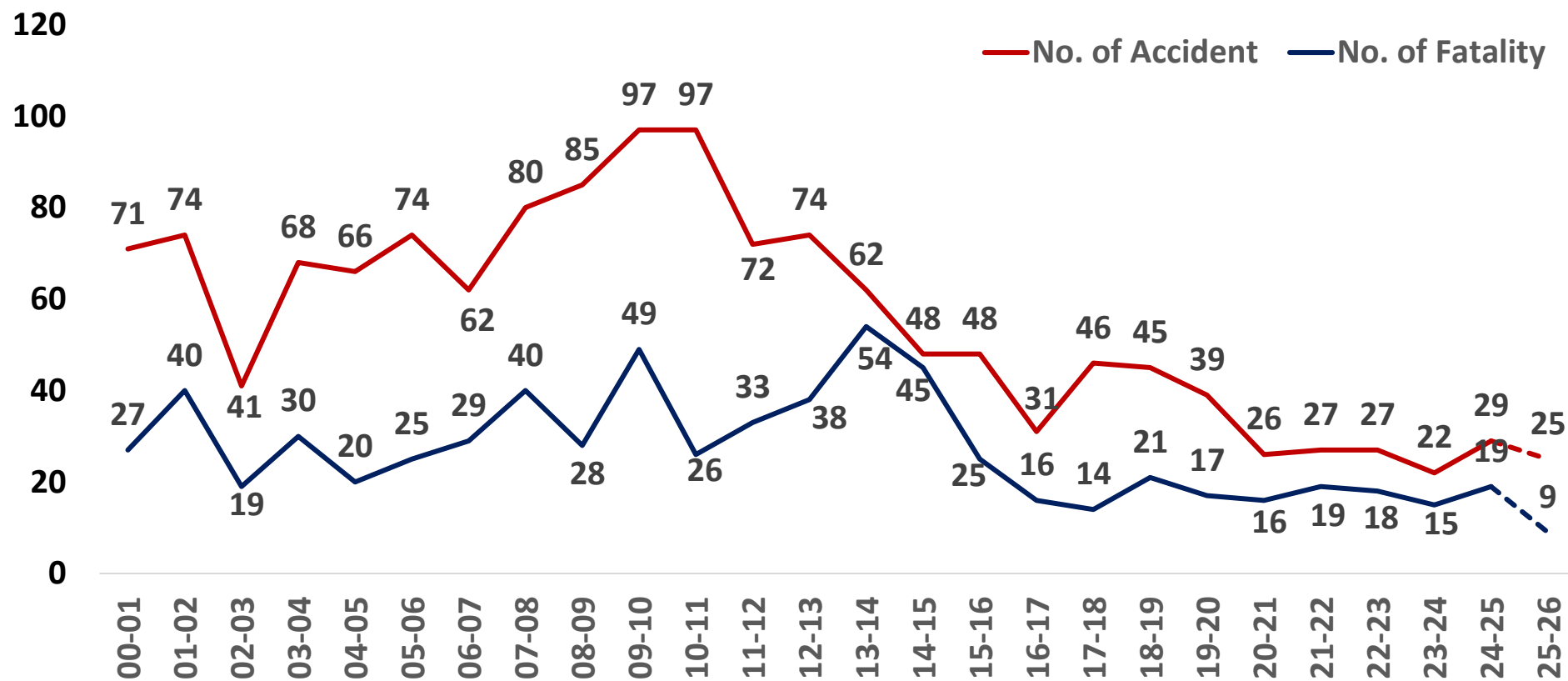


# Learning from Incidents in Process Industry

**Workshop on Hazards and Safety in Oil & Gas Industries**  
**23rd – 25th February 2026**  
**Seminar Hall, IIT Delhi**



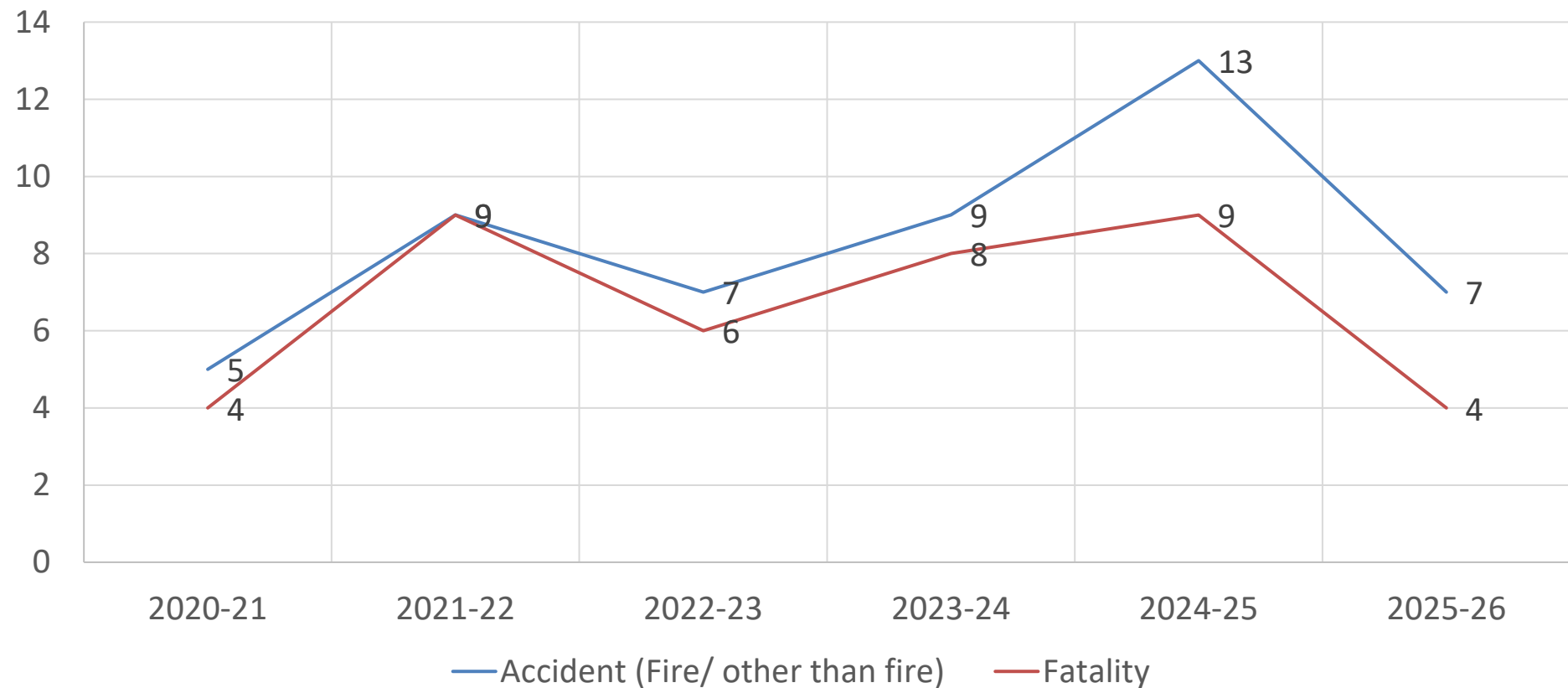
# Trend of major onsite accidents



Note-

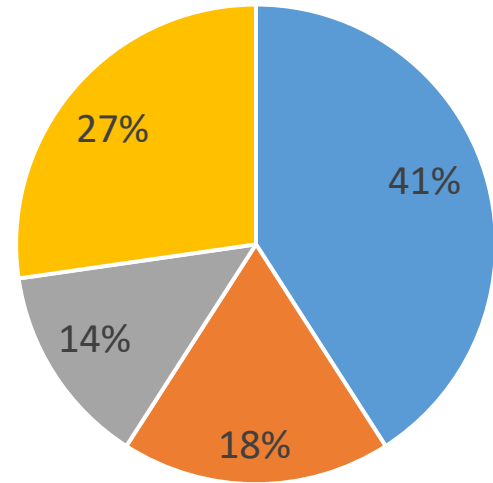
1. Does not include Retail Outlet, CGD, Offshore vessel, Helicopter, Road accident during transportation of petroleum products & Private marketing installations.
2. 2025-26: Till Dec'25

