

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

Principal Investigators Girija S. Bajpayee and David A. Hippchen
Region Director Byron E. Coy
Date of Report 7/26/2011
Subject Failure Investigation Report – Columbia Gas Transmission – Adaline Compressor Station Fire

Operator, Location, & Consequences

Date of Failure 11/14/2009
Commodity Released Natural Gas
City/County & State Cameron, Marshall County, WV
OpID & Operator Name 2616 – Columbia Gas Transmission
Unit # & Unit Name 65971 – Victory A / B Storage
SMART Activity # 129901
Milepost / Location 39 deg 46'15"N , 80 deg 38'36"W
Type of Failure Relief valve release due to system overpressure
Fatalities 0
Injuries 0
Description of area impacted Operator's compressor station was damaged by explosion and fire. All affected facilities were inside the fenced limits of the Adaline Compressor Station
Property Damage \$5,600,000

Failure Investigation Report – Columbia Gas Transmission – Adaline Compressor Station Fire

Failure Date 11/14/2009

Executive Summary

On the morning of Saturday, November 14, 2009, an explosion and fire occurred at Columbia Gas Transmission's Adaline Compressor Station located in Marshall County, West Virginia. A relief valve on a gas dehydrator unit opened to relieve pressure caused by a build-up of liquids in the system. The product exiting from the relief valve ignited. The ignition source is undetermined. There were no fatalities, evacuations, or supply disruptions as a result of the incident. One employee was burned, but did not require hospitalization.

The fire caused extensive damage to the dehydration facilities at the station, which include three 450,000 Btu reboiler skids, the shelter for the reboiler skids, Structure L-3111, pipeline liquid storage tank A11, the tank farm catwalk, and the flare unit. The Line-1 water-bath heater also was slightly damaged. All affected facilities were inside the fenced limits of the Adaline Compressor Station.

System Details

The Adaline Compressor Station injects and withdraws natural gas from the Victory Storage Field, located near the town of Cameron, WV, in Marshall and Wetzel Counties (Appendix A). Columbia commenced operations at the Victory Storage Field in 1953. The facility covers approximately 26,000 acres, including 247 wells and approximately 56 miles of pipeline. The pipeline system maximum allowable operating pressure (MAOP) is 860 psig.

Events Leading up to the Failure

At the time of the incident, compressor unit #2 was running to inject approximately 33 MMSCFD of natural gas into the Victory-A storage field. Valves at the station were configured to pull gas into the suction headers via the number one and number three dehydrators. Suction pressure from Line-10100 was being supplemented by gas from Line-1740 at approximately 430 psig. Discharge pressure to Victory-A was approximately 730 psig. The relief valve on a dehydrator opened and the escaping material ignited.

Emergency Response

A Columbia Gas Transmission employee responded at the scene and activated the station's Emergency Shut Down System (ESD) at approximately 8:09 AM by pulling one of the ESD handles at the station. The station ESD system functioned as designed and the station was evacuated of natural gas. The fire department arrived on the scene and extinguished the fire in less than an hour. Spill kits were deployed to contain ethylene glycol.

Summary of Return-to-Service

There are three dehydration units at this location. Two units were completely destroyed, and the third one was damaged (Appendix D). A new dehydration system was installed. Line 10365 was installed and is now in service from the producer Point of Delivery (POD) to the Adeline Compressor Station. Temporary launchers/receivers were installed on the pipelines to ensure that the pipeline system can be periodically cleared from excess fluids to avoid similar occurrence.

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Investigation Details

After conducting an investigation into the cause of the fire, Columbia Gas Transmission recommended a series of further actions or modifications to prevent reoccurrence. Each item recommended and the action taken is noted below:

1. Enforce the gas quality standards in place for the transmission pipelines. Require customers to remove liquid hydrocarbons and water upstream of our transmission pipelines. Require customers to abide by the standards set for hydrocarbon dew point, and water content.

Action: A new company (NiSource Midstream Services) now transports gas that does not meet the transmission gas quality standard through the newly installed Line 10365. Line 1758 is now used for wet gas service and ties in to the MarkWest plant, located adjacent to Columbia's Majorsville Compressor Station. While construction was finalized on the new facilities, a temporary extraction plant was put in place for non-interrupted receipt of wet gas production into pipeline 1740. The temporary plant piping was removed and "wet gas" is no longer accepted into Line 1740.

