
Enquiry Committee Report

Major Fire at ONGC Hazira Plant On 24.09.2020



PETROLEUM AND NATURAL GAS REGULATORY BOARD
1st Floor, World trade Centre, Barakhamba Road, Babar Lane, New Delhi-1
Tel No: 011- 23457700/23457744/23457751

CONTENTS

Section	Description	Page No
1	Introduction	3
2	Constitution of Enquiry Committee by PNGRB	3
3	Methodology adopted by the Committee	4
4	Brief about the Plant and Process	4-8
5	Preliminary briefing of incident by ONGC	9-13
6	Inspection of accident site by Committee	13-16
7	Interaction with eyewitness	16-17
8	Inspection of Control room and review of process data	18
9	Inspection of CCTV footage	19-25
10	Observations/Finding (lapses/shortcomings) observed by the Committee	26-30
11	Root cause of the failure	31-33
12	Improvements / remedial measures to prevent recurrence of such incidents	33-36

Detailed Report of Enquiry Committee constituted by PNGRB to investigate the major fire occurred at ONGC Hazira Plant on 24.09.2020

1. Introduction

It was informed by ONGC that a small to moderate Fire broke out in Gas Terminal (36-inch line coming from offshore) a part of Hazira Plant of ONGC at around 0305 hrs (in the early morning) of 24.09.2020 due to leakage of gas from a gas line. This lead to actuation of emergency alarm system and shut down of the Plant.

Ignition of the vapour cloud and large scale depressurizations, actuated due to shut downs of the units, resulted in a blast like noise. Corresponding units of the Plant were isolated & depressurized. The Fire was brought under control and completely extinguished at 0730 hrs. No casualty or injury to any person has been reported.

ONGC's initial incident report in the prescribed format of PNGRB is enclosed at **Annexure 1**.

2. Constitution of Enquiry Committee by PNGRB

Vide office Order dated 30.09.2020, an enquiry committee of following persons was constituted by PNGRB to investigate the incident.

1. Shri G S Wankhede, Former Executive Director, BPCL
2. Shri Badal Roy, Former Executive Director, ONGC
3. Shri. U S Sahay, Dy. Adviser, PNGRB

The terms of reference of the enquiry committee were as under: -

1. Identify lapses/shortcomings
2. Establish the root cause (s) of failure
3. Suggest improvements / remedial measures to prevent recurrence of such incidents

A copy of the Office Order No. PNGRB/Tech/12-Inci/ (1)/2019, dated 30.09.2019 is attached at **Annexure 2**.

3. Methodology adopted by the Committee

The committee visited the incident site and carried out the investigation from 5th to 8th October'2020. The committee inspected the site where massive fire occurred and interacted with a number of eyewitnesses including ONGC and CISF personals who were involved in the plant operations and firefighting activities.

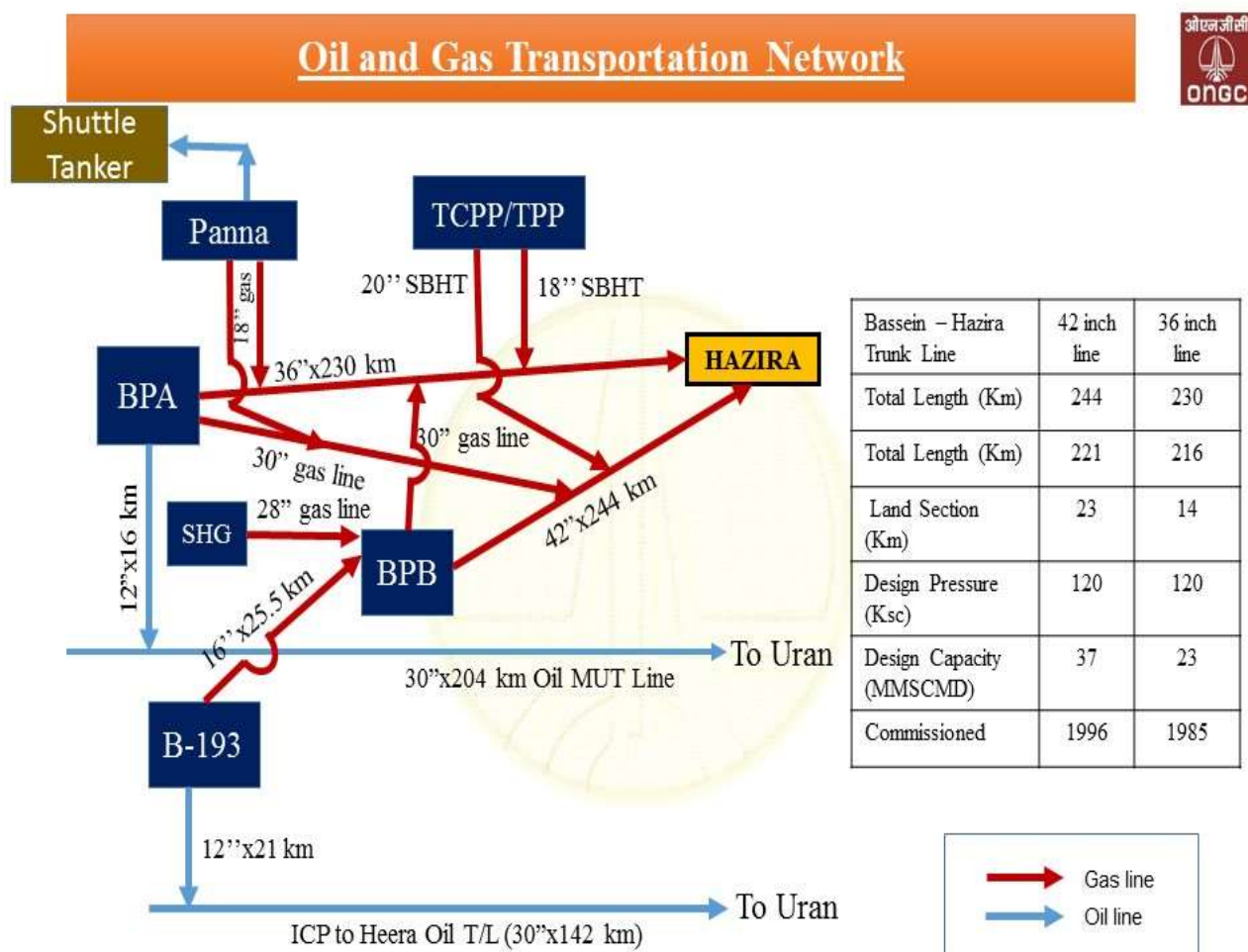
Keeping the above terms of reference in view, the committee adopted the following methodology for investigation:

- i. Brief presentation on Plant and Process by ONGC.
- ii. Preliminary briefing about the incident by ONGC. Discussion with plant Manager and other key personnel.
- iii. Inspection of accident site.
- iv. Study of the prevailing circumstances and the ongoing processes preceding and during the accident.
- v. Discussion with shift crew and other personnel present in the plant at the time of the accident and other technical personnel having knowledge of the processes and facilities in the plant.
- vi. Recording of statements of shift personnel and other personnel present at the time of accident.
- vii. Study of the available video footage from the CCTV cameras of the area of the accident during the period preceding the accident and during the accident.
- viii. Collection of evidence in form of records and electronic data.
- ix. Brainstorming among the committee members based on the facts and findings and conclusions.
- x. Final observations in line with the terms of reference.