# Major onsite accident & fatality in Refineries, CTF, GPP, LNG installations

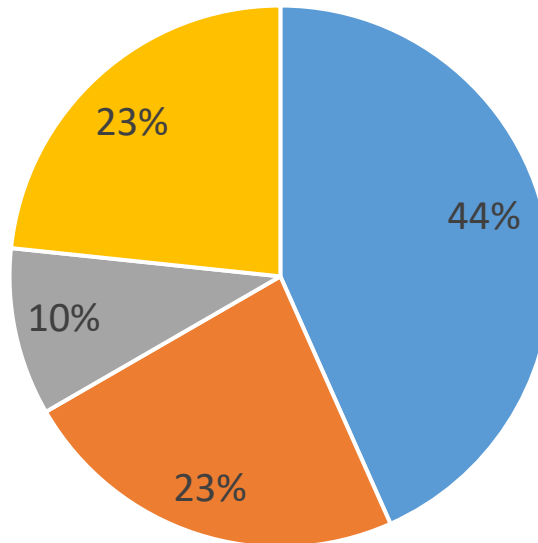


# Share of Major onsite accident in Downstream (P&E) sector to total major accidents in Oil & Gas sector

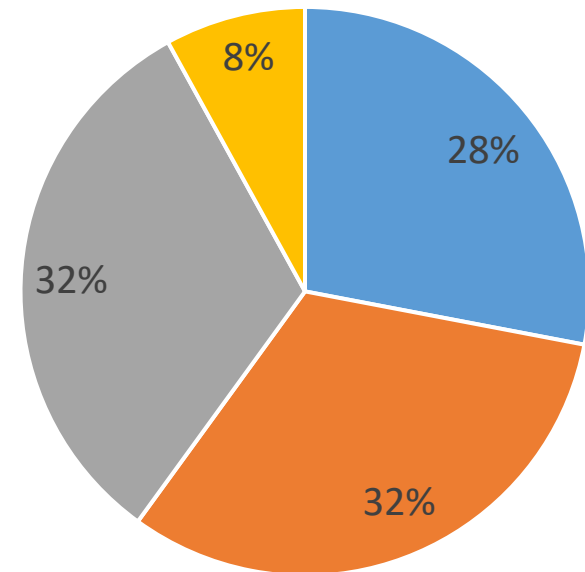
2023-24



2024-25



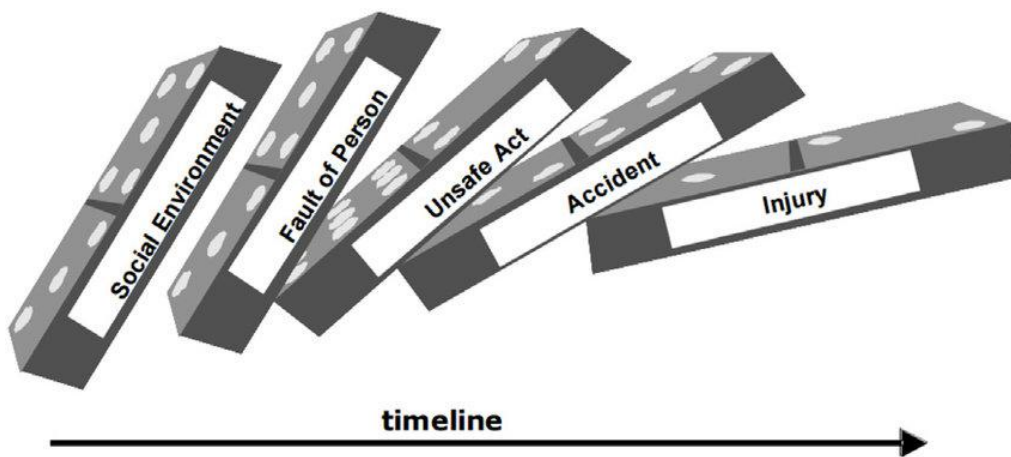
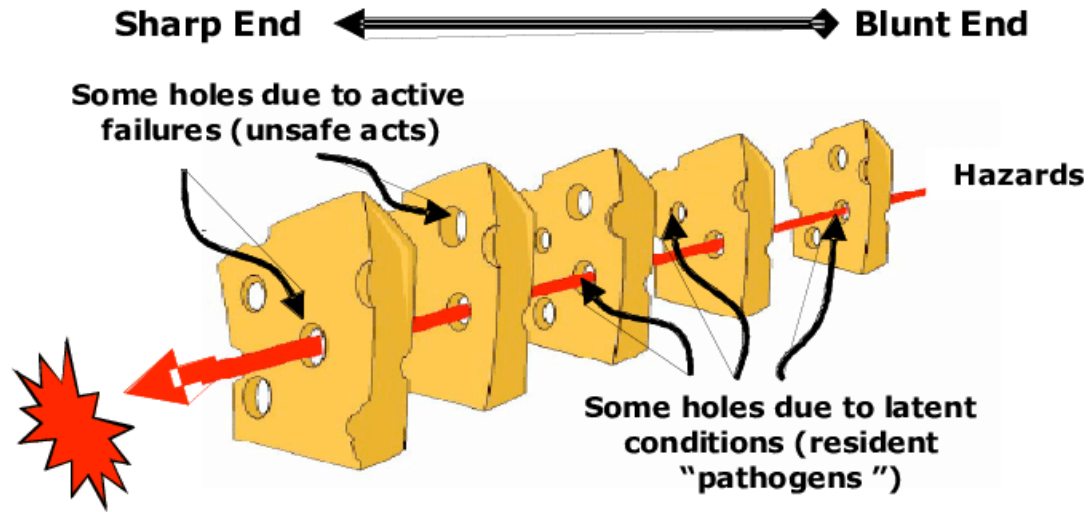
2025-26 (Till Dec'25)



