

**U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration (PHMSA)
Office of Pipeline Safety**



**Preliminary Factual Report
Plains Pipeline, LP, Failure on Line 901**

February 2016

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Executive Summary:

The mission of the Pipeline and Hazardous Materials Safety Administration (PHMSA) is to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives.

PHMSA continues to investigate the Plains Pipeline, LP Line 901 pipeline failure in Santa Barbara County, California, that occurred on May 19, 2015, to identify all of the factors that contributed to the release and expects to release its final accident investigation report in late Spring 2016.

Preliminary findings indicate that the root cause of the Line 901 failure was external corrosion. PHMSA's final accident investigation report will incorporate all aspects of the events leading up to the release and all contributory causes, including details as to the specific cause of the external corrosion and information about the operator's adherence to federal regulations regarding the operation of Lines 901 and 903.

Immediately following the incident, PHMSA issued a Corrective Action Order (CAO) that required the operator to shut down Line 901. The CAO was amended twice to order the operator to take additional safety measures on Line 903. If additional facts are found during the ongoing investigation that indicate further safety measures are needed on Lines 901 and 903, PHMSA will issue further amendments to the Corrective Action Order.

This report contains preliminary factual information regarding the events leading up to the release and the technical analysis that has been conducted to date. The information in this report is subject to change. Any new or updated information will be incorporated into PHMSA's final accident report.

Facility Background:

Plains Pipeline, LP, transports crude oil produced in Federal and State waters off the coast of Santa Barbara, California to inland refineries. Plains' pipeline is composed of two major pipeline sections: Line 901 is a 24-inch diameter pipeline that extends approximately 10.7 miles from the Las Flores Pump Station to the Gaviota Pump Station, and Line 903 is a 30-inch diameter pipeline that extends approximately 128 miles from the Gaviota Station to the Emidio Station. There is a delivery point into Line 901 from Venoco's Line 96 approximately two miles downstream of the Las Flores Pump Station. All of Line 901 crude oil throughput enters Line 903.

Lines 901 and 903 were constructed in the late 1980s, hydrostatically tested in 1990, and went into crude oil service in 1991. The pipelines are coated with coal tar urethane and covered with foam insulation and a tape wrap over the insulation. Shrink wrap sleeves, which provide a barrier between the steel pipeline and soil for corrosion prevention, are present at all of the pipeline joints on Line 901 and multiple locations on Line 903. The pipelines carry low API gravity crude oil at a temperature of approximately 135 degrees Fahrenheit.

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Lines 901 and 903 are controlled from the Plains Control Room (PCR) in Midland, Texas. Prior to the May 2015 spill, there had been four small leaks at pump stations on Lines 901 and 903. No leaks have been reported on the pipelines outside of pump stations prior to 2015. The calculated Maximum Operating Pressure¹ (MOP) of Line 901 is 1341 psig. The calculated MOP of Line 903 from Gaviota to Sisquoc is 1073 psig.

Plains All American Pipeline (PAAPL) operates Line 901 and Line 903 under a FERC certificate of economic regulatory jurisdiction that was issued in 1987. Plains Pipeline, LP, is a subsidiary of PAAPL. Based on the FERC filing, Lines 901 and 903 are currently classified as interstate pipelines, pursuant to 49 U.S.C. § 60101(7), as facilities used to transport hazardous liquid in interstate or foreign commerce, and as such, are regulated by PHMSA as interstate pipelines.

Events Immediately Prior to and During the Crude Oil Release:

On the morning of May 19, 2015, Lines 901 and 903 were transporting crude oil under “steady flow” conditions. The flow rate was approximately 1250 barrels per hour (BPH) at a Las Flores Pump Station discharge pressure of approximately 600 pounds per square inch (psig). Pumps were operating at the Las Flores Pump Station (PS) on Line 901 and the Sisquoc PS on Line 903. A Plains Instrumentation and Electrical Technician (I&E Tech) was dispatched that morning to disconnect and remove a motor from a non-operational pump at the Sisquoc station. While the I&E Tech was performing his work, the operational pump (Pump 401) at the Sisquoc PS shut down unintentionally, i.e. “uncommanded.” When Pump 401 on Line 903 stopped operating, the pressure in Line 901 increased.

