well maintained and operated in accordance with acceptable standards.

iv) Failures of instrument gauges were not considered.

v) Mechanical protection devices (PSVs, rupture discs) are expected to work.

vi) No design work / quantitative analysis will be performed during HAZOP meeting.

vii) Impact on environment (e.g. dispersion) will not be analyzed.

viii) If there is more than one train or pass, study of one is ok.

ix) Single check valve is adequate unless reverse flow may cause pressure to exceed test pressure.

x) Equipment is deemed suitable for the specified design conditions.

xi) The following items will not be considered:

- Spares for maintenance.
- Simultaneous occurrence of two unrelated incidents
- Simultaneous failure of more than one independent protection devices
- Operator's negligence (except common human error)
- Natural calamity (e.g. flood, earthquake)
- Objects falling from sky
- Sabotage

xii) The following is deemed as protection/safeguard

- Interlock / shutdown system / trip
- Alarm system for operator action
- Mechanical protection device
- Sample monitoring system
- Operating instruction and operating manuals

5 HAZID REGISTER

5.1 GENERAL

The HAZID Study is a high level qualitative risk assessment, which is commonly utilized to identify potential hazards from a facility. Hazards, which can harm personnel, environment or property are identified. The HAZID assessed the consequences taking into account the mitigation provided in the design, and then defined any actions necessary to further mitigate risk to an acceptable level.

5.2 HAZID METHODOLOGY

The HAZID was performed by a multidisciplinary team from IOCL Pattikalan & CTPL to ensure that the HAZID review was comprehensive. The agreed action items were recorded on the HAZID worksheets.

The drawings and support documents were referred to as appropriate. The study progressed through the following steps:

- The design intent and normal operating conditions of the area;
- Identify possible causes and consequences of the hazard. A hazard can be considered "meaningful" if it has a credible cause and can result in harmful consequences;
- Identify any existing safeguards, mitigations and control measures included in the design;
- Carry out a ranking of the hazards based on its safety or environmental impacts; and
- Identify recommendations and action parties if further mitigation is required.

In keeping with the purpose of the study, CTPL developed a number of guidewords that were used in the HAZID workshop to initiate discussion within the HAZID team. The guidewords used in this study are summarised in Table 5.1.

Table 3.1: Guidewords Used for the HAZID Study

S. No	Guideword
1.	Unignited Hydrocarbon Release
2.	Ignited Hydrocarbon Release – Fire
3.	Toxic Release

S. No	Guideword
4.	High/ Low Pressure
5.	High / Low Temperature
6.	Dropped Object
7.	Maintenance
8.	Confined Spaces
9.	Access / Egress / Escape / Evacuation
10.	Extreme Weather
11.	Radioactivity
12.	Explosives
13.	Sabotage / Piracy / Acts of Terrorism / Theft
14.	HAC
15.	Electrostatic
16.	Electrical Fire

5.3 RISK RANKING

Based on the estimated frequencies and consequences, the identified hazards were then assessed and ranked accordingly to their severity using the risk matrix presented in Figure 5.1.

The HAZID risk ranking is performed for consequence to people, asset, environment and reputation.

Figure 5.1: Qualitative Risk Assessment Matrix

CONSEQUENCE OF HAZARD				ANNUAL FREQUENCY				
				A	B	C	D	E
Severity	People (P)	Assets (A)	Environment (E)	< 0.00001	0.0001 – 0.00001	0.001 – 0.0001	0.01 – 0.001	> 0.01
0	No injury	No damage	No effect	L	L	L	L	L
1	Slight injury	Slight damage	Slight effect	L	L	L	L	**M**
2	Minor injury	Minor damage	Minor effect	L	L	L	**M**	**M**
3	Major injury	Localised damage	Localised effect	L	L	**M**	**M**	H
4	Single Fatality	Major damage	Major effect	L	**M**	**M**	H	H
5	Multiple Fatalities	Extensive damage	Extensive effect	**M**	**M**	H	H	H

5.4 HAZID WORKSHEETS

The HAZID sessions were recorded on worksheets as presented in Appendix B. In the “Cause” column, all the potential causes which contribute to a particular hazard were recorded. If any safeguards / mitigation measures are provided to prevent or minimize risk or further escalation, then they were documented in the “Preventive and Mitigation Measures” column. In the absence of adequate safeguards for the hazards identified, relevant recommendations from the team were noted in the “Recommendations” column.

6 RESULTS AND DISCUSSION

The completed worksheets of the HAZOP and HAZID study are attached in Appendix A and Appendix B respectively.

6.1 RESULTS OF THE HAZOP STUDY

6.1.1 LIST OF NODES

The facility under consideration was analysed / studied as four (4) nodes, based on the process and the operating conditions. The results for the node are shown in the HAZOP worksheets.