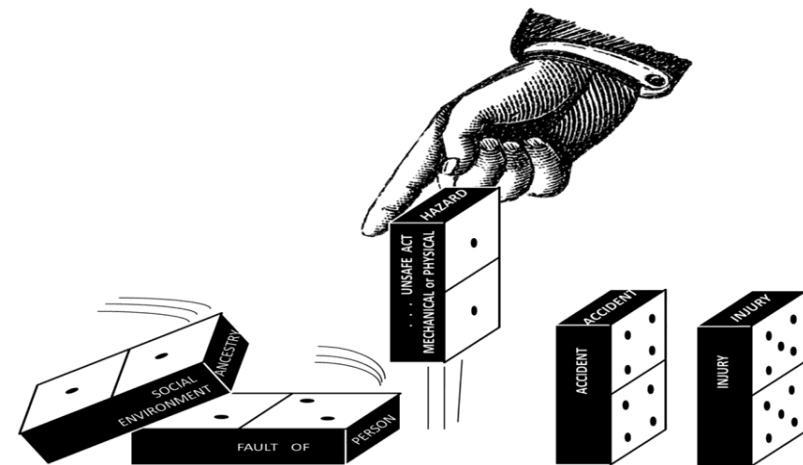
■ P&E ■ E&P ■ Pipeline ■ Marketing

# Causes of Accidents

## Swiss Cheese Model



## Domino Theory



# The Reason Model of Accident Causation

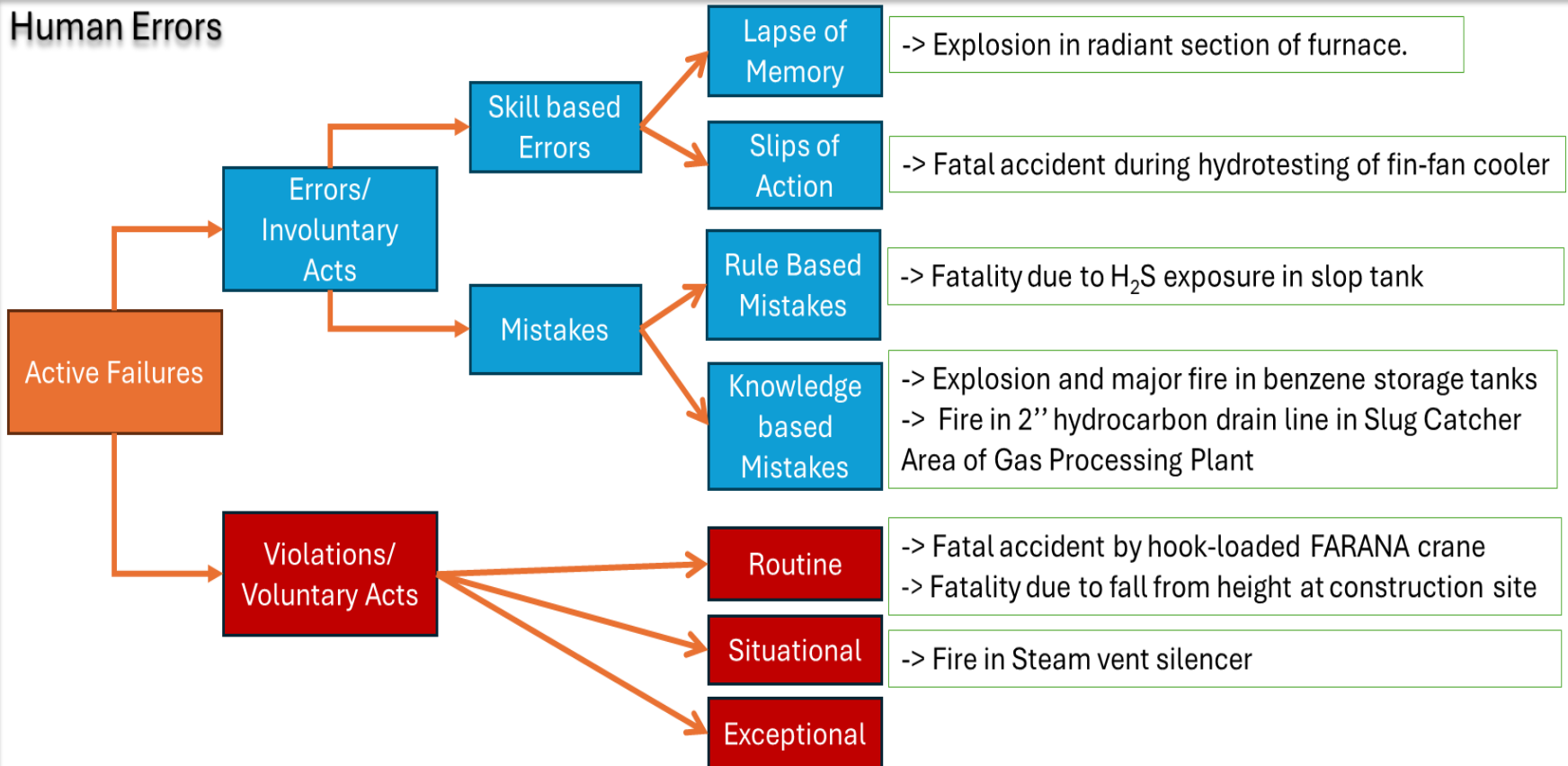
## Systemic Failures

→ Reboiler Furnace Fire Incident due to leak in convection bank tubes

## Latent Failures

→ Fire in Off-gas compressor due to leak in drain line, 220 KV cable fire incident in a RCC cable trench.

## Human Errors



# Accidents in last 2 years (P&E)

S.N.	Incident	Date of Incident
1	Fatal accident while connecting hose to Gully sucker for emptying it.	11.4.24
2	Fatal accident by hook-loaded FARANA crane	17.4.24
3	Fatal accident due to fall from height while doing insulation work	13.4.24
4	Fatal accident during hydrotesting of fin-fan cooler	28.5.24
5	Fatal accident due to fall from height at construction Site of Refinery Expansion Project	10.7.24
6	Fire incident during forklift operation for maintenance activity	20.8.24
7	Fatal accident at maintenance fabrication yard during cleaning & stacking of exchanger tubes	28.8.24
8	Explosion in furnace	14.9.24
9	Explosion and major fire in benzene storage tanks	11.11.24
10	Fire from Steam vent silencer	21.11.24
11	Naphtha Splitter Reboiler Furnace Fire Incident	21.12.24
12	Fatal Incident of Molten sulfur tanker truck driver	21.1.25
13	Fire in Off gas compressor house	18.3.25
14	LNG leakage at LCNG Station	23.4.25
15	220 KV cable fire incident in a RCC cable trench	8.7.25
16	Fatality due to H <sub>2</sub> S exposure in slop tank	12.7.25
17	Fire in 2" hydrocarbon drain line in Slug Catcher Area of Gas Processing Plant	9.8.25
18	Fatal incident during shifting of pipes at project site	12.6.25
19	Fatal incident during static running of fire tender	17.10.25

