



CASE STUDY

OISD/CS/2020-21/P&E/03.

Dt.: 18.04.2020

INTRODUCTION

- Title:** Fire incident in a river due to crude oil leakage from feeding pipeline.
- Location:** In a river near crude oil storage location.
- Activity:** Crude transfer.
- Result / Outcome:** Leakage of crude oil from feeding pipeline, flowing into river through a drain & its subsequent fire.

BRIEF OF INCIDENT

At one of the crude oil storage location, accidental activation of Emergency Shutdown Switch (ESD) of tanks resulted in sudden closure of Remote Operated Shutoff Valves (ROSOVs) and Motor Operated Valves (MOV) in the inlet and outlet lines of all the storage tanks. This sudden closure generated surge pressure resulting in leakages in pipelines at different locations within the location as well as in feeding pipeline outside the storage location. The leaked oil from feeding pipeline outside the storage location got diverted to the adjoining drain through which it flowed in to the river. This floating oil in the river was set on fire by some miscreants.

OBSERVATIONS

- The storage location is meant to receive crude from various production installations. On the day of incident, the receipt of crude oil was going on in two tanks and dispatch was going on from another two tanks.
- Station ESD got activated which gave closure command to all ROSOVs and MOVs installed in the storage location. The information about the leak incident inside the location was communicated by field operator. Information was given to all pumping locations and the pumping to location was finally stopped after 23 minutes of incident. Subsequently, arrangement was made to divert the crude supply to other storage location. The leakage of pipeline outside the location was reported 7 hours after the incident.
- Arrangements were made to arrest crude oil spillage inside and outside the location using booms, sorbent pillows, bunds and spilled crude oil was collected in drums. However, substantial quantity of leaked crude oil just outside the location boundary got mixed in nearby civil water drain and flowed into the river. The leaked crude in the river was set on fire by some miscreants which got media coverage locally and nationally.

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REASONS OF FAILURE / ROOT CAUSE

Accidental activation of Emergency Shutdown Switch (ESD) of Tanks, apparently while carrying out instrumentation job in the Main Control Room racks resulted in sudden closure of ROSOVs and MOVs of the inlet and outlet of all the storage tanks of location, which resulted in surge pressure build up within the location and feeding pipeline and development of leakage thereof inside and outside the location.

Other major shortcomings observed were as under.

- System of Management of Change is not followed in line with OISD-STD-178 while installing the ROSOV to comply with M.B. Lal recommendation. The installation was originally designed for manual operation and the facility was later upgraded without implementing the HAZOP recommendations made by consultant, which clearly specified requirement of surge analysis study and review of pump shut off pressure.
- Critical jobs like checking of control logic in Control Room was undertaken without adequate internal controls through work permit system with applicable authorization for ensuring proper monitoring and supervision.
- High pressure protection system is not installed neither at the storage location nor at the feeding locations for automatic shutoff of pumps, closing of station inlet valves in case of abnormal pressure rise. Pipeline operations are not conceptualized keeping in mind the abnormal scenarios like surge creation due to closing of ROSOV/ MOVs or any other reasons.
- Pressure control system is not provided at the location. The pressure is controlled through manual intervention by controlling the flow which is not a fail proof system.
- The pipeline parameters such as flow and pressure are not monitored at the feeding point. The operator will not have any idea about change in pipeline hydraulics in case of any leakage.
- The SOP prepared for the location is not covering basic operational parameters like flow and pressure limiting values, control and protection mechanism, which are to be followed in case of pressure offset.
- Main control room operation is not covering pipeline side parameters such as pressure as a result of which the outside leak could not be indicated based on pressure profile in the network. Trending of important parameters such as pressure is not covered which is critical for identifying any possible leak scenario in case of any emergency.
- Learning from similar type of incident which happened in similar location of the organization was not adopted. That incident also occurred due to closure of ROSOV, which resulted in leakage of feeding pipeline of other organization just outside the storage location. All such incidents should be part of Management review and sharing with all concerned & sensitizing all concerned for any remedial measures in their areas.
- No design data or history sheet of affected pipeline and piping inside location was available. Also, no schedule of external & comprehensive inspection such as thickness survey, corrosion rate based on remaining life assessment etc., as defined in OISD-STD-130 or other relevant standards, was in practice. Further, system is not in place to develop the base line data such as pressure and flow to develop system controls based on the condition and strength of the pipe.
- Coating and wrapping is not provided on buried piping inside the location which resulted into severe pitting/corrosion on the failed pipes.
- Supervisory Control and Data Acquisition (SCADA) system is not available for monitoring and control of all pumping and receipt operations. As on date there are about 17 pumping locations which is difficult to manage without online data availability.