2. Install liquid removal devices including slug catchers and pigging vessels on the transmission lines if the gas quality coming into the pipelines cannot be enforced, or is permitted to exceed the standard.

Action: Launchers and receivers were installed on Lines 1740 and 10100 to remove the hydrocarbon liquids from the pipeline. A temporary extraction plant was constructed on Line 1740 at Adaline Compressor Station to remove liquid hydrocarbons from the gas stream. Pipelines 1740 and 10100 were pigged and cleaned to remove all "wet Gas" fluid condensate from the pipeline prior to re-establishing transmission pipeline service.

3. Install the following:

- a) **liquid level shut downs on the suction headers and contactors at Adaline Station to protect the dehydration system and compression.**
- b) **liquid removal devices on all fuel gas supplies and gas powered instrument controls at the station, and along the pipelines if gas exceeding tariff parameter limits will be accepted into the pipelines.**
- c) **liquid removal devices at all Points of Delivery and consumer taps along the transmission pipelines.**

Action: Remedial action was no longer necessary due to the installation of the temporary plant, subsequent installation of the new gathering and midstream pipeline system, and removal of "wet gas" receipts.

4. Install gas detection equipment in areas where hydrocarbon vapors with a specific gravity greater than 1.0 (referenced to air) can accumulate and ignite. These areas need to be determined.

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Action: Remedial action was no longer necessary due to the installation of the temporary plant, subsequent installation of the new gathering and midstream pipeline system, and removal of “wet gas” receipts.

Prior to interim “wet gas” operation, employees were trained on the hazards of liquid hydrocarbon rich gas and vapors and the use of personal gas detection monitors that were made available for their use.

Engineering Services concluded these vapors were not a concern as the heavy hydrocarbon gases would remain entrained in the lighter than air gases and not settle to low lying areas unless pools of liquids were encountered.

5. Provide personal gas monitors to employees working on pipelines or equipment which may contain gases, or vapors from liquid hydrocarbons, with a specific gravity greater than 1.0 (referenced to air).

Action: All compressor station locations are now equipped with 4 –gas (methane, oxygen, CO₂ & H₂S) personal monitors for employee use. All employees have been trained on proper use, maintenance and calibration of the personal monitors.

Columbia Gas Transmission concluded these vapors were not a concern as the heavy hydrocarbon gases would remain entrained in the lighter than air gases and not settle to low lying areas unless pools of liquids were encountered.

6. Install monitoring equipment and program shutdowns for the Adaline reboiler skids including, but not limited to, pressure transmitters on the 3-phase separator, reboiler, and flare vent lines.

Action: Each reboiler skid now has a motor valve on the glycol inlet that works inversely from the motor valve on the 3-phase separator. If the 3-phase separator fills up to the point that the float controller is sending full pressure to the motor valve on the 3-phase separator that same pressure causes the motor valve on the glycol inlet to close, shutting off glycol flow from the contactor. This ensures that the 3-phase separator will not be overrun by fluids. No other controls have been added to the reboiler skids.

7. Install the following for the Adaline reboiler skids

- a) Temperature monitoring and program shutdowns**
- b) Level monitoring and program alarm/shutdowns**
- c) Fire detection equipment and program shut downs**

Action: Remedial action was no longer necessary due to the installation of the temporary plant, subsequent installation of the new gathering / midstream pipeline, removal of “wet gas” receipts, and the float controller installation identified above.

8. Install flame-arrestor on Line-1 water-bath heater.

Action: Completed.

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9. Enter required maintenance of installed equipment in the work management application (Maximo).

Action: Required maintenance for all applicable equipment that was installed or removed due to piping changes was entered into the electronic maintenance management system (Maximo).

10. Provide safety and technical training for operations on the formation and hazards of hydrocarbon fluids.

Action: Adaline Operations developed a Safety and Operating Plan for the safe operation of the interim “wet gas” operation. The plan incorporated safety training for dealing with liquid hydrocarbon rich gas and vapors, scheduled safety checks to ensure safe operation and a checklist for training for all employees / visitors to the site during this temporary operation.