**Fatal accident during discharge operation from Gully sucker.**



# OHS Incident (P&E)

**Location:** Refinery

**Loss/ Outcome:** Fatality of a contract worker.

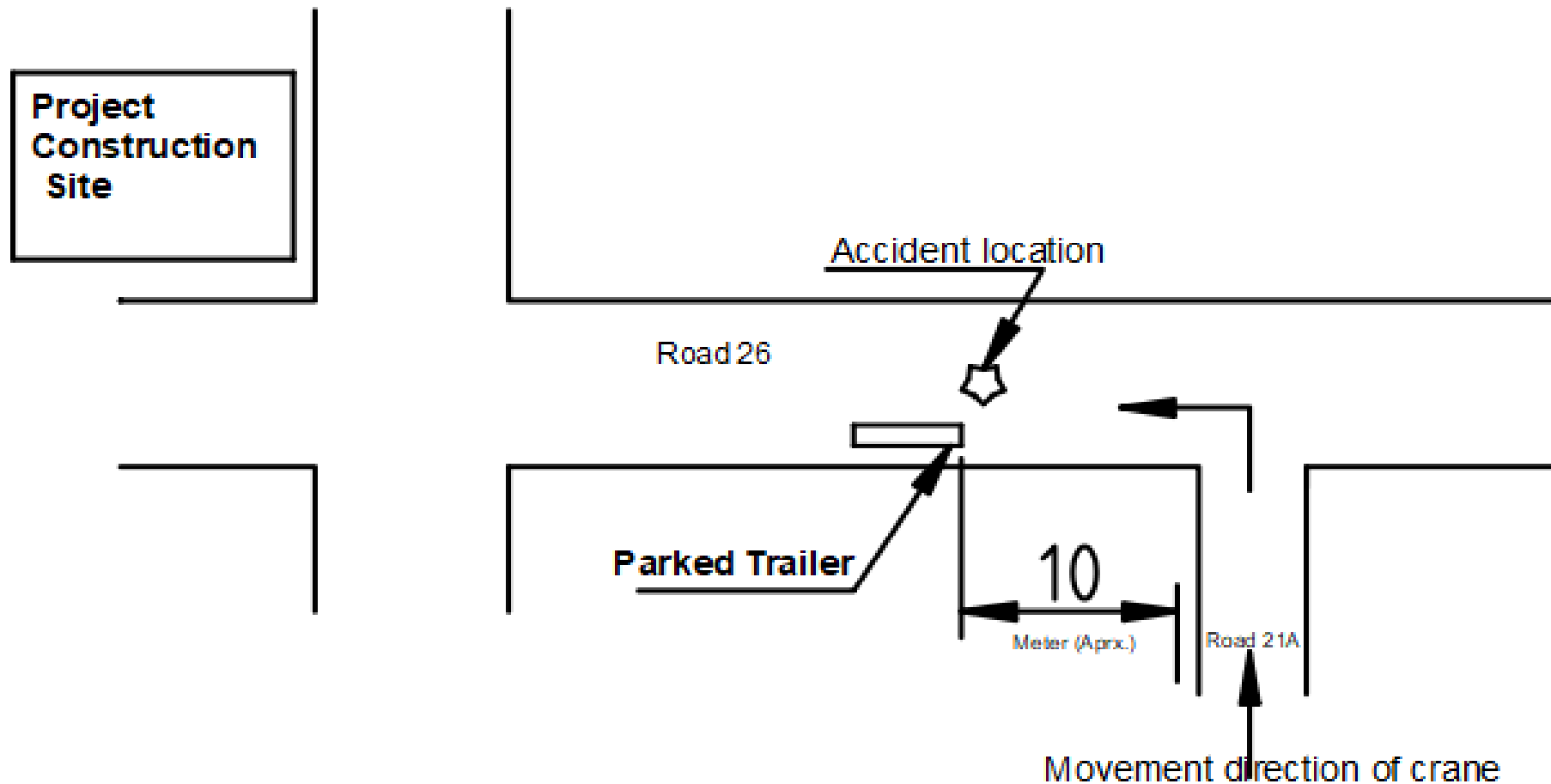
**Root Cause:** The root cause of this incident is due to backward movement of gulley sucker which was parked on slope and resulted into swing opening of back cover due to loose bolting and hydraulic load.

## **Learnings:**

- Ensure robust bolting mechanism in back cover of all gulley suckers.
- Ensure all gulley suckers are included in equipment list, prepare a schedule for gulley sucker preventive maintenance and corresponding detailed checklist to ensure its healthiness.
- Daily and Weekly checklist for Gulley sucker inspection to include the checkpoint of ensuring integrity of back cover and associated bolting mechanisms as well as application of wheel chokes when parked.

# OHS Incident (P&E)

Fatality due to accident by a FARANA crane.



**Location:** Refinery (Project Site)

**Loss/ Outcome:** Fatality of 1 contract worker.

**Root Cause:**

- Shifting of hook loaded material for a long distance by Farana crane.
- Inadequate experience of crane operator coupled with possibility of driving fast as they were getting late for lunch resulted in the accident.

**Learnings:**

- Crane (inclusive of Farana/ Hydra) should not be used for transportation of hook loaded materials.
- Jobs shall be carried out with supervision and shall not be carried out during recess/ absence of adequate manpower.
- Only experienced person shall be deployed for tasks involving skills. A robust mechanism should be developed for competency assessment before deploying the person.

# OHS Incident (P&E)

**Fatal accident due to fall from height.**



**Location:** Refinery

**Loss/ Outcome:** Fatality of a contract worker

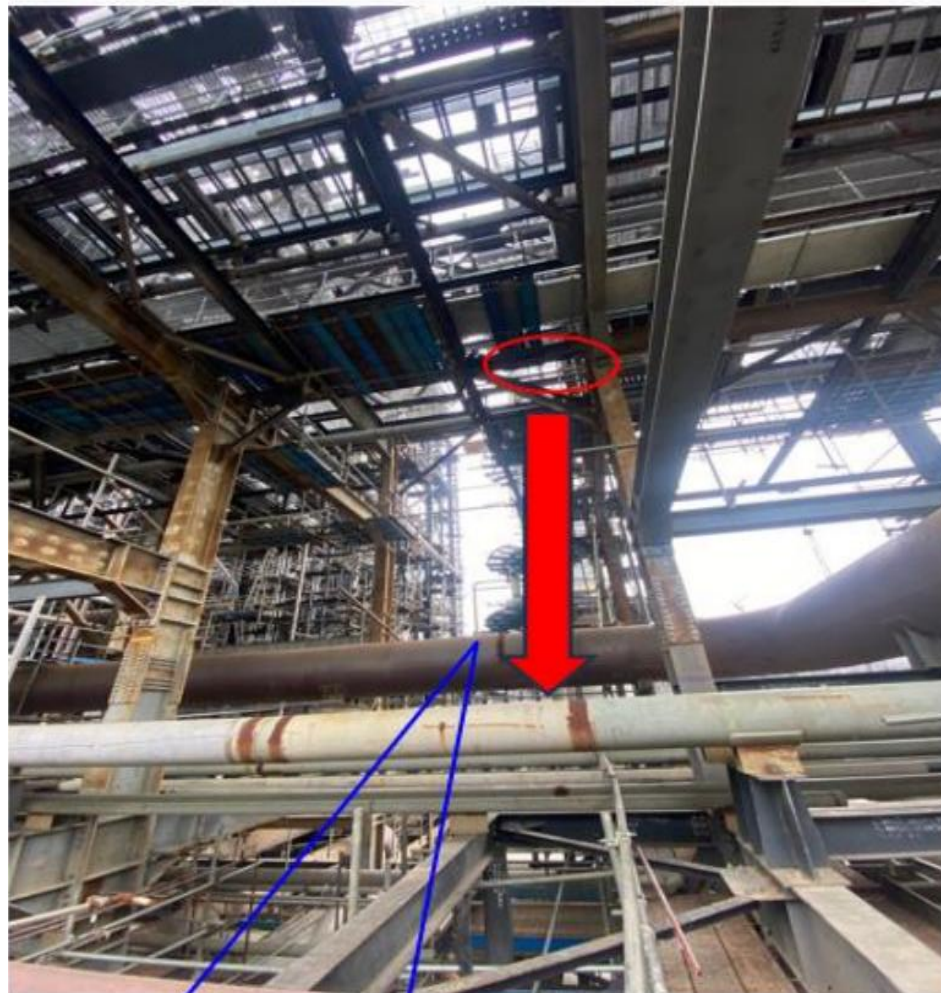
**Root Cause:**

- Simultaneous removal of both the hooks of lanyard or full body harness while movement.
- Slippage of support clamp of the scaffolding pipe.
- Inadequate supervision and monitoring, disregard of JSA.

**Learnings:**

- In scaffolding red tagging/ signboard should be displayed at the entry exit points and the transition location for all not fit for use scaffoldings.
- Safety net for arresting fall from height to be provided wherever it is required and feasible.
- Safe working platform and proper access to work site at height to be ensured before permit clearance.

**Fatal accident due to fall from height.**



Line of Fall (Height ~ 6m)



Site of Fall

# OHS Incident (P&E)

**Location:** Refinery.

**Loss/ Outcome:** Fatality of one contract workman.

**Root Cause:**

Unsafe act (by contract worker) of not anchoring the double lanyard. Further, mechanism to prevent the unsafe act/ condition (inadequate scaffold working platform and not anchoring the double lanyard while working at height) was also missing.