Listed below is the chronology of events that occurred after Pump 401 at the Sisquoc PS stopped operating, as recorded by the Plains Control Room’s Supervisory Control and Data Acquisition (SCADA)² logs:

- At 10:48:44, the Plains Controller (Controller) at the Plains Control Room (PCR) in Midland, TX issued a command to shut down Pump 102 at the Las Flores PS.
- At 10:48:52, the SCADA system in Midland, Texas, recorded that the pump had successfully shut down. The discharge pressure at the Las Flores PS immediately prior to shutdown was recorded by the SCADA to have reached approximately 677 psig at a flow rate of approximately 1250 Barrels per Hour (BPH).
- At 10:49, the I&E Tech called the Controller and notified him that he could restart Pump 401.
- At 10:52:52, the Controller at the PCR issued the command to restart Pump 102 at Las Flores PS.
- At 10:53:01, the SCADA system reported Pump 102 successfully started.

¹ The Maximum Operating Pressure is the highest allowable pressure the pipeline may operate during normal operations.

² SCADA systems are used to remotely control and monitor pipeline operations.

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- Between 10:55 and 10:56 the Pressure and Flow Data from the PCR indicated the discharge pressure at the Las Flores PS reached ~721 psig and the flow rate reached ~1959 barrels per hour (BPH). Based on pressure trends and SCADA log data, it appears that this is when the release began.
- At 10:55:52, the Controller commanded Pump 401 at the Sisquoc PS to start.
- At 10:56:52, the SCADA system reported that Pump 401 was operating.
- At 10:57:59, the SCADA system reported the discharge pressure at the Las Flores PS had dropped to 199 psig and the SCADA system reported a low-pressure alarm to the Controller.
- At 11:09:20, the SCADA system recorded that Sisquoc Pump 401 was experiencing a high case temperature that exceeded the high temperature limit switch, subsequently protecting the pump from damage.
- At 11:12, Venoco personnel called the Controller and notified him they wanted to start a delivery into Line 901 through their Line 96.
- At 11:14, Controller called the I&E Tech at the Sisquoc PS to tell him of the high temperature on Pump 401.
- At 11:15:14, the SCADA system recorded that Sisquoc Pump 401 shut down.
- At 11:15:48, Venoco started their pump to start a delivery into Line 901.
- At 11:20, Venoco personnel called the Plains Controller and told him the pressure in Line 901 was too low to operate their Line 96 pump.
- At 11:20:12, Venoco turned off their pump and closed the valve.
- At 11:22:58, the SCADA log states: “PLM inhibited.” The Pipeline Leak Monitoring System, or PLM, calculates the imbalance between volumetric meters along the pipeline. “Inhibited” means the functionality of the Leak Detection System was turned off at the Midland Control Center. The functional and operational changes associated with this record are still being investigated.
- At 11:26:43, the Controller issued a command to start Pump 401 at Sisquoc PS.
- At 11:27:50, the pump start command timed out. Pump 401 did not start. If the pump does not start within a predetermined time frame, the system is programmed to stop trying to start the pump.
- At 11:28:12, the Controller again issued a command to start Pump 401 at Sisquoc PS.
- At 11:29:20, the pump start command timed out again. Pump 401 did not start.
- At 11:29:56, the Controller issued a stop command to Pump 102 at Las Flores PS.
- At 11:30:05, the SCADA system reported that Pump 102 at Las Flores PS stopped.
 - Mainline Valve 102B at the Las Flores PS closed automatically upon Pump 102 shutdown.
 - The pressure at Las Flores was recorded by the SCADA to be between 211 and 213 psig.

