तेल उद्योग सुरक्षा निदेशालय
Oil Industry Safety Directorate
ISO 9001:2015 certified

CASE STUDY

OISD/CS/2023-24/PL/12 Dt.: 18/10/2023

INTRODUCTION

Title: Pipeline failure incident in River crossing.

Location: River crossing.

Loss/ Outcome: Inventory loss and shutdown.

BRIEF OF INCIDENT

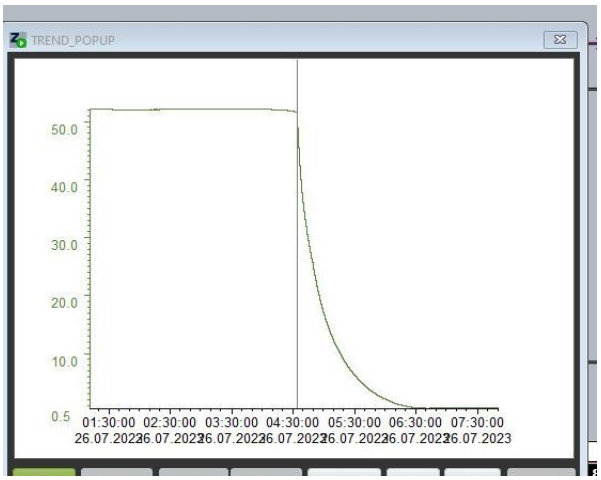
Pressure drop was observed in Natural Gas pipeline at various consumer ends and at intermediate Sectionalizing valve locations. The pressure drop was more significant between sectionalizing valves installed across the river crossing in the pipeline. There was gradual increase in flow in the pipeline at dispatch side and reduction of flow at receipt end. The Control room alerted the top management and mainline team was mobilized to field locations to verify the possibility of leak.

Later, information regarding gas leakage in river crossing was received through villagers approximately 35-40 mins after the fluctuations in monitoring parameters. The sectionalizing valves were closed for isolation of leak section and monitoring of the mainline pressure. The maintenance team reached the location and observed leakage from mainline in river crossing.

The information regarding the incident was shared with District Administration and Police Authorities and affected area was cordon off. The situation was brought under control. No fire incident/ casualties/ injuries were reported from the site. Gas leakage from the affected section was stopped after gas got released into atmosphere subsequent to isolation of the section from the supply side & downstream side.



Leakage in river



Pressure trend in SCADA at SV

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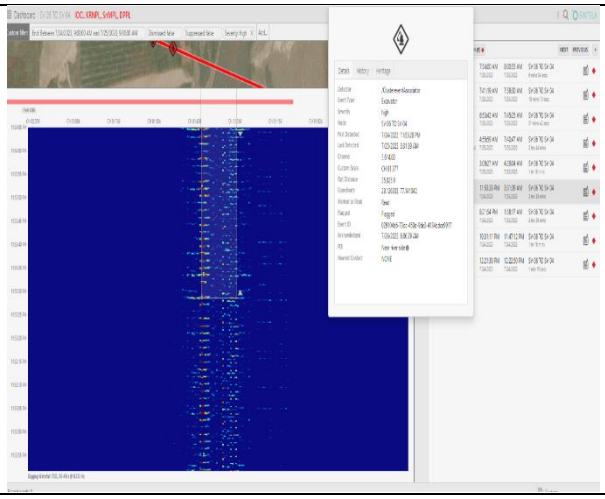	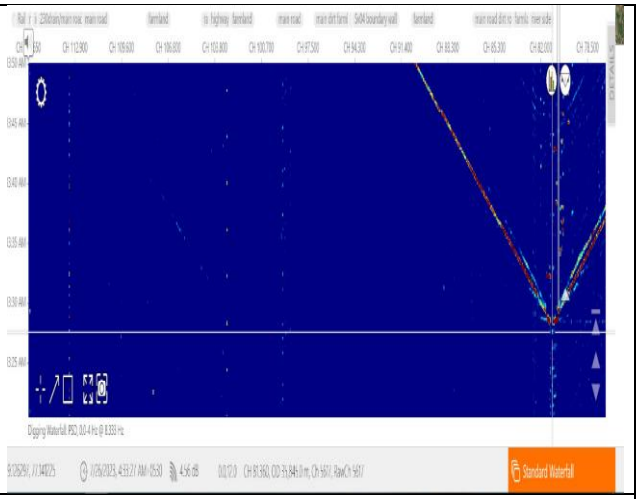
PIDWS alarms at intervening nights in river section	PIDWS alert (V shape) suggesting rupture