**Learnings:**

- Monitoring of project activities through CCTV to be done. Scrutiny of the footages, manually or through AI techniques, should be explored to identify unsafe acts/ conditions and take rectification measures thereof.
- Alternative rescue arrangements should be developed and implemented for inaccessible areas where cranes with baskets cannot approach..
- Safety awareness training shall be ensured in line with OISD-STD-154.

# OHS Incident (P&E)

**Fatal accident at maintenance fabrication yard during cleaning & stacking of tubes.**



Collapsed structure without base plate, braces, safety signage

Stacking of U-Tube bundle beside the collapsed structure

**Location:** Refinery.

**Loss/ Outcome:** Fatality of one contract workman.

**Root Cause:**

Usage of an inadequately constructed structure and the failure of system to prevent/ check the same.

**Learnings:**

- For jobs for which SOP is unavailable (for safe execution), it is mandatory to carry out JSA before issuing the work permit
- Guideline for temporary structures and its usage should be developed. The usage of the temporary structure should be restricted to the load for which it is designed.
- Rescue activities should preferably be carried out by trained personnel. Ambulance services should be preferably utilised for movement of casualty. Mock-drills for rescue should be carried out to ensure awareness to all.

# OHS Incident (P&E)

**Fatal incident during static running of fire tender.**



# OHS Incident (P&E)

**Location:** Gas Processing Plant

**Loss/ Outcome:** Fatality of fire crew.

**Root Cause:**

- Most probable cause was that the tender, was started while the driver (fire crew) was standing outside of the vehicle. When the vehicle moved (probably due to gear being engaged), he was trapped between mudguard of front wheel and adjacent concrete column.
- The above action was in deviation from Standard Operating Procedure: “Start the engine with operator positioned on driver seat & run at idle speed”.

**Learnings:**

- Strict adherence of Standard Operating Procedure to be ensured.
- The activity to be incorporated in HIRA (Hazard Identification & Risk Assessment) register of the company and risk rating to be revised.”
- Behaviour based training to be imparted to all employees/ workers periodically.

# OHS Incident (P&E)

**Fatal incident during Parking of fire tender in reverse.**



# OHS Incident (P&E)



# OHS Incidents (P&E)

## Fatal Accident due to fall from height



# OHS Incidents (P&E)

**Location:** Refinery unit Air fin cooler

**Loss/ Outcome:** 1 Fatality.

**Root Cause:**

- Injured person attempted to tighten the plug to arrest the sweating (leak) and might have accidentally loosened it (The thread of the plug and the tube were intact and there was no sign of shearing) while the equipment was still in pressurized condition for hydrotesting.
- Due to the continuous work hours and resultant fatigue, IP might have thought of finishing the job by tightening the bolts.

**Learnings:**

- No repair activity shall be carried out while the equipment is pressurised for hydrotest.
- SOPs specific to the nature of job should be shared to the executing agency or the agency should be made aware of the practices/ procedures for executing the job in a safe manner.
- For critical activities like hydrotest, a competent supervision shall be ensured.
- Effective communication should be ensured between crew members.
- Tool-box talks should cover job specific actions. Precautions against all potential hazards should be reinforced through daily tool-box talks.

**Location:** Crude Oil Terminal

**Loss/ Outcome:** Fatality of fire crew.

**Root Cause:**

- Negligent/Lack of coordination between fire tender driver & Fireman while reversing of vehicle inside parking bay.
- Inadequate driving skill of the driver cum pump operator.
- Casual behaviour of deceased fireman during guiding the fire tender in parking.
- Non-availability of reverse parking sensors as mandated by The Central Motor Vehicle rules, 1989 and its amendments.
- **Learnings:**
- Reverse parking of fire tender/other heavy vehicles, especially in enclosed areas, to be avoided
- SOP should address positioning of the person guiding the tender should be visible in the rear-view mirror during parking.
- Heavy vehicles like Fire tenders, foam nursers, Mobile Oil Spill Recovery Unit (MOSRU's) etc. to be fitted with Reverse Parking sensors. It is also suggested that rear view camera may be included in specification,

# Asset Integrity Incidents (P&E)

## Fire in Naphtha Splitter Reboiler Furnace



# Asset Integrity Incidents (P&E)

**Location:** Refinery

**Loss/ Outcome:** No Loss of life/ Injury.

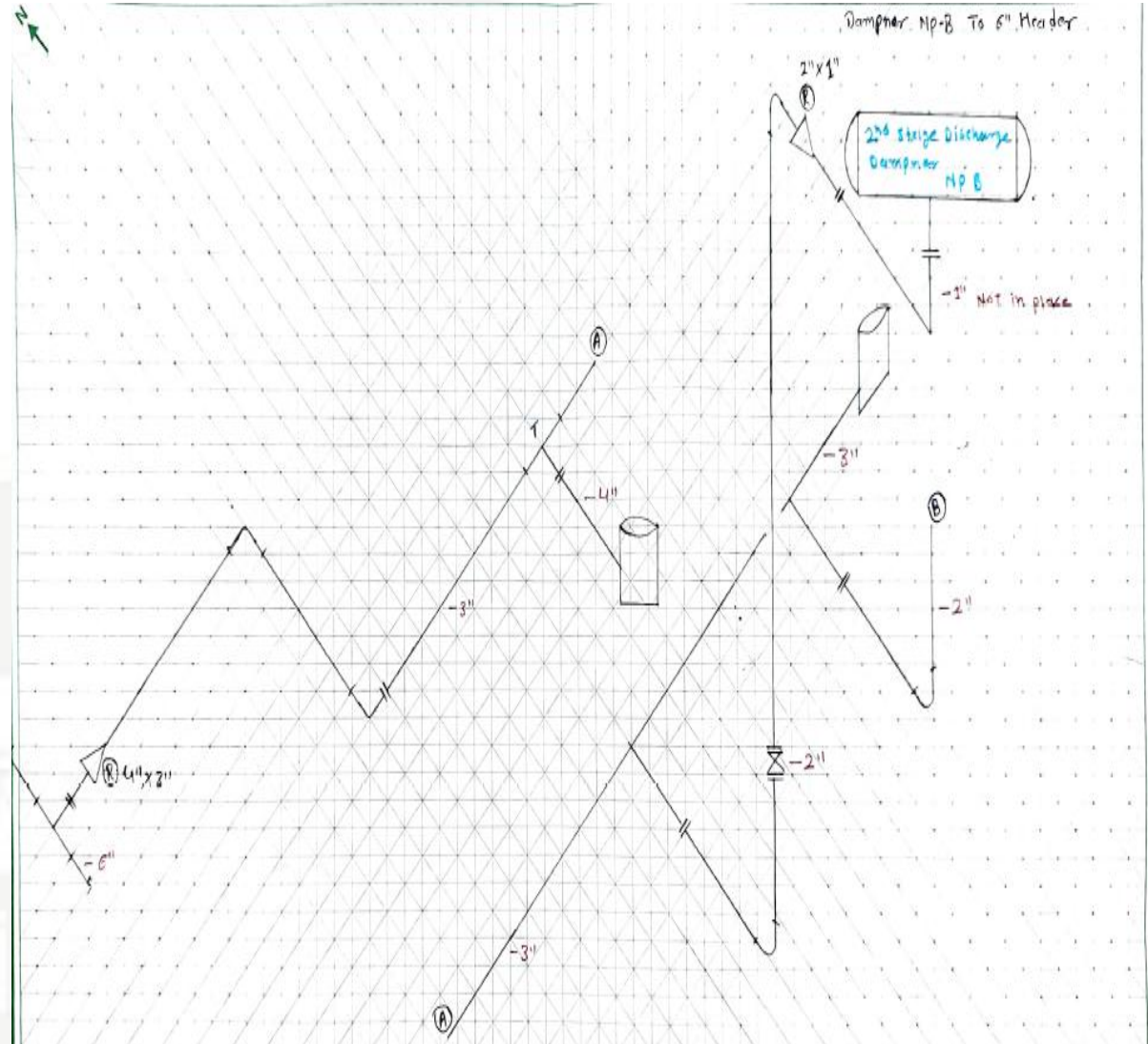
**Root Cause:** Fire in the furnace was result of naphtha leakage from the Naphtha Splitter -1 reboiler convection bank tube. Naphtha caught fire due to the high temperature (around 720°C in arch) in the furnace. Tube failure can be attributed to high rate of corrosion .