Table 4.1: List of Nodes for HAZOP Study

S.No.	Node Description	Drawing No.	Node No.
1.	To receive and store LPG in Horton Sphere and Bullets	MIA-01;	N1
2.	To pump LPG from the Bullets/Horton Sphere to Filling Machine (Carousel)	MIA-01;	N2
3.	To facilitate LPG cylinder filling operation.	MIA-02	N3
4.	To transfer LPG of Evacuation vessel to back to H/S or Bullets	MIA-01; MIA-02;	N4

6.1.2 FOLLOW UP ACTION LIST

No specific recommendations were proposed during the HAZOP sessions.

6.2 RESULTS OF THE HAZID STUDY

The details were systematically reviewed and the study was performed and recorded in the worksheet which is included in Appendix B. Each accident event has been assessed to determine its likely frequency and its consequences in terms of death / injury to personnel and damage to environment, assets and reputations. The assessment has been conducted on a qualitative basis and is inevitably subjective. It gives an indication of where to focus when carrying out more detailed analysis. A risk matrix has been used to rank the level of risk from each event and identify it as 'low', 'medium' or 'high'.

A total of Eighteen (18) hazards were identified in the HAZID session. Out of the Eighteen (18) hazards, Ten (10) were classified as low risk hazards, Eight (8) as medium risk hazards and there were no high risk hazards.

6.2.1 CORRECTIVE ACTIONS

No specific recommendation was made for the Indane Bottling Plant, Pattikalan.

6.3 GENERAL RECOMMENDATIONS

- Consequence calculations for rupture of LPG Storage in QRA to confirm requirement of mounded storage.
- Scheduled inspection and testing of Pressure Gauge, Safety Relief Valve (SRV) of compressor, Horton Sphere and Bullets to be carried out.
- Inspection and maintenance schedule for EFCVs and ROVs to be strictly followed
- Periodic maintenance of Rotogauge to be carried out.

7 REFERENCE

1. Hazard and Operability Studies (HAZOP Studies) – Application Guide. British Standard BS IEC 61882:2001.
2. HAZOP Guide to Best Practice by EPSC
3. P&IDs as obtained from IOCL Indane Bottling Plant, Pattikalan.
4. Layout as obtained from IOCL Indane Bottling Plant, Pattikalan.

APPENDIX A - HAZOP WORKSHEETS

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Receipt from Tanker, Tanker decanting Shed, LPG Compressors, LPG Horton Sphere and Bullets**	**Section/Node No:**	**N1**
Design Intention:	**To receive and store LPG in Horton Sphere and Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N1.01	Flow	More	1.ROV-501/201/203/205/213 stuck open	1.1. Possible over pressurization of the Horton Sphere/ Bullet, leading to rupture causing fire/ explosion.	1.1.1. SOP based operation. 1.1.2.Level Transmitters provided (both H/S and bullets) 1.1.3. High Level Alarm provided on both H/S and bullets 1.1.4. Gas detection system. 1.1.5. Manned Operation. 1.1.6. ESDs on Manual Intervention. 1.1.7. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 1.1.8. Fire Fighting System.		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Receipt from Tanker, Tanker decanting Shed, LPG Compressors, LPG Horton Sphere and Bullets**	**Section/Node No:**	**N1**
Design Intention:	**To receive and store LPG in Horton Sphere and Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
			2. Changeover from one Storage vessel to another failure	2.1. Process upset. 2.2. Possible over pressurization of the Horton Sphere/ Bullet, leading to rupture causing fire/ explosion.	2.1.1. SOP based operation. 2.1.2. Manned Operation 2.1.3. Level Transmitters provided (both H/S and bullets) 2.1.4. High Level Alarm provided on both H/S and bullets 2.1.5. Gas detection system. 2.1.6. ESDs on Manual Intervention. 2.1.7. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 2.1.8. Fire Fighting System.		
N1.02		Less / No	1. Empty LPG Tanker	1.1 Process upset loss of inventory to bullet / Horton Sphere.	1.1.1. Manned operation 1.1.2. SOP 1.1.3. Local pressure		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Receipt from Tanker, Tanker decanting Shed, LPG Compressors, LPG Horton Sphere and Bullets**	**Section/Node No:**	**N1**
Design Intention:	**To receive and store LPG in Horton Sphere and Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
					indications		
			2. Compressor Trips.	2.1. Process upset, operational delays	2.1.1. High discharge pressure trip provided. 2.1.2. PAVs provided in the system 2.1.3. SRV provided. 2.1.4. Manned Operation. 2.1.5. Inspection and Maintenance. 2.1.6. SOPs and DOs & DON'T'S		
			3.ROV - 501/201/203/205/213 fails close	3.1.1.Possible over pressurization upstream, leading to fire/explosion	3.1.1. PAVs provided. 3.1.2. Manned Operation. 3.1.3. Inspection and Maintenance.		
			4. Leakage / Rupture	4.1. Loss of inventory, possible fire/ explosion.	4.1.1 Excess Flow Check Valves 4.1.2. Gas detection		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Receipt from Tanker, Tanker decanting Shed, LPG Compressors, LPG Horton Sphere and Bullets**	**Section/Node No:**	**N1**
Design Intention:	**To receive and store LPG in Horton Sphere and Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
					system 4.1.3. Manned Operation. 4.1.4.ESD on Manual Intervention 4.1.5. Firefighting system. 4.1.6. Inter Horton Sphere to Bullet and LPG transfer.		
N1.03		Reverse	NFH as NRVs provided.				
N1.04		Other than	1.Water present in Indane LPG Tanker	1.1. Process Upset, no safety hazard	1.1.1. Sampling at TLD Bay by Rotogauge 1.1.2. Manned Operation 1.1.3. SOP based operation 1.1.4. Inspection 1.1.5. Water draining of Bullets/ Horton Sphere		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Receipt from Tanker, Tanker decanting Shed, LPG Compressors, LPG Horton Sphere and Bullets**	**Section/Node No:**	**N1**
Design Intention:	**To receive and store LPG in Horton Sphere and Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
					before filling operation.		
N1.05	Pressure	High	1. High Ambient Temperature	1.1. No Safety Hazard as system designed for maximum ambient temperature.			
			2. External Fire	2.1. Possible overheating, may result in over pressurization of the system. Possible damage to piping/ equipment, safety hazard.	2.1.1. Gas detection system 2.1.2. SRVs on H/S and LPG Bullets. 2.1.3.PAVs provided in the entire system 2.1.4. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 2.1.5. Sprinkler System provided to produce cooling effects. 2.1.6. Firefighting system. 2.1.7. DMP		
			Refer More Flow				

