

Failure Investigation Report – National Fuel Gas Rupture – Activity ID 128512

Principal Investigator Patrick Raichel - NYDPS
Regional Director Byron Coy
Date of Report 03/02/2011
Subject Failure Investigation Report – Line K rupture near Knoll Road

Summary:

On December 21, 2009, at approximately 11:30 am National Fuel Gas (NFG) Dispatching received a call from the local police department reporting a pipeline “explosion” in the vicinity of New Oregon Road, Eden, NY. A review of the SCADA system and additional phone calls from the public indicated that NFG’s Line K was experiencing a severe pressure loss. NFG crews were dispatched to the vicinity and valves were manned. After operating the valves, the pipeline was secured at 12:32 pm. There was no ignition or explosion of the escaping natural gas.

Further investigation determined that Line K was ruptured at a point some 641 feet south of Knoll Road, north of New Oregon Road in Eden, NY. The rupture was evident as the pipeline segment self excavated due to the operating pressure and the extent of the rupture.

On December 22, 2009, the ruptured section was removed and retained for metallurgical analysis. After removal, the line was repaired by replacing a four foot section of 20” pipe.

New York Department of Public Service (NYDPS) Staff was present during all field activities starting with the field investigations on 12/21/2009.

An analysis of the ruptured pipe was conducted by the Battelle Memorial Institute of Columbus, Ohio, which determined the following:

“A guillotine rupture occurred on Line K, a 20-inch diameter pipeline with a 0.375-inch thick wall made of early vintage Grade B steel. The operating pressure at the time of failure was reported at 180 psig.

Operator, Location, & Consequences

Date & Time of Failure: 12/21/2009
Commodity Released: Natural Gas
City/County & State: Knoll Rd., Eden, NY
OpID & Operator Name 13063 National Fuel Gas
Unit # & Unit Name 2021 Northern District
SMART Activity #: 128512
Milepost / Location Lat: N42.61020
Long: W078.81948
Type of Failure: Rupture
Fatalities: 0
Injuries 0
Description of area impacted Rural
Property damage \$84,800

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System Details

Line K originates at the NY/PA state border, carrying gas through Cattaraugus and Erie Counties. It terminates at regulator station WSE85, located along Seneca St., West Seneca, NY. It consists of 42 miles of 20" pipe and 18 miles of 16" pipe that was installed in 1910.

Events Leading up to the Failure

11:30 am, 12/21	NFG Dispatcher begins to receive phone reports of natural gas explosion along New Oregon Rd., Boston, NY
11:40 am, 12/21	NFG confirms gas loss on line K through SCADA reading and begins dispatching personnel
12:12 pm, 12/21	Valves BNE-193 and BNE-195 are closed
12:28 pm, 12/21	NYS DPS Staff is notified by NFG
12:32 pm, 12/21	Valve NCE-5 is closed, flow of gas is secured, effected pipeline segment is isolated
3:00 pm, 12/22	Ruptured segment of pipeline is cut out and secured for metallurgical testing
3:30 pm, 12/23	Pipeline is repaired
1:45 pm, 12/29	Pipeline is re-pressurized, tested and restored to service at reduced operating pressure

Emergency Response

In response to the rupture, NFG personnel secured three valves (BNE-193, BNE-195 and NCE-5). Six people were evacuated. NY DPS dispatched personnel and arrived on site at 2:30 pm on 12/21/2009.

Summary of initial start-up plan and return-to-service, including preliminary safety measures

After repair was made to pipeline segment and purged, NFG put the line back into service. The line was re-pressurized in three stages, 175 psig, 200 psig and finally 220 psig. Flame ionization surveys were conducted after each increment with negative results.

After the third leak survey, the pressure was reduced to 175 psig. On 12/29/2009, a pressure reduction was imposed by NFG Engineering Dept. on all of line K, from 220 psig MAOP to 185 psig until the section of line was replaced.

Investigation Findings & Contributing Factors

“A guillotine rupture occurred on Line K, a 20-inch diameter pipeline with a 0.375-inch thick wall made of early vintage Grade B steel. The operating pressure at the time of failure was reported at 180 psig

- Field measurements made after the line blew-down indicate that axial strains in excess of the yield strain developed due to local bending and line tension,
- The origin for the failure was identified as a pair of pits coincidentally located within the crown of the pipe in the vicinity of the maximum axial stresses,
- The unusual local axial loadings acting on the pair of coincidentally located pits was sufficient to cause through-wall instability, which given the brittle nature of the steel led to guillotine failure, which was facilitated by the winter temperatures working in
- Conjunction with the inherently high Ductile to Brittle Transition Temperature (DBTT) leading to reduced fracture toughness,
- Stress concentration at the bottom of the pits could, when acting under the effects of just the local bending strain would be (*sic*) sufficient to cause crack nucleation at the root of the pitting, which served

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as the origin for subsequent crack growth.

- The failure was due to a unique combination of factors that involved locally high bending and axial strains unique to the vicinity of over bend across the ridge where the failure occurred, free of other contributory or causative factors.”

Topography played a role in the stress loading of the pipeline at the break site. The break occurred at the top of a ravine, with the ridgeline running approximately perpendicular to the pipeline.

Appendices

- | | |
|----------|----------------------------------|
| 1 | NRC 926772 |
| 2 | Incident report 20090141 -- 8341 |
| 3 | Incident Location |

Materials Involved

Material / Chris Name	Chris Code	Total Qty.	Water Qty.
NATURAL GAS	ONG	0 UNKNOWN AMOUNT	

Medium Type: AIR
Additional Medium Information:

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

Additional Info

<u>Latitude</u>			
Degrees:	Minutes:	Seconds:	Quadrant:
<u>Longitude</u>			
Degrees:	Minutes:	Seconds:	Quadrant:
Distance from City:		Direction:	
Section:		Township:	
Range:		Milepost:	



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

- 1. Incident occurred on
Transmission System
Gathering System
Transmission Line of Distribution System
- 2. Failure occurred on
Body of pipe Pipe Seam
Joint
Component
Other: _____
- 3. Material involved (*pipe, fitting, or other component*)
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: _____
- 4. Part of system involved in incident
Pipeline Regulator/Metering System
Compressor Station Other: _____
- 5. Year the pipe or component which failed was installed: / ____ /

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.

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

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