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- At 1:27, the PCR was notified by Plains Field Personnel of the Line 901 release near Refugio Beach, approximately 4.16 miles from the Las Flores PS. The static pressure immediately downstream of the Las Flores PS was recorded by SCADA to be 211 psig.
- At 1:27:23, the Controller at the PCR issued a command to close the Refugio Creek mainline valve, which is approximately 2.83 miles downstream of the Las Flores PS.
- At 1:28:31, the Controller issued a command to close Valve 108 at Las Flores PS.
- At 1:29:34, SCADA recorded the mainline valve at Refugio Creek was successfully closed. Note: This valve is approximately 1.2 miles upstream of the release site and there is a large hill between the closed valve and the release site.
- At 1:30:34, SCADA reported Las Flores PS Valve 108 successfully closed.
- Between 1:47:14 and 1:48:13, the Controller issued commands to close valves 208A, 208C, and 209A at Gaviota PS.
- Between 1:49:51 and 1:51:11, the SCADA system recorded successful closure of valves 208A, 208C, and 209A at Gaviota PS.
- At 2:56 pm, Plains notified the NRC of the failure.
- At 3:57:48, Controller issued command to close valve 209B at Gaviota PS.
- At 4:00:49, SCADA recorded successful closure of Valve 209B at Gaviota PS.

Plains' Field Response:

On the morning of May 19, 2015, Freeport McMoRan, another pipeline operator in Santa Barbara County, had scheduled an oil spill drill required by PHMSA regulations under 49 CFR Part 194. This drill scenario included Plains personnel observing a release at the Gaviota PS and notifying Freeport McMoRan personnel. A pre-drill briefing began around 11:30 am at the offices of Santa Barbara Fire Department's (SBFD) Station 18. Two Plains representatives attended the meeting at the SBFD. The following is a timeline of Plains and responder activities conducted on the ground immediately prior to locating the leak site:

- At 11:42 am a call reporting a petroleum smell was received at Station 18. Engine 18 left the station to investigate the odor complaint near Refugio State Beach.
- At approximately 12:15 pm, the pre-drill meeting was adjourned. A representative from the Santa Barbara Office of Emergency Management (SB-OEM) received a call from the SBFD reporting that there was oil on Refugio Beach. The SB-OEM representative and the Plains representatives left the spill drill and drove separately to Highway 101 at Refugio Beach.
- At approximately 12:55 pm, the two Plains representatives arrived at the south side of Highway 101 where the SBFD personnel were. They noted oil in the ocean but could not see where the oil was coming from. One of the Plains representatives told the assembled group that he did not think the oil was coming from Line 901 because it is located on the other side of Highway 101, and there would be oil flowing across Highway 101 if it were their line.

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- The Plains representatives drove to the company's pipeline right-of-way (ROW). At approximately 1:27 pm, the Plains representatives located the leak site on the Plains ROW. They called the Controller to report the leak and to tell the Controller to leave Line 901 shut down and to close the Refugio Gate Valve. The Plains representatives used their cell phones to contact other Plains personnel, the landowner where the leak occurred, their Oil Spill Response Contractors, and others. The Plains representatives noted that crude oil from the release site had entered a culvert that crosses under the highway and railroad tracks and leads to Refugio Beach. The Plains representative, along with Fire Department personnel, attempted to stop the flow of oil into the culvert. However, the culvert was too large to stop the flow with shovels and sand bags were not readily available so their efforts were unsuccessful. As soon as additional equipment and personnel arrived, the culvert was dammed so the oil was stopped from entering the culvert.

National Response Center Notifications:

The Santa Barbara Dispatch notified the National Response Center (NRC #1116950) at 12:43 pm Pacific Daylight Time (PDT) of an unknown sheen in the ocean at Highway 101 and Refugio Beach.

A representative from Plains called the NRC to report (NRC #1116972) the release of crude oil at 2:56 pm (PDT). This report indicated that the release was at Latitude: 34° 27' 43" N; and Longitude: 120° 05' 24" W. This NRC report was made 89 minutes after the release site was found by Plains field personnel.

