



## CASE STUDY

OISD/CS/2024-25/MOPOL/06

Date: 06/06/2024

### (A) INTRODUCTION

Title : **Explosion of the Ethanol Above Ground Horizontal Tanks – 2 nos.**

Location: **POL TERMINAL**

Loss/ Outcome: **Two (2) nos. of fatality.**

### (B) DETAILS OF INCIDENT :

Location wanted to convert the two A/G (above ground) horizontal tanks of 70 KL cap. each 3m dia. x 11m length from Ethanol to Slop service. An A/G sump tank, also referred as OWS is located very close to the tank dyke.

A HWP was issued to the contractor for the modification of common inlet header of Ethanol tanks for the said conversion. Accordingly, six contract workmen arrived at the worksite two Oxygen cylinders, one LPG cylinder, few pipe sections, elbows, welding rectifier machine, welding electrodes, grinding machine, Gas cutting torch, torch ignition lighter, face shield mask, electrical JB, a bunch of electrical cable and some other material.

Flanges on the common Ethanol Inlet header of both the tanks were opened. Two buckets were kept under these open flanges for the collection and disposal of Pipeline content in the adjoining A/G sump tank.

Workers also tried to open the nut bolts of the upstream flange joint of the inlet MOV of one of the tank but it could not be opened as the same were rusted. They opened the downstream flange of the same MOV. Further, this inlet MOV was also Half Opened. This might have been done to empty out the balance Ethanol from the tank before opening the flanges.

For the 2<sup>nd</sup> tank, workers opened the upstream flange joint of its inlet MOV. This MOV was kept closed. This tank had approx. 20KL Ethanol.

Two loud explosions occurred on these tanks along with fire as seen in the CCTV footage.

One of the contract worker suffered severe burn injuries and could not come out of the work spot. He was declared brought dead when he was taken to the hospital.

Another worker could escape from the affected area. He ran towards main gate of the Installation and was immediately rushed to hospital for treatment. He had suffered approx. 40% to 50% burn injuries. Subsequently, he succumbed to the burn injuries after one month of the incident.

Terminal team reached the incident site within 3 to 3.5 min. and started fire-fighting operation. Fire was extinguished within next 7 to 8 min. Total time to extinguish the fire was approx. 10 ~ 12 min. after the explosions.





Both the Ethanol tanks after the explosion & fire. Both the end dish of left side tank flew away. Inlet dish of right side tank ruptured and fell on the dyke wall.



Pipe Alley outside the dyke of Ethanol tanks



Various material viz. Buket, Grinding Machine, Welding Rectifier, Elbows, Pipe section, Electrical JB, Cables etc. at Worksite.

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### **(C) OBSERVATIONS & LAPSES:**

- a) **Deviation from Procedure / Non availability of MOC (Management of Change) document:** MOC document having the new P&ID/ Scheme / Sketch with requisite details was not prepared for this modification. Details of the work to be done and procedure to be adopted for the said conversion was not prepared. Improper planning without any discussion and understanding the requirements of the job like sequencing of various activities viz. Isolation of tanks, emptying out the dead stock and degassing of tanks was not done before carrying out the hot work.
- b) **Non Compliance of Work Permit System :**  
Hot work permit (HWP) with JSA was issued to the contractor". However, following was noted from the Permit and site interaction of the Investigating team with workers and officials of OMC:
- HWP was approved & issued using the SAP ID & password of Location In charge (LIC), who was on leave on the day of incident.
  - Tank no. of only one of the tank was mentioned on the HWP whereas the Ethanol Inlet header, which was supposed to be modified, was common for both the Ethanol tanks.
  - It is not clear from the permit whether the person who has requested for the issuance of permit and Receiver of the permit are the same or different. Further, there is no space for the Receiver of Permit after the issuance of permit, which is not in line with the sample format of HWP as per Annexure-I of OISD-STD-105.
- c) **Loose handling of Class-A product:** All content of the Ethanol inlet header was drained & collected in the buckets and then the same was poured in the OWS / sump tank. This loose handling of the class-A product led to vapour accumulation at the worksite which ultimately led to fire & explosion of the tanks.
- d) **Hydrocarbon (H/C) free tanks:** Process of emptying out the Ethanol from the tanks and making it gas free was not ensured before starting the hot work at site. This led to rich & explosive mixture inside the tanks. This was also one of the main reason for the explosion and fire of the tanks.
- e) **Lack of Supervision / Job knowledge of the Company Personnel & Contractor Supervisor :**  
Hazard identification, Risk Assessment, Approval & Issuance of Hot Work Permit & JSA was done by the Maintenance officer, without visiting the site on the day of incident as there is no evidence of the same. He did not brief the Contractor supervisor about the hazards associated with the job and control measures to be taken at site. Toolbox talk was also not carried out. There is no record of the same.
- Further, JSA recommendations was also not followed by the contractor. One of the requirement of JSA i.e. LEL checking at regular intervals by the Permit Receiver was mentioned as "Yes". However, LEL reading has been noted as "0" only once before starting the job but there is no record of the same afterwards.
- f) **No replacement of DSO (Designated Safety Officer):** DSO of the location was on planned medical leave. However, no one else at the installation was designated as DSO in his place.
- g) **Non-functional HCDs:** HCDs were nonfunctional at the time of incident due to flooding of the location. Further, it is not mentioned in the records of the Installation even though LIC and other officers were aware of the same. Proper mitigation measures not taken to neutralize the effects of non-functional HCDs.