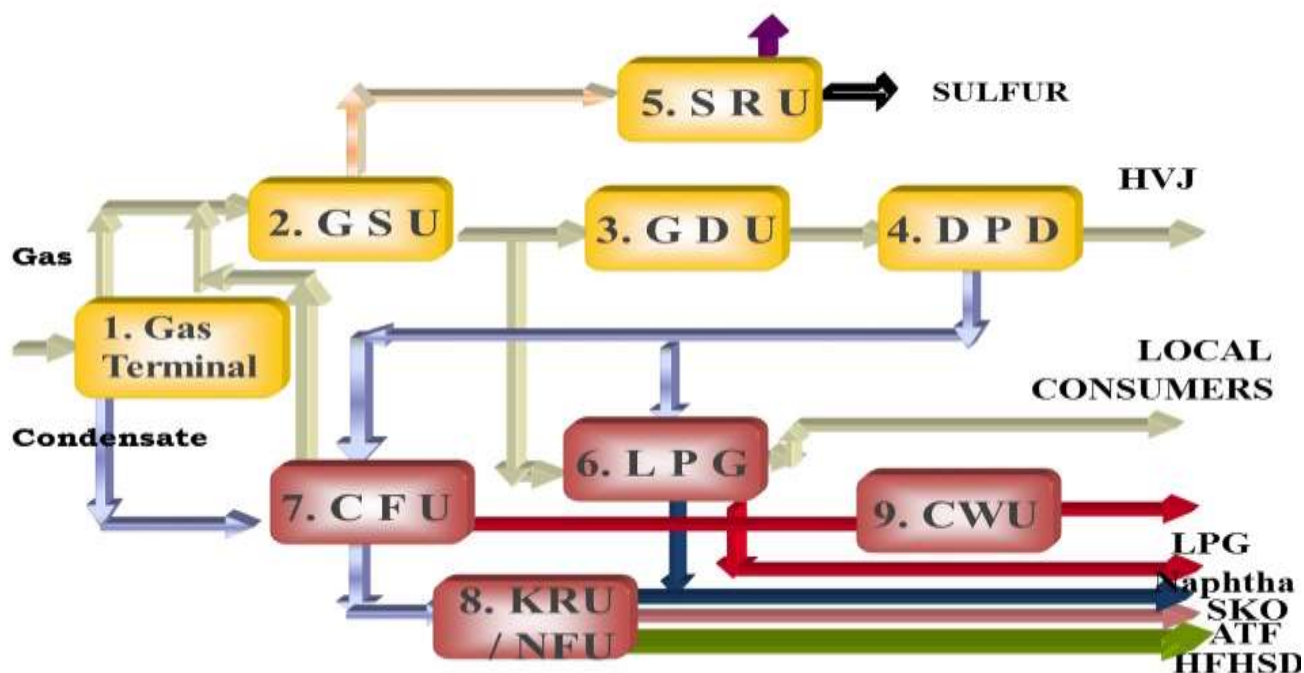
The Committee submitted its preliminary report on 14.10.2020. A copy of the preliminary report is attached at **Annexure 3**.

4. Brief about the Plant and Process:

Oil and natural Gas Corporation Ltd. owns and operates Gas processing plant located at Hazira. The Gas along with certain amount of condensate being processed at Hazira plant is received from Mumbai Offshore fields of ONGC through two trunk lines. One 36", 230 Km long pipeline commissioned in 1986 and other 42", 244Km long pipeline commissioned in 1996. The 36" pipeline has one valve station at its landfall point at Umbharat followed by three more valve stations at Danti, Dumas and Gaviyer before it enters the Hazira plant. The length of pipeline from last valve station at Gaviyer to Hazira plant is 1.7 Km. Similarly, the 42" pipeline has one valve station at its landfall point at Umbharat followed by two more valve stations at Bhata and Abhva before it enters the Hazira plant. The length of pipeline from last valve station at Abhva to Hazira plant is 5.3 Km.



4.1 Process Flow Diagram:



Sour Gas and Condensate from Offshore is received in Hazira Plant at Slug Catcher where gas and liquid condensate is separated by gravity into two streams, viz. gas and liquid. There are three sets of Slug Catchers which are a set of parallel pipe fingers of 48-inch diameter and approximately 490 meters in length. These pipe fingers are mounted at a slope and forms separation and collection zone. The sour gas separated is taken out from top riser pipes to the Gas Sweetening Units through the cyclone separators / filters and the metering skid. After processing the gas for sweetening, dehydration and pour point depression in a series of units, the sweet dehydrated gas is supplied into the HVJ pipeline. Sour liquid collected is routed to Condensate Fractionation Unit (CFU) through the Condensate metering skid. Sour Condensate received from the Slug Catcher is fractionated in Condensate Fractionation Unit (CFU) for removal of H₂S and to produce LPG & NGL (Natural Gas Liquids). NGL thus produced forms the feedstock for Kerosene Recovery Unit/NGL Fractionation Unit (NFU). Stripped off natural gas from the sour condensate, in this process, is compressed and sent to the feed stream of Gas Sweetening Units. NGL produced from Condensate Fractionation Unit is given further value addition in KRU / NFU by way of producing Naphtha, Superior Kerosene Oil (SKO) / Aviation Turbine Fuel (ATF) and High Speed Diesel (HSD). NGL Fractionation Unit has been commissioned for processing the heavier condensate from Daman field.

LPG from Condensate Fractionation Unit (CFU) contains H₂S and is therefore sour in nature, this is sweetened in this unit to bring down the concentration of H₂S within the permissible limits before it is sent for storage.

4.2 Process Facilities in Details:

The feedstock in the form of Sour Gas and Sour Gas Condensate is received from different fields of ONGC Offshore Assets located in Mumbai Offshore.

1. **Gas Terminal:** Sour Gas and Condensate is transported from Offshore through two 240 km long 36" & 42" subsea pipeline with landfall point at Umbharat, which is about 30 kms from Hazira Plant. Gas and Condensate from Offshore is received in Hazira Plant at Slug Catcher where gas and liquid condensate is separated. Gas Terminal is a specially constructed onshore terminal for receiving the Sour Gas and Associated Condensate from ONGC Offshore Fields. The Sour Gas and Condensate, received from Offshore in a multiphase flow, are separated by gravity into two streams, viz. gas and liquid. For this, the fluids coming from offshore trunk pipelines are routed through a set of Pressure reduction control system and then distributed to slug catchers for separation of gas and liquid. There are three sets of Slug Catchers. Slug Catcher I and II are having 24 fingers each and Slug Catcher III consists of 6 fingers. Slug Catchers are a set of parallel pipe fingers of 48 inch diameter and approximately 490 meters in length. These pipe fingers are mounted at a slope and forms separation and collection zone. The sour gas separated is taken out from top riser pipes to the Gas Sweetening Units through the cyclone separators / filters and the metering skid. Sour liquid thus collected is routed to Condensate Fractionation Unit (CFU) through the Condensate metering skid.
2. **Gas Sweetening Units (GSU):** The main objective of the Gas Sweetening Unit is to remove H_2S from sour gas for supply of sweet gas to consumers. The worldwide renowned MDEA process, licensed by SNEA (P) France, is adopted for Gas Sweetening. Acid gas liberated, in the sweetening process, forms the feed for the Sulfur recovery unit.
3. **Gas Dehydration Units (GDU):** Sweet gas from Gas Sweetening Unit is then taken through the Gas Dehydration Unit. This unit aims at removal of moisture from the sweetened gas. Tri ethylene glycol (TEG) process is adopted for Gas Dehydration. Due to their hygroscopicity, glycols are widely used for this purpose. Sweet Dry Gas from the unit forms the feed for Dew Point Depression Unit.
4. **Dew Point Depression Units (DPD):** Sweet and Dehydrated gas from GDU is then chilled to subzero temperature in this unit to lower the Hydrocarbon dew point of the gas well below the minimum temperature - which the gas may attain in the HVJ

pipeline. Hydrocarbon condensate recovered in this process (called sweet condensate in Hazira Plant) is pumped to the LPG or CFU Plant for production of Value Added Products. Outlet gas from DPD Unit is then transferred to GAIL for onward transportation through HVJ Pipeline.

