

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

Principal Investigator James Bunn
Region Director David Barrett
Date of Report 5/25/2012
Subject Failure Investigation Report – Southern Star Central Rupture,
Overpressure in KS

Operator, Location, & Consequences

Date of Failure 6/30/2005
Commodity Released Natural Gas
City/County & State Lawrence/Douglas County, Kansas
OpID & Operator Name 31711 Southern Star Central Gas Pipeline, Inc.
Unit # & Unit Name 15193 Tonganoxie Area
SMART Activity # 116063
Milepost / Location Pipeline Station 681+69 (Series 130 Station)
Type of Failure Rupture due to Operator Error
Fatalities 0
Injuries 0
Description of area impacted Rural Area, Class 1, Non HCA
Property Damage \$192,163

Failure Investigation Report – Southern Star Central Rupture Due to Overpressure

Failure Date 6/30/2005

Executive Summary

On June 30, 2005, Southern Star Central Gas Pipeline (SSCGP) Control Center received a SCADA system alarm at 7:52 pm. This alarm indicated electrical and communications power loss and was the result of a lightning strike at Ottawa Station. As a result, the programmable logic controller (PLC) for Ottawa Station powered down. When power was restored, the PLC placed the station in local control, and automatically moved valves and set points to the last known positions. At 7:53 pm, the Control Center received a separate alarm that indicated the maximum allowable operating pressure (MAOP) for the Topeka (ES 20-inch) pipeline had been exceeded. At 8:16 pm an SSCGP employee who worked in the Tonganoxie, KS District was contacted by a family member who reported a potential pipeline rupture south of Lawrence, KS. The Control Center had not received any loss in pressure as of 8:20 pm. The failure was confirmed by Douglas County Kansas Dispatch at 8:25 pm and was determined to be located between the towns of Lawrence and Ottawa, approximately three miles south of Lawrence, KS. The National Response Center (NRC) was contacted at 9:56 pm (CT) and the operator provided a call to the PHMSA Central Region at 10:00 pm.

As designed, when power was lost at the Ottawa Station, the working regulator on the ES 20-inch line failed in the open position. The monitor regulator however failed to operate (this regulator was designed to protect the ES 20-inch pipeline from overpressure in the event of any type of malfunction of the working regulator). With the working monitor in the open position and the monitor regulator not operational, the ES 20-inch pipeline was exposed to a pressure above the maximum allowable operating pressure (MAOP). The established MAOP was 450 psig. The maximum pressure experienced at Ottawa Station was 680 psig.

At approximately 8:15 pm, the ES-20-inch line ruptured in an agricultural field about 6.4 miles downstream of the Ottawa station. The subsequent metallurgical investigation determined that the overpressure condition resulted in higher than usual membrane stresses in the pipeline and that “the failure occurred just outside of the area of the lap-weld seam, in steel that was free of process or fabrication related defects.”

No fatalities or injuries occurred as a result of the rupture and there was no fire or explosion. The rupture occurred in a Class 1 rural area and was not in an HCA. Four individuals were evacuated by an emergency responder as a precautionary measure and twelve domestic customers were without gas service for two days. The operator reported the total cost of the accident as \$192,163.

It was later determined that the monitor regulator failed to operate due to the fact that the pneumatic controller supply valve was in a closed position. The supply valve was apparently left closed by a technician who had been performing maintenance activities on the monitor regulator on April 26, 2005.

System Details

The SSCGP system consists of over 6,000 miles of natural gas transmission pipelines in the Midwest region of the United States. The system serves several major market areas including the Kansas town of Wichita, the greater Kansas City area (KS and MO) and St. Louis, Missouri. The ES 20-inch pipeline runs north from Ottawa to Lawrence Kansas, a distance of approximately 28 miles. This pipeline is fed through two regulator stations which are located at the Ottawa Station.

The pipeline was constructed in 1929 and the portion of the line that failed consisted of 20-inch diameter line pipe with a wall thickness of 0.312 inch. The pipe was manufactured by Spang-Chalfont

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(later known as National Supply and became part of US Steel) using the furnace lap weld process. The grade of pipe was unknown but assumed to be 24,000 psi. The pipeline was joined by the oxyacetylene welding process. The girth welds had not been radiographed during construction. The depth of cover at the point of failure was 24 inches. The MAOP of the line (450 psig) was established based on the highest actual operating pressure of the pipeline during the previous five years prior to July 1, 1970. The pressure at the time and location of the failure was determined to be between 520 psig and 680 psig. The section of the line that contained the rupture had not been hydrostatically tested or inspected with internal inspection devices prior to the failure.

