

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

Principal Investigator Richard Lopez
Region Director R.M. Seeley
Date of Report 10/20/2011
Subject Failure Investigation Report – El Paso Pipe Failure at Saddle

Operator, Location, & Consequences

Date of Failure 11/5/2009
Commodity Released Natural Gas
City/County & State Bushland / Potter County, TX
OpID & Operator Name 4280 El Paso Natural Gas
Unit # & Unit Name 6464 Amarillo Complex
SMART Activity # 127304
Milepost / Location ~15 miles west of Amarillo, TX
Type of Failure Rupture caused by Pipe Failure at Reinforcing Saddle
Fatalities 0
Injuries 3
Description of area impacted Newly-developed residential area - Class Location 2
Property Damage \$436,156

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Executive Summary

At approximately 12:09 AM MST on November 5, 2009, a rupture occurred on the El Paso Natural Gas (EPNG) bi-directional, Dumas-to-Amarillo, 24-inch, Line 1102 natural gas pipeline which resulted in the release of approximately 98 million standard cubic feet (MMscf) of natural gas. The failure occurred at Mile Post 42 + 4250, in Potter County, Texas, approximately 15 miles west of Amarillo, Texas, in or near the unincorporated community of Bushland. The incident was reported to the National Response Center as NRC Report # 922663 (see Appendix A).

The natural gas pipeline rupture resulted in an explosion and fire. The incident site is a Class 2 location in a newly-developed residential area near Bushland, TX. A home near the rupture site was destroyed by fire, and three individuals occupying the home were injured and transported to area hospitals. Approximately 200 people in the adjacent subdivision were evacuated. Natural gas releasing from the pipeline continued to burn for approximately eight hours. Other fires caused by the explosion were contained and extinguished. The explosion created a crater approximately 57-feet long and 14-feet deep, and the failure resulted in approximately 80-feet of line pipe being replaced.

The failure occurred near the fillet weld of a reinforcing saddle used to make a six-inch diameter branch connection to the 24-inch natural gas pipeline and resulted in a 35-foot longitudinal rupture of the pipeline. The six-inch branch connection was installed in 1991, and it was abandoned in 2007 with a 5-foot segment of the branch connection left in-place. Certain pipe segments and appurtenances from the line section in which the failure occurred, including line pipe and appurtenances, were transported to Stress Engineering Services (SES) in Houston, TX for analysis. A metallurgical failure analysis was performed by SES, and the probable cause of the rupture was determined to be the result of a one-time overload event on laminations within the carrier pipe wall in a region along the reinforcing saddle-to-carrier pipe fillet weld. El Paso submitted a written incident report to PHMSA on December 2, 2009 (see Appendix B).

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System Details

Line 1102 originates in Dumas, TX, and proceeds south approximately 47 miles to Amarillo, TX, and then traverses in a southwesterly direction for about 200 miles to Eunice, NM (see Appendix C). The pipeline is bi-directional between Eunice, NM and Dumas, TX, and it was “in balance” with flow in neither direction at the failure site at the time of the failure. The pipeline right-of-way crosses the counties of Moore, Potter, Randall, Castro, Lamb, Hockley, Cochran, Yoakum, and Gaines, in Texas, and Lea County in New Mexico.

In Randall County, Texas, Line 1102 passes in close proximity to Buffalo Lake National Wildlife Refuge. The pipeline’s right-of-way also crosses Interstate 40 (Route 66) and various other Federal, State, and local highways. The pipeline is predominately routed through Class 1 locations, but line 1102 traverses several Class 2 and Class 3 locations.

The segment of line 1102 where the failure occurred is constructed from 24-inch (nominal diameter), 0.250-inch wall thickness, Grade X-52, electric fusion welded line pipe manufactured by A.O. Smith with coal tar enamel coating. This segment of line 1102 was constructed in 1948. The pipeline is cathodically protected by an impressed current system.

The maximum allowable operating pressure (MAOP) of the segment of line 1102 where the failure occurred is 780 psig. The MAOP was established in June 1991 by an eight-hour hydrostatic test to a pressure of 1022 psig. Actual operating pressure of the pipeline segment at time of failure was 762 psig.

The incident site is a newly-developed residential area in Bushland, TX, 15 miles west of Amarillo, TX which meets the definition of a Class 2 location under 49 C.F.R. § 192.5. The terrain is generally flat with arid soil conditions typical of the Texas high plains region.

The investigation revealed that there was a similar failure in 2003 on another pipeline operated by an El Paso Energy Company (Report # 20030036). That investigation identified that the failure was attributed to an overload fracture at the toe of a fillet weld on a saddle. The cause of failure was due to a combination of stresses from internal pressure and external stresses acting on the tap line. As a result of this incident El Paso was issued an order (5-2003-1002H) which required corrective actions and investigations. As a part of that Order El Paso perform saddle evaluations on several pipelines including Line 1102. There were 18 inspections of connections between valves No. 12 through 23 on Line 1102. No indications were detected during these inspections. However, the Bushland incident occurred between valves 2 and 3. Thus the saddle that failed was not inspected.

Events Leading up to the Failure

Line 1102 is a bi-directional pipeline. On the afternoon prior to the failure, gas flow was moving in a northerly direction from Amarillo to Dumas. Just prior to the failure, the line was “in balance” with flow in neither direction at the failure site. The line pressure was monitored through the SCADA control system which measured a fairly steady pressure of 762 psig until 12:11 AM MST when the first indication of Rate of Change alarms was noted. At 12:15 AM MST a third party contacted the El Paso control center and told them of a fire on the El Paso pipeline (see Appendix D and F).

Shortly after these events the El Paso control center personnel began implementing their shut down procedures.

