

DOT US Department of Transportation  
PHMSA Pipeline and Hazardous Materials Safety Administration  
OPS Office of Pipeline Safety  
Central Region

**Principal Investigator** Gery Bauman  
**Region Director** David Barrett  
**Date of Report** 6/4/2012  
**Subject** Failure Investigation Report – BP Oil Pipeline, External Corrosion, Interference

**Operator, Location, & Consequences**

**Date of Failure** 2/25/2004  
**Commodity Released** Refined Products - Diesel  
**City/County & State** Cincinnati/Hamilton County, Ohio  
**OpID & Operator Name** 18386 BP Oil Pipeline Co. (current)  
31189 BP Pipeline (North America) Inc. (time of the accident)  
**Unit # & Unit Name** 3903 Miami Valley Pipeline BP  
**SMART Activity #** 110420  
**Milepost / Location** MP 4.5/Engineering Station 574+62  
**Type of Failure** External Corrosion Leak, Interference  
**Fatalities** 0  
**Injuries** 0  
**Description of area** HCA, Residential Area, 2.5 miles from Ohio River, Under Pavement  
**Total Damages** \$42,000

Failure Investigation Report – BP External Corrosion Bromley-Cincinnati 6”  
Failure Date 02/25/2004

Executive Summary

On February 25, 2004, the Hamilton County, Ohio 911 service began to receive odor complaints from residents living in the 1200 block of Anderson Ferry Road in Cincinnati, OH. The Delhi Fire Department responded to the area and confirmed the odor of petroleum was present in the storm sewers. BP (the operator) was contacted by the Delhi Fire Department at 10:25 am ET regarding odors in the storm sewers. The operator suspended operations of the Bromley to Cincinnati (BOCI) refined products pipeline shortly after contact from the Delhi Fire Department. BP began patrols of the pipeline looking for the source of odor complaints. No obvious leaks were found. The operator then began a hold test which involved increasing pressure in a 5 mile section of the pipeline (up to 200 psig), shutting in this section of pipeline with the increased pressure, and monitoring this section of pipeline for pressure and temperature changes or deviations. Pressure was observed by the operator to drop approximately 1 psig every 10 minutes. During the pressure hold test, BP personnel monitoring the storm sewers began to smell fuel and BP immediately stopped the hold test and lowered pressure on this 5 mile section. The operator began excavations in an effort to determine the exact leak location. Three different locations were excavated initially. On February 29, 2004 at approximately 10:00 am ET, the source of the diesel fuel leak from the pipeline was discovered. The leak location was in front of a residence at 1221 Anderson Ferry Road, in Cincinnati, Ohio (MP 4.5, Engineering Station 547+62).

BP estimated the pressure at the leak site to be 799 psig. The Maximum Operating Pressure (MOP) of the pipeline was 1,200 psig. The pipe that failed was 6.625-inch outside diameter (OD), 0.300-inch wall thickness (WT), Grade B, Low Frequency Electric Resistance Welded (ERW) line pipe, installed in 1938 and was coated with coal tar enamel. The pipeline had been hydrotested in 1997 to a pressure of 1586 psig and smart pigged with a Magnetic Flux Leakage (MFL) tool and geometry tool in 2002. The pipeline is approximately 22.2 miles long, had several foreign line crossings (1.5 inch gas pipeline and 0.75 inch copper water line crossings) and portions of the pipeline were located under pavement in a frequently traveled roadway. An additional cathodic protection rectifier had been installed in 2002 by the operator near the area of the leak.

The operator had repaired or replaced 22 dents in the pipeline in 2003 as a result of the geometry tool indications and had performed several excavations to verify and evaluate the data obtained from the MFL tool run. BP's engineers had completed and reviewed several confirmatory digs prior to the time of the leak and had determined the initial MFL tool run data to be conservative. The initial 2002 MFL tool run data indicated a 49% maximum depth indication at the leak site. The initial MFL tool run data and BP's existing Integrity Management Procedures would not have required the leak location to be excavated or repaired.