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Receipt from Tanker, Tanker decanting Shed, LPG Compressors, LPG Horton Sphere and Bullets**	**Section/Node No:**	**N1**
Design Intention:	**To receive and store LPG in Horton Sphere and Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
			Cause 1&2.				
			Refer to Less/ No Flow Cause 3.				
N1.06		Low	1. Low Ambient Temperature.	1.1. No Safety Hazard as system designed for minimum ambient temperature.			
			Refer Less/No Flow Cause 4				
N1.07	Temperature	High	Refer to High Pressure Cause 1&2				
N1.08		Low	Refer to Low Pressure Cause 1.				
N1.09	Level	High	Refer to More Flow Cause 1 & 2.				

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Receipt from Tanker, Tanker decanting Shed, LPG Compressors, LPG Horton Sphere and Bullets**	**Section/Node No:**	**N1**
Design Intention:	**To receive and store LPG in Horton Sphere and Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N1.10		Low	1. Drainage valve left open.	1.1. Possible loss of inventory, may lead to fire/explosion.	1.1.1. SOP 1.1.2. Inspection and Maintenance 1.1.3. Drainage is strictly manned. 1.1.4. Quick Shutoff with lock protection and ball valve provided with blind flange		
			Refer to Less/ No Flow Cause 1,2, 3 and 4				
N1.11	Composition	Other than	Refer to Other Than Flow Cause1.				
N1.12	Start-up / shut down		NFH				

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Receipt from Tanker, Tanker decanting Shed, LPG Compressors, LPG Horton Sphere and Bullets**	**Section/Node No:**	**N1**
Design Intention:	**To receive and store LPG in Horton Sphere and Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N1.13	Maintenance		NFH				
N1.14	Corrosion/ Erosion		1. Presence of Impurities	1.1. Possible leakage/Rupture Safety hazard	1.1.1. Suitable MOC 1.1.2. Adequate design 1.1.3. Preventive inspection and maintenance.		
N1.15	Drawing Errors					1.1.1.1.P&IDs to be updated as per existing construction	IOCL

