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

Principal Investigator	Gene Roberson
Region Director	R. M. Seeley
Date of Report	07/16/2013
Subject	Failure Investigation Report – Enbridge Pipeline – Sump Pump Discharge Flex Hose Failure

Operator, Location, & Consequences

Date of Failure	12/14/2012
Commodity Released	Hazardous Liquid (Crude Oil)
City/County & State	Wynona, Osage County, Oklahoma
OPID & Operator Name	32080 CCPS Transportation, LLC
Unit # & Unit Name	74179 Spearhead Pipeline
SMART Activity #	142160
Milepost / Location	Pershing Pump Station
Type of Failure	Equipment Failure - Flex Hose Failure on Sump Pump Discharge Resulting in the Release of Crude Oil.
Fatalities	None
Injuries	None
Description of area impacted	Rural pump station site.
Property Damage	$157,000

Executive Summary

At approximately 8:30 a.m. Central Standard Time (CST) on December 14, 2012, CCPS Transportation, LLC (Enbridge) identified a release of crude oil within their Pershing Pump Station in Osage County, Oklahoma, in the area of the sump pump. Enbridge notified the National Response Center of the crude oil release on Friday, December 14, 2012, at 10:21 a.m. CST. PHMSA responded to the site to conduct an investigation.

Technicians performed maintenance on the high level set on Thursday, December 13, 2012, and upon completion left the sump pump in automatic mode to reduce the level in the sump. Controllers monitoring the sump indicated it had shut off upon reaching the low level set as expected. The investigation identified the source of the release to be the flex hose fitting between the sump pump and the pipeline. Enbridge activated their Oil Pollution Act (OPA) plan to clean up the site. The spill affected approximately a 20–by-20-foot area in the site. No local emergency personnel responded to the scene. There were no injuries, road closures, or resident evacuations associated with this accident. The station operations were not affected by the release.

Figure 1 Flex Hose Installation

System Details

CCPS Transportation, LLC is a subsidiary of Enbridge Pipeline. The Pershing Station is a part of the Spearhead pipeline system. Spearhead is a 650-mile, 24-inch-diameter pipeline system that runs from Flannigan, Illinois, to Cushing, Oklahoma. It is connected to Enbridge's mainline system in Flannigan, Illinois, and its primary function is transporting Canadian crude to Cushing, Oklahoma. The Southwest Region has regulatory responsibility for the 88-mile section from the Kansas border to Cushing, Oklahoma. The Pershing Station is an unmanned station located in Osage County, Oklahoma.

Figure 2 Site During Cleanup

The failure occurred in a stainless-steel flex hose fitting within the station. Pershing Station was not affected by the release, and pipeline operation continued as normal. No previous failures were noted in the station.

Pipe Specifications

No pipe failed during this event. A flex hose was found to have failed on the discharge line of the sump injection pump. The flex hose was a certified ANSI 600 fitting. Enbridge installed the flexible hose in 2009 with the intent to isolate injection pump vibrations from the main line when reinjecting crude from the sump back into the pipeline.

Events Leading up to the Failure

The Enbridge Spearhead pipeline was operating normally at the time of the accident and continued to operate normally as the release did not affect the pipeline. On December 13, 2012, station technicians performed work on the high level switch associated with the station sump. Upon completion of their duties, they activated the switch to confirm it was operational. They confirmed that it was operating correctly and left the injection pump running to empty the sump. Dispatchers then confirmed the

injection pump shut down upon the sump reaching its low level switch. This was considered a normal operation, and no personnel were required to be on site.

When the technician returned to the station on Friday, December 14, 2012, crude oil was observed affecting an approximately 20–by-20-foot area on the ground in the station around the injection pump. The investigation indicated the release had been from the flex hose located on the pump* discharge. The volume of product in sump between the high level and low level switches is 38 barrels.

*Pump only reinjects crude oil from the station sump back into the pipeline.

Enbridge reported the release to the National Response Center at approximately 10:21 a.m. CST on December 14, 2012 (See Appendix A).

Emergency Response

Enbridge isolated the Pershing Station sump and activated their OPA plan. No pooling crude oil was observed as site clean up began. No local emergency and fire personnel responded to the scene. Due to the remoteness of the station, no roads were closed, and no residents were evacuated. All of the release remained within the station site.

Summary of Return-to-Service

Following the emergency response, Enbridge locked out the station sump. The pipeline was not affected and remained in service.

The sump pump and all related piping was removed to allow soil removal for clean up. The flex hose was sent to a lab for analysis to determine the cause of failure. After soil removal was complete, the site was filled with new soil, the soil was compacted, and a new foundation was constructed to facilitate the re-installation of the pump and piping. Enbridge chose to install hard piping in the place of the flex hose.

Investigation Details

At approximately 10:21 a.m. CST, December 14, 2012, Enbridge reported a release of crude oil to the National Response Center due to a ruptured flex hose at Enbridge's Pershing Station in Osage County, Oklahoma. The station was built in 2009 to increase delivery capacities of their Spearhead pipeline to Cushing, Oklahoma. PHMSA's Southwest Region received the incident notification and made plans to have an investigator on site. The investigator arrived on site at 8:00 a.m. on December 18. The spill clean up was in progress with all of the area piping disassembled and the failed flex hose in the station shop being readied for shipment to a metallurgical lab for analysis. The investigator requested sump drawings and material documentation, and reviewed construction records available on-site. Because of the hose design, the area of failure was not visible for viewing on-site. The operator's written report can be seen in Appendix B.

The failed flex hose was a certified ANSI 600 fitting. The pipeline has an MOP of 1440 psig and was operating at 354 psig at the time of failure. The PHMSA investigator was able to view the site with the

operator. No cause for failure was apparent from a visual examination. Photos of the failed flex hose can be seen in Appendix C.