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Emergency Response

Technicians were dispatched to close remote pipeline valves. The first valve was closed at approximately 1:00 AM MST and the section of the pipeline was isolated by 1:04 AM MST. The rupture resulted in an explosion and subsequent fire. A home near the rupture site was destroyed by fire, and three individuals occupying the home were injured and transported to area hospitals. Several other homes were also damaged but not destroyed. Approximately 200 people in the adjacent subdivision were evacuated to Bushland High School. The fire was extinguished prior to PHMSA personnel arriving on the scene. Several emergency response organizations participated in the response including the fire departments from Vega and Amarillo. No concerns were identified through this investigation. The incident area was secured and made safe by approximately 3:34 AM MST on November 5, 2009 after which the evacuees returned to their homes. EPNG Controllers isolated the affected pipeline segment by 1:04 AM MST on November 5, 2009, and the fire continued to burn from the pipeline for approximately 8 hours. For a sequence of events see the timeline in Appendix D.

Summary of Return-to-Service

Following the emergency response phase when the incident site was made safe and the fire was extinguished, EPNG personnel removed and replaced approximately 80-feet of line pipe, including the section of pipe damaged from the rupture. El Paso also prepared a Return to Service Plan that was reviewed by PHMSA inspectors. The Return to Service Plan required El Paso to take several steps to determine the cause of failure and to ensure safety during and after the restart of the pipeline. El Paso proposed to do the following:

1. Remove segments of failed pipe and transport to metallurgical lab for analysis.
2. Identify all taps greater than or equal to 2-inch installed with saddles in the Amarillo to Dumas line section and begin evaluation on those taps not previously inspected.
3. Reduce the operating pressure at the point failure so as to not exceed 80% of pre-failure operating pressure.
4. In the event that EPNG needed to temporarily operate above 80% of pre-failure operating pressure, EPNG was to submit a plan for review and approval by the Director, Southwest Region.

During the course of the investigation, PHMSA issued to El Paso a Corrective Action Order which adopted many of these conditions.

Investigation Details

At approximately 5:41 AM EST on November 5, 2009 EPNG reported to the National Response Center a failure on their 1102 pipeline. PHMSA's Southwest Region received the incident notification and dispatched investigators to the site. The investigators arrived on site on November 6. Simultaneously, at the request of the Southwest Region, personnel from the Western Region visited the control room in Colorado Springs, CO.

Even though the incident area was secured and made safe by approximately 3:34 AM MST on November 5 and EPNG Controllers isolated the specific affected pipeline segment by 1:04 AM MST the fire continued to burn from the pipeline for an additional 8 hours. El Paso prepared a Work Plan to ensure a safe environment for investigating personnel entering the rupture site. The Work Plan was reviewed by all involved entities and then a pre-job meeting was held at the incident site. PHMSA Investigators were able to enter the area of the failure on November 6 and examined the failed segments of the pipeline. Initial visual inspection of the failed section of pipeline showed the failure likely initiated at an

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abandoned branch connection to the 24-inch pipeline. The failure appeared to have occurred where a reinforcing saddle was used to make a 6-inch branch connection to the 24-inch natural gas pipeline (see Appendix E).

The MAOP of the pipeline is 780 psig, established in June 1991 by an eight-hour hydrostatic test to a pressure of 1022 psig. The incident occurred below the specified MAOP. The pipeline was last inline inspected (ILI) in 2003. There were no actionable anomalies identified in the area of the failure by the ILI.

Following indications of a pipeline failure on its SCADA system (high temperature alarms and pressure rate of change alarms) controllers in the control room for EPNG directed local personnel to investigate the conditions indicated by the alarms, and controllers isolated the pipeline directing that remote valves be closed. The investigation showed that the incident was initially discovered by the control room personnel who acted promptly to secure the pipeline.

Metallurgical Analysis

The pipeline segments involved in the incident were shipped to SES in Houston, TX for metallurgical analysis. SES's analysis (see Appendix G) identifies that "The origin of the 1102 line rupture was near the saddle area of the abandoned branch connection tap". The analysis identified laminations within the carrier pipe wall in a region along the reinforcing saddle-to-carrier pipe fillet weld of the abandoned branch connection. They also report that:

1. The fracture originated in the carrier pipe at a series of step-like features spanning a region along the saddle-to-carrier pipe weld centered at the approximate 7:30 position on the underside of the branch connection (looking from the branch connection towards the carrier pipe with 12:00 being up);
3. Bending stresses on the abandoned branch connection placed tensile stresses across the thickness of the carrier pipe and across the laminations in the pipe wall;
5. Examination of the crack initiation sites at each step-like crack origins indicated that the pipe rupture was the result of a one-time 'mechanical' overload event of the laminations within the carrier pipe wall;
6. There were no indications of progressive crack growth, such as environmental cracking or fatigue, in the fracture;
7. There was there evidence of a leak present in the pipe prior to the overload event that caused the rupture of the laminations and carrier pipe.

Findings and Contributing Factors

The ultimate cause of failure was attributed to upward bending stresses on the abandoned branch connection placed tensile stresses across the thickness of the carrier pipe on the underside of the branch connection and across the laminations in the pipe wall. The branch connection was abandoned in 2007 with a 5-foot segment of the 6 inch branch connection left in-place and attached to the 24 inch carrier pipe.

There was a similar incident on another El Paso pipeline system where El Paso was ordered to investigate the cause and take certain remedial actions. The November 5, 2009 failure location was not included in the previous remedial actions.

The controller's actions were appropriate and the incident location was isolated promptly.

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Reinforcing saddles (such as was used on the failed branch connection) are used to provide reinforcement for branch outlets in accordance with ASME B31.3, B31.4, B31.8 and other applicable design codes. Reinforcing saddles are designed to slide over the welded joint between the branch connection and line pipe, and unlike full encirclement sleeves, reinforcing saddles do not distribute the load from the branch connection around the full circumference of the pipeline.

