

CASE STUDY

OISD/CS/2022-23/PL/02

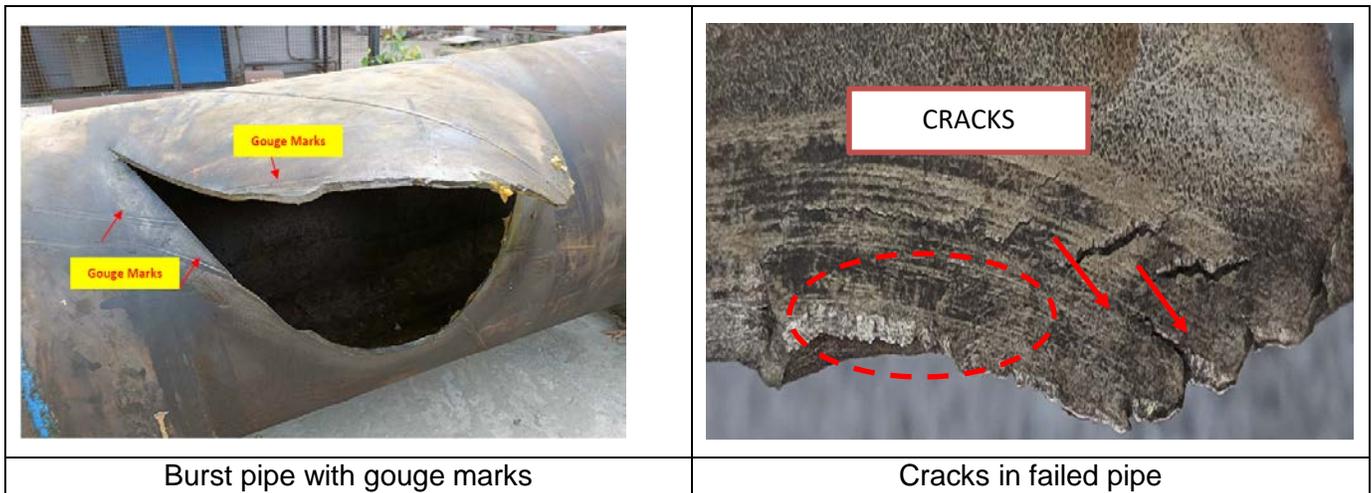
Dt.: 01/08/2022

INTRODUCTION

Title: Leakage incident in cross country crude oil pipeline.
Location: Pipeline ROU near to township location.
Loss/ Outcome: 1200 KL crude oil leaked in incident and shutdown of pipeline for 5 days.

BRIEF OF INCIDENT

The leakage happened due to burst in pipeline, operating at 59 kg/cm² with flow rate of 2450 KL/Hr. This caused tripping of mainline pumps due to low suction. Within five minutes, information received from DGR line-patrolman who was patrolling in that area about crude oil leakage. Immediately shutdown was taken for the complete pipeline and the affected section was isolated to minimize leaking volume and manpower, Mobile Oil Spill Recovery Unit (MOSRU) and fire tender were mobilized to the location to cordon off the area and recovery of the oil.



OBSERVATIONS / SHORTCOMINGS

1. Inline inspection of pipeline section was carried out in 2019. The fitness for purpose assessment report indicated more than 1000 anomalies having ERF>1 using ASME B31G criterion with Maximum Allowable Operating Pressure (MAOP) of 68.4 kg/cm². Most of the reported anomalies were having internal metal loss ranging from 5%-58%. Initially the MOP of the pipeline section was reduced to 47 Kg/cm² till all the critical anomalies were attended. Due to severity of defects as highlighted in ILI survey, Ch 0 to Ch 7.2 km section was replaced and number of Type B sleeves were welded to strengthen the mainline.