A Corrective Action Order (CPF3-2004-5005H) was issued by PHMSA on March 2, 2004 with requirements to: provide start-up procedures that included sufficient pressure monitoring, leak patrolling, and surveillance to detect leaks upon the resumed operation of the pipeline; reduce operating pressure not to exceed 80% of the pressure in effect just prior to the failure; perform

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metallurgical testing of the failed pipe section (including soil sample analysis); re-evaluate the 2002 MFL tool run data; integrate data sources and implement a written plan with corrective measures identified to address all known or suspected factors that caused or contributed to the pipe failure. The written plan was required to include: integration of all relevant data (including the failure and leak history of the pipeline); a close-interval electrical survey; criteria to be used to prioritize any integrity threats that were identified; appropriate repairs or other corrective measures to fully remediate the integrity threatening conditions for the failure area and other areas on the pipeline with similar threats; a description of the repair method used; a proposed schedule for completion of all testing and repairs.

The pipe failure was at the 10 o’clock position. Microbial Induced Corrosion (MIC) was not a factor. MIC was determined not to be present only after chemical and bacterial analysis of deposits near the leak and soils were completed (chemical analysis of deposits found in the pits near the leak, bacterial testing of deposits under the coating, and soil samples).

The metallurgical analysis identified that the cause of the leak was external corrosion “with some mild acceleration of corrosion on the seam due to selective seam corrosion.” The metallurgical analysis also suggested that if corrosion growth rates did increase as initially thought, then “the change that took place was related to the installation of a cathodic-protection rectifier in 2002 and/or other electrical interference on the line.” The report also indicated that “corrosion had reached a depth of approximately 95 percent through wall before the leak occurred.”

A review conducted later in the investigation process did find that the sensor malfunction in the 2002 MFL tool run did contribute to under sizing of the corrosion anomalies.

There were no fires or injuries associated with the leak. The volume of product released was determined by the operator to be less than 5 gallons. Total estimated damages provided by the operator were \$42,000. The operator confirmed that this included all costs incurred by the operator (for those activities not including the CAO) and the emergency response activities. Due to the size of the release and the estimated property damage of less than \$50,000, a 30 day accident report form (PHMSA 7000-1) was not completed or filed by the operator.

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### **System Details**

The BOCI pipeline transports refined products (no HVLs) from the Bromley pump station and barge terminal on the Ohio River to a truck terminal near the intersection of SR 562 and Interstate I-75. The pipeline is approximately 22.2 miles long and transport refined products through residential, business and industrial areas. The pipeline crosses numerous roadways, other underground utilities, and is located near several schools. The pipeline was constructed in 1938 from 6.625-inch OD, 0.300-inch WT, Grade B, Low Frequency ERW line pipe coated with coal tar enamel.

### **Events Leading up to the Failure**

The MOP of the pipeline is 1,200 psig and the normal operating pressure at the time of the failure was 1,198 psig. The pipeline was hydrotested in 1997 to 1,586 psig.

An additional cathodic protection rectifier was installed in 2002. This was the same year that the pipeline was smart pigged with MFL and geometry tools.

In 2003, BP repaired or replaced 22 dents to the pipeline based on the geometry tool data and excavated several sites to verify and confirm data obtained from the 2002 MFL tool run.

On February 25, 2004 residents in the 1200 block of Anderson Ferry Road in Cincinnati, Ohio contacted the area 911 service to report an odor of petroleum emanating from the storm sewers.

### **Emergency Response**

The Delhi Fire Department responded and confirmed the odor of petroleum was present in the storm sewers and checked the storm sewers with gas detectors. The gas detector readings did not indicate any measurement on the Lower Explosive Limit (LEL) scale. A petroleum odor was still prevalent. The Delhi Fire Department then contacted BP at 10:25 am ET and informed the operator of the odors and associated public calls. The Delhi Fire Department and BP continued to periodically check the sewers for an explosive fuel-air mixture. Once the source of the leak was isolated to one lateral entering the sewer system, BP used adsorbent pads to remove the product before it could spread further within the sewer system. The Delhi Fire Department continued to monitor the sewers for the presence of a hazardous atmosphere until the leak on the pipe was uncovered and product movement into the sewer was stopped.

There were no fires or injuries associated with the leak. The volume of product released was determined by the operator to be less than 5 gallons. Property Damage was estimated by the operator at \$42,000 and reported to PHMSA to include all costs incurred by the operator (for those activities not including the CAO) and the emergency response activities.

## **Leak Investigation**

BP suspended operations of the Bromley to Cincinnati (BOCI) refined products pipeline shortly after contact from the Delhi Fire Department. BP began patrols of the pipeline looking for the source of odor. The odor emanating from the sewers had dissipated and was initially no longer detectable. BP theorized that the odor complaint was the result of something randomly being poured into the sewer system.