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RECOMMENDATIONS:

The recommendations of the investigating team are as follows:

- Work permit system should be implemented for any kind of troubleshooting job in Control Room. Authorization should be maintained for different nature of jobs so that only qualified and competent persons carry out specific jobs.
- Surge analysis study to be carried out considering the design parameters. Necessary recommendations of this study shall be implemented in crude receiving location, crude feeding installation and pipelines connecting these locations.
- Management of Change (MOC) system to be implemented while carrying out any modification in any process, controls and protection system. All the HAZOP recommendations should be addressed before implementing any modification.
- Pressure control and protection mechanism to be incorporated in the existing system for maintaining pressure within normal operating range and activate automatic shutoff of pumps in case of any pressure excursion beyond acceptable limits.
- In absence of any previous history sheets of piping, a baseline data to be made for all feeding pipeline and station piping to set the various operating range and protection set points. After developing base data, Integrity assessment like thickness survey & corrosion rate based remaining life assessment should be done so that advance actions can be taken in case of piping nearing its remaining life.
- Wrapping & coating shall be done for all underground piping and its inspection to be done in line with OISD-STD-130.
- Monitoring mechanism for all pipeline parameters to be developed for ensuring safe and sustained operations. Mechanism to be developed for identification of any leak based on pipeline parameters such as flow and pressure.
- Learning should be used from past incidents across the industry for taking corrective measures across all locations to avoid reoccurrence of the same.
- Trending of important process parameters such as pressure, flow and temperature should be maintained in control server to analyze any event / incident.
- Suitable modification to be implemented to divert discharge of pressure relief system installed on inlet MOVs of tanks and manifold into close loop system such as tank or closed blow down vessel.
- All the critical encroachments in RoW should be either removed or modification to be done for ensuring pipeline is freely accessible for inspection and repair and also for avoiding damage to life and public property in case of any leak/fire incident.
- Daily reconciliation of oil dispatched and transferred should be done including pipeline inventory to get idea about any kind of minor / major leak and pilferage.
- Emergency response system should include survey of the adjoining water body and river considering worst possible scenario and deployment of booms in the flowing stream of any drain/canal/river for collecting all the spilled quantities.
- More public awareness programs should be conducted to sensitize about various risks associated with pipelines. The density of pipeline markers should be increased for information on various precautions and contact numbers in case of any emergency. Further, all the patrolling records shall maintain the status of these markers.
- Management and Safety review meetings should also include various pipeline related issues such as encroachments, integrity assessment, incident investigation, reporting of all types of near misses etc. to have focus on all areas of operation. Remedial measures should be implemented to plug any gaps identified in incident investigation.

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- SCADA should be used for monitoring and control of complete delivery and receipt operations including monitoring of leak detection.
- Offsite Mock drill considering scenarios of oil leakage in the pipeline outside the location premises to be carried out regularly.

Photographs

Ruputured seam pipe at the CTF location



Overflow pipe of septic tank of house through which crude oil released after leak

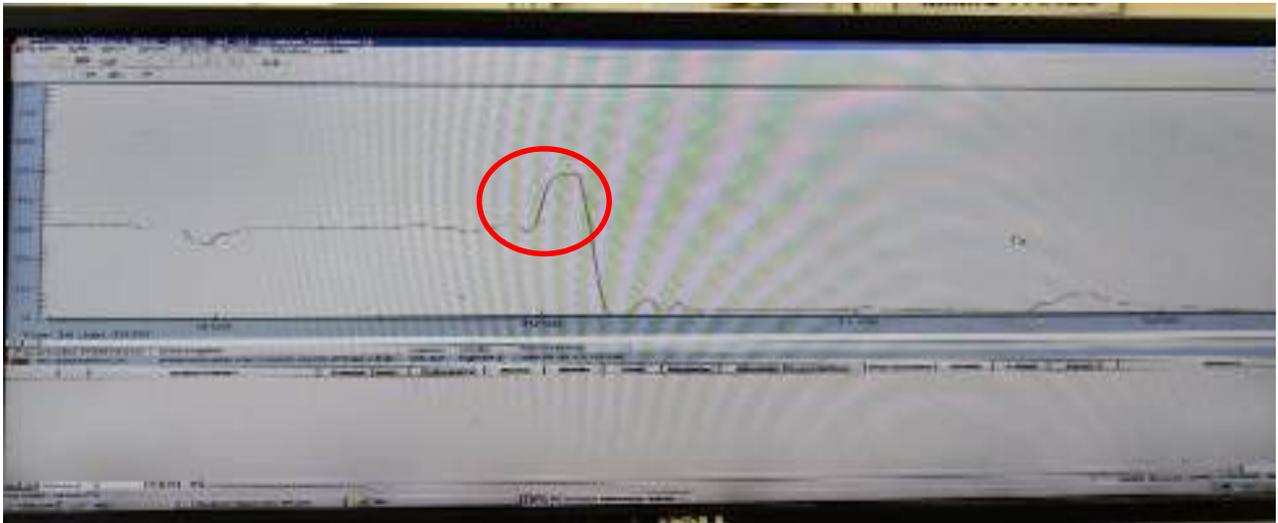


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Drain where leaked crude oil travelled before flowing into river



Pressure increase recorded in one of the crude delivery installation



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