NTSB Data Request No. DR58

NTSB Request: For the Summerfield (Noble County) Ohio release that occurred on January 21, 2019, provide a root cause statement, key metallurgical findings, key geotechnical findings and a complete list of recommendations.

Response

Overview of Incident

On January 21, 2019, at approximately 10:38 am EST, a rupture occurred on the Texas Eastern Transmission, LP (TET) 30" natural gas transmission pipeline (Line 10) approximately 2.8 miles downstream of the Berne Compressor Station in Noble County, Ohio near Summerfield, Ohio. The escaping gas from the rupture ignited at the site which resulted in two local residents receiving 1st and 2nd degree burns to exposed areas of skin. Several structures were destroyed or severely damaged.

Root Cause Statement

The root cause of the pipeline failure was ductile overload from a longitudinal tensile or bending force that exceeded the load carrying capacity of the girth weld, due to excessive soil movement applying a longitudinal force to the pipeline.

Key Metallurgical Findings

The metallurgical examination and testing conducted by DNV GL USA, Inc. concluded that the failed pipeline segment met the code requirements for pipe wall thickness, tensile strength and chemical composition and that the weld that failed was of reasonable quality and consistent with good practices at the time of construction.

Two incomplete penetration (IP) flaws were identified on the fracture surface, each approximately 2.2 - 2.3 inches in length with maximum depths of 10.7% and 21.1% of the Nominal Wall Thickness (NWT). The presence of the two IP flaws resulted in a reduced load carrying capacity of 0.345% to 1.3%. This is negligible when compared to other variables included in the calculations, such as the assumed wall thickness and material properties associated with the base metal, heat affected zone (HAZ), and weld metal, as the fracture path was observed propagating through all three regions.

The metallurgical examination also identified two wrinkles on the pipe segment west of GW 105760 (rock side) and an ovality on the pipe segment east of GW 105760 (soil side) with the short axis corresponding to the southeast and downslope movement of soil. DNV concluded that the wrinkling and ovality likely occurred pre-rupture and are indications of strain build-up on the pipeline (the ovality evidence of the soil side's distribution of strain and the wrinkles evidence of the rock side's restrained movement). The wrinkles and ovality were not identified in 2012 ILI reports.

The DNV metallurgical analysis also found the following:

- The weld HAZs for GW-3W, GW-2W and GW-2E exhibited a similar hardness or exceeded the harness of the base metal.
- The tensile properties of joints 4W and 3E met requirements for API 5L Grade X52 line pipe steel in effect at the time of manufacture (1953).
- The toughness properties for the circumferential and longitudinal specimens removed from the base metal of Joints 4W and 3E were typical for the pipe vintage.
- The toughness properties for the longitudinal cross girth weld specimens removed from GW-3W and GW-2E exhibited better toughness properties as compared to the base metal from Joints 4W and 3E.
- The chemical composition of all joints received met the requirements for API 5L Grade X52 line pipe steel in effect at the time of manufacture (1953).

Key Geotechnical Findings

A geotechnical causation investigation was conducted by BCG Engineering Inc. BCG concluded that IMU data from a 2012 ILI run indicated that Line 10 was deflected in the downslope direction by approximately 6 feet between the date of construction (1953) and the 2012 ILI run. Survey data following the incident shows that Line 10 was deflected an additional 2- to 3-ft. between 2012 and the 2019 incident, for a total deflection of 8-9 feet.

Precipitation and development of the site (i.e. road maintenance, Line 25 construction) were identified as the primary destabilizing influences associated at this site. The accelerated movement between 2012 and the date of rupture was circumstantially attributed to record rainfall amounts in the 12 months preceding the rupture.

Recommendations

R1. Projects should include a full geohazard screening review of the route for all projects, including projects built on or adjacent to an existing ROW. SMEs from Asset Integrity should be engaged in the preliminary design through construction and cleanup to ensure geohazard risks are adequately identified and mitigated as per GTM’s standards.

R2. Implement a system for use by all staff, including Area Operations, Regional Operations and Asset Integrity Program staff, for consistently recording, trending and analyzing the occurrence of all identified hazardous conditions and near misses.

R3. Revise Project Governance Standards to preclude the authorization of work that could affect the integrity of Enbridge pipelines or the ROW unless that work has been reviewed and approved by Pipeline Integrity representatives.

R4 Perform a baseline strain inline inspection (or reinspection of existing strain data) of all TET segments within the Appalachians and other geotechnically active areas to identify accumulations of concentrated strain, including ovalities, wrinkles, buckles and bending strain in excess of pipeline specific girth weld and pipe body strain capacities as justified by an Engineering Assessment.

R5. Include in the Pipeline IMP provisions for conducting fitness for service assessments examining strain capacity and demand, weld quality, including interacting features, at identified strain sites.

