National Transportation Safety Board
Washington, D.C. 20594
Pipeline Accident Brief

Pipeline Accident Number:	DCA-00-MP-005
Type of System:	Hazardous liquid
Accident Type:	Pipe failure and leak
Location:	Greenville, Texas
Date and Time:	March 9, 2000, at 10:20 p.m., central standard time
Owner/Operator:	Explorer Pipeline Company
Fatalities/Injuries:	None
Damage/Clean Up Cost:	$18 million
Material Released:	Gasoline
Quantity Released:	Approximately 564,000 gallons
Pipeline Pressure:	705 pounds per square inch, gauge, (psig) at site of failure
Component Affected:	28-inch-diameter, American Petroleum Institute Specification 5LX, Grade X-52, 0.281-inch-wall-thickness, DSAW (double seam submerged-arc welded) steel pipe

The Accident

On March 9, 2000, about 10:20 p.m., central standard time,[1] a 28-inch-diameter pipeline owned and operated by Explorer Pipeline Company (Explorer) ruptured and released 13,436 barrels (about 564,000 gallons) of gasoline. The pipeline was buried about 4 feet 6 inches under ranch land. The release site was near Greenville, Texas, about 45 miles northeast of Dallas.

Explorer's Greenville pumping station on the 28-inch pipeline was about 10.3 miles south and upstream of the rupture site. This station automatically shut down its two running pumping units when the rupture occurred. Before the failure, the pipeline had been in steady-state operation, and its flow rate was approximately 20,000 barrels per hour. About 2 minutes after the rupture and the automatic shutdown of the Greenville pumping station, the pipeline controller (located in Tulsa, Oklahoma) started a different pumping unit at the Greenville pumping station in an effort to keep the entire pipeline balanced and operating. Meanwhile, the operator of the Greenville pumping station attempted to determine the cause of the automatic shutdown of his pumping units. The pumping unit that the controller had started also shut down automatically after about 2 minutes. The controller shut down the entire line. After a few minutes, thinking that the

[1] All times reported are central standard time.

cause of the initial shutdown had been a control valve problem, the controller restarted the line at a reduced rate. About 13 minutes later (around 10:49 p.m.), the controller shut the entire line down for evaluation.

Leak Reporting and Response

Individuals near the rupture began calling 911 soon after the pipeline failure. Other residents who detected the odor of gasoline called Explorer personnel because they were aware that the Explorer pipeline passed through the area.

The released gasoline flowed a few hundred feet across the surrounding terrain and into a dry creek bed, which was a tributary to East Caddo Creek. From the tributary, the gasoline flowed downstream into East Caddo Creek. The banks of the tributary and creek contained the escaping gasoline as it flowed away from the ruptured pipe.

Explorer closed remotely operated valves at pump stations about 10:59 p.m. to isolate the ruptured section of pipeline. By 11:05 p.m., Explorer personnel were on the scene and meeting with emergency responders. About midnight, a local contractor arrived on the scene to construct dams across East Caddo Creek to stop the flow of gasoline. About 1:30 a.m., Explorer personnel manually closed a mainline valve to further isolate the rupture area.

By morning, three dams had been constructed across the East Caddo Creek. The leading edge of the escaping gasoline was eventually contained about 2 1/2 miles from the rupture site. Then, about 8:30 a.m. the morning after the rupture, heavy rains began to fall. The rain lasted throughout much of the day. An estimated 1.5 to 2 inches of rain fell in the area, and East Caddo Creek rose about 12 feet. The rising waters destroyed the three dams that had been constructed in the night and allowed the gasoline to move further downstream.

Work continued during the day, and the leading edge of the gasoline appeared to have been stopped about 15 miles from the rupture site, about 7 miles upstream of Lake Tawakoni. The lake is a major water supply for Dallas and numerous smaller communities. After the accident, the chemical MTBE (methyl tertiary butyl ether), a component of the gasoline, was found in Lake Tawakoni.

Preaccident Information

The line pipe was 28 inches in diameter, with a wall thickness of 0.281 inch. The double seam submerged-arc welded pipe had been manufactured in 1970 by the Steel Company of Canada to conform to American Petroleum Institute Specification 5LX, Grade X-52. The pipeline had been constructed in 1970. The soil in the area of the rupture consisted of “gumbo” clay and limestone marl. Koppers Bitumastic pipe coating was applied during construction to this section of the line.

An in-line inspection tool (“smart pig”) was run through this section of line in 1997. Anomalies meeting Explorer criteria were excavated, evaluated, and repaired. No anomalies meeting Explorer’s 1997 criteria were reported in the area of the March 2000 failure during the in-line inspection, so the pipe was not visually examined at this location before the failure.

Postaccident Examination of the Failed Pipe Segment

Postaccident laboratory examination of the failed pipe segment showed that the rupture area had a typical “fish-mouth type” crack; when one looked north along the pipeline, the crack was at about the 1 o’clock position on the pipe. The crack was about 50 1/2 inches long, and its maximum width was about 6 3/4 inches. The ends of the crack were located off the edge of the longitudinal seam weld, and about the middle one-third of the crack was directly adjacent to the pipe’s longitudinal seam weld.

The surface of the main fracture was examined. In the middle region, where the crack was located directly adjacent to the longitudinal seam weld, a portion of the fracture surface appeared relatively smooth, and crack arrest marks typical of fatigue were observed. Crack arrest lines appeared to nearly intersect the inner edge of the main fracture surface, but the fracture plane was at an angle of about 45 degrees, consistent with high-stress, low-cycle fatigue. In another region of the fracture surface adjacent to the outer edge, fracture features were obliterated by corrosion.

The pipe coating in the rupture area appeared wrinkled and torn. The coating bore meandering cracks, ranging up to 2 1/2 inches wide, which exposed the pipeline surface. Corrosion pits were observed on the outer surface of the pipe in areas where the coating was cracked. The corrosion pitting was generally isolated, except in the area adjacent to the failure, where zones of continuous corrosion pitting were observed. Pitting was found on the longitudinal weld, and crack-like features were observed at the longitudinal weld boundary in some of the pitted areas. The crack-like features were typical of a weld defect, such as incomplete fusion. No crack-like features were observed in any pits not on the longitudinal weld. (Upon examination after the accident, Explorer noted that, during initial construction of the pipeline section surrounding the failure site, the pipe and coating may have been backfilled before the coating had cooled sufficiently. This could have caused extensive wrinkling in the coating, as well as pulling and tearing the coating materials.)

Postaccident Activities

Before Explorer restarted the pipeline, it established a testing plan, which it gave to the U.S. Department of Transportation's Research and Special Programs Administration (RSPA) for review and approval. The plan established repair procedures, required a pressure reduction to 20 percent below the calculated failure pressure of the pipe at the rupture location, set a refilling and startup procedure, and mandated a pipeline incident review that addressed controller training and SCADA[2] design improvements, including simulation training. Additional in-line testing was conducted, and several repairs to the pipeline were made. On December 15, 2000, RSPA gave Explorer permission to return pipeline operation to the operating pressures that had been in effect before the accident.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the pipeline failure was corrosion-fatigue cracking that initiated at the edge of the longitudinal seam weld at a likely pre-existing weld defect. Contributing to the failure was the loss of pipe coating integrity.

July 6, 2001

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