Although it is permissible to use reinforcing saddles, full encirclement sleeves are designed to fully encircle the carrier pipe and distribute stresses around the full circumference of the pipe. EPNG's procedure 300 was amended in 2006 to limit the use of reinforcing saddles on pipeline branch connections and require full encirclement sleeves on certain applications for below ground service.

Appendices

- A Telephonic Notice Report – NRC #922663
- B El Paso Incident Report to PHMSA
- C Operator System Map of EPNG Line 1102
- D Events Logs and Timelines
- E Accident Site Photos
- F SCADA Records (Pump Discharge Pressures)
- G Metallurgical Evaluation Report

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El Paso Natural Gas Bushland, TX
Failure Date 11/05/2009**

Appendix A - Telephonic Notice Report (NRC # 922663)

NATIONAL RESPONSE CENTER 1-800-424-8802

*** For Public Use ***

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

Incident Report # 922663

INCIDENT DESCRIPTION

*Report taken at 05:41 on 05-NOV-09

Incident Type: PIPELINE

Incident Cause: UNKNOWN

Affected Area:

The incident was discovered on 05-NOV-09 at 04:15 local time.

Affected Medium: SOIL

SUSPECTED RESPONSIBLE PARTY

Organization: EL PASO CORPORATION
COLORADO SPRINGS, CO

Type of Organization: PRIVATE ENTERPRISE

INCIDENT LOCATION

County: POTTER

City: BUSH LAND State: TX

A MILE AND A HALF FROM INTERSTATE 40

RELEASED MATERIAL(S)

CHRIS Code: ONG Official Material Name: NATURAL GAS

Also Known As:

Qty Released: 0 UNKNOWN AMOUNT

DESCRIPTION OF INCIDENT

CALLER IS REPORTING A RELEASE OF NATURAL GAS FROM A RUPTURED PIPELINE DUE TO UNKNOWN CAUSES. CALLER STATED A FIRE ENSUED DUE TO THE PIPELINE RUPTURING. A PREVIOUS REPORT WAS TAKEN ON THIS SAME INCIDENT. PLEASE REFER TO REPORT NUMBER 922662.

INCIDENT DETAILS

Pipeline Type: TRANSMISSION

DOT Regulated: YES

Pipeline Above/Below Ground: BELOW

Exposed or Under Water: NO

Pipeline Covered: UNKNOWN

DAMAGES

Fire Involved: YES Fire Extinguished: UNKNOWN

INJURIES: YES Hospitalized: 2 Empl/Crew: 0 Passenger: 0

FATALITIES: NO Empl/Crew: Passenger: Occupant:

EVACUATIONS: NO Who Evacuated: Radius/Area:

Damages: YES \$

<u>Closure Type</u>	<u>Description of Closure</u>	<u>Length of Closure</u>	<u>Direction of Closure</u>
Air:	N		
Road:	N		Major Artery: N
Waterway:	N		
Track:	N		
Passengers Transferred: NO			

Environmental Impact: UNKNOWN

Media Interest: NONE Community Impact due to Material:

REMEDIAL ACTIONS

CALLER STATED THEY ISOLATED AREA OF EFFECTED PIPELINE. CALLER STATED 1 OF THE INJURED WAS TAKEN TO AMARILLO HOSPITAL AND THE OTHER INJURED INDIVIDUAL WAS TAKEN TO LUBBOCK HOSPITAL.

Release Secured: YES

Release Rate:

Estimated Release Duration:

WEATHER

Weather: UNKNOWN, °F

ADDITIONAL AGENCIES NOTIFIED

Federal: NONE
 State/Local: NONE
 State/Local On Scene: NONE
 State Agency Number: NONE

NOTIFICATIONS BY NRC

USCG ICC (ICC ONI)
 05-NOV-09 06:01
 DHS PROTECTIVE SECURITY ADVISOR (PSA DESK)
 05-NOV-09 06:01
 DOT CRISIS MANAGEMENT CENTER (MAIN OFFICE)
 05-NOV-09 06:01
 U.S. EPA VI (MAIN OFFICE)
 05-NOV-09 06:13
 USCG NATIONAL COMMAND CENTER (MAIN OFFICE)
 05-NOV-09 06:02
 INFO ANALYSIS & INFRA PROTECTION (MAIN OFFICE)
 05-NOV-09 06:01
 JFO-LA (COMMAND CENTER)
 05-NOV-09 06:01
 NATIONAL INFRASTRUCTURE COORD CTR (MAIN OFFICE)
 05-NOV-09 06:01
 NATIONAL INFRASTRUCTURE COORD CTR (INFRASTRUCTURE PROTECTION)
 05-NOV-09 06:01
 NOAA RPTS FOR TX (MAIN OFFICE)
 05-NOV-09 06:01
 NATIONAL RESPONSE CENTER HQ (MAIN OFFICE)
 05-NOV-09 06:03
 NTSB PIPELINE (MAIN OFFICE)
 05-NOV-09 06:01
 PIPELINE & HAZMAT SAFETY ADMIN (OFFICE OF PIPELINE SAFETY (AUTO))
 05-NOV-09 06:01
 PIPELINE & HAZMAT SAFETY ADMIN (OFFICE OF PIPELINE SAFETY WEEKDAYS (VERBAL))
 05-NOV-09 06:04
 TCEQ (MAIN OFFICE)
 05-NOV-09 06:01
 TEXAS STATE OPERATIONS CENTER (COMMAND CENTER)
 05-NOV-09 06:01

ADDITIONAL INFORMATION

CALLER STATED 1 HOME AND 1 BARN WAS DESTROYED. CALLER ALSO STATED ONE HOME WAS PARTIALLY DESTROYED.