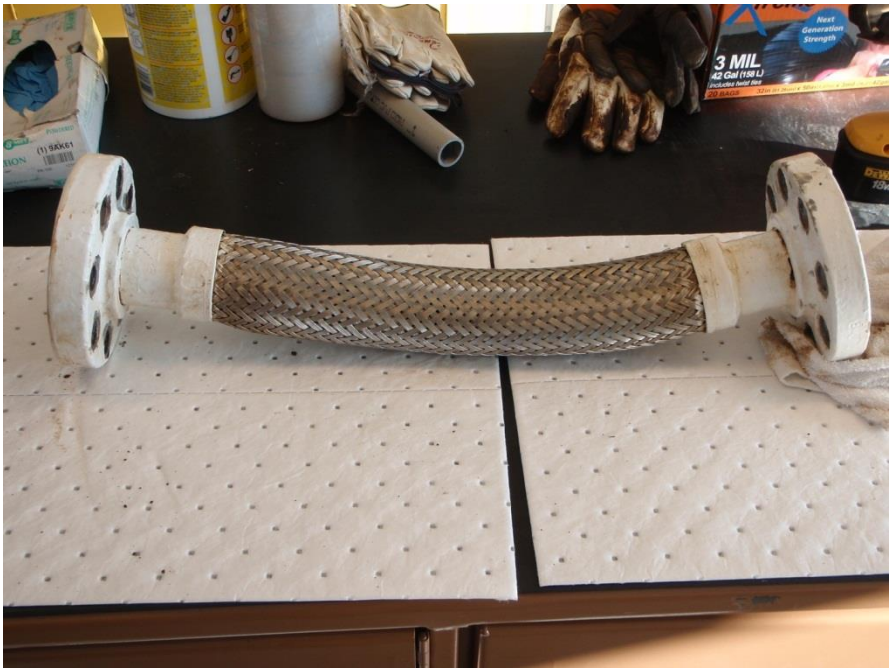

Figure 3 Failed Hose

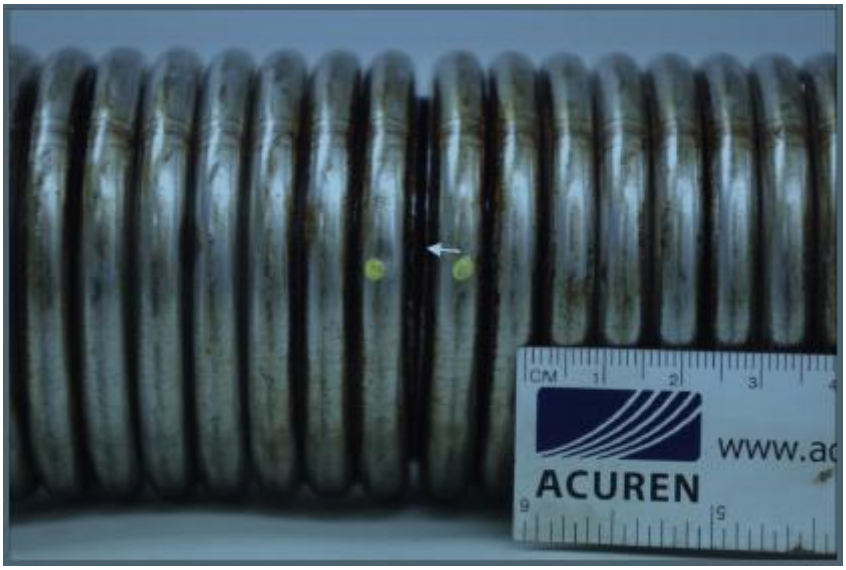

Figure 4 Failed Hose with SS Wrap Removed

The operator replaced two hoses (failed hose and another) downstream of the injection pump with hard pipe prior to returning the sump to service. The failed flex hose was sent to a metallurgical lab for testing.

Metallurgical Analysis

The flex hose was sent to an Edmonton, AB, Canada metallurgical lab for analysis (Appendix C).

The analysis concluded:

- The cause of the leak was the formation of a transverse crack along an internal convolution in approximately the middle of the hose's length.
- The failure mechanism was fatigue, and the failure cause was likely vibrations on the component resulting in high bending stresses on the convolutions.
- The uneven formation of the convolutions (with sharply bent internal convolutions) was likely a contributing factor in the failure.
- No evidence was found to suggest that material/microstructure was a factor in the failure.

Mechanical Analysis

There was no mechanical analysis to be made.

Conclusion

The failure occurred in a flex hose. Per the metallurgical analysis, the cause of the leak was the formation of a transverse crack along an internal convolution of the hose. The failure mechanism was fatigue, and the failure cause was likely vibrations on the component resulting in high bending stresses on the convolutions.

The operator chose to remove the fitting to eliminate additional releases or spills of crude oil from their system.

Appendices

A Telephonics Notice Report – NRC # 1033226

B Operator Accident Report – ODES # 20130007

C Operator Failure Investigation

APPENDIX A

PHMSA Pipeline & Hazardous Materials Safety Administration (Version 4.0.0 PROD)

HMIS->INCIDENTS->TELEPHONICS

Rules of Behavior Home Logout Menu

[Return to Search]

NRC Number: 1033226
Call Date: 12/14/2012 **Call Time:** 11:21:06

Caller Information

First Name:	DAVID	Last Name:	HODGINS
Company Name:	ENBRIDGE PIPELINE		
Address:	21979 N 1500 E RD		
City:	PONTIAC	State:	IL
Country:	USA	Zip:	61764
Phone 1:	9182851132	Phone 2:	
Organization Type:	PRIVA	Is caller the spiller?	◉ Yes ○ No ○ No Response
Confidential:	○ Yes ◉ No ○ No Response		