PHMSA's Corrective Action Order:

On May 21, PHMSA issued a Corrective Action Order, CPF No. 5-2015-5011H, to Plains. The CAO required Plains to purge Line 901; review the pipeline's construction, operating, maintenance, and integrity management history; expedite the review of data from the May 5, 2015 in-line inspection (ILI); conduct metallurgical evaluation of the failure site; repair any integrity-threatening anomalies identified by the ILI survey; and conduct a root cause failure analysis. The CAO requires Plains to keep Line 901 shut down until PHMSA approves the restart of the pipeline.

On June 3, 2015, PHMSA issued Amendment No. 1 to the CAO. The Amendment to the CAO requires Plains to conduct additional non-destructive testing of ILI anomalies on Lines 901 and 903; review the construction, operating, maintenance, integrity management, and ILI history of Line 903; and reduce the operating pressure of Line 903 to 80% of the highest pressure sustained for a continuous 8-hour period during the month before the May 19 failure. This pressure reduction provides safety until all facets of the line's integrity can be evaluated.

Plains' Line 901 has now been purged and is currently filled with an inert gas.

On November 13, 2015, PHMSA issued Amendment No. 2 to the CAO. The amendment required Plains to empty and purge Line 903 between Gaviota and Pentland Stations and fill it

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with an inert gas. Line 903 has been purged between Gaviota and Sisquoc Stations and Plains will submit a plan to finish purging the line between Sisquoc and Pentland Stations. Both lines will remain shut down until all actions required by the CAO have been completed.

Metallurgical Evaluation of Failed Pipe:

The failed pipe segment has been analyzed by third-party metallurgical experts, Det Norske Veritas – GL (DNV-GL) in Dublin, Ohio. The failed pipe assessment and testing was witnessed by PHMSA, California Department of Fish and Wildlife, and the U.S. Department of Justice.



Pipe External Surface at the Line 901 Failure Site

The Draft Report was completed and disseminated to Plains and PHMSA on August 6, 2015. The draft report was reviewed by PHMSA engineers and a number of comments and clarification requests were made. DNV-GL reviewed the comments and revised the report. The Final Report was issued on September 18, 2015.

The report provides a summary of findings, including the following excerpt:

“The results of the metallurgical analysis indicate that the leak occurred at an area of external corrosion that ultimately failed in ductile overload under the imposed operating pressure. The morphology of the external corrosion observed on the pipe section is consistent with corrosion under insulation facilitated by wet-dry cycling.”

In-Line-Inspection Survey Review by PHMSA’s Third-Party Expert:

Plains conducted ILI surveys on Line 901 to assess the integrity of the pipeline in accordance with PHMSA regulations in 2007, 2012, and 2015. The pipeline is required to be surveyed at intervals commensurate with the pipeline’s risk of integrity threats, but at least every 5 years. Plains changed Line 901 from a 5-year assessment cycle to a 3-year assessment cycle in 2012.

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The data collected during these surveys must be fully evaluated within 180 days of the ILI, and an operator must take action upon discovery of any “immediate repair conditions” as defined in § 195.452(h).

The most recent ILI survey for Line 901 was completed on May 6, 2015. The 2015 ILI data for the first two miles of Line 901, as measured from the Las Flores station, was found to be incomplete and not useable for ILI analysis. For the rest of the ILI survey, the correlation digs, which are used to gauge survey data accuracy with the preliminary report, had not been finished at the time of the May 19th failure.

PHMSA’s third-party ILI expert also performed an analysis of the data from past ILI surveys of Line 901. Preliminary data from the results of each of the ILI surveys are summarized below and show a growing number of corrosion anomalies on Line 901:

Number of Anomalies

| Percent metal loss | June 19, 2007 | July 3, 2012 | May 6, 2015 |
|--------------------|---------------|--------------|-------------|
| Greater than 80% | 0 | 0 | 2 |
| 60-79% | 2 | 5 | 12 |
| 40-59% | 12 | 54 | 80 |

The May 6, 2015 ILI survey data indicated corrosion at the failure site with an area of 5.38 inches by 5.45 inches, and a maximum depth of 47%. The DNV-GL metallurgical analysis physically measured corrosion at the failure site to have a maximum depth of 86%.³

Plains excavated the failure site and four locations that were deemed “immediate repair” conditions under § 195.452(h) from the May 2015 ILI survey data. DNV-GL physically measured the anomalies at these locations and other anomalies near these locations. PHMSA’s third-party ILI expert compared the DNV-GL physical measurements to the May 2015 ILI data. Generally, the anomalies estimated by the ILI survey to be greater than 50% depth were within tolerance, or conservatively “over-called” (i.e., the anomalies in the field were measured to be at or less than what the ILI indicated). The anomalies estimated by the ILI survey to be less than 50% depth were generally measured in the field to not be within tolerance, or were “under-called” (i.e., the anomalies measured in the field were greater than what the ILI indicated).