*** END INCIDENT REPORT # 922663 ***

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Appendix B - PHMSA 7100.2 Incident Report



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 _____ <small>City, County or Parrish, State and Zip Code</small>			

<p>2. Time and date of the incident _____ / _____ / _____ / _____ <small>hr. month day year</small></p> <p>3. Location of incident</p> <p>a. _____ <small>Nearest street or road</small></p> <p>b. _____ <small>City and County or Parrish</small></p> <p>c. _____ <small>State and Zip Code</small></p> <p>d. Mile Post/Valve Station _____</p> <p>e. Survey Station No. _____</p> <p>f. Latitude: _____ Longitude: _____ <small>(if not available, see instructions for how to provide specific location)</small></p> <p>g. Class location description Onshore: Class 1 Class 2 Class 3 Class 4 Offshore: Class 1 <small>(complete rest of this item)</small> Area _____ Block # _____ State _____ / _____ or Outer Continental Shelf</p> <p>h. Incident on Federal Land other than Outer Continental Shelf Yes No</p> <p>i. Is pipeline Interstate Yes No</p> <p>4. Type of leak or rupture</p> <p>Leak: Pinhole Connection Failure <small>(complete sec. F5)</small> Puncture, diameter <small>(inches)</small> _____</p> <p>Rupture: Circumferential – Separation Longitudinal – Tear/Crack, length <small>(inches)</small> _____ Propagation Length, total, both sides <small>(feet)</small> _____</p> <p>N/A Other: _____</p>	<p>5. Consequences <small>(check and complete all that apply)</small></p> <p>a. Fatality Total number of people: _____ / Employees: _____ / General Public: _____ / Non-employee Contractors: _____ /</p> <p>b. Injury requiring inpatient hospitalization Total number of people: _____ / Employees: _____ / General Public: _____ / Non-employee Contractors: _____ /</p> <p>c. Property damage/loss <small>(estimated)</small> Total \$ _____ Gas loss \$ _____ Operator damage \$ _____ Public/private property damage \$ _____</p> <p>d. Release Occurred in a 'High Consequence Area'</p> <p>e. Gas ignited – No explosion f. Explosion</p> <p>g. Evacuation <small>(general public only)</small> _____ / people Reason for Evacuation: Emergency worker or public official ordered, precautionary Threat to the public Company policy</p> <p>6. Elapsed time until area was made safe: _____ / hr. _____ / min.</p> <p>7. Telephone Report _____ / _____ / _____ / _____ <small>NRC Report Number month day year</small></p> <p>8. a. Estimated pressure at point and time of incident: _____ PSIG</p> <p>b. Max. allowable operating pressure <small>(MAOP)</small>: _____ PSIG</p> <p>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)</p> <p>d. Did an overpressurization occur relating to the incident? Yes No</p>
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PART B – PREPARER AND AUTHORIZED SIGNATURE

(type or print) Preparer's Name and Title _____	_____
	<small>Area Code and Telephone Number</small>
Preparer's E-mail Address _____	_____
	<small>Area Code and Facsimile Number</small>
Authorized Signature _____	_____
<small>(type or print) Name and Title</small>	<small>Date</small>
	<small>Area Code and Telephone Number</small>

**Failure Investigation Report –
El Paso Natural Gas Bushland, TX
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Appendix C - Operator System Map of EPNG Line 1102

This document is on file at PHMSA

**Failure Investigation Report –
El Paso Natural Gas Bushland, TX
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Appendix D - Events Logs and Timelines

This document is on file at PHMSA

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Appendix E - Accident Site Photos



View of rupture site



View of abandoned tap that failed



Aerial view of incident site



View of pipe at failure origin - tap was located at this point

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**Appendix F - SCADA Records (Pump Discharge
Pressures)**

Amarillo Compressor Station (Suction Pressure)

TagName	Reading #	Read Time	Spot Value	Alarm Status
AMA_SuctP	1	11/5/09 3:37 AM	0.0	LL
AMA_SuctP	2	11/5/09 3:14 AM	0.0	LL
AMA_SuctP	3	11/5/09 3:11 AM	13.0	LL
AMA_SuctP	4	11/5/09 3:08 AM	16.0	LL
AMA_SuctP	5	11/5/09 3:04 AM	15.0	LL
AMA_SuctP	6	11/5/09 3:01 AM	8.0	LL
AMA_SuctP	7	11/5/09 2:58 AM	3.0	LL
AMA_SuctP	8	11/5/09 2:55 AM	2.0	LL
AMA_SuctP	9	11/5/09 1:00 AM	0.0	LL
AMA_SuctP	10	11/5/09 12:36 AM	0.0	LL
AMA_SuctP	11	11/5/09 12:33 AM	1.0	LL,-ROC
AMA_SuctP	12	11/5/09 12:30 AM	295.0	LL,-ROC
AMA_SuctP	13	11/5/09 12:27 AM	359.0	LL,-ROC
AMA_SuctP	14	11/5/09 12:24 AM	379.0	-ROC
AMA_SuctP	15	11/5/09 12:21 AM	403.0	-ROC
AMA_SuctP	16	11/5/09 12:17 AM	439.0	-ROC
AMA_SuctP	17	11/5/09 12:14 AM	485.0	-ROC
AMA_SuctP	18	11/5/09 12:13 AM	511.0	
AMA_SuctP	19	11/5/09 12:13 AM	513.0	-ROC
AMA_SuctP	20	11/5/09 12:11 AM	568.0	-ROC
AMA_SuctP	21	11/4/09 9:49 PM	762.0	
AMA_SuctP	22	11/4/09 9:26 PM	762.0	
AMA_SuctP	23	11/4/09 9:23 PM	761.0	
AMA_SuctP	24	11/4/09 9:20 PM	762.0	
AMA_SuctP	25	11/4/09 9:17 PM	761.0	
AMA_SuctP	26	11/4/09 8:57 PM	762.0	
AMA_SuctP	27	11/4/09 8:53 PM	761.0	
AMA_SuctP	28	11/4/09 8:47 PM	762.0	
AMA_SuctP	29	11/4/09 7:19 PM	761.0	
AMA_SuctP	30	11/4/09 6:56 PM	761.0	
AMA_SuctP	31	11/4/09 6:50 PM	762.0	
AMA_SuctP	32	11/4/09 5:47 PM	761.0	
AMA_SuctP	33	11/4/09 5:24 PM	761.0	
AMA_SuctP	34	11/4/09 3:33 PM	760.0	
AMA_SuctP	35	11/4/09 3:10 PM	760.0	
AMA_SuctP	36	11/4/09 3:07 PM	759.0	
AMA_SuctP	37	11/4/09 2:44 PM	759.0	
AMA_SuctP	38	11/4/09 2:21 PM	758.0	
AMA_SuctP	39	11/4/09 2:01 PM	757.0	
AMA_SuctP	40	11/4/09 1:58 PM	756.0	
AMA_SuctP	41	11/4/09 1:55 PM	757.0	
AMA_SuctP	42	11/4/09 1:52 PM	756.0	
AMA_SuctP	43	11/4/09 1:47 PM	757.0	
AMA_SuctP	44	11/4/09 1:18 PM	756.0	
AMA_SuctP	45	11/4/09 12:56 PM	756.0	