BP then initiated a shut in test to prove the pipeline integrity. BP closed a mainline block valve approximately 5 miles north of the Bromley pump station and intentionally elevated pressure on the pipeline to 200 psig. Pressure and temperature were then monitored for deviation or changes. Pressure was observed to drop about 1 psi every 10 minutes. During the hold or shut in test, BP personnel monitoring the storm sewers identified a return of the petroleum odor. BP immediately stopped the shut in test and lowered the pressure on the pipeline. BP excavated the pipeline at three different locations in an effort to identify the leak location. On February 29, 2004 at about 10:00 am ET, the source of the diesel fuel leak from the pipeline was discovered. The leak location was identified to be in front of the residence at 1221 Anderson Ferry Road, Cincinnati, Ohio (MP 4.5, engineering survey station 547+62).

One lane of Anderson Ferry Road had to be closed to make repairs to the pipeline. This lane closure was required as part of the pipeline was located parallel to Anderson Ferry Road underneath the road pavement.

## **Summary of Return-to-Service**

Once the specific location of the leak was identified, the pipe was temporarily repaired by the use of a bolt on leak clamp. When temporary repairs were finished, permanent repair plans were developed. The operator's repair plan included the drain down of the pipeline and the installation of new pipe to replace portions of the pipe in the area that had leaked. BP installed and replaced 47 feet of old pipe with new pipe. A CAO, CPF 3-2004-5005H, was issued on March 2, 2004 and encompassed requirements that impacted the return to service plan.

## **Investigation Details**

A pipeline section containing the leak location was sent to Kiefner and Associates for metallurgical analysis. A review of cathodic protection annual test station records for the previous three years indicated all on values were more negative than -1 volt. A review of the rectifier records for the previous 3 years showed acceptable performance of the pipeline rectifiers and the addition of a rectifier in 2002 about 1 mile south of the leak site.

Records of a 2002 close-interval-survey were reviewed and indicated all areas recorded were more negative than -0.850 mv off. The area adjacent to the leak was not covered in the close-interval-survey due to the location of the pipeline being under the road pavement (the pipeline at the leak site was under the south bound lane of Anderson Ferry Road). The original bell hole dug to expose the leak location was required to go through approximately 6” of asphalt, 4” of gravel, 8” of concrete (appeared

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to be abandoned road bed), and then 3’ of brown clay. The presence of the asphalt and concrete explained the lack of close-interval-survey readings in the area of the leak.

A PHMSA Investigator was onsite during the excavation of the leak site. The Investigator noticed that copper water service lines (3/4 inch in size) from a water main were in direct contact with the coating of the pipeline. Any inadvertent contact between the copper water lines and the metallic pipeline could have negatively impacted cathodic protection in the vicinity of the contact. At least one additional foreign line crossing was noted in the 2002 ILI tool run summary information (a 1-1/2 inch gas pipeline).

An MFL smart pig inspection of the pipeline was performed on April 23, 2002. The MFL tool originally identified ten joints with corrosion features with maximum depth percentages between 40% and 49%. The tool run data was reported to be complete and of good quality except for two inoperable sensor carriers. Sensor #2 was inoperable for 92% of the 22 mile run and Sensor #6 was inoperable for 100% of the 22 mile run. Prior to the leak and after the MFL data was reported to BP, two joints with reported corrosion features were excavated to confirm the MFL tool run information. Actual corrosion measurements were taken and compared with those identified by the MFL tool. The initial confirmatory dig analysis revealed that the MFL tool corrosion data was reported to be conservative, indicating that the tool was accurately depicting the size of anomalies within expected tool tolerance. The joint that leaked was not examined during the confirmatory dig phase of the program because of its location (below pavement in a residential neighborhood) and the initial reported value of metal loss. The 2002 MFL data initially reported a 49% metal loss at the leak site. Based on the previous confirmation digs, the reported depth of 49%, and BP’s existing Integrity Management Procedures, the anomaly at the failure site was determined by BP to be acceptable and no repair or further action was determined to be necessary.

BP estimated the pressure at the leak site to be 799 psig. The Maximum Operating Pressure (MOP) of the pipeline was 1,200 psig. The pipe failed at the 10 o’clock position and was 6.625-inch in outside diameter (OD), 0.300-inch wall thickness (WT), Grade B, Low Frequency Electric Resistance Welded (ERW) line pipe, installed in 1938 and coated with coal tar enamel. The pipeline had been hydrotested in 1997 to a pressure of 1586 psig.

