



Figure 8. Fatigue initiating at toe of weld on interior surface of pipe.

Preaccident Events

Fatigue Cracking in Enbridge Pipe Manufactured by U.S. Steel

Enbridge's 34-inch U.S. Steel DSAW pipe had a documented history of longitudinal seam weld failures due to fatigue cracks. Metallurgical analysis reports of longitudinal seam weld failures in Enbridge's U.S. Steel pipe in 1974, 1979, 1982, 1986, 1989, and 1991 identified the causes as fatigue cracking at the toe of the weld. Enbridge's 34-inch pipeline system also used A.O. Smith flash-welded pipe, Canadian Phoenix electric resistance welded pipe, and Kaiser Steel submerged arc welded (SAW) pipe. All of the longitudinal seam weld failures caused by fatigue cracks in this pipeline have occurred in pipe manufactured by U.S. Steel.

Operational Reliability Assessments of the Pipeline

After the 1991 pipe rupture at the toe of the weld in the 34-inch pipeline resulted in the release of 40,500 barrels (1,701,000 gallons) of crude oil, Enbridge signed a consent order with RSPA's Office of Pipeline Safety to conduct an operational reliability assessment of the 34-inch pipeline from Gretna, Manitoba, Canada, to Superior, Wisconsin. The assessment was to include a review of pipeline operating conditions and an analysis of the previous pipe failures. The operator was also required to restrict

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