ROC = Rate of Change
 LL = Lo-Lo Alarm

Amarillo Compressor Station (Suction Pressure)

TagName	Reading #	Read Time	Spot Value	Alarm Status
AMA_SuctP	46	11/4/09 12:49 PM	755.0	
AMA_SuctP	47	11/4/09 12:45 PM	756.0	
AMA_SuctP	48	11/4/09 12:10 PM	755.0	

Amarillo Compressor Station (Discharge Pressure)

TagName	Reading #	Read Time	Spot Value	Alarm Status
AMA_DischP	1	11/5/09 6:58 AM	554.0	
AMA_DischP	2	11/5/09 6:55 AM	555.0	
AMA_DischP	3	11/5/09 6:35 AM	555.0	
AMA_DischP	4	11/5/09 6:16 AM	556.0	
AMA_DischP	5	11/5/09 5:59 AM	557.0	
AMA_DischP	6	11/5/09 5:37 AM	557.0	
AMA_DischP	7	11/5/09 5:20 AM	558.0	
AMA_DischP	8	11/5/09 4:57 AM	558.0	
AMA_DischP	9	11/5/09 4:53 AM	559.0	
AMA_DischP	10	11/5/09 4:50 AM	558.0	
AMA_DischP	11	11/5/09 4:46 AM	559.0	
AMA_DischP	12	11/5/09 4:43 AM	558.0	
AMA_DischP	13	11/5/09 4:10 AM	559.0	
AMA_DischP	14	11/5/09 3:47 AM	559.0	
AMA_DischP	15	11/5/09 2:12 AM	560.0	
AMA_DischP	16	11/5/09 1:52 AM	560.0	
AMA_DischP	17	11/5/09 1:46 AM	559.0	
AMA_DischP	18	11/5/09 1:43 AM	558.0	
AMA_DischP	19	11/5/09 1:39 AM	556.0	
AMA_DischP	20	11/5/09 1:36 AM	554.0	
AMA_DischP	21	11/5/09 1:33 AM	551.0	
AMA_DischP	22	11/5/09 1:30 AM	548.0	
AMA_DischP	23	11/5/09 1:27 AM	544.0	
AMA_DischP	24	11/5/09 1:23 AM	538.0	
AMA_DischP	25	11/5/09 1:20 AM	533.0	
AMA_DischP	26	11/5/09 1:16 AM	525.0	
AMA_DischP	27	11/5/09 1:13 AM	517.0	
AMA_DischP	28	11/5/09 1:10 AM	509.0	
AMA_DischP	29	11/5/09 1:07 AM	497.0	+ROC
AMA_DischP	30	11/5/09 1:04 AM	480.0	+ROC
AMA_DischP	31	11/5/09 1:00 AM	453.0	+ROC
AMA_DischP	32	11/5/09 12:56 AM	407.0	+ROC
AMA_DischP	33	11/5/09 12:53 AM	265.0	LL
AMA_DischP	34	11/5/09 12:50 AM	274.0	LL
AMA_DischP	35	11/5/09 12:46 AM	284.0	LL
AMA_DischP	36	11/5/09 12:43 AM	295.0	LL
AMA_DischP	37	11/5/09 12:40 AM	305.0	LL
AMA_DischP	38	11/5/09 12:36 AM	316.0	LL
AMA_DischP	39	11/5/09 12:33 AM	330.0	LL
AMA_DischP	40	11/5/09 12:30 AM	340.0	LL,-ROC
AMA_DischP	41	11/5/09 12:27 AM	362.0	L,-ROC
AMA_DischP	42	11/5/09 12:24 AM	382.0	-ROC
AMA_DischP	43	11/5/09 12:21 AM	406.0	-ROC
AMA_DischP	44	11/5/09 12:17 AM	442.0	-ROC
AMA_DischP	45	11/5/09 12:14 AM	489.0	-ROC

ROC = Rate of Change

LL = Lo-Lo Alarm

EPNGUS-000015
11/5/09 Rupture (Bushland)

Amarillo Compressor Station (Discharge Pressure)