5. **Sulfur Recovery Unit (SRU):** Sulfur Recovery Unit, employing LOCAT process, aims at converting acid gas in to elemental sulfur. Acid gas from the Gas Sweetening Unit enter the oxidizer / absorber of SRU where it comes in contact with the catalytic LOCAT solution and is thus converted into Sulfur. The vent from SRU consists predominantly of CO₂ with traces of H₂S, hydrocarbons, moisture, etc.
6. **LPG Unit:** A part of sweet gas from outlet of Gas Sweetening Unit and the sweet condensate from Dew Point Depression Units are taken as feed to LPG Recovery Unit. The LPG Plant recovers LPG and Naphtha from the sweet gas & sweet condensate and supplies lean gas to various local consumers. Turbo-Expander is used in the Unit for producing LPG & Naphtha through Cryogenic Process.
7. **Condensate Fractionation Unit (CFU):** Sour Condensate received from the Slug Catcher is fractionated in this unit for removal of H₂S and to produce LPG & NGL (Natural Gas Liquids). NGL thus produced forms the feedstock for Kerosene Recovery Unit/NGL Fractionation Unit (NFU). Stripped off natural gas from the sour condensate, in this process, is compressed and sent to the feed stream of Gas Sweetening Units.
8. **Kerosene Recovery Unit (KRU)/ NGL Fractionation Unit (NFU):** NGL produced from Condensate Fractionation Unit is given further value addition in KRU / NFU by way of producing Naphtha, Superior Kerosene Oil (SKO) / Aviation Turbine Fuel (ATF) and High Speed Diesel (HSD). NGL Fractionation Unit has been commissioned for processing the heavier condensate from Daman field.
9. **Caustic Wash Unit (CWU):** LPG from Condensate Fractionation Unit (CFU) contains H₂S and is therefore sour in nature, this is sweetened in this unit to bring down the concentration of H₂S within the permissible limits before it is sent for storage.

The volumes of gas and condensate handled are as under:

FY	Gas in MMSCM	Condensate Receipt KT
2018-19	12258.588	1297.709
2019-20	11865.984	1237.8795
2020-21(till Sept'20)	5202.780	500.384

5. Briefing of incident by ONGC

Following sequence of events was informed by ONGC during their presentation given in the presence of Plant Head and briefing to the Committee.

A) Incident:

- At around 0215hrs.on 24th September, CISF Constable Sh. Chavare Vishal Suresh who was deployed on duty at Watch Tower no: 3 located on the north west periphery of the plant, observed noise followed by vapour cloud from Gas Terminal area located near the tower towards its north. He informed about the incident to CISF Main Gate Control Room, Fire Station, Main LPG Control Room and to the Patrolling party which happened to be in the area at that time.
- At about the same time, CISF Head constable, Sh. G S Rao, posted at Gas Terminal-Gate, located towards east of the Gas terminal, heard the noise and observed vapor cloud in Gas Terminal Area. Sh. Rao reported about the leakage to CISF Main Gate Control Room and CCTV Control Room. Based on the above information CISF SI Sh. Rakesh Kumar observed the affected area through CCTV.
- Based on the information received, at around 0218 Hrs. CISF sub-inspector Sh. Rakesh Kumar observed the affected area through CCTV and informed Mr N. R. Shaikh, CE (P) in Gas Terminal Control Room.
- Mr. N. R. Shaikh, CE (P) & Mr. Aakar Patel, JEA (Mech)-F1, who were performing night shift duty in Gas Terminal observed the vapour cloud and made attempts to approach the affected area to locate the source of leakage. However, they couldn't approach due to dense Vapour Cloud.
- Around 0220 hrs. Mr. Shaikh Informed about the status of Vapour Cloud & Leakage to GSP Shift In-charge, Sh. D K Deb, DGM (P), LPG Shift In charge, Sh. R Ram Kumar Babu, DGM (P) & CFU Panel Engineer in Main Control Room.
- GSP Shift In-charge, Sh. D K Deb immediately informed about the Leakage to Sh. J. R. Phukon, over-all Shift In-charge (Site Incident Controller (SIC)).
- SIC-Sh. Phukon along with GSP shift In-charge reached the site and informed Fire Station to abstain from any vehicle movement near incident area and to remain alert & Standby.
- Subsequently, the road leading to Slug Catcher from the main road and opposite side was barricaded by CISF team.

- i) Meanwhile, LPG shift In-charge from Main Control Room informed about the incident to Chief Resident Engineer (CRE), Sh S. Umesha-GM (P), Head Operations (HO), Sh J V N Rao, CGM (P) and Plant Manager, Sh. D M Roy, GGM Simultaneously, GSP Control Room informed Offshore about the leakage in Hazira Plant and to remain alert.
- j) Resident Engineer arrived at the incident site and based on assessment of SIC, block valve of Ph-I condensate metering skid near PH-I Slug-Catcher Liquid outlet was closed.
- k) Head Operations and Area In-charge, Sh Malaya Kumar Mishra, GM (P) simultaneously reached at site. Sh J V N Rao being head operations immediately took the charge as SIC. Based on the assessment of leakage, SIC-Sh. J V N Rao, immediately instructed to isolate the system and initiate shutdown procedure. (0300-0308 hrs.)
- l) At 0304 hrs IST hrs. Pressure Control Valve of 36" Pressure Reducing Skid was closed by Mr. N. R. Shaikh from Gas Terminal Control Room.
- m) SIC-Sh. J V N Rao instructed through Walkie-Talkie to Main Control room to inform Offshore and stop supply of Gas and Condensate in 36" & 42" trunk lines.
- n) Main Control Room also conveyed the message for halt in supply of Gas to HVJ consumer line including KRIBHCO.
- o) Simultaneously, Area In-Charge with his team was also instructed for isolation of Trunk-line Sectionalization Valves in Gavier (36") and Abhwa (42") by Head Operations-(SIC).
- p) Fire broke out at around 0308 hrs. IST.