OBSERVATIONS / SHORTCOMINGS

1. During construction, design of the HDD crossing was modified based on site conditions. Initial design was having single HDD section, which was modified to two HDD sections with tie-in at the midpoint. The pipeline tie-in section was constructed by excavating pit in the middle of the river during dry season. At tie-in portion, in-situ concreting was done on pipeline at 5-meter intervals for providing anti-buoyancy measure.
2. Design approval documents related to the initial HDD, final design of tie-in section and in-situ concreting design for support blocks was found not available. Any kind of Management of Change (MOC) document for the design change considering risk of washout of the tie in portion was not evidenced.
3. Though the tie-in section was identified for frequent check for erosion on account of heavy floods during monsoon in project closure, any additional monitoring plan & implementation was not observed.
4. There was decreasing trend of pressure at dispatch and receipt side along with increase of flow at dispatch side and decrease of flow at receipt side, suggesting loss of flow at intermediate point. LDS alarm and Pipeline Intrusion Detection and Warning System (PIDWS) generated alert with signature (V shape) of burst observed in Control Room.
5. Inline inspection (ILI) of the pipeline could not be done since commissioning in 2010 due to unexpected quantity of dust and debris received during scrapper pigging operations causing tripping of customer plant. Later, additional Knock Out Drums (KODs) were installed to increase filtration capacity. Pigging exercise was again started in 2022, but ILI could not be done due to contractual issues.
6. The muck analysis report points out presence of iron & iron oxides indicative of internal corrosion effects, which need to be substantiated with integrity inspection data of ILI.
7. The river crossing inspection being followed was based on visual inspection of washout as per internal format and not covering the profile study of the river course. As per the profile data of the river, it was observed that river course had shifted towards downstream side by about 500 m laterally. The tie-in point, which was located at a dry zone within the

river channel at the time of construction, was currently submerged in river. Learnings from OISD issued Safety alert OISD/SA/2022-23/PL/07 dated 6th September, 2022 was not considered in river inspection procedure.

8. Such scenario was covered in ERDMP document. Control measures by isolating the section by closing upstream and downstream valves.
9. Continuity of the pipeline was not observed across the river crossing through CP-PSP system, which suggested mechanical discontinuity in the pipe section. Due to high flow conditions, the physical verification of the pipe section could not be done.
10. Downstream sectionalizing valve across river could not be closed on remote mode from Control Room, as there was no pressure in the pipeline after closing of upstream valve. Functioning of charged hydraulic system was not evident for emergency handling.

REASONS OF FAILURE / ROOT CAUSE

Based on data and evidence collected, it can be concluded that lapses relating to the design and monitoring of river course, caused the pipe portion exposed to high stresses in tie-in portion, which led to its failure.

RECOMMENDATIONS

1. Design of the critical pipeline features like major river crossing should be done considering its hydrological data, channel detail, changes in course etc, which was not evident/ available in the initial project document. The document shall be maintained during the operating phase of the pipeline.
2. To the extent feasible, HDD should be done in single shot avoiding any tie in section within river channel. In case of constraint, the design of tie-in section shall be considering washout and mechanical protection in flood situation.
3. In case of any major change in the initial design due to site factors, system of MOC should be used for proper review and approval at the appropriate level, so that all the aspects including risk assessment get covered in the revised design.
4. Vulnerable sections of the pipeline (Identified through project close out report/ Risk assessment) should be effectively monitored during the operating phase. Online mechanism can be used to map these sections with the possible issues in the system during the handing over/ taking over of the pipelines between projects & operation for effective monitoring during operating phase.
5. Functioning of the Leak Detection System should be given more focus. All the pressure and flow data must be updated on real time basis in SCADA and monitoring format should be developed to verify on regular basis.
6. Training of operating & maintenance personnel should include the response during emergency conditions, application of various systems of pipeline like SCADA, LDS, PIDWS for identifying leaks.
7. Swift response in case of emergency should be addressed in ERDMP document covering communication protocol to affected consumers and isolation of leaking section.
8. For handling emergency situations, security guards manning SV stations should be given basic/ refresher training on regular basis on manual operation of valves, use of fire extinguishers etc. The validation of the same should be done.

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9. Auto closure functionality also to be explored based on pressure drop and abnormal flow increase conditions as per clause no 7.6.5 (Safe Operating Limits) of OISD-GDN-206.
10. Cleaning activity in the pipeline before commissioning should be done using proven cleaning tools like active cleaning tool used during ILI. Inline Inspection (ILI) should be carried out within the scheduled time for maintaining safe, sustainable, and reliable operations of the pipeline.
11. The presence of a high quantity of debris shall be investigated and necessary mitigation to be carried out.
12. Monitoring of features like major river crossings which are prone to changes in profile/ course should include main flow channel profile and its shifting using google images/ drone survey, soil cover data, use of Geotechnical surveys like SONAR etc. inorder to check course of river crossing
13. All the documents should be maintained for operation and maintenance purposes as per clause no 12.4 of OISD-STD-226. While handing over/ taking over between project & operations, it should be ensured by respective project/ operations head that documents are available in hard copy/ digital form. The availability of these documents should also be verified in various audits.
14. Root cause analysis for failure of valve closure on remote to be done and necessary inspection & rectification in hydraulic/ gas closure system to be carried out. Further, schedule preventive maintenance of valve hydraulic system to be carried out as per OEM guidelines/industry practices.
15. All pipeline operators shall consider tie-in section as the vulnerable portion of the HDD crossing and frequent watch to be kept to check any erosion on account of heavy floods during monsoon.

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