Discharger Information

First Name:	DAVID	Last Name:	HODGINS
Company Name:	ENBRIDGE PIPELINE		
Address:	21979 N 1500 E RD		
City:	PONTIAC	State:	IL
Country:	USA	Zip:	61764
Phone 1:	9182851132	Phone 2:	
Organization Type:	PRIVA		

Spill Information

State:	OK	County:	OSAGE
Nearest City:	WYNONA	Zip Code:	

Location

21443 STATE RD 99

Spill Date:	12/14/2012 (mm/dd/yyyy)	Spill Time:	08:30:00 (24hh:mm:ss)
DTG Type:	<- Select DTG Type ->		
Incident Type	ALL	Reported Incident Type	PIPELINE

Description

CALLER STATED THAT THEY HAVE A PUMPING STATION AND THE SUMP PUMP DISCHARGE LINE FAILED AND DISCHARGED 1620 GALLONS OF CRUDE OIL ONTO THE SOIL.

Materials Involved

Material / Chris Name	Chris Code	Total Qty.	Water Qty.
OIL: CRUDE	OIL	1620 GALLON(S)	

Medium Type: <- Select Medium Type

Additional Medium Information:

GROUND

Injuries: Fatalites:

Evacuations: ☐ Yes ◉ No ☐ Unknown No. of Evacuations:

Damages: ☐ Yes ◉ No ☐ Unknown Damage Amount:

Federal Agency Notified: ☐ Yes ☐ No ◉ Unknown State Agency Notified: ☐ Yes ☐ No ◉ Unknown

Other Agency Notified: ☐ Yes ☐ No ◉ Unknown

Remedial Actions

COLLECT THE SOIL AND DISPOSE OF IT PROPERLY.

Additional Info

Latitude

Degrees: Minutes: Seconds: Quadrant:

Longitude

Degrees: Minutes: Seconds: Quadrant:

Distance from City: Direction:

Section: Township:

Range: Milepost:

☐ Rescinded **Comments** (max 250 characters)

<< Previous 1..1 of 1 >> Save >>

APPENDIX B

NOTICE: This report is required by 49 CFR Part 195. Failure to report can result in a civil penalty not to exceed $100,000 for each violation for each day that such violation persists except that the maximum civil penalty shall not exceed $1,000,000 as provided in 49 USC 60122.		OMB NO: 2137-0047 EXPIRATION DATE: 01/31/2014
U.S Department of Transportation Pipeline and Hazardous Materials Safety Administration	**Original Report Date:**	01/11/2013
	No.	20130007 - 17553 --- (DOT Use Only)

ACCIDENT REPORT - HAZARDOUS LIQUID PIPELINE SYSTEMS

A federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act unless that collection of information displays a current valid OMB Control Number. The OMB Control Number for this information collection is 2137-0047. Public reporting for this collection of information is estimated to be approximately 10 hours per response (5 hours for a small release), including the time for reviewing instructions, gathering the data needed, and completing and reviewing the collection of information. All responses to this collection of information are mandatory. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to: Information Collection Clearance Officer, PHMSA, Office of Pipeline Safety (PHP-30) 1200 New Jersey Avenue, SE, Washington, D.C. 20590.

INSTRUCTIONS

Important: *Please read the separate instructions for completing this form before you begin. They clarify the information requested and provide specific examples. If you do not have a copy of the instructions, you can obtain one from the PHMSA Pipeline Safety Community Web Page at http://www.phmsa.dot.gov/pipeline.*

PART A - KEY REPORT INFORMATION

Report Type: *(select all that apply)*	**Original:**	**Supplemental:**	**Final:**
		Yes	**Yes**
Last Revision Date:	03/15/2013		
1. Operator's OPS-issued Operator Identification Number (OPID):	32080		
2. Name of Operator	CCPS TRANSPORTATION, LLC		
3. Address of Operator:			
3a. Street Address	1100 LOUISIANA, SUITE 3300		
3b. City	HOUSTON		
3c. State	Texas		
3d. Zip Code	77002		
4. Local time *(24-hr clock)* and date of the Accident:	12/14/2012 08:30		
5. Location of Accident:			
Latitude:	35.59243		
Longitude:	-96.30796		
6. National Response Center Report Number (if applicable):	1033226		
7. Local time *(24-hr clock)* and date of initial telephonic report to the National Response Center (if applicable):	12/14/2012 10:21		
8. Commodity released: *(select only one, based on predominant volume released)*	Crude Oil		
- Specify Commodity Subtype:			
- If "Other" Subtype, Describe:			
- If Biofuel/Alternative Fuel and Commodity Subtype is Ethanol Blend, then % Ethanol Blend: %:			
- If Biofuel/Alternative Fuel and Commodity Subtype is Biodiesel, then Biodiesel Blend (e.g. B2, B20, B100): B			
9. Estimated volume of commodity released unintentionally (Barrels):	38.50		
10. Estimated volume of intentional and/or controlled release/blowdown (Barrels):			
11. Estimated volume of commodity recovered (Barrels):	38.50		
12. Were there fatalities?	No		
- If Yes, specify the number in each category:			
12a. Operator employees			
12b. Contractor employees working for the Operator			
12c. Non-Operator emergency responders			
12d. Workers working on the right-of-way, but NOT associated with this Operator			
12e. General public			
12f. Total fatalities (sum of above)			
13. Were there injuries requiring inpatient hospitalization?	No		
- If Yes, specify the number in each category:			
13a. Operator employees			
13b. Contractor employees working for the Operator			
13c. Non-Operator emergency responders			