Cathodic Protection Findings:

Cathodic Protection (CP) is required by the Federal pipeline safety regulations to prevent external corrosion of the pipeline. Historical CP records for Line 901 have been reviewed and

³ PHMSA has access to this data through a view-only web portal.

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reveal protection levels that typically are sufficient to protect non-insulated, coated steel pipe. Line 901 and Line 903, however, are insulated. Increasing frequency and extent of corrosion anomalies have been noted on both Lines 901 and 903 in ILI survey results, anomaly excavations, and repairs. PHMSA inspectors noted moisture entrained in the insulation at four (4) excavations performed by Plains on Line 901 after the May 19th spill and prior to the PHMSA-mandated purging of the pipeline.

Spill Volume Estimate from Plains Engineers:

Plains initially estimated the volume of spilled crude oil to be approximately 2400 barrels. On August 4, 2015, Plains reported to the Unified Command that they still stand by their 2400 barrels release estimate. However, after Plains completed the PHMSA-mandated purge, the company's calculations indicated that up to 3400 barrels had possibly been released from the pipeline. Plains notified the Unified Command that the third-party investigator was still trying to reconcile the difference. Plains has reportedly recovered 997 barrels of crude oil.

In November 2015, Plains verbally reported the spill amount to be 2960 barrels, however Plains has not provided technical documentation or a final accounting report to PHMSA.

Preliminary Findings:

1. The pipeline failed at an approximate pressure of 750 psig which is 56% of the Maximum Operating Pressure.
2. The leak occurred between 10:55 and 10:56 am Pacific Daylight Time.
3. The Controller shut down Line 901 at approximately 11:30 am because of operational problems at the Sisquoc Station on Line 903.
4. Line 901 operated for approximately 35 minutes after the leak occurred.
5. The Plains field staff responded to reports of a crude oil release at Refugio Beach that came from the public and local responders.
6. The SCADA did not record a pressure drop at Las Flores after the line was shut down at 11:30 am.
7. The Controller closed the remotely-controlled valves upstream of the release immediately after the Plains field staff found the leak and reported it to the Controller.
8. Plains notified the NRC of the failure at 2:56 pm.
9. The recent ILI survey (May 6, 2015) did not accurately size the amount of external corrosion in the area of the release.
10. The recent ILI survey did not size corrosion anomalies consistently compared to field measurements of all anomalies investigated after the May 19th spill.
11. Plains' existing corrosion control system is not preventing external corrosion of the pipe under insulation.

Further PHMSA Actions:

PHMSA is continuing its investigation, with particular focus on:

- 1) Review of the DNV-GL metallurgical report;

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- 2) Review of the DNV Root Cause Failure Analysis Report;
- 3) Third-party analysis of the ILI surveys;
- 4) Complete analysis of the Plains Control Room including Controller Actions;
- 5) Complete review and analysis of Plains Integrity Management Program;
- 6) Review of the adequacy of the placement and closure requirements of valves;
- 7) Need for additional pressure/flow monitoring devices; and
- 8) Investigation of the Plains Facility Response Plan (FRP), FRP implementation, appropriateness of emergency response strategies, and identification of unknown transport paths prior to the spill (e.g., culverts to the ocean).

PHMSA's final report will incorporate all aspects of the events leading up to the release and all contributory causes. PHMSA expects to release its final accident report in late Spring 2016.

If additional facts are found that indicate further safety mandates are needed, PHMSA will issue further Amendments to the Corrective Action Order.