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The Enbridge Michigan Pipeline Oil Spill - Some Clues as to What May Have Happened

Posted by Gail the Actuary on August 14, 2010 - 10:40am
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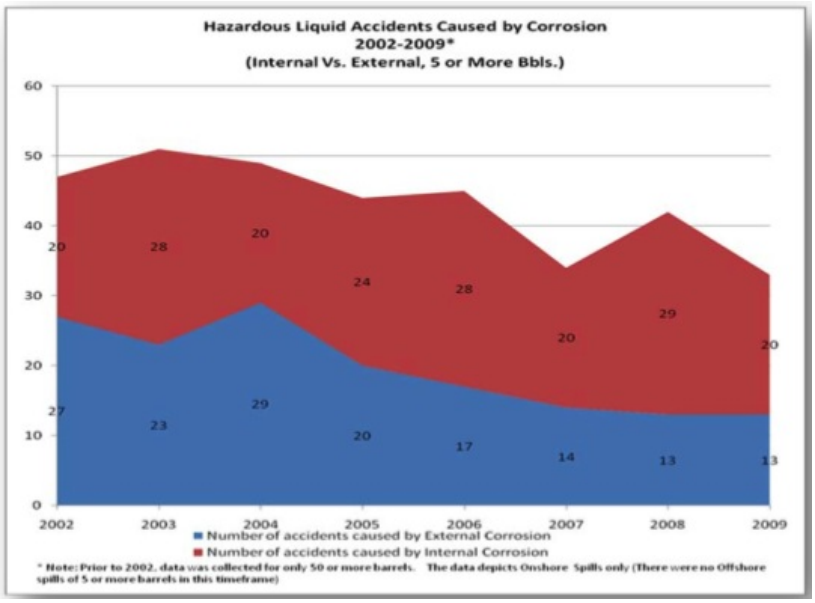
Tags: enbridge, oil spill [list all tags]

Besides BP's massive offshore oil spill, we have been reading about Enbridge's much smaller oil spill in Michigan. The amount of the Michigan oil spill is estimated to be 19,500 barrels, which is well under a single day's spill from the Deepwater Horizon, but is a record for a Midwest pipeline spill.

The federal agency that regulates pipelines is the US Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA), a division of the National Transportation Safety Board (NTSB). The PHMSA reports that in general the number of hazardous liquid accidents caused by corrosion is trending downward, but clearly, something happened in this case (not necessarily corrosion) that caused a large spill.



I checked to see what I could find online about the cause of the spill. The cause of the spill at this point is still be investigated, but there are a few clues. The spill occurred from a ruptured seam about 5 feet in length, on a pipeline that was over 40 years old--the pipeline was put in service in 1969. There was also another very similar spill in 2002, which may also provide insight.

Enbridge's pipeline 6B, which ruptured July 26, in Michigan (Photo from NTSB)

The PHMSA issued a corrective action order to Enbridge. In it, it described its preliminary findings. These included:

> • At approximately 9:45 a.m. COT on July 26, 2010, Respondent discovered that a rupture occurred on its Line 6B hazardous liquid pipeline, resulting in the release of an estimated 19,500 barrels of crude oil. The failure occurred at Mile Post (MP) 608, approximately one mile south of the town of Marshall, Michigan. Marshall is located approximately half-way between the cities of Kalamazoo and Jackson, Michigan. The incident was reported to the National Response Center (NRC Report No. 948903).
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> • Spilled oil from Respondent's pipeline entered the Talmadge Creek and the Kalamazoo River. Emergency responders closed two nearby county roads. Various state and federal agencies including the Environmental Protection Agency, U.S. Coast Guard, and the Michigan Department of Environmental Quality are deploying boom and taking other response and collection measures. Spilled oil has migrated as far downriver as Augusta, Michigan.
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> • The cause of the failure is unknown and the investigation is ongoing. The NTSB will take custody of the failed pipe section once it is excavated and transport it to a metallurgist for examination and failure analysis.
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> • The pipe in the affected segment was manufactured by Siderius in 1969 and is constructed of 30-inch x 0.250-inch wall thickness, grade X-52 submerged arc weld pipe. It has a Polyken tape coating and an impressed current cathodic protection system.
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> • At the time of the incident, the estimated operating pressure at the failure site was 425 psig. The maximum operating pressure (MOP) of this line segment is 624 psig and the Marshall Station discharge set point was 523 psig.
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> • Line 6B was last re-assessed for corrosion in June, 2009 with Ultrasonic Technology and prior to that in October, 2007 with Magnetic Flux Leakage technology. On July 15, 2010 Respondent notified PHMSA of an alternative remediation plan for metal loss

> anomalies found in this survey to consider pipe replacement instead of repair. Enbridge further notified PHMSA that the alternative remediation method would result in exceeding the allowable timeframe to complete remediation.

The way I read this, the failure occurred at a relatively low pressure, in a 41 year old pipeline with a lot of "metal loss anomalies". Enbridge wanted to replace the problem portions of the pipeline, but PHMSA is concerned that this will take too long. Other reports indicated that the areas where corrosion were identified were not in the segment where the spill occurred, and that there had been no plans to replace that segment of the pipe.