Findings and Contributing Factors

Columbia identified **3 causal factors** for this event: (Appendix E)

1. The pipeline system was not designed for “wet gas”. The network of pipelines in and around Adaline Compressor Station were designed and constructed to move pipeline quality dry gas into and out of storage. The lines and support facilities were not designed to transport wet gas.
2. The dehydration system was designed to remove liquid water and water vapor from the Victory A and B storage fields; there was minimal to no capability to remove hydrocarbon liquids.
3. The operating staff in this unit did not have any experience with issues related to hydrocarbon liquids in this pipeline system, and they were not immediately able to deal with the impact of these liquids on the dehydration system.

The root cause discussed in Appendix E is a lack of enforcement of the company's gas quality standard, or the practice of permitting waivers to this standard. Historically gas in the transmission lines in and out of Adaline has been pipeline quality gas. Gas meeting the standards for dew point and water content does not contain liquid hydrocarbons during normal operation. Also, gas meeting the standards does not contain water in levels high enough to cause problems with the Columbia pipeline system. If the gas flowing through the dehydrators on or before November 14, 2009 had remained within the original company tariff, this event would not have occurred.

Specifically, the root cause is a "Company Standards, Policies and Administrative Controls Enforcement Issue". The quality of the gas coming into the compressor station was outside of standards. The fluid handling facilities were not capable of removing the hydrocarbon fluids in a safe and efficient manner.

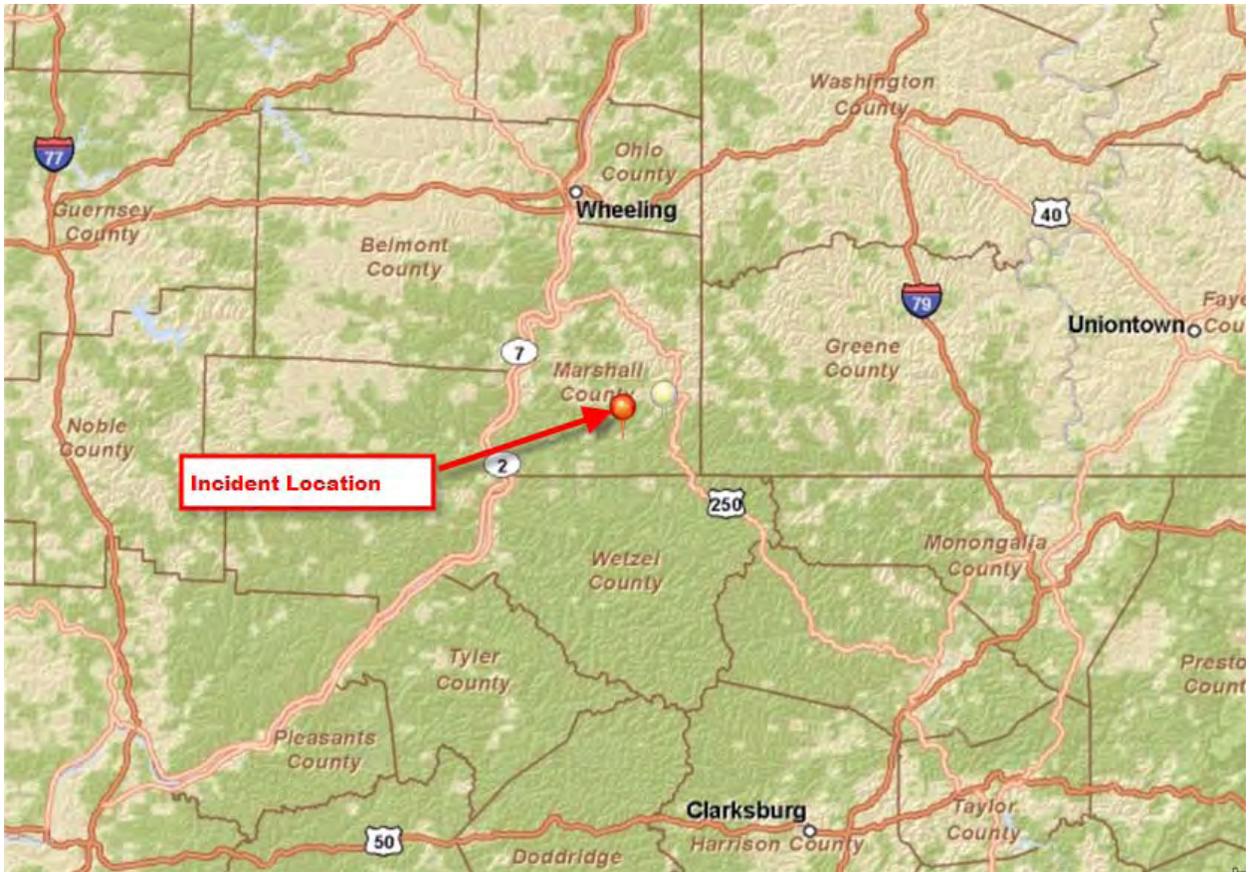
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Failure Date 11/14/2009