TagName	Reading #	Read Time	Spot Value	Alarm Status
AMA_DischP	46	11/5/09 12:13 AM	515.0	
AMA_DischP	47	11/5/09 12:13 AM	516.0	-ROC
AMA_DischP	48	11/5/09 12:11 AM	572.0	-ROC
AMA_DischP	49	11/4/09 11:29 PM	763.0	
AMA_DischP	50	11/4/09 11:29 PM	763.0	
AMA_DischP	51	11/4/09 11:26 PM	762.0	
AMA_DischP	52	11/4/09 10:59 PM	763.0	
AMA_DischP	53	11/4/09 10:59 PM	763.0	
AMA_DischP	54	11/4/09 10:55 PM	762.0	
AMA_DischP	55	11/4/09 10:36 PM	763.0	
AMA_DischP	56	11/4/09 10:28 PM	762.0	
AMA_DischP	57	11/4/09 10:25 PM	763.0	
AMA_DischP	58	11/4/09 10:22 PM	762.0	
AMA_DischP	59	11/4/09 10:08 PM	763.0	
AMA_DischP	60	11/4/09 10:05 PM	762.0	
AMA_DischP	61	11/4/09 9:55 PM	763.0	
AMA_DischP	62	11/4/09 9:49 PM	762.0	
AMA_DischP	63	11/4/09 9:46 PM	763.0	
AMA_DischP	64	11/4/09 9:36 PM	762.0	
AMA_DischP	65	11/4/09 9:30 PM	763.0	
AMA_DischP	66	11/4/09 5:56 PM	762.0	
AMA_DischP	67	11/4/09 5:34 PM	762.0	
AMA_DischP	68	11/4/09 4:58 PM	761.0	
AMA_DischP	69	11/4/09 4:58 PM	761.0	
AMA_DischP	70	11/4/09 4:54 PM	760.0	
AMA_DischP	71	11/4/09 4:48 PM	761.0	
AMA_DischP	72	11/4/09 4:05 PM	760.0	
AMA_DischP	73	11/4/09 3:43 PM	760.0	
AMA_DischP	74	11/4/09 3:30 PM	761.0	
AMA_DischP	75	11/4/09 3:17 PM	760.0	
AMA_DischP	76	11/4/09 2:57 PM	760.0	
AMA_DischP	77	11/4/09 2:54 PM	759.0	
AMA_DischP	78	11/4/09 2:50 PM	760.0	
AMA_DischP	79	11/4/09 2:37 PM	759.0	
AMA_DischP	80	11/4/09 2:14 PM	758.0	
AMA_DischP	81	11/4/09 1:34 PM	757.0	
AMA_DischP	82	11/4/09 1:12 PM	757.0	
AMA_DischP	83	11/4/09 12:39 PM	756.0	
AMA_DischP	84	11/4/09 12:17 PM	756.0	

ROC = Rate of Change
 LL = Lo-Lo Alarm

EPNGUS-0000016
 11/5/09 Rupture (Bushland)

Southwest Portland Meter Station (Temperature)

TagName	Reading #	Read Time	Spot Value	Alarm Status
M01455701SWPTMP..ANA	1	11/5/09 1:26 AM	198.2	HH
M01455701SWPTMP..ANA	2	11/5/09 12:12 AM	198.2	HH,+ROC
M01455701SWPTMP..ANA	3	11/5/09 12:11 AM	198.2	HH,+ROC
M01455701SWPTMP..ANA	4	11/5/09 12:09 AM	198.2	HH,+ROC
M01455701SWPTMP..ANA	5	11/5/09 12:02 AM	49.4	
M01455701SWPTMP..ANA	6	11/4/09 11:55 PM	51.3	
M01455701SWPTMP..ANA	7	11/4/09 11:51 PM	48.7	
M01455701SWPTMP..ANA	8	11/4/09 11:48 PM	49.4	
M01455701SWPTMP..ANA	9	11/4/09 11:45 PM	50.6	
M01455701SWPTMP..ANA	10	11/4/09 11:42 PM	51.4	
M01455701SWPTMP..ANA	11	11/4/09 11:35 PM	49.1	
M01455701SWPTMP..ANA	12	11/4/09 11:32 PM	50.4	
M01455701SWPTMP..ANA	13	11/4/09 11:26 PM	51.1	
M01455701SWPTMP..ANA	14	11/4/09 11:23 PM	48.8	
M01455701SWPTMP..ANA	15	11/4/09 11:19 PM	50.0	
M01455701SWPTMP..ANA	16	11/4/09 11:13 PM	51.3	
M01455701SWPTMP..ANA	17	11/4/09 11:10 PM	48.9	
M01455701SWPTMP..ANA	18	11/4/09 11:07 PM	49.9	
M01455701SWPTMP..ANA	19	11/4/09 11:03 PM	51.1	
M01455701SWPTMP..ANA	20	11/4/09 11:00 PM	51.6	
M01455701SWPTMP..ANA	21	11/4/09 10:55 PM	49.1	
M01455701SWPTMP..ANA	22	11/4/09 10:52 PM	50.3	
M01455701SWPTMP..ANA	23	11/4/09 10:45 PM	51.3	
M01455701SWPTMP..ANA	24	11/4/09 10:42 PM	49.2	
M01455701SWPTMP..ANA	25	11/4/09 10:39 PM	50.4	
M01455701SWPTMP..ANA	26	11/4/09 10:37 PM	51.2	
M01455701SWPTMP..ANA	27	11/4/09 10:32 PM	51.9	
M01455701SWPTMP..ANA	28	11/4/09 10:29 PM	49.6	
M01455701SWPTMP..ANA	29	11/4/09 10:26 PM	50.5	
M01455701SWPTMP..ANA	30	11/4/09 10:23 PM	51.8	
M01455701SWPTMP..ANA	31	11/4/09 10:20 PM	52.7	
M01455701SWPTMP..ANA	32	11/4/09 10:16 PM	51.3	
M01455701SWPTMP..ANA	33	11/4/09 10:13 PM	50.3	
M01455701SWPTMP..ANA	34	11/4/09 10:10 PM	51.6	
M01455701SWPTMP..ANA	35	11/4/09 10:07 PM	52.6	
M01455701SWPTMP..ANA	36	11/4/09 10:04 PM	50.2	
M01455701SWPTMP..ANA	37	11/4/09 10:00 PM	50.2	
M01455701SWPTMP..ANA	38	11/4/09 9:57 PM	51.3	
M01455701SWPTMP..ANA	39	11/4/09 9:51 PM	52.8	
M01455701SWPTMP..ANA	40	11/4/09 9:44 PM	50.8	
M01455701SWPTMP..ANA	41	11/4/09 9:41 PM	51.9	
M01455701SWPTMP..ANA	42	11/4/09 9:38 PM	52.9	
M01455701SWPTMP..ANA	43	11/4/09 9:35 PM	52.3	
M01455701SWPTMP..ANA	44	11/4/09 9:32 PM	51.0	
M01455701SWPTMP..ANA	45	11/4/09 9:28 PM	52.4	