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG loading pumps**	**Section/Node No:**	**N2**
Design Intention:	**To pump LPG from the Bullets/Horton Sphere to Filling Machine (Carousel)**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**--**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N2.01	Flow	More	1. ROVs stuck open	1.1. Possible over pressurization in the system 1.2. Possible hose/line damage, may lead to rupture	1.1.1. SOP based operation. 1.1.2. Gas detection system. 1.1.3. Manned Operation. 1.1.4. PAVs provided 1.1.5. ESDs on Manual Intervention. 1.1.6. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 1.1.7. Fire Fighting System.		
N2.02		Less/ No	1. Transfer Pump trips (provided compressor is running)	1.1. Possible over pressurization of Bullet/Horton Sphere upto inlet of pump, leading to rupture, resulting in fire/	1.1.1.SOP based operation 1.1.2. Gas detection system. 1.1.3. Manned		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG loading pumps**	**Section/Node No:**	**N2**
Design Intention:	**To pump LPG from the Bullets/Horton Sphere to Filling Machine (Carousel)**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**--**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
				explosion	operation. 1.1.4. SRVs on Horton Sphere/ Bullet 1.1.5. PAVs in the system 1.1.6. Compressor Trips 1.1.7. ESDs on Manual Intervention. 1.1.8. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 1.1.9. Fire Fighting System.		
			2. Pump strainer choked (provided compressor is running)	2.1. Possible pump damage. 2.2. Possible over pressurization of Bullet/Horton Sphere leading to rupture, resulting in fire/ explosion	2.1.1. SOP based operation 2.1.2. Gas detection system. 2.1.3. Manned operation. 2.1.4. SRVs on Horton Sphere/ Bullet 2.1.5. PAVs in the		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG loading pumps**	**Section/Node No:**	**N2**
Design Intention:	**To pump LPG from the Bullets/Horton Sphere to Filling Machine (Carousel)**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**--**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
					system 2.1.6. Compressor Trips 2.1.7. ESDs on Manual Intervention. 2.1.8. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 2.1.9. Fire Fighting System.		
			3. ROVs fails close.	3.1. Possible over pressurization upstream, leading to fire/explosion	3.1.1. PAVs provided. 3.1.2. Manned Operation. 3.1.3. Inspection and Maintenance.		
			4. Loss of feed to Pump	4.1. Possible vapour locking in the pumps, leading to dry running of pumps.	4.1.1. SOP based operation 4.1.2. Manned Operation 4.1.3. Dispersion of vapour from the pump suction line to a safe height (flare line)		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG loading pumps**	**Section/Node No:**	**N2**
Design Intention:	**To pump LPG from the Bullets/Horton Sphere to Filling Machine (Carousel)**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**--**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
			5. Leakage/ Rupture	5.1. Inventory Loss leading to fire/ explosion.	5.1.1. Gas detectors at strategic points. 5.1.2. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 5.1.3. Fire fighting system. 5.1.4. ESDs on manual intervention		
N2.03		Reverse	NFH as NRVs provided.				
N2.04		Other than	NFH				
N2.05	Pressure	High	1. High Ambient Temperature	1.1. No Safety Hazard as system designed for maximum ambient temperature.			
			2. External Fire	2.1. Possible overheating, damage to equipment/ piping. Safety hazard.	2.1.1. Gas detection system. 2.1.2.PAVs provided in the entire system 2.1.3. Sprinklers based		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG loading pumps**	**Section/Node No:**	**N2**
Design Intention:	**To pump LPG from the Bullets/Horton Sphere to Filling Machine (Carousel)**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**--**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
					on Quartzoid Bulb (triggers at 79 DegC) 2.1.4. Sprinkler System provided to produce cooling effects. 2.1.5. Firefighting system. 2.1.6. DMP		
			Refer More Flow Cause 1& 5.				
			Refer Less/No Flow Cause 1,2 &3				
N2.06		Low	Refer Less/No Flow Cause 4 & 6				
N2.07	Temperature	High	1. Refer to High Pressure Cause 1 & 2				
N2.08		Low	1. Low Ambient Temperature.	1.1. No Safety Hazard as system designed for			

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG loading pumps**	**Section/Node No:**	**N2**
Design Intention:	**To pump LPG from the Bullets/Horton Sphere to Filling Machine (Carousel)**	**Revision No:**	**0**
Drawings No.:	**MIA-01**	**Revision Date:**	**--**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
				minimum ambient temperature.			
N2.09	Level	High	NFH				
N2.10		Low	NFH				
N2.11	Composition	Other than	NFH				
N2.12	Start-up / shut down		NFH				
N2.13	Maintenance		NFH				
N2.14	Corrosion / Erosion		1. Presence of Impurities	1.1. Possible leakage/Rupture. Safety hazard	1.1.1. Suitable MOC. 1.1.2. Preventive inspection and maintenance.		
N2.15	Drawing Errors					1.1.1.1.P&IDs to be updated as per existing construction	IOCL

Project:	**HAZOP Study for IOCL's LPG Bottling Plant, Patti Kalan**	**Session Date:**	**23rd April , 2014**
Section Description:	**LPG Pipeline to Carousel and Carousel**	**Section/Node No:**	**N3**
Design Intention:	**To facilitate LPG cylinder filling operation.**	**Revision No:**	**0**
Drawings No.:	**MIA-02**	**Revision Date:**	

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N3.01	Flow	More	NFH				
N3.02		Less / No	1. Loss of feed to Carousel.	1.1. No safety hazard, operational delay.			
			2. Leakage / Rupture	2.1. Possible loss of inventory, may result in fire/ explosion.	2.1.1. Gas detectors at strategic points. 2.1.2. Vapour extraction unit with suction point at various places. 2.1.3. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 2.1.4. Fire fighting system. 2.1.5. ESDs on manual intervention		

Project:	**HAZOP Study for IOCL's LPG Bottling Plant, Patti Kalan**	**Session Date:**	**23rd April , 2014**
Section Description:	**LPG Pipeline to Carousel and Carousel**	**Section/Node No:**	**N3**
Design Intention:	**To facilitate LPG cylinder filling operation.**	**Revision No:**	**0**
Drawings No.:	**MIA-02**	**Revision Date:**	

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N3.03		Reverse	1.Cylinder not being filled by Filling guns	1.1. Possible over pressurization in the system, leading to leakage/rupture causing fire/explosion	1.1.1. SOPs 1.1.2. Manned Operation 1.1.3. Inspection & Maintenance 1.1.4. Provision of bypass line with Differential Pressure Valve and carousal return line		
N3.04		Other than	NFH				
N3.05	Pressure	High	1. High Ambient Temperature	1.1. No Safety Hazard as system designed for maximum ambient temperature.			