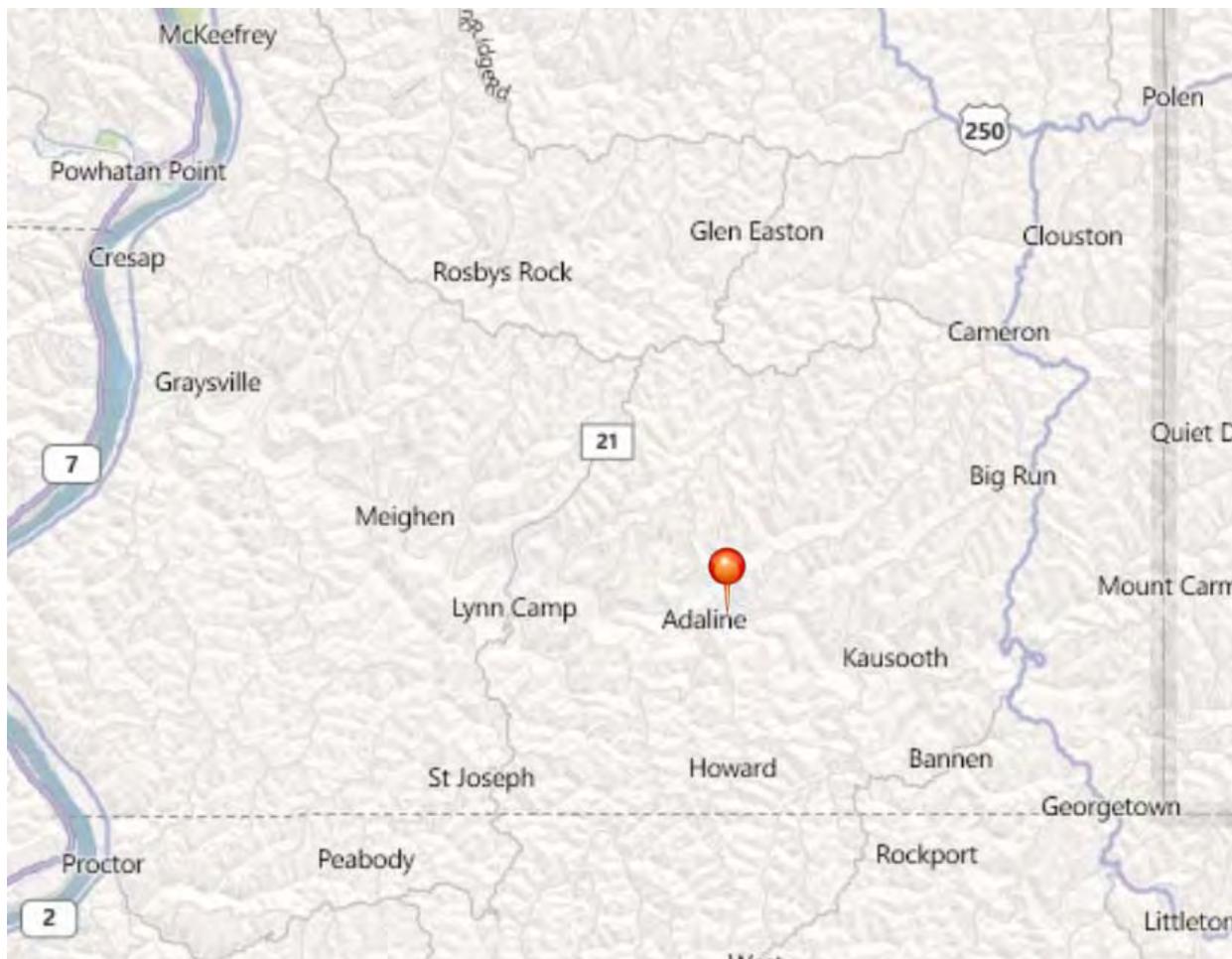
Appendices

Appendix	Description
A	Incident Location Maps
B	Incident Report Final 20090131-8362
C	NRC Report 923543
D	Photographic Documentation
E	Root Cause Analysis

