



## CASE STUDY

OISD/CS/2020-21/P&E/01

Dt.: 29/04/2020

### **INTRODUCTION**

Title: Fire incident in Effluent treatment plant (ETP) at one of the Indian Refinery

Location: Inlet sump of ETP

Loss/ Outcome: One death and burn injuries to 5 persons

### **BRIEF OF INCIDENT**

A fire incident took place in the inlet sump of the effluent treatment plant of a Refinery during a modification job. Six nos. of personnel suffered burn injuries during the incident and one of the victim succumbed to his injury six days later.

### **OBSERVATIONS/ SHORTCOMINGS**

- Volatile Organic Compound (VOC) recovery system was under implementation at ETP. Half cylindrical arched roofs with side covers were placed over the top of the inlet sump (IS) to create a confined VOC chamber. Earlier, one spent caustic branch line (8" dia) to the ETP inlet sump was found obstructing the placement of the support structures for the VOC system. As this line was not in regular use, it was cut and removed as a temporary measure to facilitate installation of the VOC cover and structures.
- Subsequently after completion of the VOC system project jobs, on the day of the incident, restoration of the earlier cut out line of the spent caustic line back to the VOC chamber sump was taken up for execution. Pre fabrication of the line section was done outside and was brought to site for fitting.
- The subject job necessitated cutting of existing spent caustic line elbow, surface preparation, fit-up and welding of a flange on the existing spent caustic line to fix the fabricated line section.
- The elbow cutting job was done using gas cutter just outside the covered VOC chamber. Gas testing was done prior to this job and LEL was found 'Nil'. During this operation, influent sump remained blocked by the side cover of the VOC collection chamber.
- Hot permit was not taken for the above noted jobs near VOC chamber. Instead it was done under a composite hot permit issued for various projects related hot jobs for piping erection, fit-up, cutting etc. at ETP plant area.
- Before welding of the pre-fabricated pipe spool flange (8" dia) to the cut out face of spent caustic line, it was decided to check the position of the line spool. Therefore, VOC cover was opened and spool was lifted manually to adjust & mark its position. Metal pipe and wooden blocks were used to lift and rest the line section.
- Three persons were adjusting the new spool section at the edge of inlet sump, while three persons including one welder were working at the other end of the spool section for alignment of the piece with the cut out face of the spent caustic line.

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- While this activity was going on, a sudden flash fire broke out at site, which also engulfed the IS VOC sump.
- Firefighting team responded promptly with two fire tenders and fire was extinguished within 8 minutes by applying foam.
- Six personnel involved in the job at site suffered burn injury during the fire incident. One person subsequently succumbed to his injuries after 6 days.



Elbow was cut ; Pre-fabricated line section (with flange fitting) was placed over the cut cross section for proper placement before final welding ;  
Open Side cover of IS VOC chamber.

### **REASONS OF FAILURE/ ROOT CAUSE**

- Possible source of fuel for the fire incident: -
  - Prior to the fire incident, elbow on the spent caustic line was removed by gas cutting. As reported, HC gas test in the area before this gas cutting job was found normal. However, this can be attributed to the fact that the VOC side cover remained closed during this activity.
  - After the gas cutting job, the side cover of VOC system was removed and kept aside for inserting the pre-fabricated pipe piece and aligning the flange end to the existing cut pipe of the spent caustic line.
  - No gas test was carried out after removal of the side cover of VOC system till the time of the flash fire incident. This is considered as a major lapse.
  - It was observed through the opened side cover that there was accumulation of an oil layer over the oily effluent liquid hold up in the IS and smell of hydrocarbon could be felt there.
  - It is concluded that Hydrocarbon vapor had escaped from the inlet sump through the side cover opening and accumulated in the adjacent work site to form a flammable HC-Air mixture.
- Possible source of ignition for the fire incident: -
  - For execution of the fit up job, a metal pipe was used to lift the spool piece and the flanged end was adjusted on top of the rough edge of the cut out pipeline. So, it is possible that spark could have been generated from the metal to metal contact/ friction: -

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- ❖ Between the pre-fabricated pipe piece and the metal pipe used for lifting.
- ❖ Between the flanged end of the pre-fabricated pipe piece and the rough edge of the cut out spent caustic pipeline
- As workers were not wearing fire retardant coverall or cotton cloths during execution of the job, generation of static charge from the cloth wears cannot be ruled out.
- Welding machine with connected cable & electrode holder was positioned at the site before the incident took place. Presence of welding machine with cable connections and electrode holder near incident site corroborates the fact that the site was ready for carrying out welding job. It is possible that there might have been an attempt to start the welding job or touch the electrode to nearby metal piece as a practice to start welding job. Spark generation on account of this appears another probable cause of fire.

### **CONCLUSION**

From the above analysis, it is concluded that the immediate cause of the fire was the result of formation of vapor cloud near the incident site due to removal of side cover of ETP influent VOC chamber and possible ignition source as noted above.

### **RECOMMENDATIONS**

- During any hot work, the risk should be reassessed after deviation from the existing conditions.
- Detailed Job Safety Analysis (JSA)/ Risk Assessment involving multidisciplinary sections (including the plant shift in charge) should be carried out for non-routine jobs during operation/ maintenance/ modification.
- Work permit should be taken for specific jobs with clear and complete description of the work and execution site. Same shall be linked with corresponding JSA.
- Tool box talk/ pre job safety meeting shall be held for the specific job involving all the crew assigned for that job and record maintained.
- While carrying out hot job in areas where presence of HC gas/ oil is likely to prevail, continuous monitoring of flammable substances should be arranged.
- Wearing of Fire retardant/ cotton coverall is to be made mandatory in the operational area.
- Fire tender to be kept as standby during hot job where presence of hydrocarbon is anticipated. This requirement should be assessed in JSA and work permit.
- Proper planning should be done for lifting of heavy material and such material shall be handled through crane/ fork lift or other suitable means.
- Competency of working crew needs to be ensured.

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