OPS issued Alert Notices on January 28, 1988 and March 8, 1989 informing pipeline operators that low-frequency ERW pipe is subject to longitudinal weld seam failures caused by the presence of manufacturing defects in the ERW seams that can grow over time. Seam corrosion and cyclical fatigue have been found to contribute to the growth of these defects and in some cases, operational failures have occurred many months or years after successful hydrostatic testing was conducted.

As a result of the location of this failure, the fact that the commodity entered the sewer system, the specifics of the Alert Notices and a knowledge of the pipeline system components, a Corrective Action Order (CPF3-2004-5005H) was issued by PHMSA on March 2, 2004 with requirements to: provide start-up procedures that include sufficient pressure monitoring, leak patrolling, and surveillance to detect leaks upon the resumed operation of the pipeline; reduce operating pressure not to exceed 80% of the pressure in effect just prior to the failure; perform metallurgical testing of the failed pipe section

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(including soil sample analysis); re-evaluate the 2002 MFL tool run data; integrate data sources and implement a written plan with corrective measures identified to address all known or suspected factors that caused or contributed to the pipe failure. The written plan was required to include: integration of all relevant data (including the failure and leak history of the pipeline); a close-interval electrical survey; criteria to be used to prioritize any integrity threats that were identified; appropriate repairs or other corrective measures to fully remediate the integrity threatening conditions for the failure area and other areas on the pipeline with similar threats; a description of the repair method used; a proposed schedule for completion of all testing and repairs.

A review conducted later in the investigation identified that the tool run sensor malfunction in 2002 MFL data did contribute to the corrosion anomalies being undersized.

Microbial Induced Corrosion (MIC) was determined not to be a factor after chemical and bacterial analysis of deposits and soil samples was completed (chemical analysis of deposits found in the pits near the leak, bacterial testing of deposits under the coating, and soil samples).

The metallurgical analysis identified that the cause of the leak was external corrosion “with some mild acceleration of corrosion on the seam due to selective seam corrosion”. The metallurgical analysis also suggested that if corrosion growth rates did increase as initially thought, then the analysis suggested “the change that took place was related to the installation of a cathodic-protection rectifier in 2002 and/or other electrical interference on the line.” The report indicated “corrosion had reached a depth of approximately 95 percent through wall before the leak occurred.”

The operator did not complete a root cause investigation, an internal accident investigation, or a 30 day (PHMSA Form 7000-1) accident report. The operator’s procedures placed the decision to investigate this size of release at the discretion of the Team Leader or District Manager. In this accident, no one internal to BP in the position of decision making identified the need for an internal investigation beyond those actions required in the PHMSA Corrective Action Order. This release would have been considered as a Tier 1, Level 1 per the operator’s RCFA Reporting and Documentation Matrix.

### **Findings & Contributing Factors**

Kiefner and Associates completed a metallurgical investigation of the pipe. The metallurgical analysis identified that the cause of the leak was external corrosion “with some mild acceleration of corrosion on the seam due to selective seam corrosion.” The metallurgical analysis also suggested that if corrosion growth rates did increase as initially thought, then “the change that took place was related to the installation of a cathodic-protection rectifier in 2002 and/or other electrical interference on the line.” This was supported by the fact that the copper water lines were visually found to be in direct contact with the pipeline when the excavation of the leak site occurred. The metallurgical report indicated that “corrosion had reached a depth of approximately 95 percent through wall before the leak occurred.”

Cathodic Protection records indicated acceptable levels of protection at the test station locations. A close interval survey did not obtain readings for the pipeline area under the pavement in the area of the 1200 block of Anderson Ferry Road in Cincinnati, OH. The 2002 MFL tool run data initially indicated 49%

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wall loss at the leak site. A 49% wall loss report was below the action level of BP’s Integrity Management Plan existing at the time of the leak. A contributing cause for this leak was later determined to be the two inoperable sensors during the 2002 MFL tool run.

A Form 7000-1 Accident Report was not filed or completed by the operator because the spill volume was less than 5 gallons and property damage did not exceed \$50,000.

**Appendices**

Appendix A - Site Map

Appendix B - Photographs

Appendix C – NRC Report

Appendix D - Kiefner and Associates Metallurgical Report

## **Appendix A**

### **Site Map**

This document is on file at PHMSA

Appendix B - Photographs



Photo 1 - View looking south on Anderson Ferry Road at leak site.