### **(D) PROBABLE REASONS OF FAILURE / ROOT CAUSE / CONCLUSION:**

- a) Investigating team has concluded that in order to modify the common inlet header of the Ethanol tanks, flanges of the same were opened, pipeline content was collected in buckets and it was poured into the adjoining A/G open sump. This might have led to the accumulation and spread of Ethanol vapour at the worksite. When one of the contract workman might have attempted to ignite the gas cutting torch to cut the nuts & bolts, the accumulated vapours at the worksite immediately caught fire. This flame might have travelled up to inside the left side tank through the open inlet header and its half open Inlet MOV.

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- b) Since there was a dead stock of approx. 1.4 KL in this tank and it was full of rich vapors, the flame caused explosion of the same. Intensity of the explosion was such that both dish ends of this tank were blown away approx. 24 & 30m respectively. Residue product of tank spilled in the dyke, resulting into pool fire there.
- c) Explosion in the first tank and fire in the dyke area might have caused heating up of adjacent tank, resulting in rise of its internal pressure and consequently its explosion & rupture. Inlet side dish of this tank fell inside the dyke area due to its rupture.

#### **(E) RECOMMENDATIONS:**

Following corrective actions are recommended to avoid recurrence of such / similar incidents:

a) **Preparation of MOC :**

MOC having the new P&ID/ Sketch with requisite details shall be prepared & approved for any modification & change of service of tanks prior to executing the same as per clause no. 4.i) of OISD-STD-178

Detail discussions, analysis and planning shall be done including understanding the requirements of job and sequencing of the same based on the MOC and P&ID before executing the same.

b) **Work Permit System :**

Strict adherence to work permit system as per OISD-STD-105 shall be ensured including:

- Work permit shall be filled up accurately ensuring detailed and providing complete information in all sections/ sub sections in line with site conditions, risk assessment and safety requirements of the job. Sketches should be attached wherever possible to avoid any kind of miscommunication, as per clause no. 6.4.2 of OISD-STD-105.
- Hazard identification and risk analysis (HIRA) of the job shall be done as per clause no. 6.1 of OISD-GDN-206. Accordingly, a careful JSA shall be done based on the same to determine the appropriate safeguards before starting the work as per clause no. 6.3.1 of OISD-STD-105.
- JSA shall also prescribe the frequency of the gas test (continuous detection using portable gas detectors or hourly or after every shift) as per clause no. 6.3.1.viii) and the same shall be complied.
- No one shall share his / her SAP ID & Password with others (including LIC / Permit issuer and Receiver) for the Permit related jobs or otherwise.
- Overall, Work Permit system shall be completely aligned with OISD-STD-105 including the format of HWP as per Annexure-I of OISD-STD-105.

c) **Loose handling of the Product:** It shall never be done at any installation or any worksite.

d) **Hydrocarbon (H/C) free tanks:** Tanks & worksite shall be made gas-free or positive isolation of the same shall be ensured before carrying out any hot work at the installations.

e) **Effective Supervision of works including Toolbox talks:** Toolbox talk coupled with proper supervision shall be ensured depending on the nature of work as per clause no. 6.3.3. of OISD-STD-105. The work shall not be allowed without proper supervision.

f) **Deployment of alternate DSO:** Alternate DSO shall be given the charge in case of non-availability of regular DSO due to his leave or other official engagements.

g) **Hydrocarbon Detectors (HCDs) :** Periodic checking of Safety Critical Equipment (SCE) e.g. PSVs, ESDs, HCDs etc. and their healthiness should be ensured and documented. Any deviation/ non availability/ impairment should be duly logged, approved and communicated to all concerned with alternate mitigation measures/ course of action as per clause no. 7.6.8.c) of OISD-GDN-206. SCE which are not available/ by pass should be marked in field also.

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