129901 Appendix A Incident Location Maps



129901 Appendix A Incident Location Maps



129901 Appendix A Incident Location Maps



129901 Appendix B Incident Report Final 20090131-8362

NOTICE: This report is required by 49 CFR Part 191. Failure to report can result in a civil penalty not to exceed \$25,000 for each violation for each day that such violation persists except that the maximum civil penalty shall not exceed \$500,000 as provided in 49 USC 1678. Form Approved OMB No. 2137-0522



INCIDENT REPORT - GAS TRANSMISSION AND GATHERING SYSTEMS

Report Date _____
 No. _____
 (DOT Use Only)

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 Office Of Pipeline Safety Web Page at <http://ops.dot.gov>.

PART A – GENERAL REPORT INFORMATION

Check one or more boxes as appropriate:

Operator Name and Address

Original Report **Supplemental Report** **Final Report**

- a. Operator's 5-digit Identification Number (when known) / _____ /
- b. If Operator does not own the pipeline, enter Owner's 5-digit Identification Number (when known) / _____ /
- c. Name of Operator _____
- d. Operator street address _____
- e. Operator address _____
 City, County or Parrish, State and Zip Code

2. Time and date of the incident

/_____/ /_____/ /_____/ /_____/
 hr. month day year

3. Location of incident

- a. _____
 Nearest street or road
- b. _____
 City and County or Parrish
- c. _____
 State and Zip Code
- d. Mile Post/Valve Station _____
- e. Survey Station No. _____
- f. Latitude: _____ Longitude: _____
 (if not available, see instructions for how to provide specific location)
- g. Class location description
 Onshore: Class 1 Class 2 Class 3 Class 4
 Offshore: Class 1 (complete rest of this item)
 Area _____ Block # _____
 State /_____/ or Outer Continental Shelf
- h. Incident on Federal Land other than Outer Continental Shelf
 Yes No
- i. Is pipeline Interstate Yes No

4. Type of leak or rupture

- Leak: Pinhole Connection Failure (complete sec. F5)
 Puncture, diameter (inches) _____
- Rupture: Circumferential – Separation
 Longitudinal – Tear/Crack, length (inches) _____
 Propagation Length, total, both sides (feet) _____
- N/A
- Other: _____

5. Consequences (check and complete all that apply)

- a. Fatality Total number of people: /_____/
 Employees: /_____/ General Public: /_____/
 Non-employee Contractors: /_____/
- b. Injury requiring inpatient hospitalization Total number of people: /_____/
 Employees: /_____/ General Public: /_____/
 Non-employee Contractors: /_____/
- c. Property damage/loss (estimated) Total \$ _____
 Gas loss \$ _____ Operator damage \$ _____
 Public/private property damage \$ _____
- d. Release Occurred in a 'High Consequence Area'
- e. Gas ignited – No explosion f. Explosion
- g. Evacuation (general public only) /_____/ people
 Reason for Evacuation:
 Emergency worker or public official ordered, precautionary
 Threat to the public Company policy

6. Elapsed time until area was made safe:

/_____/ hr. /_____/ min.

7. Telephone Report

/_____/ /_____/ /_____/ /_____/
 NRC Report Number month day year

8. a. Estimated pressure at point and time of incident:

_____ PSIG
 b. Max. allowable operating pressure (MAOP): _____ PSIG

- c. MAOP established by 49 CFR section:
 192.619 (a)(1) 192.619 (a)(2) 192.619 (a)(3)
 192.619 (a)(4) 192.619 (c)

d. Did an overpressurization occur relating to the incident? Yes No

PART B – PREPARER AND AUTHORIZED SIGNATURE

 (type or print) Preparer's Name and Title Area Code and Telephone Number

 Preparer's E-mail Address Area Code and Facsimile Number

 Authorized Signature (type or print) Name and Title Date Area Code and Telephone Number