13d. Workers working on the right-of-way, but NOT associated with this Operator	
13e. General public	
13f. Total injuries (sum of above)	
14. Was the pipeline/facility shut down due to the Accident?	No
- If No, Explain:	M/L and Sta are operating. Sump will be emptied manually until repair complete.
- If Yes, complete Questions 14a and 14b: *(use local time, 24-hr clock)*	
14a. Local time and date of shutdown:	
14b. Local time pipeline/facility restarted:	
- Still shut down? (* Supplemental Report Required)	
15. Did the commodity ignite?	No
16. Did the commodity explode?	No
17. Number of general public evacuated:	0
18. Time sequence *(use local time, 24-hour clock)*:	
18a. Local time Operator identified Accident:	12/14/2012 08:30
18b. Local time Operator resources arrived on site:	12/14/2012 08:30
PART B - ADDITIONAL LOCATION INFORMATION	
1. Was the origin of Accident onshore?	Yes
If Yes, Complete Questions (2-12)	
If No, Complete Questions (13-15)	
- If Onshore:	
2. State:	Oklahoma
3. Zip Code:	74084
4. City	Wynona
5. County or Parish	Oasage
6. Operator-designated location:	Survey Station No.
Specify:	Reinjection L
7. Pipeline/Facility name:	CCPS Transportation
8. Segment name/ID:	L 55 Pershing Station
9. Was Accident on Federal land, other than the Outer Continental Shelf (OCS)?	No
10. Location of Accident:	Totally contained on Operator-controlled property
11. Area of Accident (as found):	Aboveground
Specify:	Typical aboveground facility piping or appurtenance
- If Other, Describe:	
Depth-of-Cover (in):	
12. Did Accident occur in a crossing?	No
- If Yes, specify below:	
- If Bridge crossing –	
Cased/ Uncased:	
- If Railroad crossing –	
Cased/ Uncased/ Bored/drilled	
- If Road crossing –	
Cased/ Uncased/ Bored/drilled	
- If Water crossing –	
Cased/ Uncased	
- Name of body of water, if commonly known:	
- Approx. water depth (ft) at the point of the Accident:	
- Select:	
- If Offshore:	
13. Approximate water depth (ft) at the point of the Accident:	
14. Origin of Accident:	
- In State waters - Specify:	
- State:	
- Area:	
- Block/Tract #:	
- Nearest County/Parish:	
- On the Outer Continental Shelf (OCS) - Specify:	
- Area:	
- Block #:	
15. Area of Accident:	
PART C - ADDITIONAL FACILITY INFORMATION	
1. Is the pipeline or facility:	Interstate
2. Part of system involved in Accident:	Onshore Pump/Meter Station Equipment and Piping
- If Onshore Breakout Tank or Storage Vessel, Including Attached Appurtenances, specify:	

3. Item involved in Accident:	Other
- If Pipe, specify:	
3a. Nominal diameter of pipe (in):	
3b. Wall thickness (in):	
3c. SMYS (Specified Minimum Yield Strength) of pipe (psi):	
3d. Pipe specification:	
3e. Pipe Seam , specify:	
- If Other, Describe:	
3f. Pipe manufacturer:	
3g. Year of manufacture:	
3h. Pipeline coating type at point of Accident, specify:	
- If Other, Describe:	
- If Weld, including heat-affected zone, specify:	
- If Other, Describe:	
- If Valve, specify:	
- If Mainline, specify:	
- If Other, Describe:	
3i. Manufactured by:	
3j. Year of manufacture:	
- If Tank/Vessel, specify:	
- If Other - Describe:	
- If Other, describe:	Flex Hose
4. Year item involved in Accident was installed:	2009
5. Material involved in Accident:	Material other than Carbon Steel
- If Material other than Carbon Steel, specify:	Stainless Steel
6. Type of Accident Involved:	Rupture
- If Mechanical Puncture – Specify Approx. size:	
in. (axial) by	
in. (circumferential)	
- If Leak - Select Type:	
- If Other, Describe:	
- If Rupture - Select Orientation:	Other
- If Other, Describe:	
Approx. size: in. (widest opening) by	
in. (length circumferentially or axially)	
- If Other – Describe:	

PART D - ADDITIONAL CONSEQUENCE INFORMATION

1. Wildlife impact:	No
1a. If Yes, specify all that apply:	
- Fish/aquatic	
- Birds	
- Terrestrial	
2. Soil contamination:	Yes
3. Long term impact assessment performed or planned:	No
4. Anticipated remediation:	No
4a. If Yes, specify all that apply:	
- Surface water	
- Groundwater	
- Soil	
- Vegetation	
- Wildlife	
5. Water contamination:	No
5a. If Yes, specify all that apply:	
- Ocean/Seawater	
- Surface	
- Groundwater	
- Drinking water: *(Select one or both)*	
- Private Well	
- Public Water Intake	
5b. Estimated amount released in or reaching water (Barrels):	
5c. Name of body of water, if commonly known:	
6. At the location of this Accident, had the pipeline segment or facility been identified as one that "could affect" a High Consequence Area (HCA) as determined in the Operator's Integrity Management Program?	No
7. Did the released commodity reach or occur in one or more High Consequence Area (HCA)?	No
7a. If Yes, specify HCA type(s): *(Select all that apply)*	
- Commercially Navigable Waterway:	

Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	
- High Population Area:	
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	
- Other Populated Area	
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	
- Unusually Sensitive Area (USA) - Drinking Water	
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	
- Unusually Sensitive Area (USA) - Ecological	
Was this HCA identified in the "could affect" determination for this Accident site in the Operator's Integrity Management Program?	
8. Estimated Property Damage:	
8a. Estimated cost of public and non-Operator private property damage	$ 0
8b. Estimated cost of commodity lost	$ 7,000
8c. Estimated cost of Operator's property damage & repairs	$ 40,000
8d. Estimated cost of Operator's emergency response	$ 50,000
8e. Estimated cost of Operator's environmental remediation	$ 60,000
8f. Estimated other costs	$ 0
Describe:	
8g. Total estimated property damage (sum of above)	$ 157,000