Events Leading up to the Failure

On June 30, 2005 a lightning strike at the SSCGP Ottawa Station disrupted the electrical power and the communication systems at the station. The lightning strike apparently blew a fuse for the electrical circuit that provided power to the PLC that controlled multiple working pressure regulators. The PLC did not remain on battery power when the main power failed.

The loss of power caused the regulators to lose diaphragm pressure to the respective valve actuators. This caused the regulators to fail in the open position. Each of the working regulators relied on an individual monitor regulator as an overpressure protection device. Each of the monitor regulators performed as designed except for monitor regulator 1137 RM, which should have provided overpressure protection to the ES 20-inch line. The failure of the 1137 RM regulator led to an overpressure condition in the ES-20- inch pipeline and the subsequent rupture of the pipe (approximately ½ mile south of Douglas County Road 460 on East 1400 Road).

Electrical surge suppression had not been implemented and unshielded instrumentation cable had been used. Transmitters had not been electrically isolated from the piping.

Emergency Response

The SSCGP Control Center received a SCADA system alarm at 7:52 pm that indicated that the Ottawa Station lost electrical power and communications systems. The loss of power and communications systems occurred when the Ottawa Station was struck by lightning. When the power was restored, the local PLC placed the station in local control and restored valves and set points to the last known positions. At 7:53 pm the Control Center received another alarm that indicated that the pressure in the ES 20-inch line had exceeded the MAOP of the pipeline. The Control Center contacted the on-call operator for the Ottawa Station. An SSCGP employee arrived at Ottawa station at 8:09 pm. The Control Center attempted to alleviate the overpressure condition on the pipeline by making a valve mode change; however the attempt was unsuccessful because a PLC at the station had placed the station in the local control mode. At 8:15 pm, the on-call operator and another employee arrived at the Ottawa station and began lowering the pressure on the ES 20-inch line. At 8:16 pm, a Tonganoxie District employee received a phone call from a family member who reported a possible pipeline rupture just south of Lawrence, KS.

Douglas County Emergency personnel arrived at the site at 8:25 pm and confirmed the rupture to the Douglas County, KS Dispatch Office. At 9:09 pm, the first SSCGP responder arrived at the rupture location. The section of the line that ruptured was isolated at 9:42 pm by the Baldwin mainline gate valve closure. SSCGP notified the NRC of the release at 9:56 pm on June 30, 2005 (NRC report number 764055).

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Summary of Return-to-Service

SSCGP replaced the failed section of pipe with 60 feet of pre-tested pipe and reinforced four girth welds on either side of the replacement pipe. All initial repair work was completed by July 3, 2005 and the replaced pipeline was backfilled. The ES 20-inch line was pressurized in several increments (four 100 psig increments in most locations) and after each incremental pressure increase, a leak survey was conducted. Additional leak surveys were done at road crossings and near residential dwellings. No leaks were found and the line was returned to service on July 19, 2005.

After the line was returned to service SSCGP made a decision to replace the lap welded pipe in the line and also replace all portions of the line that contained oxyacetylene girth welds. Approximately ten miles of pipe was replaced. The balance of the ES 20-inch line that was affected by the overpressure condition is modern line pipe which has been hydrostatically tested to a pressure of 720 psig.

Investigation Details

SSCGP sent the portion of the pipe that contained the rupture origin and several adjacent girthwelds to an independent metallurgical laboratory for analysis. The metallurgical investigation determined that the overpressure condition resulted in higher than usual membrane stresses in the pipeline and that “the failure occurred just outside of the area of the lap-weld seam, in steel that was free of process or fabrication related defects.” Fractures propagated in both the upstream and downstream directions to the girth welds at each end of the pipe joint. Both girth welds tore around the circumference of the pipe and the joint was ejected from the right-of-way. The joint of pipe was found approximately 150 feet away from the crater that was formed as a result of the rupture. The crater itself was approximately 20 feet in diameter.

The SSCGP Control Center notified appropriate field personnel of an overpressure condition approximately three minutes after the overpressure alarm had been received in the Control Center. SSCGP field and office personnel immediately began to respond. SSCGP personnel were at Ottawa Station by 8:09 pm and at 8:16 pm, an SSCGP employee was advised of a potential pipeline rupture by members of his family and he in turn contacted the Control Center at 8:20 pm. Douglas County Emergency responders arrived at the rupture site at 8:25 pm and confirmed the incident location with the Douglas County, Kansas Dispatch Office. The Emergency Personnel also evacuated a residence that was located approximately ¼ mile from the site.

SSCGP conducted an internal investigation in order to determine the root cause of this accident.