B) Actions:

- a) All the Shift crew with SIC in Gas Terminal Control Room and field moved out of the area. No one was injured.
- b) While evacuating the area SIC informed Sh Ram Kumar Babu, LPG Control Room Shift In-charge on walkie-talkie about the fire and instructed to immediately convey for complete offshore shutdown and for sounding the major fire at level-II siren and Mutual Aid members were called to assist. Observing that fire was spreading fast. SIC-Sh J V N Rao declared level-III Off-Site Emergency in consultation with Plant Manager.
- c) At 0310 hrs IST, Sh P. I. Macwana, DGM(P), GSP Control Room, informed Offshore (VCR control Room) to stop the Gas supply in 36" and 42" SBHTs.
- d) SIC-Sh J V N Rao, reached LPG control room and took stock of the situation. He also observed that instrument air pressure was healthy and compressors were operational. All GSU, GDU, DPD, SRU, LPG, CFU and KRU Trains were shutdown. Meanwhile, Cogeneration Control Room was also informed that Gas availability for GTs and Boilers will not be available. Accordingly, GTs and Boilers were shutdown. Steam was no more available and power was available from the grid. Cooling towers were kept functioning.

- e) Plant Manager immediately took the charge as CIC and reached Emergency Control Room.
- f) Isolation & depressurization of connected process units was started as per procedure.
- g) All process Panel engineers took necessary actions in their process areas after the shutdown for securing their units.
- h) Immediately, Fire personnel were instructed to approach for cooling of the surrounding area.
- i) At 0330 hrs. IST. Team of Area In-Charge deputed for closure of Sectional Valves confirmed that Isolation valves at Sectionalisation Valves stations at Gavier (36 Inch) and Abhwa (42") were closed.

Depressurisation/Fire Fighting:

Plant shutdown of all downstream units and depressurization started. with following actions:

- Depressurization of Gas Section was initially carried out from all the GSU trains. (Train #31 to #39).
- Gas Side 24"-Interconnection valve between Slug-Catcher Ph-I & II was closed to isolate the Slug-Catcher-I & Slug Catcher-II.
- Subsequently after segregation of Gas Sweetening Phase-I & II from Phase-III & IV, Gas Section depressurization continued through Train #31 to #34 of GSU. (Refer sheet no. 8 & 9 at Annexure-1)
- Initially, liquid condensate of Slug- Catcher - I & II was evacuated to reduce inventory through all Condensate Fractionation Units i.e. Train #71-77.
- CFU header 8"-interconnection valve between CFU Phase-I and CFU Phase-II was closed to isolate the Slug-Catcher-I &II (liquid side) (Around 04.30 hrs. IST)
- Subsequently after segregation Slug-Catcher Phase-I and Phase-II condensate header, depressurizations continued from CFU train # 71 & # 72.
- Control room personnel were instructed to ensure operation of Flare KOD pumps if level rises in them. After some time, SIC received the confirmation from field that there was no liquid level build up in the KODs.
- SIC instructed Area-In charge Utility Sh. S.K. Chand to ensure that all cooling water systems remain functional.
- SIC instructed Sh. Bir Singh Chauhan, Fire Officer over walkie Talkie to approach the area and start fire monitors. Cooling in the area was started around 0350 hrs.

- Parameters of Fire water system were closely monitored from the main LPG control room. Both the Tank level and the Fire water header pressure were healthy throughout the incident. Three electrical Fire water pumps namely 47PE003 A, C, D were operated during the cooling activity.
- Sh P.K.Patel, I/c Raw Water system confirmed that he had reached the Raw Water Pump House and is ensuring supply to the Fire water tank in main fire water pump house.
- As the fire intensity reduced and Fire team provided Water Curtain. Temperature of surrounding area dropped and it helped in access of Isolation valve no. MOV# 50 & 52.
- Inlet Valve of Slug Catcher-I & outlet valves (MOV# 50 & 52) were closed to isolate bulk of Hydrocarbon (both Gas & Condensate) from Slug-catcher to the affected area.(Around 05:30 Hrs IST)
- After depletion of the hydrocarbons in the affected section the fires subsided and fire was brought in control by 06:00.
- Cooling operation continued in affected area.
- MOV# 03 (Isolation Valve) in the inlet of 36” Trunk line was closed at round 0700 Hrs. IST as the area was now approachable. This action ensured the isolation of 36” main trunk line feed to Hazira Plant.
- After ensuring zero LEL and head count, SIC – Sh. J V N Rao recommended all clear to CIC.
- All clear declared by CIC at 07:30 hrs.

Losses

- i)No fatality or injury reported due to the incident.
- ii) 36” condensate facilities/pipelines to CFU are badly damaged and needs major replacements.
- iii)Minor environment damage to few trees

Sequence of major events:

Following sequence of events were communicated to Committee by ONGC.

Time (hrs.)	Events
02:15	CISF Constable Sh. Chavare Vishal Suresh observed vapour cloud, informed to CISF Main Gate Control Room, Fire station & Main LPG Control Room.
02:15	CISF Head Constable, Sh. G S Rao observed vapour cloud, informed to CISF Main Gate control Room & CCTV Control Room.
02:18	CISF SI Sh Rakesh Kumar observed the heavy leakage and formation of gas cloud through CCTV.
02:20	Gas Terminal Control Room received phone call from CCTV Control Room.
02:20	Gas Control Room informed to GSP Shift in charge, LPG Shift in Charge & Main Control Room.
03:04	Pressure Control Valve of 36" Pressure reducing Skid was closed.
03:08:15	Fire broke out. (as per CCTV footage)
03:10	GSP Control room informed offshore (VCR Control room) to stop the gas supply in 36" & 42" lines.
03:11	Fire Fighting Started.
03:30	Closure of Sectionalisation Valves at Gavier 36" & Abhwa (42").
06:00	Fires subsided was brought in control.
07:00	MOV 3 (Isolation Valve) in the inlet of 36" was closed.
07:30	All clear declared.

6. Inspection of accident site by Committee

Enquiry committee visited sites and made observations as below:

(a). Damaged plate of meter 310FT01



(b). Plate of meter 310FT02 in place



(c). Damaged pipelines



(d). Overview of both meters of condensate pipelines



(e). Gas pipeline view



(f). Open FLP fitting (probable ignition source)



(g). Damaged condensate metering area



(h). Overview of part area with tower where CCTV is provided



(i). Damaged pipelines/structures



7. Interaction with eyewitness:

Following persons working on the fateful night of fire incident were interviewed to get the possible scenario of the incident.

(a). Constable, CISF: Mr. Chavare Vishal Suresh was on duty at Watch Tower No:3 from 2100 hrs on the north west periphery of the plant. At 0215 hrs, he observed noise followed by vapour cloud from Gas Terminal Area. He informed CISF Main Control room, Fire Control room and LPG Control room. Later CISF patrol vehicle reached at site and he informed Mr N.S. Negi, CISF personal and left the location with him.

(b). Head Constable, CISF: Mr. G S Rao was on night shift duty at Gas Terminal Gate, located towards east of the Gas terminal. At 0215 hrs, he heard the noise and observed

vapour cloud behind Gas terminal building. At 0216. He informed CCTV Control room and CISF main gate control room.

(c). Sub-Inspector, CISF: Mr. Rakesh Kumar was on night shift duty at CCTV Control Room. At 0215 hrs, he received phone call from Mr G S Rao Gas regarding noise and vapour cloud behind the Gas terminal building. He informed Gas terminal control room and CISF main gate control room.