## **Learnings:**

- MOC system in line with OISD-STD-178 to be followed for all changes.
- Any scheme raised in MOC system should be drawn to its proper conclusion.
- Inspection report shall include all the observations in details.
- The monitoring of critical parameters, feed quality, etc. should be strengthened/ frequency increased for known failure cases.
- API standard 530 shall be used to calculate remaining life of heater tubes as stipulated in clause no 10.2.4 of OISD-STD-133.
- Process trip incidences should be properly investigated and record to be maintained.
- Shut Down planning of units shall be decided based on the health of the critical equipment and activities shall be taken up accordingly.

# Asset Integrity Incidents (P&E)

## Fire Incident in Gas Compressor House



# Asset Integrity Incidents (P&E)

**Location:** Gas Processing Plant

**Loss/ Outcome:** No Loss of life/ injury.

**Root Cause:**

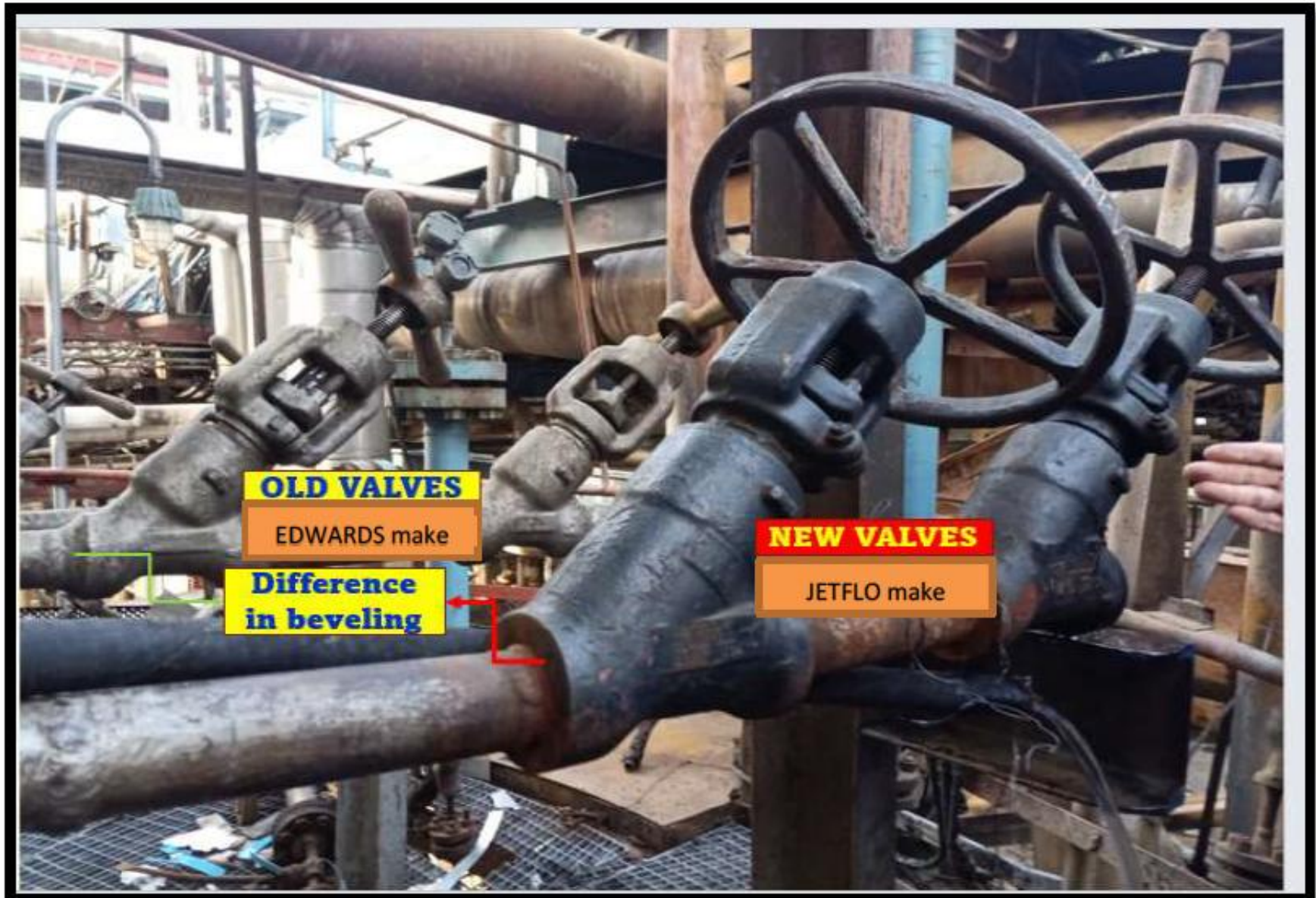
- 1” drain line from the weld joint connected to the discharge volume bottle of the compressor snapped at the weld joint, weakened by internal corrosion & erosion. The failure was aggravated by mechanical stress due to absence of proper pipe support coupled with high vibration.

**Learnings:**

- Pipeline supports shall be provided based on detailed load calculations.
- Lack of timely response to various alarms should be properly addressed.
- Comprehensive inspection plan for small bore pipe inspection should be followed.
- Casing vibration and bearing temperature should be monitored on periodic frequency.



# Asset Integrity Incidents (P&E)



# Asset Integrity Incidents (P&E)

**Location:** Refinery

**Loss/ Outcome:** Damage to HC Pipelines, Electrical/ instrumentation cables, Piperack & Production loss

**Root Cause:**

- Newly installed valve had manufacturing defects.
- Forged TPI by Vendor.
- Brittle fracture has happened at the bevel end of the “Y” type globe valve which resulted in release of hydrogen, hydrogen sulphide and hydrocarbon followed by explosion and fire.