PART E - ADDITIONAL OPERATING INFORMATION

1. Estimated pressure at the point and time of the Accident (psig):	354.00
2. Maximum Operating Pressure (MOP) at the point and time of the Accident (psig):	1,440.00
3. Describe the pressure on the system or facility relating to the Accident (psig):	Pressure did not exceed MOP
4. Not including pressure reductions required by PHMSA regulations (such as for repairs and pipe movement), was the system or facility relating to the Accident operating under an established pressure restriction with pressure limits below those normally allowed by the MOP?	No
- If Yes, Complete 4.a and 4.b below:	
4a. Did the pressure exceed this established pressure restriction?	
4b. Was this pressure restriction mandated by PHMSA or the State?	
5. Was "Onshore Pipeline, Including Valve Sites" OR "Offshore Pipeline, Including Riser and Riser Bend" selected in PART C, Question 2?	No
- If Yes - (*Complete 5a. – 5e. below)*	
5a. Type of upstream valve used to initially isolate release source:	
5b. Type of downstream valve used to initially isolate release source:	
5c. Length of segment isolated between valves (ft):	
5d. Is the pipeline configured to accommodate internal inspection tools?	
- If No, Which physical features limit tool accommodation? (*select all that apply)*	
- Changes in line pipe diameter	
- Presence of unsuitable mainline valves	
- Tight or mitered pipe bends	
- Other passage restrictions (i.e. unbarred tee's, projecting instrumentation, etc.)	
- Extra thick pipe wall (applicable only for magnetic flux leakage internal inspection tools)	
- Other -	
- If Other, Describe:	
5e. For this pipeline, are there operational factors which significantly complicate the execution of an internal inspection tool run?	
- If Yes, Which operational factors complicate execution? (*select all that apply*)	

- Excessive debris or scale, wax, or other wall buildup	
- Low operating pressure(s)	
- Low flow or absence of flow	
- Incompatible commodity	
- Other -	
- If Other, Describe:	
5f. Function of pipeline system:	> 20% SMYS Regulated Trunkline/Transmission
6. Was a Supervisory Control and Data Acquisition (SCADA)-based system in place on the pipeline or facility involved in the Accident?	Yes
If Yes -	
6a. Was it operating at the time of the Accident?	Yes
6b. Was it fully functional at the time of the Accident?	Yes
6c. Did SCADA-based information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the detection of the Accident?	No
6d. Did SCADA-based information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the confirmation of the Accident?	No
7. Was a CPM leak detection system in place on the pipeline or facility involved in the Accident?	No
- If Yes:	
7a. Was it operating at the time of the Accident?	
7b. Was it fully functional at the time of the Accident?	
7c. Did CPM leak detection system information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the detection of the Accident?	
7d. Did CPM leak detection system information (such as alarm(s), alert(s), event(s), and/or volume calculations) assist with the confirmation of the Accident?	
8. How was the Accident initially identified for the Operator?	Local Operating Personnel, including contractors
- If Other, Specify:	
8a. If "Controller", "Local Operating Personnel", including contractors", "Air Patrol", or "Guard Patrol by Operator or its contractor" is selected in Question 8, specify the following:	Operator employee
9. Was an investigation initiated into whether or not the controller(s) or control room issues were the cause of or a contributing factor to the Accident?	No, the Operator did not find that an investigation of the controller(s) actions or control room issues was necessary due to: (provide an explanation for why the Operator did not investigate)
- If No, the Operator did not find that an investigation of the controller(s) actions or control room issues was necessary due to: *(provide an explanation for why the operator did not investigate)*	The facility would have appeard to be operating normally to a controller.
- If Yes, specify investigation result(s): *(select all that apply)*	
- Investigation reviewed work schedule rotations, continuous hours of service (while working for the Operator), and other factors associated with fatigue	
- Investigation did NOT review work schedule rotations, continuous hours of service (while working for the Operator), and other factors associated with fatigue	
Provide an explanation for why not:	
- Investigation identified no control room issues	
- Investigation identified no controller issues	
- Investigation identified incorrect controller action or controller error	
- Investigation identified that fatigue may have affected the controller(s) involved or impacted the involved controller(s) response	
- Investigation identified incorrect procedures	
- Investigation identified incorrect control room equipment operation	
- Investigation identified maintenance activities that affected control room operations, procedures, and/or controller response	
- Investigation identified areas other than those above:	
Describe:	

PART F - DRUG & ALCOHOL TESTING INFORMATION

1. As a result of this Accident, were any Operator employees tested under the post-accident drug and alcohol testing requirements of DOT's Drug & Alcohol Testing regulations?	No
- If Yes:	
1a. Specify how many were tested:	

1b. Specify how many failed:	
2. As a result of this Accident, were any Operator contractor employees tested under the post-accident drug and alcohol testing requirements of DOT's Drug & Alcohol Testing regulations?	No
- If Yes:	
2a. Specify how many were tested:	
2b. Specify how many failed:	

PART G – APPARENT CAUSE

Select only one box from PART G in shaded column on left representing the APPARENT Cause of the Accident, and answer the questions on the right. Describe secondary, contributing or root causes of the Accident in the narrative (PART H).