(d). Mr. N R Shaikh, CE(P): Mr. Sheikh was on night shift duty from 2000 hrs at Gas Terminal Control Room. At around 0220 hrs Mr. Sheikh heard alarm on the annunciator panel and the same time he received a phone call from CISF SI Rakesh Kumar from CCTV Control room informing him about some vapour cloud or steam leakage in Gas Terminal PH I area. Mr Sheikh along with Mr. Aakar Patel JEA(Mech-F-1) went outside the control room and saw the heavy cloud in phase I area. Sh. N.R Sheikh then informed GSP Shift I/C Shri D.K. Deb, LPG S/C Sh. Ram Kumar Babu & CFU panel engineer in Main Control Room.

(e). Mr. Aakar Patel, JEA (M): Mr. Patel was on night shift duty from 2000 hrs at Gas Terminal Control Room. At 0220 hrs Mr. Patel heard alarm and phone call simultaneously. He went out of the control room and observed leakage and intense smell from Phase-I area. Visibility was very poor. He informed the site situation to Mr. Sheikh.

(f). Mr. Dipak Kumar Deb, DGM (P): Mr. Deb was on GSP shift In-charge duty. At around 0235 hrs, Mr. Deb received phone call from LPG Control Room and Gas Terminal control room, it was informed that heavy gas leakage near 36” metering area. Mr Deb along with Overall Shift Incharge (Mr J R Phukon) reached at Gas Terminal Gate. Mr Deb tried to enter the Gas Control room area but could not enter due to heavy gas smell. He informed Fire station to abstain from any vehicle movement in the plant. He has informed LPG C/R and GSP C/R. Further Mr Deb closed the MOV 54 inlet condensate line from slug catcher to 36” metering area at about 0301 hrs. Thereafter fire occurred.

(g). Mr. J R Phukon, GM (P): Mr. Phukon was on overall shift in-charge duty. Mr Phukon received phone call from LPG C/R at around 0235 hrs regarding the leakage in Gas Terminal Area. Mr Phukon along with Mr deb reached at site and informed the Fire station to remain alert and be on standby. Mr Phukon phoned Gas Terminal Control Room and instructed to close the 36” line pressure control valve and get out of the control room. He informed LPG C/R and asked immediately informed to Resident Engineer, Head operations, Plant Manager and all other concerned.

8. Inspection of Control room and review of process data:

8.1 Following document/reports were made available by ONGC and those were reviewed by the committee at site:

- Organogram
- Layout of the Plant
- Layout of Plant along with F&G detectors
- Layout of MCP-Gas Terminal
- P&ID of Pipelines receiving Gas
- Details of 36" pipeline route map
- Self Safety Audit Report
- Internal Safety Audit Report
- External Safety Audit Report
- Maintenance data of condensate meters
- Pipeline thickness data
- Work permit
- Monthly fire drills

9. Inspection of CCTV footage:

CCTV footage of cameras available at the plant were made available to committee. CCTV footage was clearly showing the movement of Gas terminal shift personnel before the fire incident. This CCTV camera was installed in between the Gas Terminal area and Gas terminal control room.

(a). Time – 02:11:43 (Dated 24.09.2020), Clear picture of facilities



(b). Time – 02:12:50 (Dated 24.09.2020), Commencement of Vapour leakage



(c). Time – 02:15:35 (Dated 24.09.2020), Vapour cloud near GT control room



(d). Time – 02:15:41 (Dated 24.09.2020), vapour cloud on road near GT control room



(e). Time – 02:15:45 (Dated 24.09.2020), vapour cloud in piping area



(f). Time – 02:15:49 (Dated 24.09.2020), vapour cloud increased



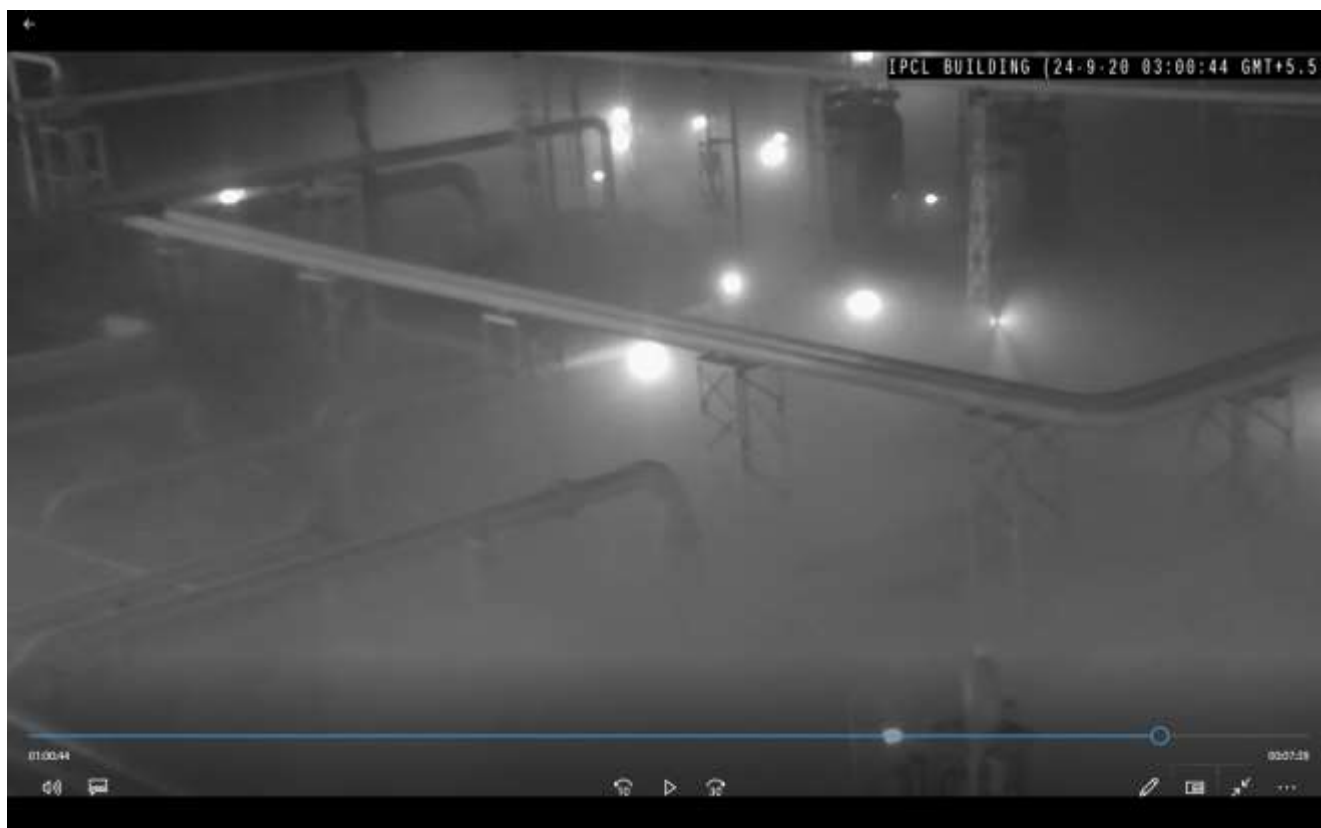
(g). Time – 02:16:04(Dated 24.09.2020), Dispersed vapour cloud



(h). Time – 02:16:13 (Dated 24.09.2020), vapour cloud intense



(i). Time – 03:00:44 (Dated 24.09.2020), vapour all around even at height



(j). Time – 03:08:14 (Dated 24.09.2020), vapour all around even at height



(k). Time – 03:08:15 (Dated 24.09.2020), flash started



(l). Time – 03:08:16 (Dated 24.09.2020), fire occurred



(m). Time – 03:08:17 (Dated 24.09.2020), dense vapour clouds all around



(n). Time – 03:08:20 (Dated 24.09.2020), major fire all around



(o). Time – 03:08:22 (Dated 24.09.2020), major fire continued, CCTV capturing discontinued due to burnt of CCTV cable.