ROC = Rate of Change
 HH = HI-HI Alarm

Southwest Portland Meter Station (Temperature)

TagName	Reading #	Read Time	Spot Value	Alarm Status
MO1455701SWPTMP..ANA	46	11/4/09 9:25 PM	53.3	
MO1455701SWPTMP..ANA	47	11/4/09 9:22 PM	52.6	
MO1455701SWPTMP..ANA	48	11/4/09 9:19 PM	51.3	
MO1455701SWPTMP..ANA	49	11/4/09 9:15 PM	52.4	
MO1455701SWPTMP..ANA	50	11/4/09 9:09 PM	53.0	
MO1455701SWPTMP..ANA	51	11/4/09 9:06 PM	51.2	
MO1455701SWPTMP..ANA	52	11/4/09 9:02 PM	52.3	
MO1455701SWPTMP..ANA	53	11/4/09 9:01 PM	52.8	
MO1455701SWPTMP..ANA	54	11/4/09 8:56 PM	53.4	
MO1455701SWPTMP..ANA	55	11/4/09 8:53 PM	51.6	
MO1455701SWPTMP..ANA	56	11/4/09 8:50 PM	52.4	
MO1455701SWPTMP..ANA	57	11/4/09 8:43 PM	53.5	
MO1455701SWPTMP..ANA	58	11/4/09 8:38 PM	51.9	
MO1455701SWPTMP..ANA	59	11/4/09 8:35 PM	53.1	
MO1455701SWPTMP..ANA	60	11/4/09 8:32 PM	54.0	
MO1455701SWPTMP..ANA	61	11/4/09 8:29 PM	53.2	
MO1455701SWPTMP..ANA	62	11/4/09 8:24 PM	52.6	
MO1455701SWPTMP..ANA	63	11/4/09 8:19 PM	54.2	
MO1455701SWPTMP..ANA	64	11/4/09 8:16 PM	53.5	
MO1455701SWPTMP..ANA	65	11/4/09 8:13 PM	52.4	
MO1455701SWPTMP..ANA	66	11/4/09 8:10 PM	53.4	
MO1455701SWPTMP..ANA	67	11/4/09 8:07 PM	54.4	
MO1455701SWPTMP..ANA	68	11/4/09 8:03 PM	53.8	
MO1455701SWPTMP..ANA	69	11/4/09 7:59 PM	52.8	
MO1455701SWPTMP..ANA	70	11/4/09 7:51 PM	54.5	
MO1455701SWPTMP..ANA	71	11/4/09 7:46 PM	53.2	
MO1455701SWPTMP..ANA	72	11/4/09 7:41 PM	54.8	
MO1455701SWPTMP..ANA	73	11/4/09 7:37 PM	54.1	
MO1455701SWPTMP..ANA	74	11/4/09 7:33 PM	53.3	
MO1455701SWPTMP..ANA	75	11/4/09 7:24 PM	54.7	
MO1455701SWPTMP..ANA	76	11/4/09 7:21 PM	54.5	
MO1455701SWPTMP..ANA	77	11/4/09 7:17 PM	54.5	
MO1455701SWPTMP..ANA	78	11/4/09 7:11 PM	55.1	
MO1455701SWPTMP..ANA	79	11/4/09 7:08 PM	53.6	
MO1455701SWPTMP..ANA	80	11/4/09 7:06 PM	54.1	
MO1455701SWPTMP..ANA	81	11/4/09 6:58 PM	55.7	
MO1455701SWPTMP..ANA	82	11/4/09 6:55 PM	54.4	
MO1455701SWPTMP..ANA	83	11/4/09 6:45 PM	55.5	
MO1455701SWPTMP..ANA	84	11/4/09 6:42 PM	54.1	
MO1455701SWPTMP..ANA	85	11/4/09 6:39 PM	55.1	
MO1455701SWPTMP..ANA	86	11/4/09 6:32 PM	55.7	
MO1455701SWPTMP..ANA	87	11/4/09 6:29 PM	54.5	
MO1455701SWPTMP..ANA	88	11/4/09 6:20 PM	55.4	
MO1455701SWPTMP..ANA	89	11/4/09 6:16 PM	54.5	
MO1455701SWPTMP..ANA	90	11/4/09 6:13 PM	55.4	

ROC = Rate of Change

HH = HI-HI Alarm

Southwest Portland Meter Station (Temperature)

