

Conclusions

Findings

1. Enbridge's pipeline control center personnel responded in a timely manner to the indications of a pipeline leak.
2. After storage, the accident pipe was likely inadequately loaded for transportation, which led to the initiation of fatigue cracking along a longitudinal seam weld before the pipe was placed in service.
3. After installation the preexisting fatigue crack grew with pressure cycle stresses until the crack reached a critical size and the pipe ruptured.
4. The American Petroleum Institute recommended practice 5L1, *Recommended Practice for Railroad Transportation of Line Pipe*, and American Petroleum Institute recommended practice 5LW, *Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels*, may significantly underestimate the stresses in the pipe at the bearing or separator strips.
5. Hydrostatic pressure testing of a pipeline is insufficient to expose all transportation fatigue cracks that may eventually cause pipe failure.
6. There is a potential risk of pipe damage due to fatigue crack initiation during marine vessel transportation of pipe, similar to the risk during rail transportation, for both hazardous liquid and natural gas pipelines.
7. The absence of industry loading standards for truck transportation of pipe might create risks to the integrity of both natural gas and hazardous liquid pipelines.
8. The Elastic Wave in-line inspection conducted before the accident recorded an indication at the point where the pipe eventually failed; however, preaccident and postaccident interpretations of the recorded data found that the indication did not meet the feature selection criteria to identify it as a crack.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the July 4, 2002, pipeline rupture near Cohasset, Minnesota, was inadequate loading of the pipe for transportation that allowed a fatigue crack to initiate along the seam of the longitudinal weld during transit. After the pipe was installed, the fatigue crack grew with pressure cycle stresses until the crack reached a critical size and the pipe ruptured.

Recommendations

As a result of its investigation of the July 4, 2002, pipeline rupture near Cohasset, Minnesota, the National Transportation Safety Board makes the following safety recommendations:

To the Research and Special Programs Administration:

Remove the exemption in 49 *Code of Federal Regulations* 192.65 (b) that permits pipe to be placed in natural gas service after pressure testing when the pipe cannot be verified to have been transported in accordance with the American Petroleum Institute recommended practice 5L1. (P-04-01)

Amend 49 *Code of Federal Regulations* to require that natural gas pipeline operators (Part 192) and hazardous liquid pipeline operators (Part 195) follow the American Petroleum Institute recommended practice 5LW for transportation of pipe on marine vessels. (P-04-02)

Evaluate the need for a truck transportation standard to prevent damage to pipe, and, if needed, develop the standard and incorporate it in 49 *Code of Federal Regulations* Parts 192 and 195 for both natural gas and hazardous liquid line pipe. (P-04-03)

To the American Society of Mechanical Engineers:

Amend American Society of Mechanical Engineers B31.8, *Gas Transmission and Distribution Piping Systems*, section 816, to remove the provision that pressure testing may be used to verify the integrity of pipe that may not have been transported in accordance with the American Petroleum Institute recommended practices for transportation of pipe by railroad or marine vessels. (P-04-04)

Amend American Society of Mechanical Engineers B31.4, *Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids*, section 434.4, to require the use of the American Petroleum Institute recommended practice 5LW for marine transport of pipe. (P-04-05)

To the American Petroleum Institute:

Review the equations in American Petroleum Institute recommended practice 5L1, *Recommended Practice for Railroad Transportation of Line Pipe*, and American Petroleum Institute recommended practice 5LW, *Recommended Practice for Transportation of Line Pipe on Barges and Marine Vessels*, for calculating the static load stresses at the bearing or separator strips and revise the recommended practices based on that review. (P-04-06)