R6. Develop and provide training to Area Operations Pipeliners and Regional Operations Integrity experts on the recognition, risk and management of geohazards.

R7. Revise SOP 1-6060 to include approved methods for monitoring both leading indicators of pipeline strain (e.g. slope movement) and lagging measures of pipeline strain using pipeline position that can be used in the period between inline inspections. The intent is to provide Area Operations staff a toolkit to be applied as needed in response to observed local conditions and risk factors.

R8. Revise or replace TRG 490 with a comprehensive geohazard management program applying to all Enbridge GTM pipeline assets. The program should be consistent with other threat management programs and include as a minimum:

i) provisions for detection and system wide susceptibility screening of a wide range of geohazards identified through ROW patrol, operational reporting, incidents (internal and external), hazard identification exercises, literature reviews and SME expertise;

ii) provisions for conducting site specific inspections and studies;

iii) provisions for risk assessment of geohazard sites and threats;

iv) inspection and response strategies for accumulation of bending strain, buckling and other geometric features related to applicable geohazards;

v) provisions for monitoring of leading indicators, including intervention criteria, to permit detection and response to hazardous conditions in between ILI or other periodic inspections.

Revise SOP 9-3010 with the sanctioned results.

R9. Examine the roles for integrity management across GTM to ensure accountability for program management and execution of threat management is both clear and adequately resourced in each operating region.

R10. Develop a quasi-independent verification process that assesses whether all integrity hazards will be reasonably and prudently addressed through the integrity risk controls in the IMP. The verification should be a routine component of the IMP review and provide an indication of whether threat management programs are likely to reduce integrity risks below risk targets.

R11. Include in the IMP a process to evaluate the effectiveness of all integrity risk controls in managing applicable hazards, utilizing input from area and regional staff, incidents, near misses, integrity inspection data, monitoring data and other leading or lagging indicators of control performance. The performance assessment should identify whether risk targets were met by each threat management program and be conducted by a group of SMEs independent from the planning or execution of each threat management program. (Intent to supplement the high level review of the integrity program as a whole with information on the performance of all individual inspection, monitoring or prevention programs)

R12. GTM's ground disturbance procedure should be modified to include other hazards which may plausibly occur when working adjacent to buried infrastructure, including working on side slopes and unstable soils.

R13. Enbridge Projects should include in project requirements for Excavation Contractors to have contingency plans to protect adjacent infrastructure from destabilizing effects of construction when working on slopes or in areas identified as having slope stability hazards.

R14. Enbridge Projects should review its practices for conducting pre-job hazard/safety analysis during constructability reviews to ensure that a full range of location and asset specific hazards are being addressed by qualified SMEs. Enbridge Projects should update project management procedures with requirements for conducting job safety analysis and/or field level hazard assessments based on the results of the review.

R15. Enbridge Projects should review education / training requirements for pipeline inspectors to ensure inspectors are trained on identifying a full range of hazards related to working on projects near adjacent pipelines, pipeline facilities and/or other infrastructure (e.g. power lines).

R16. Enbridge Projects should review protocols within specifications and project standards for evaluating changes between as-surveyed conditions and record drawings to ensure that errors and changes in process safety information/record drawings are captured and conveyed back to the Business Unit.

R17. S&R Lands and ROW should review the transfer of ROW issues between the Projects and Operations with an emphasis on ensuring ongoing hazards are identified and communicated to Operations and Safety & Reliability programs.

R18. S&R Lands and ROW, with input from Operations and the BU Safety and Reliability Programs, should define within ROW Agent procedures the pertinent information for direct communication back to the Safety and Reliability Program, including ROW hazards that constitute an immediate and direct notification.

R19. GTM should consider enhancing the characterization of land use and structures (the nature of structures, types of occupancy, etc.) as an input into risk models for determining consequence values. (Intent is to ensure Enbridge is making informed risk decisions regarding mitigation of ROW encroachment through operational controls.)

R20. Assess the suitability of the engineering controls on TET to determine whether the current controls allow for an appropriate and timely response, as well as achievement of risk reduction targets (i.e. compare increase in capacity vs. increase in consequence risk due to running in common mode). The assessment should give consideration to a wide range of potential consequences, including forest fires or fires in populated areas; supply disruption at critical times of the year; fatalities and property damage; and reputation damage. The assessment should be conducted as part of a structured risk assessment that examines the availability, redundancy and sufficiency of TET's operational controls preventing major accident hazards and catastrophic consequences.

R21. Evaluate the benefit of short term administrative controls solution to track position of valves on TET (similar to a CarSeal Valve program where field personnel must contact HGC, who administratively tracks the valve position). The evaluation should be completed through a formal Management of Change process.