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2. Pipeline was repaired by sleeving in very close to the burst point. During site visit, 3 heavy (mechanical) scratch marks / Gouging marks were visible on pipeline near to burst point, which were going upward. Scratch mark was not visible on sleeve, which indicates their scratch/Gouge occurrence happened before sleeving job. Gouge mark due to mechanical damage was not reported by the contractor during pipeline repair work. Pipeline was burst at point where scratch was deepest.
3. Work permit was issued to the contractor for sleeving job. However, neither permit was signed by contractor nor permit was closed after completion of work. Role of operator's personnel/Third Party Inspector (TPI), in the supervision and acceptance of the job, could not be ascertained especially during excavation, backfilling and pipeline condition before coating.
4. As per PO (placed by operator for pipeline repair) terms and conditions:
 - a. In excavation activity, safety of human being has been addressed, however, safety of pipeline is not addressed.
 - b. Penalty clause, for any kind of damage to pipeline, is a detrimental factor to report any unsafe act/ condition by contractor to operator, when job is completely supervised and carried out by contractor.
5. At the time of leak incident, leak detection system was not functional. So, system was unable to identify any kind of leak. Non functionality of leak detection system was highlighted during previous External Safety Audits (ESAs) also.
6. Functionality of SCADA was not satisfactory. Historical archiving system of SCADA was also not functional since last 6 months, so historical trends could be viewed in SCADA and back up of SCADA server was also not getting updated for last 1 month. Further, flow spike at the leak was also not captured in PLC as data communication from flow computer to PLC was through Modbus communication with inherent delay in scan time.
7. The sectionalizing valve was closed locally with 10 minutes delay through technician. The remote operation of the valve could not be done from Control Room.
8. Emergency shut down of pipeline section covering closure of sectionalizing valve stations and stoppage of all running pumps, was not conceptualised as per clause 6.2.1 of OISD-STD-141. Moreover, ESD matrix indicated that tripping of booster pumps was not conceptualised on any abnormal operating parameters i.e., low suction, high discharge/ flow, low flow.
9. The burst pipe spool was having lot of internal pits. This indicated the corrosive property of the crude. In previous two ILI runs; the internal corrosion activity was indicated. The same was also highlighted in ESA audit conducted by OISD. Regular testing of crude corrosiveness for various grades was not established. The results of corrosion coupon and ER probe was also not matching with outcome of ILI.
10. Failed pipe sample Fractographic scanning indicated presence of microscopic cracks in midsection, propagation from outer to inner side indicating generation of crack from impact of external force.

REASONS OF FAILURE / ROOT CAUSE

- a. On analysis of probable cause as mentioned above, it suggested that gouge mark might have come during excavation work during sleeve welding job.
- b. Gouge mark was not taken seriously, and pipeline was left with only coating repair, as later during DCVG or On-Off survey did not show any kind of coating defect at incident site.

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- c. No documentary evidence, indicating any kind of supervision by operator or third-party agency during entire pipeline repair work, could be found.
- d. Contractor also did not report any incident though damage was visible on the pipeline.

With above, it may be concluded that inadequate supervision & precaution during excavation, caused mechanical damage and same was left without inspection & repair. This was the main reason for this failure.

RECOMMENDATIONS

1. Operator has been advised to constitute a committee
 - a. To identify scope of improvement in contract clauses related to pipeline safety.
 - b. To encourage reporting of unsafe acts/ conditions by site personal/ contractor, and rewards for the same.
 - c. To establish the roles and responsibilities of key officials i.e., site in-charge and HSE officer of operator.
 - d. To ensure methodology to witness and assess the pipeline repair work by operator personnel/ Third Part Inspection (TPI) along with documentary evidence.
 - e. To review mechanised excavation procedure to safeguard mainline from any damage especially during such repair & maintenance jobs on a running pipeline.
2. Corrosivity of crude shall be assessed in terms of sulphur content at scheduled frequency and mitigation measures like biocide and corrosion inhibitor dosing shall be ensured
3. In view of lot of defect repair carried out in supervision of contractor, it is recommended to have ILI run with crack detection capability tool on priority, to assess any such cases at other locations where sleeving work was done. This is also to assess any cracks initiation due to excessive internal corrosion defects as observed during last ILI.
4. Inline inspection shall be ensured at frequency not more than 5-year interval as applicable for sour crude in line with clause 9.1 of OISD-STD-188. ILI tool specifications and frequency to be finalized keeping in mind various types of anomalies, corrosion growth and various failures in similar pipelines to maintain integrity of the pipeline.
5. In future, for crude pipeline, handling sour crude oil and significant water content, corrosion allowance should be considered as per clause 5.1.6.3 of OISD-STD-141.
6. Corrosion growth shall be established through ILI data if actual corrosion rate is not indicated by corrosion coupon. Efficacy of dosing rate of Corrosion inhibitor and testing of fluid corrosivity to be ensured on regular basis.
7. Functionality of SCADA and leak detection system shall be restored immediately and preventive maintenance to be planned to keep system healthy all the time. Reliability of SCADA and LDS system to be ensured and status should be reviewed during top management review meeting.
8. Flow meter should be configured for trend analysis as PLC is not able to capture the changes of very short duration due to data pooling through Modbus communication.
9. Station ESD concept to be developed for pipeline rupture scenarios. Further, pipeline ESD to be ensured as per clause 6.2.1 of OISD-STD-141. Records of testing shall be retained.
10. Tripping of booster pumps shall be conceptualised as per OEM recommendation and process requirement.

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