Findings & Contributing Factors

SSCGP determined that the root cause of the failure was operator error and the result of an employee not following procedures on April 26, 2005 when performing regulator maintenance. This error caused the monitor regulator, 1137 RM, to be left in an inoperable condition as the SSCGP employee left the valve in the pneumatic supply line to the regulator in the closed position (after performing a maintenance operation). The technician had qualifications revoked and was then re-qualified through the OQ process.

The lap welded pipe in the line was replaced (approximately 10 miles of pipeline) as were numerous oxyacetylene girth welds.

In order to prevent this type of failure in the future SSCGP added several control revisions including high select relays in an effort to provide pneumatic backup to the working regulators.

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SSCGP personnel implemented additional measures to protect the electrical systems from lightning strikes. This included improvements to the grounding systems, surge suppression, installation of shielded instrumentation cable, electrical isolation of transmitters from the pipeline, and relocation of a transmitter.

Appendices

- Appendix A Maps and Photographs
- Appendix B NRC Report Number 764055
- Appendix C Operator Incident Report
- Appendix D Metallurgical Laboratory Analysis

Appendix A Map

This document is on file at PHMSA













Appendix A - Maps and Photographs











Appendix B - NRC Report Number 764055

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 # 764055

INCIDENT DESCRIPTION

*Report taken at 22:56 on 30-JUN-05

Incident Type: PIPELINE

Incident Cause: EQUIPMENT FAILURE

Affected Area:

The incident occurred on 30-JUN-05 at 20:25 local time.

Affected Medium: AIR ATMOSPHERE

SUSPECTED RESPONSIBLE PARTY

Organization: SOUTHERN STAR CENTRAL GAS PIPELINE
OWENSBORO, KY 42301

Type of Organization: PRIVATE ENTERPRISE

INCIDENT LOCATION

COUNTY RD 460 County: DOUGLAS
EAST 1400 RD
State: KS

RELEASED MATERIAL(S)

CHRIS Code: ONG Official Material Name: NATURAL GAS

Also Known As:

Qty Released: 0 UNKNOWN AMOUNT

DESCRIPTION OF INCIDENT

THE CALLER IS REPORTING A NATURAL GAS RELEASE TO THE ATMOSPHERE FROM A RUPTURED 20 INCH PIPELINE.

INCIDENT DETAILS

Pipeline Type: TRANSMISSION
DOT Regulated: YES
Pipeline Above/Below Ground: BELOW
Exposed or Under Water: NO
Pipeline Covered: UNKNOWN

DAMAGES

Fire Involved: NO Fire Extinguished: UNKNOWN
INJURIES: NO Hospitalized: Empl/Crew: Passenger:
FATALITIES: NO Empl/Crew: Passenger: Occupant:
EVACUATIONS: UNKN Who Evacuated: Radius/Area:
Damages: NO

<u>Closure Type</u>	<u>Description of Closure</u>	<u>Length of Closure</u>	<u>Direction of Closure</u>	<u>Major Artery:</u>
Air:	N			
Road:	N			N
Waterway:	N			
Track:	N			

Environmental Impact: UNKNOWN

Media Interest: NONE Community Impact due to Material: NO

REMEDIAL ACTIONS

IN THE PROCESS OF ISOLATING THE LINE

Release Secured: NO

Release Rate:

Estimated Release Duration:

WEATHER

Weather: CLEAR, °F

ADDITIONAL AGENCIES NOTIFIED

Federal:

State/Local:

State/Local On Scene: POLICE AND THE FIRE DEPT.

State Agency Number:

NOTIFICATIONS BY NRC

DOT CRISIS MANAGEMENT CENTER (PRIMARY)

30-JUN-05 23:00

U.S. EPA VII (PRIMARY)

30-JUN-05 23:03

NATIONAL INFRASTRUCTURE COORD CTR (PRIMARY)

30-JUN-05 23:00

NOAA 1ST CLASS BB RPTS FOR KS (PRIMARY)

30-JUN-05 23:00

RSPA OFFICE OF PIPELINE SAFETY (PRIMARY)

30-JUN-05 23:02

DEPT HEALTH AND ENV ATTN:MR HENNING (PRIMARY)

30-JUN-05 23:00

DOI/OEPC DENVER (PRIMARY)

30-JUN-05 23:00

ADDITIONAL INFORMATION

NONE

*** END INCIDENT REPORT # 764055 ***

The National Response Center is strictly an initial report taking agency and does not participate in the investigation or incident response. The NRC receives initial reporting information only and notifies Federal and State On-Scene Coordinators for response. The NRC does not verify nor does it take follow-on incident information. Verification of data and incident response is the sole responsibility of Federal/State On-Scene Coordinators. Data contained within the FOIA Web Database is initial information only. All reports provided via this server are for informational purposes only. Data to be used in legal proceedings must be obtained via written correspondence from the NRC.