Apparent Cause:	G6 - Equipment Failure
G1 - Corrosion Failure - only one **sub-cause** can be picked from shaded left-hand column	
External Corrosion:	
Internal Corrosion:	
- If External Corrosion:	
1. Results of visual examination:	
- If Other, Describe:	
2. Type of corrosion: *(select all that apply)*	
- Galvanic	
- Atmospheric	
- Stray Current	
- Microbiological	
- Selective Seam	
- Other:	
- If Other, Describe:	
3. The type(s) of corrosion selected in Question 2 is based on the following: *(select all that apply)*	
- Field examination	
- Determined by metallurgical analysis	
- Other:	
- If Other, Describe:	
4. Was the failed item buried under the ground?	
- If Yes :	
□4a. Was failed item considered to be under cathodic protection at the time of the Accident?	
If Yes - Year protection started:	
4b. Was shielding, tenting, or disbonding of coating evident at the point of the Accident?	
4c. Has one or more Cathodic Protection Survey been conducted at the point of the Accident?	
If "Yes, CP Annual Survey" – Most recent year conducted:	
If "Yes, Close Interval Survey" – Most recent year conducted:	
If "Yes, Other CP Survey" – Most recent year conducted:	
- If No:	
4d. Was the failed item externally coated or painted?	
5. Was there observable damage to the coating or paint in the vicinity of the corrosion?	
- If Internal Corrosion:	
6. Results of visual examination:	
- Other:	
7. Type of corrosion *(select all that apply)*: -	
- Corrosive Commodity	
- Water drop-out/Acid	
- Microbiological	
- Erosion	
- Other:	
- If Other, Describe:	
8. The cause(s) of corrosion selected in Question 7 is based on the following *(select all that apply)*: -	
- Field examination	
- Determined by metallurgical analysis	
- Other:	
- If Other, Describe:	
9. Location of corrosion *(select all that apply)*: -	
- Low point in pipe	
- Elbow	

- Other:	
- If Other, Describe:	
10. Was the commodity treated with corrosion inhibitors or biocides?	
11. Was the interior coated or lined with protective coating?	
12. Were cleaning/dewatering pigs (or other operations) routinely utilized?	
13. Were corrosion coupons routinely utilized?	
Complete the following if any Corrosion Failure sub-cause is selected AND the "Item Involved in Accident" (from PART C, Question 3) is Tank/Vessel.	
14. List the year of the most recent inspections:	
14a. API Std 653 Out-of-Service Inspection	
- No Out-of-Service Inspection completed	
14b. API Std 653 In-Service Inspection	
- No In-Service Inspection completed	
Complete the following if any Corrosion Failure sub-cause is selected AND the "Item Involved in Accident" (from PART C, Question 3) is Pipe or Weld.	
15. Has one or more internal inspection tool collected data at the point of the Accident?	
15a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run: -	
- Magnetic Flux Leakage Tool	
Most recent year:	
- Ultrasonic	
Most recent year:	
- Geometry	
Most recent year:	
- Caliper	
Most recent year:	
- Crack	
Most recent year:	
- Hard Spot	
Most recent year:	
- Combination Tool	
Most recent year:	
- Transverse Field/Triaxial	
Most recent year:	
- Other	
Most recent year:	
Describe:	
16. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Accident?	
If Yes -	
Most recent year tested:	
Test pressure:	
17. Has one or more Direct Assessment been conducted on this segment?	
- If Yes, and an investigative dig was conducted at the point of the Accident::	
Most recent year conducted:	
- If Yes, but the point of the Accident was not identified as a dig site:	
Most recent year conducted:	
18. Has one or more non-destructive examination been conducted at the point of the Accident since January 1, 2002?	
18a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
G2 - Natural Force Damage - only one **sub-cause** can be picked from shaded left-handed column	
Natural Force Damage – Sub-Cause:	
- If Earth Movement, NOT due to Heavy Rains/Floods:	

1. Specify:	
- If Other, Describe:	
- If Heavy Rains/Floods:	
2. Specify:	
- If Other, Describe:	
- If Lightning:	
3. Specify:	
- If Temperature:	
4. Specify:	
- If Other, Describe:	
- If High Winds:	
- If Other Natural Force Damage:	
5. Describe:	
Complete the following if any Natural Force Damage sub-cause is selected.	
6. Were the natural forces causing the Accident generated in conjunction with an extreme weather event?	
6a. If Yes, specify: *(select all that apply)*	
- Hurricane	
- Tropical Storm	
- Tornado	
- Other	
- If Other, Describe:	
G3 - Excavation Damage - only one **sub-cause** can be picked from shaded left-hand column	
Excavation Damage – Sub-Cause:	
- If Excavation Damage by Operator (First Party):	
- If Excavation Damage by Operator's Contractor (Second Party):	
- If Excavation Damage by Third Party:	
- If Previous Damage due to Excavation Activity:	
Complete Questions 1-5 ONLY IF the "Item Involved in Accident" (from PART C, Question 3) is Pipe or Weld.	
1. Has one or more internal inspection tool collected data at the point of the Accident?	
1a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run: -	
- Magnetic Flux Leakage	
Most recent year conducted:	
- Ultrasonic	
Most recent year conducted:	
- Geometry	
Most recent year conducted:	
- Caliper	
Most recent year conducted:	
- Crack	
Most recent year conducted:	
- Hard Spot	
Most recent year conducted:	
- Combination Tool	
Most recent year conducted:	
- Transverse Field/Triaxial	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
2. Do you have reason to believe that the internal inspection was completed BEFORE the damage was sustained?	
3. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Accident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
4. Has one or more Direct Assessment been conducted on the pipeline segment?	
- If Yes, and an investigative dig was conducted at the point of the Accident:	
Most recent year conducted:	
- If Yes, but the point of the Accident was not identified as a dig site:	