Project:	**HAZOP Study for IOCL's LPG Bottling Plant, Patti Kalan**	**Session Date:**	**23rd April , 2014**
Section Description:	**LPG Pipeline to Carousel and Carousel**	**Section/Node No:**	**N3**
Design Intention:	**To facilitate LPG cylinder filling operation.**	**Revision No:**	**0**
Drawings No.:	**MIA-02**	**Revision Date:**	

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
			2. External Fire	2.1. Possible damage to cylinders/ piping, may lead to domino effect.	2.1.1. Gas detection system. 2.1.2. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 2.1.3. Fire fighting system. 2.1.4. ESDs on manual intervention 2.1.5. DMP		
N3.06		Low	Refer Less/No Flow Cause 1, 2				
N3.07	Temperature	High	Refer to High Pressure Cause 1 & 2				
N3.08		Low	1. Low Ambient Temperature.	1.1. No Safety Hazard as system designed for minimum ambient temperature.			

Project:	**HAZOP Study for IOCL's LPG Bottling Plant, Patti Kalan**	**Session Date:**	**23rd April , 2014**
Section Description:	**LPG Pipeline to Carousel and Carousel**	**Section/Node No:**	**N3**
Design Intention:	**To facilitate LPG cylinder filling operation.**	**Revision No:**	**0**
Drawings No.:	**MIA-02**	**Revision Date:**	

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N3.09	Level	High	1. Malfunctioning of load cell.	1.1. Possible overfilling of cylinder, safety hazard. May lead to Fire/ Explosion	1.1.1. Gross weighing of cylinder to check weight of cylinders. 1.1.2. ESD on manual intervention. 1.1.3. Manned operation 1.1.4. Gas detection system. 1.1.5. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 1.1.6. Fire fighting system.		
N3.10		Low	1. Faulty load cell	1.1. Process upset. 1.2 Operational delay			
			Refer to Less/No Flow 1, 2				
N3.11	Composition	Other than	NFH				

Project:	**HAZOP Study for IOCL's LPG Bottling Plant, Patti Kalan**	**Session Date:**	**23rd April , 2014**
Section Description:	**LPG Pipeline to Carousel and Carousel**	**Section/Node No:**	**N3**
Design Intention:	**To facilitate LPG cylinder filling operation.**	**Revision No:**	**0**
Drawings No.:	**MIA-02**	**Revision Date:**	

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N3.12	Start-up / shut down		NFH				
N3.13	Maintenance		1.1 LPG present de-shaping of scrap cylinders	1.1. Possible leak, leading to fire/explosion	1.1.1. SOP 1.1.2.Manned Operation 1.1.3. Fire fighting system. 1.1.4. DMP		
N3.14	Corrosion / Erosion		1. Presence of Impurities	1.1. Possible leakage. Safety hazard	1.1.1. Suitable MOC. 1.1.2. Preventive inspection and maintenance.		
N3.15	Drawing Errors						

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Evacuation Compressors**	**Section/Node No:**	**N4**
Design Intention:	**To transfer LPG of Evacuation vessel back to H/S or Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01; MIA-02**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N4.01	Flow	More	NFH				
N4.02		Less/ No	1. Blocked Evacuation Compressor outlet.	1.1. Possible over pressurization upstream.	1.1.1. High discharge pressure trip provided. 1.1.2. High discharge Temperature trip provided. 1.1.3. PAVs provided in the system 1.1.4. SRV provided. 1.1.5. Manned Operation. 1.1.6. Inspection and Maintenance.		
			2.ROV fails close	2.1.1. Possible over pressurization upstream.	2.1.1. PAVs provided. 2.1.2. Manned Operation. 2.1.3. Inspection and Maintenance.		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Evacuation Compressors**	**Section/Node No:**	**N4**
Design Intention:	**To transfer LPG of Evacuation vessel back to H/S or Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01; MIA-02**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
			3. Leakage / Rupture	3.1. Loss of inventory, possible fire/ explosion.	3.1.1. Gas detection system 3.1.2. Manned Operation. 3.1.3.ESD on Manual Intervention 3.1.4 Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 3.1.5. Firefighting system. 3.1.6. Inter Horton Sphere to Bullet LPG transfer.		
N4.03		Reverse	NFH				
N4.04		Other than	1.Water present in LPG Cylinders	1.1. No Safety Hazard			
N4.05	Pressure	High	1. High Ambient Temperature	1.1. No Safety Hazard as system designed for maximum ambient temperature.			