TagName	Reading #	Read Time	Spot Value	Alarm Status
M01455701SWPTMP..ANA	91	11/4/09 5:55 PM	56.7	
M01455701SWPTMP..ANA	92	11/4/09 5:49 PM	55.7	
M01455701SWPTMP..ANA	93	11/4/09 5:45 PM	56.3	
M01455701SWPTMP..ANA	94	11/4/09 5:42 PM	56.8	
M01455701SWPTMP..ANA	95	11/4/09 5:36 PM	55.7	
M01455701SWPTMP..ANA	96	11/4/09 5:33 PM	56.5	
M01455701SWPTMP..ANA	97	11/4/09 5:30 PM	57.1	
M01455701SWPTMP..ANA	98	11/4/09 5:23 PM	56.5	
M01455701SWPTMP..ANA	99	11/4/09 5:20 PM	57.1	
M01455701SWPTMP..ANA	100	11/4/09 5:17 PM	57.6	
M01455701SWPTMP..ANA	101	11/4/09 5:12 PM	56.9	
M01455701SWPTMP..ANA	102	11/4/09 5:07 PM	57.8	
M01455701SWPTMP..ANA	103	11/4/09 4:56 PM	58.4	
M01455701SWPTMP..ANA	104	11/4/09 4:45 PM	59.3	
M01455701SWPTMP..ANA	105	11/4/09 4:41 PM	60.0	
M01455701SWPTMP..ANA	106	11/4/09 4:38 PM	60.6	
M01455701SWPTMP..ANA	107	11/4/09 4:35 PM	61.1	
M01455701SWPTMP..ANA	108	11/4/09 4:32 PM	61.7	
M01455701SWPTMP..ANA	109	11/4/09 4:26 PM	62.9	
M01455701SWPTMP..ANA	110	11/4/09 4:19 PM	63.4	
M01455701SWPTMP..ANA	111	11/4/09 4:06 PM	64.0	
M01455701SWPTMP..ANA	112	11/4/09 4:03 PM	64.8	
M01455701SWPTMP..ANA	113	11/4/09 3:54 PM	65.4	
M01455701SWPTMP..ANA	114	11/4/09 3:50 PM	66.3	
M01455701SWPTMP..ANA	115	11/4/09 3:37 PM	66.8	
M01455701SWPTMP..ANA	116	11/4/09 3:34 PM	67.8	
M01455701SWPTMP..ANA	117	11/4/09 3:26 PM	66.8	
M01455701SWPTMP..ANA	118	11/4/09 3:23 PM	67.8	
M01455701SWPTMP..ANA	119	11/4/09 3:20 PM	68.8	
M01455701SWPTMP..ANA	120	11/4/09 3:17 PM	68.2	
M01455701SWPTMP..ANA	121	11/4/09 3:10 PM	67.3	
M01455701SWPTMP..ANA	122	11/4/09 3:07 PM	68.3	
M01455701SWPTMP..ANA	123	11/4/09 3:04 PM	67.8	
M01455701SWPTMP..ANA	124	11/4/09 3:01 PM	66.6	
M01455701SWPTMP..ANA	125	11/4/09 2:44 PM	65.7	
M01455701SWPTMP..ANA	126	11/4/09 2:31 PM	66.3	
M01455701SWPTMP..ANA	127	11/4/09 2:28 PM	67.2	
M01455701SWPTMP..ANA	128	11/4/09 2:24 PM	68.0	
M01455701SWPTMP..ANA	129	11/4/09 2:15 PM	67.5	
M01455701SWPTMP..ANA	130	11/4/09 2:08 PM	66.7	
M01455701SWPTMP..ANA	131	11/4/09 2:01 PM	67.3	
M01455701SWPTMP..ANA	132	11/4/09 1:49 PM	68.1	
M01455701SWPTMP..ANA	133	11/4/09 1:41 PM	70.2	
M01455701SWPTMP..ANA	134	11/4/09 1:38 PM	69.5	
M01455701SWPTMP..ANA	135	11/4/09 1:35 PM	68.8	

ROC = Rate of Change

HH = HI-HI Alarm

Southwest Portland Meter Station (Temperature)

TagName	Reading #	Read Time	Spot Value	Alarm Status
M01455701SWPTMP..ANA	136	11/4/09 1:32 PM	69.6	
M01455701SWPTMP..ANA	137	11/4/09 1:29 PM	71.2	
M01455701SWPTMP..ANA	138	11/4/09 1:25 PM	70.2	
M01455701SWPTMP..ANA	139	11/4/09 1:19 PM	68.8	
M01455701SWPTMP..ANA	140	11/4/09 1:13 PM	70.6	
M01455701SWPTMP..ANA	141	11/4/09 1:09 PM	69.4	
M01455701SWPTMP..ANA	142	11/4/09 1:06 PM	68.5	
M01455701SWPTMP..ANA	143	11/4/09 1:00 PM	70.5	
M01455701SWPTMP..ANA	144	11/4/09 12:57 PM	69.5	
M01455701SWPTMP..ANA	145	11/4/09 12:54 PM	68.3	
M01455701SWPTMP..ANA	146	11/4/09 12:50 PM	69.0	
M01455701SWPTMP..ANA	147	11/4/09 12:47 PM	70.0	
M01455701SWPTMP..ANA	148	11/4/09 12:44 PM	68.8	
M01455701SWPTMP..ANA	149	11/4/09 12:38 PM	68.2	
M01455701SWPTMP..ANA	150	11/4/09 12:34 PM	69.7	
M01455701SWPTMP..ANA	151	11/4/09 12:31 PM	68.6	
M01455701SWPTMP..ANA	152	11/4/09 12:25 PM	67.7	
M01455701SWPTMP..ANA	153	11/4/09 12:22 PM	69.2	
M01455701SWPTMP..ANA	154	11/4/09 12:18 PM	68.5	
M01455701SWPTMP..ANA	155	11/4/09 12:12 PM	67.1	
M01455701SWPTMP..ANA	156	11/4/09 12:09 PM	68.8	
M01455701SWPTMP..ANA	157	11/4/09 12:06 PM	67.8	

ROC = Rate of Change
 HH = HI-HI Alarm

EPNGUS-0000028
 11/5/09 Rupture (Bushland)

**Failure Investigation Report –
El Paso Natural Gas Bushland, TX
Failure Date 11/05/2009**

Appendix G – Metallurgical Evaluation Report

This document is on file at PHMSA