Other clues about nature of the spill can be found in some articles comparing the current Michican spill to another spill which took place in Minnesota in 2002. According to this recent Michigan Messenger article the two spills had several things in common, including the fact that they were very old, and carrying very heavy crude from the Canadian oil sands. (Since the pipelines were built years ago, one might expect that they were built to carry less viscous oils.)

> Both lines were put in the ground in a similar time frame, with Line 4 being buried in 1967 and 6B being buried in 1969. They both have carried a combination of crude oils from Alberta, Canada to points in the Midwest of the United States as well as refineries in Sarnia, Ontario. Both were likely transported by rail and truck line to their final resting places. And both were buried in marshy wetlands.
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> In addition, both lines caused the supervisory control and data acquisition system, or SCADA, to trigger pressure and suction alarms in the Enbridge Edmonton control center. SCADA is a system of complicated computer monitoring sensors up and down thousands of miles of Enbridge pipeline. Those sensors are constantly measuring various values, including pressure and suction in the line, sending thousands of readings into that control center an hour.

Another Michigan Messenger article explains some of the issues related to these pressure readings:

> Richard Kuprewicz, an expert in oil pipeline safety with 40 years experience, says that the thicker viscosity of the tar sands oil and the use of diluents to thin it out for pipeline transport also create frequent pressure warnings in the pipeline monitoring system, false positives that can make it more difficult to detect a real pressure problem in the pipe, which can indicate a leak.

There were further similarities:

> There were also warning signs of possible trouble before each incident. Prior to both spills, inline testing of the pipes indicated weak spots in the line. In Minnesota, the testing indicated a crack that was not substantial enough to set off red flags. In Michigan's case, the EPA had warned Enbridge of corrosion issues in the same pipeline

and the company was asking for more time to correct them.

But Kuprewicz says there is a "95 percent probability" the line did not rupture as a result of corrosion, at least based on the initial information available, particularly the location of the rupture. Officials have said the rupture was located at the three o'clock position on the 30 inch pipe, and Kuprewicz says corrosion-induced ruptures are almost always at the bottom of the pipe. . .

Finally, each rupture produced what Kuprewicz identified as "fish mouth" rupture holes. Those rupture images are a telltale sign of a pressure fracture or seam blow out, he said. But defining the cause will require detailed metallurgical analysis of the pipelines. In the case of the 2002 rupture, the determination was made that the rupture happened as the result of a stress fracture that began when the steel pipeline was loaded for its trip to Minnesota in 1967.

"[Fish mouth] ruptures are typical, but the initiating failure could be different," Kuprewicz said.

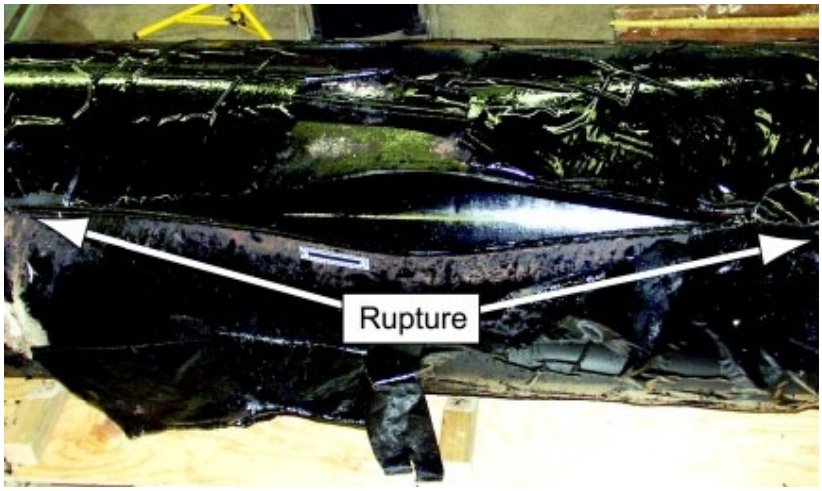

Photo of seam rupture in line 4 in Minnesota in 2002 (Photo by NTSB)

The full report on the Minnesota spill can be found at this PDF.

Paul Austik reports in 24/7 Wall Street that the "service life of a pipeline is typically judged to be about 30-40 years". I don't know whether this is true for all pipelines, but the amount of corrosion found would seem to suggest the pipeline was approaching the end of its normal lifetime. While the graph shown at the top shows a decline in corrosion related spills, this decline seems to be primarily driven by a decline in spills caused by external factors--someone hitting a pipeline while digging, for example. Spills related to internal corrosion seem to bounce around, but are closer to flat.

The Oil Drum has readers with quite varied experience, who can perhaps offer their insights. In this particular instance, it appears that a seam burst, in an older pipeline that was carrying very viscous oil from the oil sands (among other types of liquids), and that monitoring alarms didn't work well, because there were a lot of false positives related to the very viscous oil being transported. Since the pipeline was in a marsh, it may have been flexed more than usual, as water levels changed. It will be interesting to see what the government report concludes. Even the limited reports to date seem to suggest caution in sending very viscous oil through very old

pipelines, and perhaps the need for new standards in this regard.

Oil Spill Map