**Learnings:**

- Proper scrutiny of TPI witness test certificates during material receipt.
- Suitable mechanism should be adopted for confirmation & verifications of inspection certificates directly from TPI
- Industry should directly appoint the TPI rather than selection by the vendor
- 100% Positive material identification (PMI) shall be ensured for all High rating valves in High Pressure section at Site including all carbon steel loop in order to identify the dissimilar metals

# Asset Integrity Incidents (P&E)

## Fire Incident at Cryogenic storage

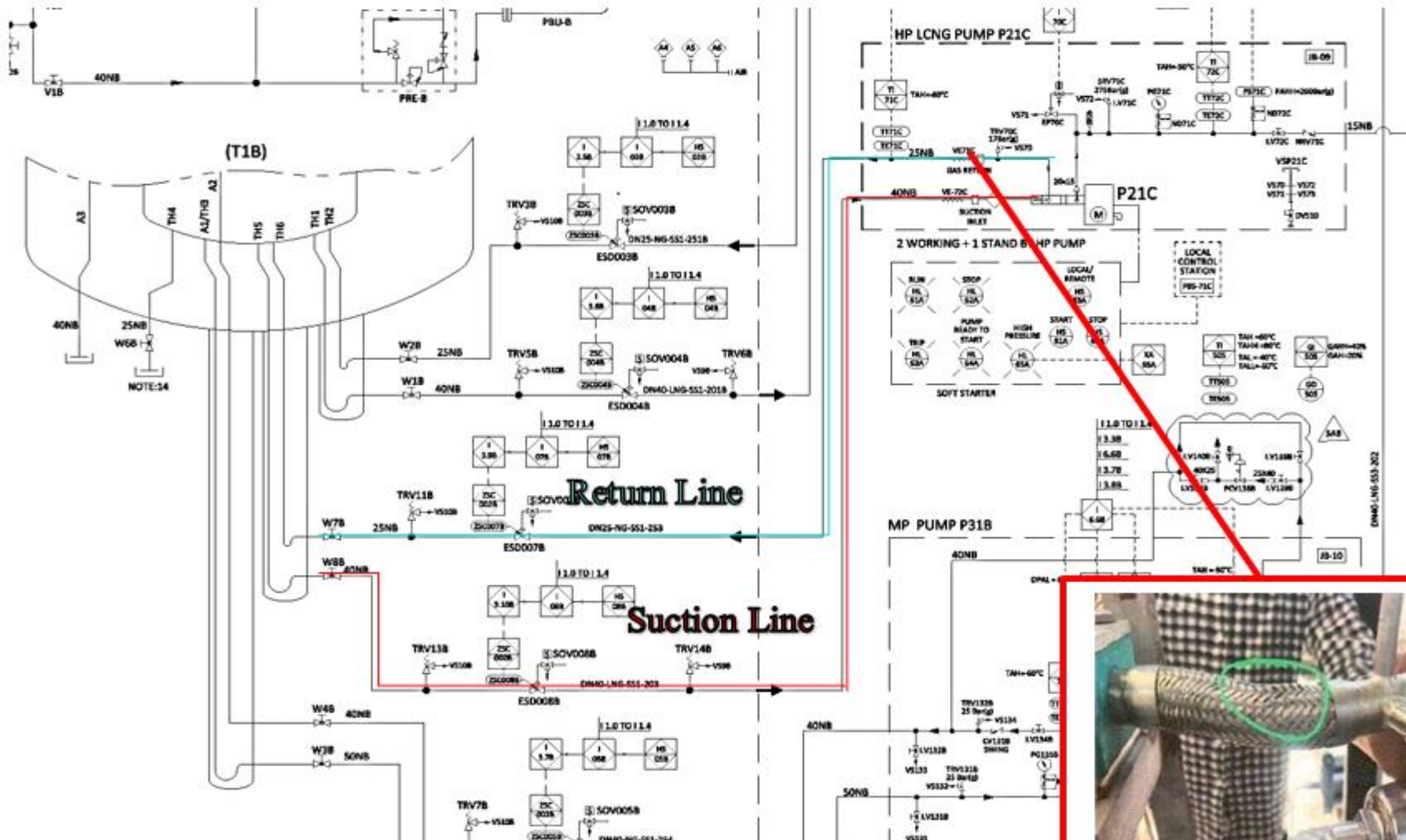


Figure 1: Snipped from P&ID showing Pump P-21 C suction, return and

# Asset Integrity Incidents (P&E)

**Location:** LCNG Storage

**Loss/ Outcome:** No Loss to Life/ Injury and No Property damage.

**Root Cause:**

- Return line flexible connector (hose ) of pump which leaked failed due to cyclic exposures to cryogenic temperatures, intermittent operations and continuous vibrations. No hydrotesting of the hose was carried out. Delayed hydrocarbon detector response resulted in icing of the return ESD valve actuator due to vapour impingement and its failure to close.

**Learnings:**

- Cryogenic Flexible Hoses), all cryogenic flexible connectors (hoses) must undergo routine visual inspections under operating conditions at defined intervals
- Review of the requirement of hydrotesting the connecting flexible connectors may be carried out preferably in consultation with OEM.
- All ESD valves actuators in cryogenic system should be fitted with protective thermal jackets.
- Use of infrared (IR)–type flammable-gas detectors should be considered based on a formal gas-dispersion analysis to ensure optimal coverage

# Electrical Incidents (P&E)

## 220 KV cable fire incident in a RCC cable trench



Extensive damage to all 12 power cables in a stretch of 175 m

Bare copper conductor with all outer covering viz XLPE insulation etc. melted away

Initiation point of the damage with extensive damage to cable trays, supports, adjacent concrete structure & melting away of copper conductor

Cable joint after explosion

# Electrical Incidents (P&E)

**Location:** Refinery

**Loss/Outcome:** Complete damage of 4 nos. of 220 KV feeders in a span of 175m

**Root Cause:**

- The cable joint likely deteriorated due to poor workmanship during jointing or manufacturing defects. Upon energization, switching surge triggered joint failure, causing an explosion and subsequent thermal damage to adjacent feeder cable insulations, leading to multiple cable failures.
- Absence of systemic monitoring such as Partial Discharge (PD) detection resulted in undetected deterioration. Additionally, despite availability of the Distributed Temperature Monitoring System (DTMS), early warning and preventive action could not be taken due to non-utilization and lack of monitoring.

**Learnings:**

- Ensure continuous monitoring of distributed temperature measuring system (DTMS)
- Online Partial discharge (PD) monitoring system for all EHV systems shall be provided for detecting faults at an incipient stage
- EHV Cable joints inside a cable trench should be protected against fire/explosions by suitable means like fire- and explosion-proof partitions, joint protection boxes, fire- and explosion-proof blankets, covering with sand etc.

# Process Incidents (P&E)

## Furnace Blast in CDU Unit



# Process Incidents (P&E)

**Location:** Refinery

**Loss/Outcome:** Property damage & loss of production

**Root Cause:**

- Resetting of the fuel gas control card led to closure of the control valve, extinguishing the burner flames. Subsequent manual opening of the valve without proper furnace purging caused accumulation of unburnt gas, which ignited upon contact with hot tubes, resulting in detonation.

**Learnings:**

- In case of flame failure/ failure of Fuel Gas/ Fuel Oil, furnace light up procedure i.e., box purging, pilot burner light up, main burner light up etc. shall be followed.
- Lapses in compliance with the work permit system, interlock bypass procedure, SOP for “Managing Exigency During Heavy Rain” to be rectified.
- Installation of Burner Management system (BMS) in furnaces