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Evacuation Compressors**	**Section/Node No:**	**N4**
Design Intention:	**To transfer LPG of Evacuation vessel back to H/S or Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01; MIA-02**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
			2. External Fire	2.1. Possible overheating, damage to equipment/ piping. Safety hazard.	2.1.1. Gas detection system. 2.1.2.PAVs provided in the entire system 2.1.3. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 2.1.4. Sprinkler System provided to produce cooling effects. 2.1.5. Firefighting system. 2.1.6. DMP		
			NFH				
			Refer to Less/No Flow Cause 1,2				
N4.06		Low	Refer Less/No Flow Cause 3				
N4.07	Temperature	High	Refer to High Pressure Cause 1 & 2				

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Evacuation Compressors**	**Section/Node No:**	**N4**
Design Intention:	**To transfer LPG of Evacuation vessel back to H/S or Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01; MIA-02**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
			Refer to Less/No flow Cause 1.				
N4.08		Low	1. Low Ambient Temperature.	1.1. No Safety Hazard as system designed for minimum ambient temperature.			
N4.09	Level	High	NFH				
N4.10		Low	Refer to Less/ No Flow Cause 3.				
N4.11	Composition	Other than	Refer to Other Than Cause 1.				
N4.12	Start-up / shut down		NFH				
N4.13	Maintenance		NFH				
N4.14	Corrosion / Erosion		1. Presence of Impurities	1.1. Possible leakage. Safety hazard	1.1.1. Suitable MOC. 1.1.2. Preventive inspection and maintenance.		

Project:	**HAZOP Study for IOCL LPG Bottling Plant, Pattikalan**	**Session Date:**	**23rd April, 2014**
Section Description:	**LPG Evacuation Compressors**	**Section/Node No:**	**N4**
Design Intention:	**To transfer LPG of Evacuation vessel back to H/S or Bullets**	**Revision No:**	**0**
Drawings No.:	**MIA-01; MIA-02**	**Revision Date:**	**-**

Ref. No.	Parameter	Guideword	Cause	Consequence	Safeguards	Recommendation	Action By
N4.15	Drawing Errors		NFH				

APPENDIX B-HAZID WORKSHEET

PROJECT	HAZID Study for IOCL LPG Bottling Plant, Pattikalan	SESSION DATE	April 23rd, 2014
CLIENT	Indian Oil Corporation Limited	JOB NO	J0519
SECTION	LPG Bottling Plant		

GUIDEWORD	CAUSES	MAJOR EFFECTS	PREVENTIVE & MITIGATION MEASURES	FREQ	CONS	RISK	RECOMMENDATION	ACTION BY
1. Unignited HC Release	1.1 Overfilling of LPG cylinder.	1.1. Operator may be exposed to HC vapours.	1.1.1.1 Gross weighing method for cylinder filling. 1.1.1.2 Continuous monitoring of filling operation. 1.1.1.3 Gas detection system. 1.1.1.4.Vapor extraction Unit 1.1.1.5 ESD on manual intervention. 1.1.1.6 PPEs 1.1.1.7 DMP	B	2	L		
	1.2 Leakage/ Rupture	1.2.1 Loss of containment, possible operator exposure to HC vapours.	1.2.1.1. Excess Flow Check Valves provided. 1.2.1.2. PAVs/SRVs provided in the entire system 1.2.1.3 Gas detection system. 1.2.1.4 ESD on manual intervention. 1.2.1.5 Inspection & maintenance. 1.2.1.6 Provision for	D	2	M		

PROJECT	HAZID Study for IOCL LPG Bottling Plant, Pattikalan			SESSION DATE			April 23rd, 2014	
CLIENT	Indian Oil Corporation Limited			JOB NO			J0519	
SECTION	LPG Bottling Plant							
GUIDEWORD	**CAUSES**	**MAJOR EFFECTS**	**PREVENTIVE & MITIGATION MEASURES**	**FREQ**	**CONS**	**RISK**	**RECOMMENDATION**	**ACTION BY**
			inter Horton sphere and bullet LPG transfer. 1.2.1.7 PPEs 1.2.1.8 DMP					
	1.3 Uncontrolled drainage from H/S	1.3.1 Possible operator exposure to HC vapours.	1.3.1.1. Excess Flow Check Valves provided 1.3.1.2. Gate valve and quick shut off valve 1.3.1.3 SOPs 1.3.1.4 Gas detection system. 1.3.1.5 ESDs on manual intervention. 1.3.1.6 Drainage is strictly manned. 1.3.1.7 Inspection & maintenance. 1.3.1.8 PPEs 1.3.1.9 DMP	C	2	L		
2. Ignited HC Release	2.1 Overfilling of LPG cylinder.	2.1.1 Possible fire/ explosion, safety hazard.	2.1.1.1 Gross Weighing method for cylinder filling. 2.1.1.2 Continuous monitoring of filling operation.	B	4	M		

PROJECT	**HAZID Study for IOCL LPG Bottling Plant, Pattikalan**	**SESSION DATE**	**April 23rd, 2014**
CLIENT	**Indian Oil Corporation Limited**	**JOB NO**	**J0519**
SECTION	**LPG Bottling Plant**		