10. Observations/Finding of the Committee:

A. FACILITIES:

- a) Reference drawings no. 02-310-AO-101 Rev.1, 2x6" lines & 1x2" lines for metering system are shown but valves & meters configuration are not matching. As old drawings were lost, new drawings are made by a vendor but the same has not been checked & approved by ONGC. Three Pressure transmitters 310PT4, 310PT5 & 310PT6 are shown in the drawing. It was informed that no pressure transmitter data are available in the system. No pressure data in Gas Terminal area is available/ provided to check rise in pressure in the metering lines.
- b) Time stamping in DCS systems provided in various control rooms is varying from 2 minutes to 12 minutes and data matching is difficult.
- c) 310DT1 has been shown in P&ID but the same is not shown/ configured in the DCS.
- d) MOVs are provided in the gas terminal station for local operations but they are not having remote operation from control room during emergency.
- e) Hydrocarbon/ H₂S detectors are configured to Annunciator Panel for display but not in DCS for history.
- f) F & G detection system does not have provision for auto shut down of plant or activation of fire suppression system.

B. SAFETY:

- a) Safety self-audit is conducted by a multi-disciplinary team based on the checklist prepared by the location. The checklist is comprehensive but not related to specific plants and in the process, lot of observations are missing. The duration of audit is not indicated and in most of the items, compliances are indicated, but during our inspection, the data is found to be incomplete & not in line with OISD standards/ manuals. Approved manuals/ SOPs were not available.
- b) Internal Safety Audit was conducted in 2018 & 2019 for 4 & 3 days respectively by a 3-member committee and the observations are given without the filled checklist. The checklist format is not available to check completeness of audit areas.
- c) External safety audit was conducted in February 2018, and 296 out of 308 recommendations are complied with. Balance are in various stages and dates are extended till 30/04/2021. Document indicating approval from Director Offshore for extending the target date was not available as per the procedure.
- d) Fire drill reports are available in SAP but without any data on actions taken/ recommendations. Separate data is maintained which is not in line with the approved guidelines.
- e) As per SAP notification of incident reporting system, 79 incidences are reported. Classification of incidences is not done properly. Even the product leakage, minor

incidences are classified as nearmiss. NIL reports are sent to OISD. Closing of notification with the recommendations are not carried out properly. Review mechanism by the HSE/OPS / Plant Head is not in place.

- f) Work Permits are issued in SAP and hard copy of work permits are at sites during execution of work. After completion of work, the originals are filed. On checking the same, it was found that few of the work permits were missing. No data is kept on such missing permits. Job safety Plan is not attached/ given in SAP document. Closing of permits & actions indicated in work needs review.
- g) In ERDMP, scenario for Level 3 emergencies are taken from the plant failures. Heavy product/ gas leakages from pipelines & tanks are considered but decision on isolation/closure of plant/pipelines is not mentioned.

FIRE FIGHTING FACILITIES:

- a) Two tanks of 4500m³ & 5000m³ each are provided with replenishment rate of 1800 m³/hr from the reservoir. 4 Electrical and 4 Diesel Driven pump of 410 m³/hr capacity are provided in Phase I & 2 Electrical and 4 Diesel driven pumps of 616 m³/hrs are being commissioned at Ph-II.
- b) Electrical / Diesel fire pumps are operated for 30minutes per week which is not meeting OISD norms.
- c) Capacity test of these pumps are not conducted and records are not available for the deviation.
- d) Out of 4 diesel pumps 410 m³/hr, 2 pumps are under maintenance, one operated for 30 minutes & fourth pumps is tripping after 2 minutes. The reason for tripping is not identified or actions have not been recorded.
- e) Diesel consumption for operating diesel pump is not documented in the logsheet.
- f) Operation & Maintenance of pumps, tanks, pipelines, hydrants/monitors are carried out by various departments such as Utilities, mechanical maintenance & other agencies and therefore the functioning of the equipment is not ensured and as a result, the effectiveness of firefighting gets affected.
- g) Fire stations are manned by CISF staff and firefighting is carried out by CISF under guidance of the Fire Chief. During Shift operations, CISF reports to ONGC shift in-charge instead of the Fire Chief.

MAINTENANCE

- a) Two 6" meters are provided for measuring the condensate flow to CFU and data is transmitted to DCS in Gas terminal station Control Room. These meters are calibrated every 6 months by a team from the plant and B&S Asset Group. During calibration from 17/12/2019 to 18/12/2019, calibration was changed from 16000 mmwc to 2540 mmwc for 310FT01 without any mention of this change in the calibration documents signed by the team. During next calibration for meter 310FT01 was again changed to 16000 MMWC. No checklist is followed while carrying such critical jobs of high pressure/risk.

- b) Notification no. 3800419840 was raised on 17/09/2020 for malfunction of meter no.1. On 18/09/2020, upstream valve was opened by operations & maintenance staff & observed leak from meter. As original gaskets from OEM are not procured, 'O' rings were bought from Local markets & were used without any quality control measures. The meter was taken online after testing at operating pressure only. No SOP was available for calibration methods of these meters of condensate. This notification was not closed after completion of the job.
- c) Cleaning/ servicing/ calibration of meters 1 & 2 was carried out on 12th & 13th Nov 2018. Afterwards, meter no.1 was cleaned on 25/02/2019 & gasket was changed. Again on 18/09/2019, gasket was changed which leaked within one year. Calibration equipment data/ master meter details are not mentioned in the report.
- d) 7935 Notifications are raised during this year & 1060 are pending. Actions are not completed for 252 which are more than 3 months old. No actions are initiated for 79 notifications (more than 3 months old). There is no mechanism for review/ escalation to seniors for the progress/compliance. It was observed that few notifications are closed without entering any proper data on the actions taken/ replacement of materials, etc.

Electrical Maintenance

- a) The system does not have a provision for recording reasons for time overrun of any scheduled preventive maintenance job. Nor is there a provision for escalation of the notification to a higher level in the hierarchy in case of the execution of the job being delayed even for an unlimited time period. The notification simply remains open till the job is undertaken and closed by the executor and in charge on completion. On review of some of the closed notifications, it was observed that the job completion reports were very brief without any details of the job undertaken.
- b) Since most of the gas terminal area is covered under zone 1, all the electrical equipment and fittings including lighting installed in the area are flame proof. Recognizing the importance of maintaining integrity of all the flame proof fittings in the area, an half yearly inspection and maintenance schedule has been developed for these equipment.
- c) The last two schedule preventive maintenance of electrical lighting in the area was taken up January 2019 & October 2019 against notifications raised in January 2019 and July 2019 respectively. The next notification for the job was self - generated in April 2020. This suggests that when execution of a job gets delayed (like the job against July 2019 notification was taken up in October 2019) the schedule automatically shifts to next six months (in this case the notification which should have been generated in January 2020 got generated in April 2020 – six months from October 2020). No reasons for delay in execution of the job in July 2019 were noted while closing the notification. The details of the jobs carried out are also very brief covering only the equipment which have been repaired and give no information about the inspection of other equipment.