PART C - ORIGIN OF THE INCIDENT

- | | |
|---|--|
| <p>1. Incident occurred on
Transmission System
Gathering System
Transmission Line of Distribution System</p> <p>2. Failure occurred on
Body of pipe Pipe Seam
Joint
Component
Other: _____</p> | <p>3. Material involved (<i>pipe, fitting, or other component</i>)
Steel
Plastic (If plastic, complete all items that apply in a-c)
Plastic failure was: a.ductile b.brittle c.joint failure
Material other than plastic or steel: _____</p> <p>4. Part of system involved in incident
Pipeline Regulator/Metering System
Compressor Station Other: _____</p> <p>5. Year the pipe or component which failed was installed: / ____ /</p> |
|---|--|

PART D - MATERIAL SPECIFICATION (if applicable)

1. Nominal pipe size (NPS) / ____ / in.
 2. Wall thickness / ____ / in.
 3. Specification _____ SMYS / ____ /
 4. Seam type _____
 5. Valve type _____
 6. Pipe or valve manufactured by _____ in year / ____ /

PART E - ENVIRONMENT

1. Area of incident In open ditch
Under pavement Above ground
Under ground Under water
Inside/under building Other: _____
 2. Depth of cover: _____ inches

PART F - APPARENT CAUSE

Important: There are 25 numbered causes in this section. Check the box to the left of the **primary** cause of the incident. Check one circle in each of the supplemental items to the right of or below the cause you indicate. See the instructions for this form for guidance.

F1 - CORROSION

If either F1 (1) External Corrosion, or F1 (2) Internal Corrosion is checked, complete all subparts a - e.

- | | |
|------------------------------|---|
| <p>1. External Corrosion</p> | <p>a. Pipe Coating b. Visual Examination c. Cause of Corrosion</p> <p>Bare Localized Pitting Galvanic Stray Current</p> <p>Coated General Corrosion Improper Cathodic Protection</p> <p>Other: _____ Microbiological</p> <p>Other: _____</p> <p>Stress Corrosion Cracking</p> <p>Other: _____</p> |
| <p>2. Internal Corrosion</p> | <p>d. Was corroded part of pipeline considered to be under cathodic protection prior to discovering incident?
No Yes, Year Protection Started: / ____ /</p> <p>e. Was pipe previously damaged in the area of corrosion?
No Yes, How long prior to incident: / ____ / years / ____ / months</p> |

F2 - NATURAL FORCES

3. Earth Movement => Earthquake Subsidence Landslide Other: _____
 4. Lightning
 5. Heavy Rains/Floods => Washouts Flotation Mudslide Scouring Other: _____
 6. Temperature => Thermal stress Frost heave Frozen components Other: _____
 7. High Winds

F3 - EXCAVATION

8. Operator Excavation Damage (*including their contractors*) / Not Third Party
9. Third Party Excavation Damage (*complete a-d*)
- a. Excavator group
General Public Government Excavator other than Operator/subcontractor
- b. Type: Road Work Pipeline Water Electric Sewer Phone/Cable Landowner Railroad
Other: _____
- c. Did operator get prior notification of excavation activity?
No Yes: Date received: / ____ / mo. / ____ / day / ____ / yr.
Notification received from: One Call System Excavator Contractor Landowner
- d. Was pipeline marked?
No Yes (*If Yes, check applicable items i - iv*)
i. Temporary markings: Flags Stakes Paint
ii. Permanent markings: Yes No
iii. Marks were (*check one*) Accurate Not Accurate
iv. Were marks made within required time? Yes No

F4 - OTHER OUTSIDE FORCE DAMAGE

10. Fire/Explosion as primary cause of failure => Fire/Explosion cause: Man made Natural
 11. Car, truck or other vehicle not relating to excavation activity damaging pipe
 12. Rupture of Previously Damaged Pipe
 13. Vandalism

129901 Appendix C NRC Report 923543



HMIS->INCIDENTS->TELEPHONICS

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NRC Number: 923543
Call Date: 11/14/2009 **Call Time:** 13:35:36

Caller Information

First Name: EARNEST G. Last Name: CLAYTOR
 Company Name: COLUMBIA GAS TRANSMISSION
 Address: 34646 OLD VALLEY PKE
 City: STRASBURG State: VA
 Country: USA Zip: 22657
 Phone 1: 5403353138 Phone 2:
 Organization Type: PRIVA1 Is caller the spiller? Yes No No Response
 Confidential: Yes No No Response