GUIDEWORD	CAUSES	MAJOR EFFECTS	PREVENTIVE & MITIGATION MEASURES	FREQ	CONS	RISK	RECOMMENDATION	ACTION BY
			2.1.1.3 Gas detection system. 2.1.1.4 ESD on manual intervention. 2.1.1.5 Fire detectors and Fire fighting system. 2.1.1.6. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 2.1.1.7 PPEs 2.1.1.8 DMP					
	2.2 Leakage/ Rupture	2.2.1 Fire/ Explosion, safety hazard.	2.2.1.1. Excess Flow Check Valves provided. 2.2.1.2 Gas detection system. 2.2.1.3 ESD on manual intervention. 2.2.1.4 Inspection & maintenance. 2.2.1.5 Provision for inter Horton Sphere and bullet LPG transfer. 2.2.1.6 Fire detectors and Fire fighting	B	4	M		

PROJECT	HAZID Study for IOCL LPG Bottling Plant, Pattikalan			SESSION DATE			April 23rd, 2014	
CLIENT	Indian Oil Corporation Limited			JOB NO			J0519	
SECTION	LPG Bottling Plant							
GUIDEWORD	**CAUSES**	**MAJOR EFFECTS**	**PREVENTIVE & MITIGATION MEASURES**	**FREQ**	**CONS**	**RISK**	**RECOMMENDATION**	**ACTION BY**
			system. 2.1.1.7. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 2.2.1.8 PPEs 2.2.1.9 DMP					
	2.3 Uncontrolled drainage from H/S	2.3.1 Possible fire/ explosion, safety hazard.	2.3.1.1 SOPs 2.3.1.2 Gas detection system. 2.3.1.3 ESD on manual intervention. 2.3.1.4 Drainage is strictly manned. 2.3.1.5 Inspection & maintenance. 2.3.1.6 Fire detectors and Fire fighting system. 2.3.1.7 Vapour trap/water seals provided in the kerb wall 2.1.1.8. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC)	C	4	M		

PROJECT	HAZID Study for IOCL LPG Bottling Plant, Pattikalan	SESSION DATE	April 23rd, 2014
CLIENT	Indian Oil Corporation Limited	JOB NO	J0519
SECTION	LPG Bottling Plant		

GUIDEWORD	CAUSES	MAJOR EFFECTS	PREVENTIVE & MITIGATION MEASURES	FREQ	CONS	RISK	RECOMMENDATION	ACTION BY
			2.4.1.9 PPEs 2.4.1.10 DMP					
3. Toxic exposure.	NFH							
4. High/ low Pressure	4.1 LPG pump discharge closed.	4.1.1. Possible damage to pump and discharge line causing leakage/ rupture, safety hazard.	4.1.1.1. Inspection 4.1.1.2. Double Mechanical seal failure leads to pump trip. 4.1.1.3 Gas detection system at pump house. 4.1.1.4. PAVs provided in the pump discharge line 4.1.1.5. Fire detectors and Firefighting system. 4.1.1.6. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 4.1.1.7 ESD on manual intervention. 4.1.1.8 SOP/ DO'S AND DONT'S	C	3	M		
	4.2 LPG pump suction blocked.	4.2.1 Possible pump damage due to dry running leading to pump	4.2.1.1. Inspection 4.2.1.2. Vapour lock protection for pumps.	B	3	L		

PROJECT	HAZID Study for IOCL LPG Bottling Plant, Pattikalan			SESSION DATE			April 23rd, 2014	
CLIENT	Indian Oil Corporation Limited			JOB NO			J0519	
SECTION	LPG Bottling Plant							
GUIDEWORD	**CAUSES**	**MAJOR EFFECTS**	**PREVENTIVE & MITIGATION MEASURES**	**FREQ**	**CONS**	**RISK**	**RECOMMENDATION**	**ACTION BY**
		failure	4.2.1.3. SOP/ DO'S AND DONT'S					
5. High/low temperature	5.1 High fluctuations in ambient temperature.	5.1.1 Possible wear & tear due to thermal expansion and contraction.	5.1.1.1 Proper design accounting for historical weather data. 5.1.1.2. Equipment interlock with Cooling water 5.1.1.3. PAVs provided in the entire facility 5.1.1.4. High discharge Temperature trip for Compressor.	B	2	L		
	5.2 External fire.	5.2.1 Possible Horton Sphere/ system failure leading to consequence escalation.	5.2.1.1. Fireproof coating on the legs of H/S 5.2.1.2 Fire detectors and Fire fighting system. 5.1.1.3. Sprinklers based on Quartzoid Bulb (triggers at 79 DegC) 5.2.1.4 SRVs on H/S and Bullet. 5.2.1.5. PAVs provided	B	4	M		