- d) The job against the April 2020 notification was not undertaken. There is no record of reasons for non-execution of the job or escalation of notification to higher levels in the hierarchy about the same.
- e) Flame proof Electrical equipment like light fittings or junction boxes are not identified with unique identification numbers, hence it is not possible to know whether a particular fitting has been inspected for integrity of flame proof function during undertaking preventive maintenance. In this case, the likelihood of missing the damaged light fitting or inadvertently keeping the job on it incomplete during one of the previous preventive maintenance jobs cannot be ruled out as no record about its inspection is maintained.
- f) Post the incident, an electrical audit of the affected area was carried out by the plant maintenance team. Considering that the audit was carried out to identify the damage to the equipment, the report is too generic and short (One page) and does not cover details of damages. For example; the report has clubbed all nine 125 W HPMV FLP lamps together and reported 'cable burnt and fitting damaged due to heat' as status for all of them. However, the unique condition of one particular lamp due to the type of damage suffered by it with respect to its area of installation was not mentioned in the report. This also suggests that even after the incident, the inspection was generic and each equipment was not examined for the kind of damage. As a whole, the electrical maintenance system is a lot more skewed towards breakdown maintenance and lays little emphasis on systematic preventive maintenance and inspection.

Corrosion Monitoring & Maintenance

Corrosion monitoring and maintenance of pipeline, piping and static equipment in the plant is under corrosion monitoring group under Asset Integrity maintenance cell. The monitoring of pipeline and piping within the plant is for external corrosion only. For this purpose, ONGC has a contract in place for carrying out periodic NDT of the pipes. The system used for monitoring is spot Ultrasonic thickness measurement of the pipes.

- a) The laid down schedule for thickness measurement is every four years. The agency engaged for carrying out the job has been assigned the comprehensive job of carrying out thickness measurement of the pipes, analyse the results and generate report including isometric drawings and comparison of the results with earlier results. The procedure for selection of location of the spots for thickness measurement is decided by ONGC and the agency works on the guidelines provided by ONGC.
- b) As per the records, the last two thickness measurement exercise was carried out in 2011 and 2017 which suggests that the schedule of four years is not being adhered to strictly.
- c) It is observed that for a large number of pipes, especially in gas terminal area baseline data of pipe thickness is not available. The original drawings and the schedules of the pipes are also not available. In most cases only two thickness

details of 2011 and 2017 is available for a pipe which is commissioned in 1986. Under such circumstances, the process of decision making for taking corrective action on the lines due to reduced thickness is difficult.

- d) The procedure for selection of the spots for measurement of thickness does not ensure that spot thickness is measured at the same spot every time on a particular pipe, hence it is likely that the analysis reports being generated may not be fully correct.
- e) As per the report of 2017, several pipes have been identified with significant thickness loss and need for corrective action. However, even after three years no plan has been developed for the corrective actions to be taken for those lines. Mere measurement of thickness without corrective action does not complete the process of maintaining the integrity of pipes.
- f) In one of the cases, a reduction of thickness of 1.03mm along with heavy pitting and painting peeling off was observed in one of the segments of 36" pipeline in gas terminal in July 2019. The corrective action of painting was completed in Dec. 2019. However, as per the available data, the design thickness of the pipeline is 23.83mm with zero corrosion allowance. It needs to be examined whether painting as a corrective action would suffice in such cases and the mechanism of deciding on a corrective action needs to be reviewed.

Overall, although the process of spot UT survey of pipes are in place, the mechanism of follow up action in terms of decision making, planning and execution is lacking.

GENERAL:

- a) Important telephone numbers are available in a small sheet kept hanging in the Control Panel and difficult to read.
- b) New Control Room (blast proof) for Gas Terminal Station was constructed recently. The layout of various panels is not well planned. Annunciator Panel is behind the main panel & this hindering the view of the alarms in Annunciator Panel. The doors provided in Control room are not blast-proof and are not properly fixed.
- c) It was observed that the control room operations are carried out by persons inadequately trained in safety, operations, control room handling, logbook records and actions during emergency. It is informed that four days training programme is conducted for new recruitment/ transfer staff which is general in nature and later the job training is carried out. Qualification of this staff is also not defined in HR/ Operations Policy. Most of the staff have attended only One Basic Course since 2018.
- d) PELCO make PTZ cameras (Model D5230D) are provided at few places and has turn around (360°) at the time of about 90 seconds. Visibility from this camera is limited.
- e) Management of Change (MOC) philosophy/SOP was published in August 2016. However, the procedure indicated in the document is not implemented while

carrying out change of Low-Pressure Gas to Kribhico from Medium Pressure Gas headers in LPG Plant in 2013 & 2018. It is informed no more MOCs are implemented in the plant since 2018.

- f) Ordinary Registers are used for logbooks and data on the activities conducted, alarms, events during the shifts are not logged properly. Handing over/ Taking over is not recorded.

11. Root cause of the failure:

After thorough investigation, the committee identified the following,

A) Leak:

The site was inspected, and it was observed that the condensate metering skid was totally damaged & various pipelines have got damaged/ shifted. In condensate metering system, two 6" size meters & one 2" size meter are provided. 6" meter with ID 310FE1 was extensively damaged with all bolts out of the flange arrangement and only one bolt damaged for 310FE2 (6" size). The condensate might have leaked from the meter 310FE1. Leakage from pipeline due to corrosion/flange leak from other sources could not be ascertained due to total damage of the pipelines in the area.

Viewing at the footages from CCTV, it clearly indicated huge vapour cloud and condensate lines would have leaked as gas pipelines were intact & not damaged.

Condensate Metering System was checked for performance of meter functioning during 14/9 to 17/9. While checking Meter no.2, it was indicating some jerks from meter 1. SAP Notification 3800419840 dt. 17.09.2020 was raised for checking meter 1.

On 18.09.20, when upstream valve was opened by operations and maintenance teams, leakage was observed from meters. The meter is very old (1986) and having rectangular slot for the gasket. Original Specifications of gasket are not available, and the gaskets were not being procured from the OEMs. Instead, use of locally purchased 'O' ring was done in its place as a regular practice. There was no specification or quality control during the purchase of the 'O' rings. There is no record of date or authority of the decision to switch over from OEM supplied gasket to locally purchased gasket.

For the same meter, these 'O' ring gaskets were replaced on 12.11.2018 and 25.02.2019. After calibration of the meter 310FE01, the gasket was replaced on 18.09.2020. No hydro test was done after replacement of the gasket. The system was only pressurised to operating pressure (Both meters were in line) and isolated. Next day meter 310FE01 was taken on online and was in use at the time of Incident.

Probable cause of leak is due to use of nonstandard gasket and not testing the system to designed pressure. No standard operating procedure is in place for calibration and taking back in service of these meters which are operating at high pressures.



Meter ID 310 FF1



Meter ID 310 FF2

B. Stoppage of Leaks:

Gas Terminal control room was informed about the vapour cloud at about 0220 hrs and same was seen by shift personnel. Vapour cloud was also seen by Shift In-charge/ Overall Shift In-charge However, the valve from slug catcher to condensate metering unit/CFU was closed at 0301 hrs & pressure control valve of 36" was closed from control room at about 0304 hrs. Decision of closure of valve was taken after about 40 minutes resulting the spread of vapour cloud in increased area. As per DMP On site Hazira Plant, guidelines to be followed in case of hydrocarbon leakage are included but does not include isolation/stoppage of facilities/pipelines.