Most recent year conducted:	
5. Has one or more non-destructive examination been conducted at the point of the Accident since January 1, 2002?	
5a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
Complete the following if Excavation Damage by Third Party is selected as the sub-cause.	
6. Did the operator get prior notification of the excavation activity?	
6a. If Yes, Notification received from: *(select all that apply)* -	
- One-Call System	
- Excavator	
- Contractor	
- Landowner	
Complete the following mandatory CGA-DIRT Program questions if any Excavation Damage sub-cause is selected.	
7. Do you want PHMSA to upload the following information to CGA-DIRT (www.cga-dirt.com)?	
8. Right-of-Way where event occurred: *(select all that apply)* -	
- Public	
- If "Public", Specify:	
- Private	
- If "Private", Specify:	
- Pipeline Property/Easement	
- Power/Transmission Line	
- Railroad	
- Dedicated Public Utility Easement	
- Federal Land	
- Data not collected	
- Unknown/Other	
9. Type of excavator:	
10. Type of excavation equipment:	
11. Type of work performed:	
12. Was the One-Call Center notified?	
12a. If Yes, specify ticket number:	
12b. If this is a State where more than a single One-Call Center exists, list the name of the One-Call Center notified:	
13. Type of Locator:	
14. Were facility locate marks visible in the area of excavation?	
15. Were facilities marked correctly?	
16. Did the damage cause an interruption in service?	
16a. If Yes, specify duration of the interruption (hours)	
17. Description of the CGA-DIRT Root Cause *(select only the one predominant first level CGA-DIRT Root Cause and then, where available as a choice, the one predominant second level CGA-DIRT Root Cause as well):*	
Root Cause:	
- If One-Call Notification Practices Not Sufficient, specify:	
- If Locating Practices Not Sufficient, specify:	
- If Excavation Practices Not Sufficient, specify:	
- If Other/None of the Above, explain:	
G4 - Other Outside Force Damage *- only one **sub-cause** can be selected from the shaded left-hand column*	
Other Outside Force Damage – Sub-Cause:	
- If Nearby Industrial, Man-made, or Other Fire/Explosion as Primary Cause of Incident:	
- If Damage by Car, Truck, or Other Motorized Vehicle/Equipment NOT Engaged in Excavation:	
1. Vehicle/Equipment operated by:	
- If Damage by Boats, Barges, Drilling Rigs, or Other Maritime Equipment or Vessels Set Adrift or Which Have Otherwise Lost	

Their Mooring:	
2. Select one or more of the following IF an extreme weather event was a factor:	
- Hurricane	
- Tropical Storm	
- Tornado	
- Heavy Rains/Flood	
- Other	
- If Other, Describe:	
- If Routine or Normal Fishing or Other Maritime Activity NOT Engaged in Excavation:	
- If Electrical Arcing from Other Equipment or Facility:	
- If Previous Mechanical Damage NOT Related to Excavation:	
Complete Questions 3-7 ONLY IF the "Item Involved in Accident" (from PART C, Question 3) is Pipe or Weld.	
3. Has one or more internal inspection tool collected data at the point of the Accident?	
3a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run:	
- Magnetic Flux Leakage	
Most recent year conducted:	
- Ultrasonic	
Most recent year conducted:	
- Geometry	
Most recent year conducted:	
- Caliper	
Most recent year conducted:	
- Crack	
Most recent year conducted:	
- Hard Spot	
Most recent year conducted:	
- Combination Tool	
Most recent year conducted:	
- Transverse Field/Triaxial	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
4. Do you have reason to believe that the internal inspection was completed BEFORE the damage was sustained?	
5. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Accident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
6. Has one or more Direct Assessment been conducted on the pipeline segment?	
- If Yes, and an investigative dig was conducted at the point of the Accident:	
Most recent year conducted:	
- If Yes, but the point of the Accident was not identified as a dig site:	
Most recent year conducted:	
7. Has one or more non-destructive examination been conducted at the point of the Accident since January 1, 2002?	
7a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted:	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
- If Intentional Damage:	
8. Specify:	
- If Other, Describe:	
- If Other Outside Force Damage:	

9. Describe:	
G5 - Material Failure of Pipe or Weld - only one **sub-cause** can be selected from the shaded left-hand column	
Use this section to report material failures ONLY IF the "Item Involved in Accident" (from PART C, Question 3) is "Pipe" or "Weld."	
Material Failure of Pipe or Weld – Sub-Cause:	
1. The sub-cause selected below is based on the following: *(select all that apply)*	
- Field Examination	
- Determined by Metallurgical Analysis	
- Other Analysis	
- If "Other Analysis", Describe:	
- Sub-cause is Tentative or Suspected; Still Under Investigation (Supplemental Report required)	
- If Construction, Installation, or Fabrication-related:	
2. List contributing factors: *(select all that apply)*	
- Fatigue or Vibration-related	
Specify:	
- If Other, Describe:	
- Mechanical Stress:	
- Other	
- If Other, Describe:	
- If Original Manufacturing-related (NOT girth weld or other welds formed in the field):	
2. List contributing factors: *(select all that apply)*	
- Fatigue or Vibration-related:	
Specify:	
- If Other, Describe:	
- Mechanical Stress:	
- Other	
- If Other, Describe:	
- If Environmental Cracking-related:	
3. Specify:	
- Other - Describe:	
Complete the following if any Material Failure of Pipe or Weld sub-cause is selected.	
4. Additional factors: (*select all that apply*):	
- Dent	
- Gouge	
- Pipe Bend	
- Arc Burn	
- Crack	
- Lack of Fusion	
- Lamination	
- Buckle	
- Wrinkle	
- Misalignment	
- Burnt Steel	
- Other:	
- If Other, Describe:	
5. Has one or more internal inspection tool collected data at the point of the Accident?	
5a. If Yes, for each tool used, select type of internal inspection tool and indicate most recent year run:	
- Magnetic Flux Leakage	
Most recent year run:	
- Ultrasonic	
Most recent year run:	
- Geometry	
Most recent year run:	
- Caliper	
Most recent year run:	
- Crack	
Most recent year run:	
- Hard Spot	
Most recent year run:	
- Combination Tool	
Most recent year run:	
- Transverse Field/Triaxial	
Most recent year run:	
- Other	