तेल उद्योग सुरक्षा निदेशालय

Oil Industry Safety Directorate

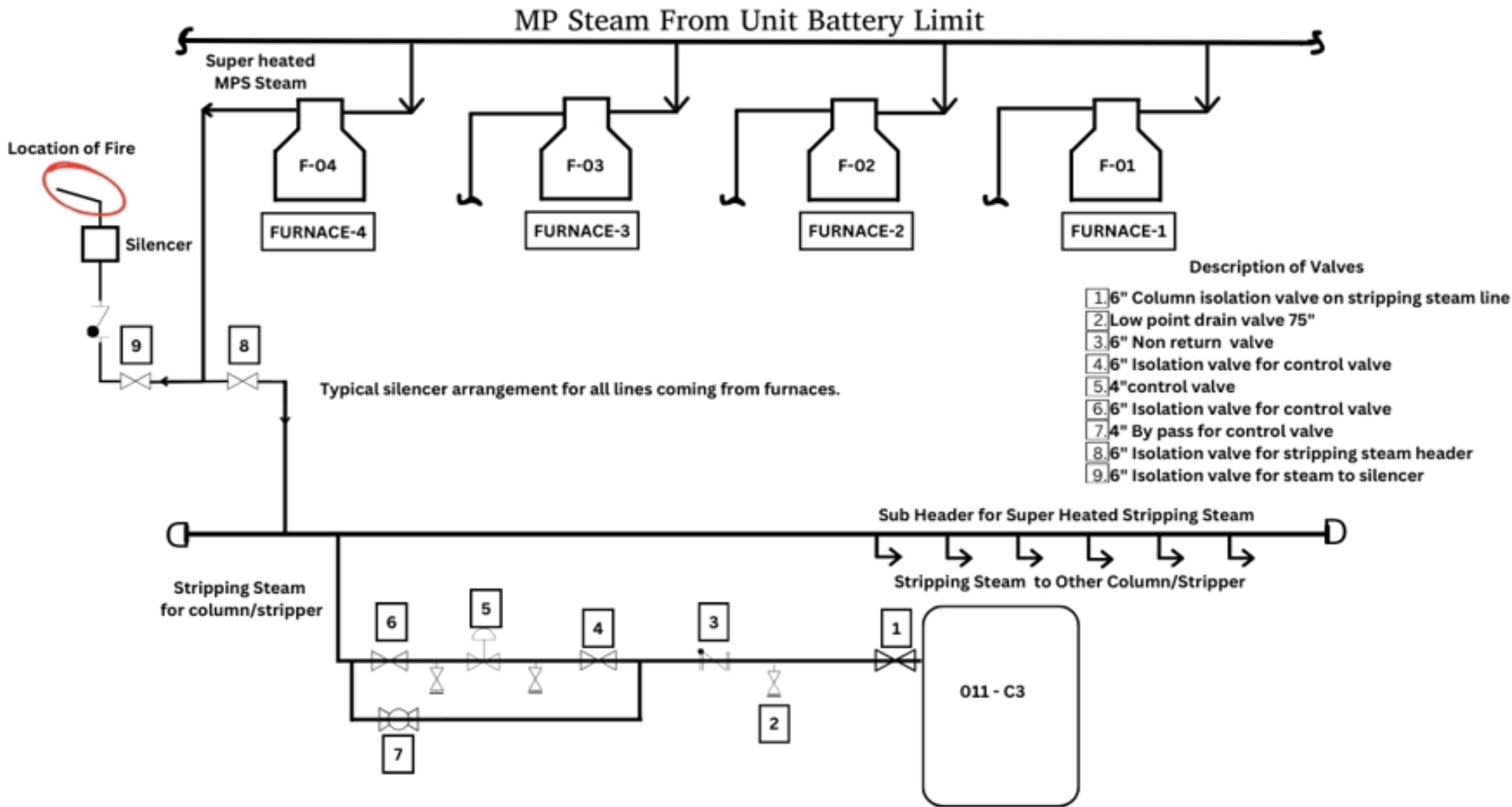
# Process Incidents (P&E)

## Fire from steam silencer in Atmospheric Vacuum Unit



# Process Incidents (P&E)

## Fire from steam silencer in Atmospheric Vacuum Unit



# Process Incidents (P&E)

**Location:** Refinery

**Loss/Outcome:** Property damage & injury to 9 persons

**Root Cause:**

- Naphtha backed up from heavy naphtha stripper (11-C-3) due to passing of isolation valves and NRV in stripping steam circuit possibly aided by high liquid level in the HN stripper. Hence, the stripping steam line up to the 6" diversion valve located at silencer platform was already full of Naphtha before the 6" diversion valve for routing steam from vent to the stripping steam header was crack opened. The liquid naphtha, when came in contact with superheated steam (320oC) vaporized and discharged through the steam silencer as in the downstream side, there was a blocked outlet condition.

**Learnings:**

- Installation of double NRV shall be reviewed in utility/ process interface circuit for enhancing system integrity.
- Method to check passing of critical NRVs should be developed. Means should be explored for online checking of such NRVs
- SOP to be developed for charging of steam headers. The same shall be known to all the concerned operating personnel.

## Explosion and Fire in Benzene Tanks



*Figure 1: Dome of the first exploded tank, outside the dyke.*



*Figure 2: Dome of the second exploded tank.*

## Explosion and Fire in Benzene Tanks



*Figure 3: Image of the first exploded tank.*



*Figure 4: Image of the second exploded tank.*

# Process Incidents (P&E)

**Location:** Refinery

**Loss/Outcome:** Two fatality and one injury

**Root Cause:**

- The first explosion was caused by the confined vapor cloud explosion between the floating roof deck, and the fixed roof ignited most likely by the discharge of static charge (accumulated during the receipt of material).
- The second explosion occurred due to boiling of material in the second tank, aggravated during the foam application interruption.

**Learnings:**

- Sampling and gauging devices shall be either completely conductive or completely nonconductive.
- Review the effectiveness of conductive equipment/ earthing system associated with low-conductive flammable liquids on quarterly basis.
- Gauge hatch shall be non-sparking (or lined with non-sparking material) and self-closing type
- Nitrogen blanketing for internal floating roof tanks/ fixed roof tanks should be considered for storing products like benzene, etc.
- Anti-static additives may be added for increasing the conductivity.

## FATAL ACCIDENT OF H<sub>2</sub>S EXPOSURE IN TANK FARM AREA



# Process Incidents (P&E)

**Location:** Refinery Tank Farm area

**Loss/Outcome:** 2 Fatalities

**Root Cause:**

- Acute Inhalation of H<sub>2</sub>S gas at IDLH concentration
- Entering confined space without appropriate precautions
- Cognizance of prior indication of H<sub>2</sub>S in slop tank was not taken and suitable risk mitigation measures were not implemented.
- Lack of awareness amongst operators regarding potential H<sub>2</sub>S hazard in slop tank.
- Lack of supervisory actions against routine violation of entering floating roof deck without confined space permit.

**Learnings:**

- Identify and control routing of H<sub>2</sub>S-rich streams to slop tanks; implement SOPs for proper communication, monitoring, and recording of slop transfers.
- Install fixed H<sub>2</sub>S detectors with audio-visual alarms, warning signages, and provide peripheral marking at 3-m level inside tank shell to enhance hazard awareness.
- Strictly enforce the Work Permit System, conduct regular training and refresher programs, and carry out periodic rescue drills for H<sub>2</sub>S exposure scenarios

# Process Incidents (P&E)

## Fire in 2" hydrocarbon drain line



# Process Incidents (P&E)

**Location:** Slug Catcher Area in Gas Processing Plant

**Loss/Outcome:** Unit outage & production loss,

**Root Cause:**

- The cause of hydrocarbon leak was the JCB hitting the 'L' shaped 2" drain line (located at the proximity of road) of the 18" interconnection gas line in the slug catcher area during the scrapping of Road for cement surfacing work.
- The latent failure was absence of marking/ barricading around the protruding drain line as well as non-availability of crash barrier/ barricading on roadside to protect the pipelines.
- The systemic lapses included improper hazard identification, deviation in the work permit renewals, non-compliance with MOC procedures.

**Learnings:**

- Crash Barrier or physical barricading shall be provided along the slug catchers to prevent any impact on the hydrocarbon lines
- Any modification shall only be undertaken after following proper MOC procedures
- Permit should be issued/ renewed only after due diligence. Periodic audit of work permit system should be carried out
- Structured training of concerned personnel should be ensured. All potential hazards, associated with the job, should be comprehensively identified & addressed in Job Safety Analysis (JSA).



***THANK YOU***