Photo 2 - View looking north at leak site.

Appendix B - Photographs



Photo 3 – Leak origin.



Photo 4 – Close-up of corrosion pit.

Appendix B - Photographs



Photo 5 shows temporary leak clamp and stopple fitting used to drain pipeline in preparation for the pipe cut out.



Photo 6 shows bell hole through pavement, top of stopple fitting is visible.

NATIONAL RESPONSE CENTER 1-800-424-8802

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Information released to a third party shall comply with any applicable federal and/or state Freedom of Information and Privacy Laws

Incident Report # 714345

INCIDENT DESCRIPTION

\*Report taken at 12:55 on 25-FEB-04

Incident Type: UNKNOWN SHEEN

Incident Cause: UNKNOWN

Affected Area: STORM SEWER

The incident was discovered on 25-FEB-04 at 12:30 local time.

Affected Medium: WATER STORM SEWER

SUSPECTED RESPONSIBLE PARTY

XX

Type of Organization: UNKNOWN

INCIDENT LOCATION

County: HAMILTON

City: CINCINNATI State: OH

ANDERSON FERRY AND CLEANDER ROAD

RELEASED MATERIAL(S)

CHRIS Code: OUN Official Material Name: UNKNOWN OIL

Also Known As:

Qty Released: 0 UNKNOWN AMOUNT Qty in Water: 0 UNKNOWN AMOUNT

DESCRIPTION OF INCIDENT

CALLER IS REPORTING A PETROLEUM SHEEN IN THE STORM SEWER.

INCIDENT DETAILS

Platform Rig Name:

Platform Letter:

Location Area ID:

Location Block ID:

OCSG Number:

OCSF Number:

State Lease Number:

Pier Dock Number:

Berth Slip Number:

---WATER INFORMATION---

Body of Water: STORM SEWER

Tributary of: MUDDY CREEK TREATMENT CENTER

Nearest River Mile Marker:

Water Supply Contaminated: NO

DAMAGES

Fire Involved: NO Fire Extinguished: UNKNOWN

INJURIES: NO Hospitalized: Empl/Crew: Passenger:

FATALITIES: NO Empl/Crew: Passenger: Occupant:

EVACUATIONS: NO Who Evacuated: Radius/Area:

Damages: NO

<u>Closure Type</u>	<u>Description of Closure</u>	<u>Length of Closure</u>	<u>Direction of Closure</u>
Air:	N		
Road:	N		

Major Artery: N

Waterway: N

Track: N

Passengers Transferred: UNKNOWN

Environmental Impact: UNKNOWN

Media Interest: NONE Community Impact due to Material: NO

REMEDIAL ACTIONS

INVESTIGATION UNDERWAY

Release Secured: UNKNOWN

Release Rate:

Estimated Release Duration:

WEATHER

Weather: SUNNY, 30°F

ADDITIONAL AGENCIES NOTIFIED

Federal:

State/Local:

State/Local On Scene:

State Agency Number:

NOTIFICATIONS BY NRC

MSO LOUISVILLE (PRIMARY)

25-FEB-04 13:11

NOAA 1ST CLASS BB RPTS FOR OH (PRIMARY)

25-FEB-04 13:01

ORSANCO ATTN: J. SCHULTE (PRIMARY)

25-FEB-04 13:01

IN DEPT ENV MNGMT ATTN: BEAUCHAMP (PRIMARY)

25-FEB-04 13:01

KY DEP/ERT ATTN: MR. BLAIR (PRIMARY)

25-FEB-04 13:01

OH EPA ATTN: DUTY OFFICER (PRIMARY)

25-FEB-04 13:01

ADDITIONAL INFORMATION

CALLER WILL NOTIFY;OH EPA

\*\*\* END INCIDENT REPORT # 714345 \*\*\*

The National Response Center is strictly an initial report taking agency and does not participate in the investigation or incident response. The NRC receives initial reporting information only and notifies Federal and State On-Scene Coordinators for response. The NRC does not verify nor does it take follow-on incident information. Verification of data and incident response is the sole responsibility of Federal/State On-Scene Coordinators. Data contained within the FOIA Web Database is initial information only. All reports provided via this server are for informational purposes only. Data to be used in legal proceedings must be obtained via written correspondence from the NRC.

**Appendix D**  
**Metallurgical Report**

This document is on file at PHMSA