Cause of Ignition:

On inspection of electrical fittings, it was observed that three bolts on one of the flame proof lamps were missing resulting in it being open with its integrity compromised, glass case got detached from the main body and had opened out about 5 to 6 cms. The nearby fittings were found intact. Proper identification of these light fittings/ junction boxes/ etc. is not available. General Data on preventive maintenance and number of fittings/ bulbs replaced is available. No electrical Audit is conducted. The schedule for the inspection is six monthly. Last inspection was carried out in July 2019. No inspection carried out in schedule of April 2020. The closure of work notification is also very brief without any details. As the fire had happened at 0300 hrs and no traces of fire beyond the road inside the plant, the origin of Fire is within Plant only. Therefore, it is concluded that cause of fire is ignition source from electrical fittings.



1. Reconstruction and Analysis of the incident

- i. As per the eye witness, version of the control room crew, recorded data in DCS and CCTV footage, heavy leakage of hydrocarbon started at around 0212 hrs.
- ii. Inspection of the area indicates that the leakage has occurred from the retaining plate of the orifice in the condensate metering skid.
- iii. In the absence of too much wind it developed into a gas cloud.
- iv. The control room crew after examining the situation decided not to enter the gas cloud to find the source of leakage.
- v. The gas cloud in the area was provided with an ignition source by one of the flameproof lamps which had its integrity compromised which resulted in the gas cloud getting ignited.

2. Root Cause(s)

- i. Loss of containment in the condensate metering area due to failure of 'O' ring of the retaining plate of orifice in the condensate metering skid.
- ii. Use of Nonstandard 'O' ring
- iii. Lack of control over material sourcing.
- iv. Ignition of gas cloud due to exposed electrical fitting
- v. Inadequate preventive maintenance systems
- vi. Non isolation/stoppage of 36" pipeline operation

IMPROVEMENTS/ REMEDIAL MEASURES:

Based on inspection of the documentations and the discussion with staff at the location, we give below the recommendations for improvements/remedial measures to be taken as under:

A) Facilities:

1. **P &ID:** All P&ID, made by the vendor, are to be checked and approved with “as built” configuration and preferably digitised.
DCS: All field instruments like Pressure transmitters, hydrocarbon detectors, H2S detectors, Densitometer etc. are to be configured in DCS with proper alarms, events & history archiving. The F&G detection system needs to be interlocked to automatic plant shut down and activation of fire suppression system.
2. **MOV:** All MOVs are to be made remote operated from Control Room.

B) Safety:

1. **SSA:** Checklist for Self-Safety Audit for individual plants are to be developed and audit for 3 to 4 days duration at least twice in an year be conducted by multidisciplinary team & recommendations implemented. Checklist shall be signed on all pages with dates.
2. **ESA:** Status reports of ESA recommendations and compliance are to be made available. In case of extension of compliance dates, approval competent authority to be taken and evidence made available.
3. **Fire Drills:** All data such as actions taken/ observations and recommendations are to be filled/ uploaded in SAP.
4. **Incident Reports:** Proper analysis and reporting of all incidents as per ONGC’s corporate policy is to be done & incidents to be correctly categorised into near miss/ minor incidents. Quarterly review of these incidents is to be done & lessons learnt shall be circulated to all plants.
5. **Work Permits:**
 - i. All non-routine/ hazardous work is to be carried out with a permit to work with proper authorization as per the work permit procedure. Maintenance notifications are not be assumed as permit to work.
 - ii. All completed work permits are to be serially filed & data of missing permits if any, to be documented. Sample Checks/ review of work permits by seniors /team for compliances shall be introduced. Work permit system is to be checked during self-audits.
6. **ERDMP:** Heavy product/ gas leakages from pipelines/ tank rupture may be considered to be included as one of the scenarios and action Plan for the same to be documented in ERDMP.

C) Firefighting:

1. Fire Pumps:

- i. Fire pumps are to be operated twice a week as per OISD standard.
- ii. Capacity Test of each fire pump to be carried out as per OISD standard.
- iii. The logbook needs to include diesel consumption/ start/stop time and maintenance data such as tripping of pump/overheating.
- iv. Periodic inspection and maintenance of the fire water pumps and preservation of the records to be carried out as per relevant OISD standard.
- v. Pumps under maintenance/ new pumps to be commissioned at the earliest.

2. Fire staff:

- i. Development of a dedicated Fire Group may be considered to look after operations/ maintenance of all firefighting equipment and facilities to ensure functioning of all equipment to its specification all the time and single point responsibility for the same.

D) Maintenance:

1. Meters:

- i. During calibration of meters/ other instruments, details of Master calibrator / action taken/ replacement/ deviation from procedure if any, is to be documented in the calibration certificate.
- ii. Proper SOP is to be developed along with checklist for maintenance work on high pressure gas/ liquid pipelines metering system.

2. PM Notifications in SAP:

- i. Escalation methodology for notifications not being attended in time is to be developed and quarterly monitoring of the same done after due classification of notifications in terms of critical/noncritical/urgent.
- ii. Sample checks/ approval of closure of notifications by Senior Officers to be introduced to ensure proper entry of data / actions taken.

3. Pipelines:

- i. Pipeline Thickness data for the year 2011 & 2017 may act as baseline data and thickness measurement to be done in 2020 & 2021 and correlation study can be done to identify corrosion areas.
- ii. Prompt action for appropriate corrective actions is to be undertaken where metal loss is beyond acceptable limits.
- iii. UT meter details / master meter needs to be given in the report.

4. Electrical:

All flame proof electrical fittings and junction boxes need to have proper identification with unique identification tags. Periodic inspection and preventive maintenance of electrical fittings is to be done plant-wise and detailed inspection/ maintenance details to be documented/ uploaded in SAP.

E) Provisioning:

1. In case a decision is taken to develop/procure spares from local market in the event of original spares not being available from OEM, such decision is to be documented with proper authorization from appropriate authority, preferably through Management of Change.
2. If the spares are being developed /procured from open market, proper specifications of gaskets and other spares is to be ensured through technical inputs and quality control checks.
3. Storage and inventory management of rubberised items needs to be formalized with documentation.

F) General:

1. Proper display of important telephone numbers is to be done in control room.
2. Details of Trips/ Alarms of the plant is to be displayed in concerned control rooms/master control room.
3. Proper blast-proof doors need to be provided in Gas terminal control room and staff educated to keep the doors closed at all times.
4. Proper layout of panels is to be done in Gas Terminal Control Room to improve visibility and access.
5. The operating staffs of control room needs to be trained for at least 1 month (preferably on simulators) before being assigning Control Room duties enabling them to handle operations & emergencies effectively.
6. Proper basic/ refresher training programmes are to be developed and it is to be ensured that training is provided to all the staff on regular basis.
7. CCTV arrangement shall be provided for each plant including separately with display at plant control rooms as well as master control/ CISF station.
8. Logbooks are to be developed plant-wise Control Rooms covering all aspects of operations/ data requirements. SOP for logbook documentation is to be made on the frequency of record/ events/ alarms to be logged & also handing/ taking over details must be mentioned.