Discharger Information

First Name: EARNEST G. Last Name: CLAYTOR
 Company Name: COLUMBIA GAS TRANSMISSION
 Address: 34646 OLD VALLEY PKE
 City: STRASBURG State: VA
 Country: USA Zip: 22657
 Phone 1: 5403353138 Phone 2:
 Organization Type: PRIVA1

Spill Information

State: WV County: MARSHALL
 Nearest City: Zip Code:
Location

Spill Date: 11/14/2009 (mm/dd/yyyy) Spill Time: 11:50:00 (24hh:mm:ss)
 DTG Type: OCCURRED
 Incident Type: PIPELINE Reported Incident Type: PIPELINE

Description

CALLER STATED THAT THERE WAS A PIPELINE CONDENSATE LEAK OF 100 GALLONS. 70 PERCENT WATER AND 30 PERCENT CONDENSATE. A SYSTEM WAS BEING PUT BACK INTO SERVICE WHEN THE SYSTEM FAILED. THE CAUSE WAS EQUIPMENT FAILURE.

Materials Involved

Material / Chris Name	Chris Code	Total Qty.	Water Qty.
PIPELINE CONDENSATE	NCC	30 GALLON(S)	

129901 Appendix C NRC Report 923543

WATER	NCC	70 GALLON(S)	
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Medium Type: LAND

Additional Medium Information:

CEMENT

Injuries: | | Fatalities: | |
 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

CLEANUP COMPLETED.

Additional Info

CALLER HAD NO ADDITIONAL INFORMATION.

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 >>



Photograph number -1

Name of the operator - Columbia Gas Transmission L.L.C.

Location of the photograph – the structure that housed the integrated dehydration units of the Adaline compressor station.

This photograph reveals – the relief valve of the dehydration unit #1 through which the liquid and the flammable gas came out and consequently caused the fire and explosion.

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Photograph number -2

Name of the operator - Columbia Gas Transmission L.L.C.

Location of the photograph – the structure that housed the integrated dehydration units of the Adaline compressor station.

This photograph reveals – the pit caused by the thrust of the gas & liquid that came out through the relief valve of the dehydration unit #1.

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Photograph number -3

Name of the operator - Columbia Gas Transmission L.L.C.

Location of the photograph – the structure that housed the integrated dehydration units of the Adaline compressor station.

This photograph reveals – the damage of the dehydration unit #1, caused by the fire & explosion.

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Photograph number -4

Name of the operator - Columbia Gas Transmission L.L.C.

Location of the photograph – the structure that housed the integrated dehydration units of the Adaline compressor station.

This photograph reveals – the damage of the dehydration unit #2, caused by the fire & explosion.

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Photograph number -5

Name of the operator - Columbia Gas Transmission L.L.C.

Location of the photograph – the structure that housed the integrated dehydration units of the Adaline compressor station.

This photograph reveals – the damage of the dehydration unit #2, caused by the fire & explosion.

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Photograph number -6

Name of the operator - Columbia Gas Transmission L.L.C.

Location of the photograph – the structure that housed the integrated dehydration units of the Adaline compressor station.

This photograph reveals – the damage of the dehydration unit #3, caused by the fire & explosion.

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Photograph number -7

Name of the operator - Columbia Gas Transmission L.L.C.

Location of the photograph – close to the structure that housed the integrated dehydration units of the Adaline compressor station.

This photograph reveals – the damage to the nearby vessel due to the fire.

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Photograph number - 8

Name of the operator - Columbia Gas Transmission L.L.C.

Location of the photograph – close to the structure that housed the integrated dehydration units of the Adaline compressor station.

This photograph reveals – the damage to the nearby structure due to the intensity of the fire (the metal of the fence even melted).

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



The damage due to the fire to the portion of the dehydration unit #1, that existed above the structure.

Photograph number - 9

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



The damage due to the fire to the portion of the dehydration unit #2, that existed above the structure.

Photograph number - 10

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



The damage due to the fire to the portion of the dehydration unit #3, that existed above the structure.

Photograph number - 11

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Fire damage to the items that existed inside the annexed structure

Photograph number -12

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



The contaminated soil that was collected & placed within the plastic bags

Photograph number - 13

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.



Photograph number - 14

Note: Photos were taken 11/17/2009 – The date stamp on the camera was set incorrectly.

Appendix E Root Cause Analysis

This document is on file at PHMSA