PROJECT	HAZID Study for IOCL LPG Bottling Plant, Pattikalan			SESSION DATE			April 23rd, 2014	
CLIENT	Indian Oil Corporation Limited			JOB NO			J0519	
SECTION	LPG Bottling Plant							
GUIDEWORD	**CAUSES**	**MAJOR EFFECTS**	**PREVENTIVE & MITIGATION MEASURES**	**FREQ**	**CONS**	**RISK**	**RECOMMENDATION**	**ACTION BY**
			5.2.1.6 DMP					
6. Dropped Object	NFH							
7. Maintenance	7.1 Inadequate/ improper maintenance of equipment/ instrument.	7.1.1 Possible failure. Safety hazard and equipment/ instrument damage.	7.1.1.1 Inspection 7.1.1.2 Proper maintenance procedures and schedule.	C	2	L		
8. Confined Spaces	8.1 Inspection and maintenance.	8.1.1 Personnel injury.	8.1.1.1 SOP 8.1.1.2 Permit to Work 8.1.1.3. Personnel support by various means 8.1.1.4. Use of explosive meter before entering.	B	3	L		
9. Access/Egress/ Escape /Evacuation	9.1 Emergency scenario (fire / explosion)	9.1.1 Escalation of hazardous situation.	9.1.1.1 Periodic mock drills. 9.1.1.2. Emergency response drill 9.1.1.3. Proper training for emergency scenarios. 9.1.1.4. Emergency Gates at various points	B	4	M		

PROJECT	HAZID Study for IOCL LPG Bottling Plant, Pattikalan			SESSION DATE			April 23rd, 2014	
CLIENT	Indian Oil Corporation Limited			JOB NO			J0519	
SECTION	LPG Bottling Plant							
GUIDEWORD	**CAUSES**	**MAJOR EFFECTS**	**PREVENTIVE & MITIGATION MEASURES**	**FREQ**	**CONS**	**RISK**	**RECOMMENDATION**	**ACTION BY**
			9.1.1.5. Emergency Assembly Point 9.1.1.6. Mutual aid 9.1.1.7. ESD on manual intervention.					
10. Extreme weather	10.1 Lightning. 10.2. High wind speed. 10.3 Earthquake. 10.4 Heavy rains.	10.1.1 Personnel injury and possible damage to equipment.	10.1.1.1 Proper design accounting for historical weather data. 10.1.1.2 Proper grounding and earthing of equipment/ buildings. 10.1.1.3 Lightning arrestors on high mast towers/Sheds 10.4.1.1 Adequate drainage system (with provision of water seals)	A	3	L		
11. Radioactivity	NFH							
12. Explosives (Other than LPG)	NFH							
13. Sabotage/ Piracy/ Acts of Terrorism/ Theft	13.1 Pilferage/ sabotage.	13.1.1 Personnel injury. 13.1.2.May lead to Property damage	13.1.1.1 Access control and Security. 13.1.1.2 Frisking of Plant Personnel 13.1.1.3 CCTVs at	B	3	L		

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CLIENT	Indian Oil Corporation Limited			JOB NO			J0519	
SECTION	LPG Bottling Plant							
GUIDEWORD	**CAUSES**	**MAJOR EFFECTS**	**PREVENTIVE & MITIGATION MEASURES**	**FREQ**	**CONS**	**RISK**	**RECOMMENDATION**	**ACTION BY**
			various locations 13.1.1.4. Periodic mock drills 13.1.1.5. Surprise night inspection/mock drills to ensure plant personnel awareness 13.1.1.6. In-house Intelligence cell 13.1.1.7.Quick Response Team 13.1.1.8. Bomb threat contingency plan 13.1.1.9. Security contingency plan					
14. HAC	14.1 Improper HAC	14.1.1 Safety hazard. Possible damage to equipment.	14.1.1.1 HAC as per established guidelines. 14.1.1.2 Equipment/ instrument selection as per HAC.	B	3	L		
15. Electrostatic	15.1 Charge generation/development during routine operations	15.1.1 Fire/explosion hazard	15.1.1.1 Bottom filling of the bullets/Horton Sphere. 15.1.1.2 Proper grounding and earthling/bonding of	B	3	L		

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GUIDEWORD	**CAUSES**	**MAJOR EFFECTS**	**PREVENTIVE & MITIGATION MEASURES**	**FREQ**	**CONS**	**RISK**	**RECOMMENDATION**	**ACTION BY**
			piping/ equipment 15.1.1.3. Use of non-sparking tools in the facility 15.1.1.4 Antistatic Mastic flooring 15.1.1.5. Use of Safety shoes					
16. Electrical Fire	16.1. Electrical fittings failures 16.2 Short circuit 16.3 Unsuitable electrical fitting	16.1.1 Fire/explosion hazard	16.1.1.1. Suitable electrical fittings as per HAC 16.1.1.2. Electrical tripping 16.1.1.3. Use of insulating mats for working in electrical areas 16.1.1.4 Fire extinguishers 16.1.1.5 Permit to Work 16.1.1.6 PPEs 16.1.1.7 Trained and certified operators 16.1.1.8.First-aid Trained personnel	C	3	M		

APPENDIX C- ATTENDANCE SHEET

Chilworth Technology (Pvt.) Ltd

HAZID/ HAZOP ATTENDANCE RECORD

Date : 23rd April 2014

Job No. : J0519 IOCL Pattikalan

Name	Company	Department	Signature
Siddhant	CTPL	HAZOP / HAZID Facilitator	Siddhant
Sujeet Kr	IOCL	LPG operations.	