Appendix C - Operator Incident Report

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

 U.S. Department of Transportation Research and Special Programs Administration	<h3 style="margin: 0;">INCIDENT REPORT - GAS TRANSMISSION AND GATHERING SYSTEMS</h3>	Report Date _____ No. _____ (DOT Use Only)
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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			

<p>2. Time and date of the incident</p> <p>_____ / _____ / _____ / _____ hr. month day year</p> <p>3. Location of incident</p> <p>a. _____ Nearest street or road</p> <p>b. _____ City and County or Parrish</p> <p>c. _____ State and Zip Code</p> <p>d. Mile Post/Valve Station _____</p> <p>e. Survey Station No. _____</p> <p>f. Latitude: _____ Longitude: _____ (if not available, see instructions for how to provide specific location)</p> <p>g. Class location description</p> <p>Onshore: Class 1 Class 2 Class 3 Class 4</p> <p>Offshore: Class 1 (complete rest of this item)</p> <p>Area _____ Block # _____</p> <p>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 (complete sec. F5) Puncture, diameter (inches) _____</p> <p>Rupture: Circumferential – Separation Longitudinal – Tear/Crack, length (inches) _____ Propagation Length, total, both sides (feet) _____</p> <p>N/A Other: _____</p>	<p>5. Consequences (check and complete all that apply)</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 (estimated) 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 (general public only) _____ / 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 _____ / _____ / _____ / _____ / NRC Report Number month day year</p> <p>8. a. Estimated pressure at point and time of incident: _____ PSIG</p> <p>b. Max. allowable operating pressure (MAOP): _____ 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	Area Code and Telephone Number
_____	_____
Preparer's E-mail Address	Area Code and Facsimile Number
_____	_____
Authorized Signature	Date
(type or print) Name and Title	Area Code and Telephone Number

Appendix C - Operator Incident Report

F5 – MATERIAL AND WELDS

Material

- | | | | | | | |
|-----|-----------------|--------|---------|--------------|-----------------|--------------|
| 14. | Body of Pipe => | Dent | Gouge | Wrinkle Bend | Arc Burn | Other: _____ |
| 15. | Component => | Valve | Fitting | Vessel | Extruded Outlet | Other: _____ |
| 16. | Joint => | Gasket | O-Ring | Threads | | Other: _____ |

Weld

- | | | | | | | |
|-----|--------------|--------|-------------|----------|---------------|--------------|
| 17. | Butt => | Pipe | Fabrication | | | Other: _____ |
| 18. | Fillet => | Branch | Hot Tap | Fitting | Repair Sleeve | Other: _____ |
| 19. | Pipe Seam => | LF ERW | DSAW | Seamless | Flash Weld | |
| | | HF ERW | SAW | Spiral | | Other: _____ |

Complete a-g if you indicate **any** cause in part F5.



a. Type of failure:

- | | | | |
|------------------------|------------------|------------------------|------------------------------|
| Construction Defect => | Poor Workmanship | Procedure not followed | Poor Construction Procedures |
| Material Defect | | | |

b. Was failure due to pipe damage sustained in transportation to the construction or fabrication site? Yes No

c. Was part which leaked pressure tested before incident occurred? Yes, complete d-g No

d. Date of test: / / mo. / / day / / yr.

e. Test medium: Water Natural Gas Inert Gas Other: _____

f. Time held at test pressure: / / hr.

g. Estimated test pressure at point of incident: _____ PSIG

F6 – EQUIPMENT AND OPERATIONS

- | | | | | | |
|-----|--|---------|-----------------|----------------------|--------------|
| 20. | Malfunction of Control/Relief Equipment => | Valve | Instrumentation | Pressure Regulator | Other: _____ |
| 21. | Threads Stripped, Broken Pipe Coupling => | Nipples | Valve Threads | Mechanical Couplings | Other: _____ |
| 22. | Ruptured or Leaking Seal/Pump Packing | | | | |

23. Incorrect Operation

- a. Type: Inadequate Procedures Inadequate Safety Practices Failure to Follow Procedures Other: _____
- b. Number of employees involved who failed post-incident drug test: / / Alcohol test: / /
- c. Were most senior employee(s) involved qualified? Yes No d. Hours on duty: / /

F7 – OTHER

24. Miscellaneous, describe: _____
25. Unknown
Investigation Complete Still Under Investigation (submit a supplemental report when investigation is complete)

PART G – NARRATIVE DESCRIPTION OF FACTORS CONTRIBUTING TO THE EVENT (Attach additional sheets as necessary)

Appendix D
Metallurgical Report

This document is on file at PHMSA