# National Transportation Safety Board

**Washington, D.C. 20594**

## Pipeline Accident Brief

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| Pipeline Accident Number: | DCA-00-MP-004 |
| Type of System: | Hazardous liquid |
| Accident Type: | Pipe failure and leak |
| Location: | Winchester, Kentucky |
| Date and Time: | January 27, 2000, 12:12 p.m. central standard time (CST) |
| Owner/Operator: | Marathon Ashland Pipe Line LLC |
| Fatalities/Injuries: | None |
| Damage/Clean Up Cost: | $7.1 million |
| Material Released: | Crude oil |
| Quantity Released: | About 489,000 gallons |
| Pipeline Pressure: | 606 pounds per square inch, gauge, (psig) at site of failure |
| Component Affected: | 24-inch-diameter, API 5L, X-52, 0.250-inch-wall-thickness, steel pipe |

## The Accident

About 12:12 p.m. CST[1] on January 27, 2000, a Marathon Ashland Pipe Line LLC (Marathon Ashland) 24-inch-diameter pipeline that runs 265 miles between Owensboro and Catlettsburg, Kentucky, ruptured near Winchester, Kentucky. The ruptured pipeline released about 11,644 barrels (about 489,000 gallons) of crude oil onto a golf course and into Twomile Creek. No injuries or deaths resulted from the accident. As of December 13, 2000, Marathon Ashland had spent about $7.1 million in response to the accident.

## Preaccident Information

The pipe was 0.250-inch-wall-thickness, 24-inch-diameter, steel pipe. It was constructed in 1973. In the area of the rupture, the pipeline ran through a layer of shale and rested on cinderblock-size pieces of Styrofoam. These Styrofoam "pillows" were installed to keep the pipe from lying directly on the shale. The pipeline had a maximum operating pressure of 780 psig.

[1] All references to time in this report are CST. Although the Marathon Ashland operations center is in the eastern time zone (in Findley, Ohio), this pipeline originates in the CST zone.

In January 1997, a contractor's magnetic flux standard resolution inline inspection tool was run through the entire pipeline. Excavations were then made at locations along the pipeline where the inspection tool indicated significant anomalies. At the site where the pipeline ruptured, the 1997 inspection data showed an anomaly that the contractor had interpreted as a "dent." The pipeline had not been excavated at this location because the dent did not appear to meet the repair criteria being used at the time. The repair criteria used required that, for a dent to be repaired, it had to be deeper than 2 percent of the outside diameter of the pipe.

## Leak Reporting and Response

During the morning of January 27, 2000, the pipeline had been shut down for previously planned maintenance work at the Catlettsburg terminal. The shutdown of the line began at 6:59 a.m., and the line was out of operation until 11:12 a.m. At this time, a controller at the Marathon Ashland operations center in Findlay, Ohio, opened manifold valves at Owensboro and Catlettsburg to allow the pipeline to return to normal operations.

At 11:14 a.m., the controller began to restart the pipeline. About 11:30 a.m., a pipeline leak monitor (PLM) alarm sounded in the Findlay operations center and flashed on the supervisory control and data acquisition (SCADA) screen.[2] This alarm indicated that the liquids into and out of the pipeline were not in balance. After the controller focused on some pressure set points and flow rates to reestablish balance, he resumed starting additional pumping units on the line. About 11:52 a.m., the SCADA system flashed "NORMAL" on the screen, indicating that the alarm had cleared and the flow rates were in balance. The controller continued to monitor pressures at stations along the line. At 12:00 noon, a PLM alarm again sounded, indicating that the parameters for the 2-hour and 4-hour line balance were still showing an imbalance on the system. (The controller explained during a postaccident interview that he had expected the PLM alarms to sound during the startup of the system, so he was not surprised by the alarms sounding.) SCADA records show that the pipeline rupture occurred between the Marathon Ashland Tates Creek and Preston Stations at approximately 12:12 p.m. A PLM alarm displayed almost immediately after the pipeline ruptured.

About 12:37 p.m., the controller, uncomfortable about the lower-than-expected pressures at pumping stations along the pipeline and a lost flow rate at Catlettsburg, started to shut the system down. Additional PLM alarms, showing losses, displayed at 12:45 and 12:54 p.m.

[2] Pipeline controllers use the SCADA system to remotely monitor and control movement through pipelines. Using the SCADA system, controllers can monitor flow rates and pressures along the lines and control valves and pumps to adjust the flow at pump stations and other locations throughout the pipeline system.

About 1:00 p.m., the controller paged the operations supervisor and, shortly afterwards, the supervisor came into the Findlay operations center. After the controller and the supervisor had discussed the situation and reviewed the data, they called the area supervisor for this pipeline segment.

