

## CASE STUDY

OISD/CS/2023-24/P&E/10

Dt.: 14/09/2023

### INTRODUCTION

Title: **Accident during maintenance activity**

Location: **Refinery**

Loss/ Outcome: **Burn injury to fourteen persons.**

### BRIEF OF INCIDENT

In Crude Distillation Unit, vacuum residue (VR) quench circuit line from vacuum column bottom to VR exchanger inlet was under replacement for metallurgy upgradation, as per inspection recommendation. At the same time, the exchanger downstream circuit was planned to be de-chocked upto vacuum column due to reduced flow observed during operations. Steaming of the circuit was done after flushing by flush oil (FLO). On the day of incident, steam was isolated in the VR-quench circuit at 08:00 hrs and condensate was being drained from 2" corrosion probe nozzle and three low point drains (LPDs) in the circuit. After ensuring that no condensate was flowing from any of the drain point, bolts of 12" common outlet valve of VR-exchanger was opened at 11:30hrs. Valve was dropped at around 12:25 hrs with the help of a crane. After few minutes, a sudden gush of steam and condensate along with tarry material/coke lumps came from the open 12" line splashing on the personnel present in nearby area.

### OBSERVATIONS/ SHORTCOMINGS

- Site was congested due to project job scaffolding all around the accident location. Reportedly, one of the injured had fallen while running away from the site and had maximum burns.



- Dropped 12" common outlet valve of VR exchanger was found chocked with tarry material/coke.

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- The vertical loop of line was in tension and after removal of the valve, the line had shifted slightly towards battery limit.
- Provision for draining of steam condensate and fouling material had been made from the 2" horizontal stub of vertical header. The stub had a high possibility of being choked.
- The temperature indicator, installed in the circuit further downstream at some distance from the incident location, was showing a temperature of more than 150°C prior to valve opening and started fluctuation and coming down to 130°C after valve opening (as per the recorded trend).
- It was reported that steaming had discontinued during night shift prior to incident, due to some choking as material had stopped coming from the drain and the hose had become cold. Steaming was restarted in morning shift without any analysis of stoppage of steam/ possibility of choking. Although, loop was handed over to maintenance on morning shift by isolating the steam at around 08:00hrs.
- Cold work permit for valve dropping, issued few days ago of incident, had check box of "line flushing/steaming and drain/depressurized" marked as complied even before the activities had started.
- The clearance of project job of line replacement and scaffolding modification was given just after the valve was dropped. No layoff period was given in such a critical job.
- The panel personnel was unaware of the temperature indicator reading and its significance.

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

There was hot condensate trapped in the choked line. Due to blockage, the pressure buildup must have kept the condensate in liquid phase (saturation pressure at 150°C is 3.82 kg/cm<sup>2</sup>G). On release of pressure, caused by dislodging of the tarry material/coke, which was probably initiated because of the jerk of valve removal and the release of tension in the line, the condensate evaporated violently sending out a gush of steam/condensate from the open end of the line. The lowering of the temperature corroborates the phenomenon.

### **CONCLUSION**

It is evident that ignorance of the reading of temperature indicator and overlooking the fact that line may be choked lead to the incident. Further, multi work permit issued in same area, increased the number of personnel in the area thereby increasing the probability of injury.

### **RECOMMENDATIONS**

- Flushing job SOP may be reviewed like consideration of water flushing post steam flushing to ensure that temperatures are lowered before job is taken up. In case of suspected choking, all precautions shall be taken for line flushing as well as during opening of the line.
- Safe work practice shall be ensured as per Cl.7.3 of OISD-GDN-206(2023) like, Identification of anticipated or inherent/ specific hazard and risk involved should be done through:
  - ✓ Systematic evaluation of stepwise activities involved in the non-routine job or it's execution.
  - ✓ Identification of possible unsafe conditions in the surrounding
  - ✓ Identification of Hazard and risk from other job in the vicinity (if any).

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The emergency response & evacuation procedure at the site shall be referred in the JSA. The workers shall know what to do in the event of an emergency as per CI.6.3.1 of OISD-STD-105(2023).

- Compliance of work permit system as per OISD-STD-105 to be ensured. Actual situation in field is to be verified before mentioning the conformity of stipulated conditions in the permit.
- Inherently flame retardant (IFR) clothing shall be made mandatory for performing jobs in operational area.
- Handover for maintenance/project job shall be done only after ensuring proper depressurisation/HC freeing/cooling, etc. of the circuit.
- Knowledge level of employees should be evaluated and training programs as per CI 7.4 of OISD-GDN-206(2023) to be ensured so that personnel are aware and attentive of the various indications/parameters and their implications.

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