Most recent year run:	
Describe:	
6. Has one or more hydrotest or other pressure test been conducted since original construction at the point of the Accident?	
- If Yes:	
Most recent year tested:	
Test pressure (psig):	
7. Has one or more Direct Assessment been conducted on the pipeline segment?	
- If Yes, and an investigative dig was conducted at the point of the Accident -	
Most recent year conducted:	
- If Yes, but the point of the Accident was not identified as a dig site -	
Most recent year conducted:	
8. Has one or more non-destructive examination(s) been conducted at the point of the Accident since January 1, 2002?	
8a. If Yes, for each examination conducted since January 1, 2002, select type of non-destructive examination and indicate most recent year the examination was conducted: -	
- Radiography	
Most recent year conducted:	
- Guided Wave Ultrasonic	
Most recent year conducted:	
- Handheld Ultrasonic Tool	
Most recent year conducted:	
- Wet Magnetic Particle Test	
Most recent year conducted:	
- Dry Magnetic Particle Test	
Most recent year conducted:	
- Other	
Most recent year conducted:	
Describe:	
G6 – Equipment Failure - only one **sub-cause** can be selected from the shaded left-hand column	
Equipment Failure – Sub-Cause:	Other Equipment Failure
- If Malfunction of Control/Relief Equipment:	
1. Specify: *(select all that apply)* -	
- Control Valve	
- Instrumentation	
- SCADA	
- Communications	
- Block Valve	
- Check Valve	
- Relief Valve	
- Power Failure	
- Stopple/Control Fitting	
- ESD System Failure	
- Other	
- If Other – Describe:	
- If Pump or Pump-related Equipment:	
2. Specify:	
- If Other – Describe:	
- If Threaded Connection/Coupling Failure:	
3. Specify:	
- If Other – Describe:	
- If Non-threaded Connection Failure:	
4. Specify:	
- If Other – Describe:	
- If Defective or Loose Tubing or Fitting:	
- If Failure of Equipment Body (except Pump), Tank Plate, or other Material:	
- If Other Equipment Failure:	
5. Describe:	Crack in 2" stainless steel braided flex hose.
Complete the following if any Equipment Failure sub-cause is selected.	
6. Additional factors that contributed to the equipment failure: *(select all that apply)*	
- Excessive vibration	Yes
- Overpressurization	
- No support or loss of support	

- Manufacturing defect	
- Loss of electricity	
- Improper installation	Yes
- Mismatched items (different manufacturer for tubing and tubing fittings)	
- Dissimilar metals	
- Breakdown of soft goods due to compatibility issues with transported commodity	
- Valve vault or valve can contributed to the release	
- Alarm/status failure	
- Misalignment	
- Thermal stress	
- Other	
- If Other, Describe:	

G7 - Incorrect Operation - only one **sub-cause** can be selected from the shaded left-hand column

Incorrect Operation – Sub-Cause:	
Damage by Operator or Operator's Contractor NOT Related to Excavation and NOT due to Motorized Vehicle/Equipment Damage	No
Tank, Vessel, or Sump/Separator Allowed or Caused to Overfill or Overflow	No
1. Specify:	
- If Other, Describe:	
Valve Left or Placed in Wrong Position, but NOT Resulting in a Tank, Vessel, or Sump/Separator Overflow or Facility Overpressure	No
Pipeline or Equipment Overpressured	No
Equipment Not Installed Properly	No
Wrong Equipment Specified or Installed	No
Other Incorrect Operation	No
2. Describe:	

Complete the following if any Incorrect Operation sub-cause is selected.	
3. Was this Accident related to *(select all that apply)*: -	
- Inadequate procedure	
- No procedure established	
- Failure to follow procedure	
- Other:	
- If Other, Describe:	
4. What category type was the activity that caused the Accident?	
5. Was the task(s) that led to the Accident identified as a covered task in your Operator Qualification Program?	
5a. If Yes, were the individuals performing the task(s) qualified for the task(s)?	

G8 - Other Accident Cause - only one **sub-cause** can be selected from the shaded left-hand column

Other Accident Cause – Sub-Cause:	
- If Miscellaneous:	
1. Describe:	
- If Unknown:	
2. Specify:	

PART H - NARRATIVE DESCRIPTION OF THE ACCIDENT

On December 14, at approximately 08:30, the local maintenance technician for Pershing Station (an unmanned station) discovered oil on the ground near the sump pump. Initial observations at the time indicated that a section of the flex hose on the discharge side of the pump had failed.

On Tuesday December 11, the high-high level switch was replaced. The sump tank was filled to test the newly replaced switch. The technician worked with the ECC to make sure that the switch was working properly, which included observation of the tank being able to empty back into the mainline. The sump level was at approximately 40' when the technician left the Pershing Station and informed the ECC to notify him if the pump did not shut off within the hour. The technician did not receive a call from the ECC. It is thought that the flexible hose failed as the sump pump was pumping the tank from the 40' to 16' level.

The failed portion of pipe is in the process of being repaired.

The contaminated soil has been removed from the leak site. The cause is still under investigation and will be determined when the failure analysis from the metallurgical lab is completed.

Update March 13, 2013
The total amount of contaminated soil removed from the leak site was approximately 307 cubic yards. All repairs have been completed and the sump system has been placed in service.

The failed flex hose was sent to a metallurgical lab for examination. The results of that examination revealed the immediate cause of the failure to be fatigue cracking. This examination was considered as part of the failure analysis, which concluded that improper installation of the hose was the main contributory cause of the failure.

File Full Name

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Appendix C

Enbridge Failure Investigation Analysis

This document is on file at PHMSA