The two supervisors discussed the situation and agreed that they should pressure up the pipeline to monitor the pressures. The downstream valves at Catlettsburg were closed about 1:02 p.m. About 1:28 p.m., a single pumping unit at Owensboro, the originating pump station, was started to put pressure on the pipeline. Pressures along the pipeline were observed and recorded. About 1:00, 1:38, 1:40, and 1:44 p.m., PLM alarms sounded and showed on the SCADA screen. At 1:46 p.m., and again at 1:57 p.m., the pressures were recorded.

About 2:00 p.m., the controller expressed concern to the operations supervisor that they had put about 1,000 barrels of crude oil into the pipeline, but pressures were not rising as expected. After making a phone call to the area supervisor, the operations supervisor told the controller to shut down the pipeline. The shutdown was accomplished about 2:05 p.m.

Shortly afterwards, at 2:11 p.m., the Winchester Fire Department called the pipeline operations center in Findlay, Ohio, to report the odor of gas in the air. The operations center immediately relayed this information to the area supervisor, who dispatched a four-person crew to close the two manual valves nearest the leak site. Marathon Ashland employees closed these manual valves at 3:30 p.m.

About 2:20 p.m., a landowner downstream of the leak site telephoned the Findlay operations center to report oil flowing onto his property. The operations supervisor told the controller to automatically shut the mainline block valves at the Preston and Tates Creek Stations.

## Postaccident Examination of the Failed Pipe

The rupture was found on the bottom of the pipe. (See figure 1.) Postaccident laboratory examination of the pipe showed transgranular cracks that had the appearance typical of fatigue progression. The combined depth of the progressive cracks in the areas of maximum penetration was about 90 to 95 percent of the pipe wall thickness.

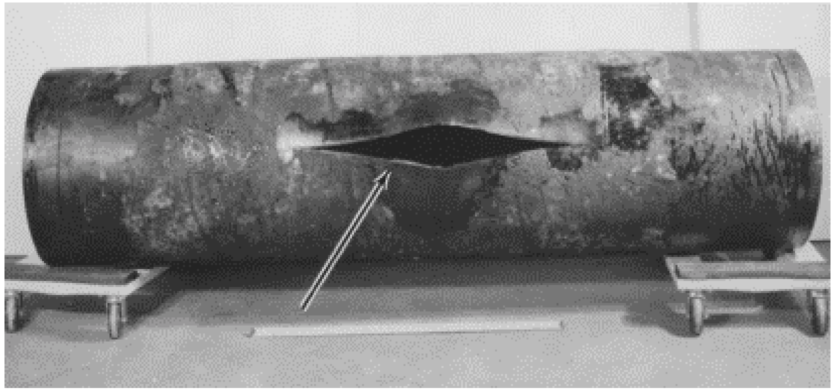

Figure 1. Photograph of ruptured pipe; arrow indicates rupture site

Primary and secondary origin areas of fatigue cracking were found at the edges of a dent in the pipe wall. The dent was consistent with contact with a hard object, although no hard object likely to have caused it (such as a rock) was found during the investigation. Numerous secondary cracks were in the vicinity of the two origin areas.

## Postaccident Developments

After the accident, the U.S. Department of Transportation's Research and Special Programs Administration issued a Corrective Action Order requiring Marathon Ashland "to take the necessary corrective action to protect the public and the environment from potential hazards associated with its 24-inch pipeline." In part, these actions included: maintaining a 20-percent operating pressure reduction; conducting all analysis necessary to determine an interim maximum operating pressure; developing and implementing a work plan for the testing and repair or replacement of sections of pipe with significant defects; evaluating the effectiveness of full encirclement sleeves for repairing significant defects identified by a transverse flux inline inspection tool; and submitting a report of the results of all removal, testing, and analysis performed under the work plan to the regional director of the Office of Pipeline Safety. Marathon Ashland ran slope/deformation and transverse flux inspection tools in the pipeline and reported the findings to the Office of Pipeline Safety. (These tools are used to discover anomalies in the line, such as dents, corrosion, or cracking.) As a result of these internal inspections, anomalies meeting the repair criteria for the entire pipeline were reviewed, inspected, and repaired.

## Postaccident Training

Before the spill, Marathon Ashland had allocated funds for and ordered (1) a SCADA training simulator for its controllers and (2) a full-time training supervisor. The training supervisor began duties in March 2000. The simulator arrived on May 15, 2000, and the first pipeline simulation model, of a Marathon Ashland 10-inch products system, was used to train 43 controllers. A second pipeline simulation, of a Marathon Ashland 22-inch crude oil system, was installed on October 6, 2000. As of January 2001, four controllers had completed training on this second simulation. Marathon Ashland intends the simulator training to help its controllers recognize and react to problems more effectively.

## Probable Cause

The probable cause of the accident was fatigue cracking due to a dent in the pipe that, in combination with fluctuating pressures within the pipe, produced high local stresses in the pipe wall. Contributing to the severity of the accident was the failure of the controller and supervisors to timely recognize the rupture, shut down the pipeline, and isolate the ruptured section of the pipeline.

**Approved: May 3, 2001**